

# A rational choice model of informative positive and negative campaigning

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## Abstract

This paper develops a theoretical model of informative campaigning, both positive and negative. We argue that some information on a candidate can be transmitted more efficiently by his opponents and that negative campaigning, on average, facilitates a more informed choice by the electorate.

In our model, voters have incomplete information about candidates' qualities. Each candidate can either lead a "positive" campaign (interpreted as issue-focused, indicating his high quality) or a "negative" campaign, by revealing detrimental information about his competitor. Voters receive the information that candidates choose to reveal and rationally update their beliefs about the remaining issues. We derive the equilibrium behavior of candidates in this framework and compare it to stylized facts of negative campaigning reported in the empirical literature.

Keywords: Elections, political campaigns, negative campaigning, information.

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# 1 Introduction

Negative campaign advertisements and complaints about negative campaigning are both pervasive in U.S. politics. For example, Young (1987) asserts that in the 1980s, every second political ad was negative while in the 1960s, only 20% were negative. It is our impression that the percentage may even be higher today. Both journalists and political scientists express concern that the increase in negative campaigning may harm the political system in the long term. For example, in an influential article Ansolabehere, Iyenger, Simon, and Valentino (1994) ask whether attack advertising demobilizes and shrinks the electorate and thus threatens the democratic culture in the U.S.

On the other hand, negative campaigns also provide essential, decision-relevant information to voters, just like positive campaigns. Philip Gailey draws this distinction in an editorial:<sup>1</sup> *“Unfortunately, negative campaigning has become synonymous with dirty campaigning in the political lexicon, and the press is partly to blame. Criticizing a candidate’s voting record or pointing out his hypocrisy on an issue is in the best tradition of American politics. Editorial writers and political commentators do it. So why shouldn’t campaigns do it? It may be negative, but it’s one way to keep the politicians honest.”* Whether a candidate dodged the draft, has a voting record that is inconsistent with his present platform, or purposely misled the public is essential information for voters and is often exposed by an opponent through negative campaigning.

In fact, while some information about a candidate’s relevant characteristics can be transmitted by the candidate himself (like, his policy platform, his education and experience in relevant jobs), we will argue that there is other information about a candidate (in particular related to the candidate’s character, voting history, corruption) that can be most efficiently revealed by his opponent and not by the candidate himself. This provides an efficiency rationale for negative campaigning.

Our objective in this paper is to provide a formal model of informative positive and negative campaigning. Moreover, we analyze this model in a setting where candidates cannot transmit all information that they have to voters; rather, they have to make a choice on which information they would like to stress. In our model, voters initially are not completely informed on some essential characteristics of candidates. Each candidate can inform the electorate about the true value in one dimension, but has to choose which one; this captures the idea that candidates are constrained in the number of issues that they can emphasize. Each candidate can either lead a “positive” campaign (interpreted as focusing on the issue that this candidate is good at) or a “negative” campaign, by revealing unfavorable information about his competitor.

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<sup>1</sup>St. Petersburg Times, September 1, 2002.

Voters receive the information that candidates choose to reveal and rationally update their beliefs about the parameters on which no information was transmitted. We will show that a candidate in equilibrium campaigns positively if either he can convey positive information about himself (or his platform) and/or if his opponent does not have severe flaws, because then a negative campaign will not have a beneficial effect for the sponsor. On the other hand, negative campaigning is more likely, if the other candidate is weak and/or if the sponsor does not have positive information to reveal about himself. Therefore, a negative campaign, in our model, does not only provide voters with direct information about the target, but also indirectly with (negative) information about the sponsor. Conversely, a positive campaign by Candidate 1 also conveys some positive information about Candidate 2, because if there had been very detrimental information about Candidate 2, Candidate 1 would have chosen to reveal it.

Previous literature (which we will review in more detail below) has often modeled positive and negative campaigning taking a black box approach, in which the effect of a positive campaign is to convert undecided voters into supporters, while a negative campaign converts the targeted opponent's supporters into undecided voters. In contrast, the main contribution of this paper is that we explicitly model positive and negative campaigning as both transmitting valuable information to voters, who rationally update their prior beliefs when deciding for whom to vote. Apart from the advantage of being firmly founded in a setting where all agents are rational, our approach also makes it possible to analyze voters' welfare in a meaningful way.

We will discuss the previous literature in detail in section 7, so we will be relatively brief here. There is a large empirical literature on the effects of positive and negative advertising on voter turnout in elections. Ansolabehere et al. (1994) find in an experiment that negative campaigning depresses voter turnout, while Freedman and Goldstein (1999), Kahn and Kenney (1999) and Finkel and Geer (1998) find evidence from election campaigns that negative campaigning actually may increase voter participation.

Another strand of the empirical literature analyzes the question of who uses positive or negative campaigning. These studies show that negative campaigning is more often used by trailing candidates than by front-runners,<sup>2</sup> more often when the race is close and more often near the end of the campaign.<sup>3</sup> In addition, there is evidence that voters' opinion about the sponsor of a negative ad almost always deteriorates, while the effect on the opinion about the target is more ambiguous (i.e., may sometimes even increase). While in particular the latter results may appear somewhat strange at first sight, the equilibrium of our model generates predictions that are consistent with these stylized facts.

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<sup>2</sup>See Haynes and Rhine (1998) and Lau and Pomper (2002).

<sup>3</sup>See Damore (2002).

On the theoretical side, Skaperdas and Grofman (1995) and Harrington and Hess (1996) develop models in which candidates choose a resource allocation between positive and negative campaigning. Skaperdas and Grofman (1995) assume that positive campaigning attracts undecided voters, and negative campaigning reduces the opponent’s support by converting some of his initial supporters to undecided voters. Negative campaigning is also costly for the initiator in a sense that it may turn off some of his own initial supporters. In their equilibrium, challengers focus more on negative campaigning, while front runners use primarily positive campaigning. In a related study, Harrington and Hess (1996), using a spatial model, treat campaigning as a tool to skew voters’ perceptions of candidates’ ideologies.

The reduced form approach in these two papers can explain many interesting stylized facts about negative campaigning and has the advantage of being quite flexible for extension; for example, it can also handle more than two candidates (which would be more difficult in our model). A disadvantage is, however, that voters are modeled as passive and the mechanism through which positive and negative campaigning affects voters decisions remains a black box. Our model provides a framework in which all players including the voters behave completely rationally and campaigning (both positive and negative) serves the role of providing information to the electorate.

Another advantage of our framework is also that it allows us to meaningfully answer normative questions, for example, whether there is “too much” or “too little” negative campaigning from the voters’ point of view. This question may be most relevant in the context of primary elections, as there it is conceivable that the party leaders could try to discourage negative campaigning of candidates against their fellow party members and competitors for their party’s nomination. For example, Howard Dean appealed in December 2003, when he was still the presumed front-runner for the Democratic presidential nomination, to DNC chairman Terry McAuliffe to intervene against alleged “negative campaigning” (by Dean’s rivals), arguing that excessive negative campaigning would harm the party and the prospects of the nominee in the general election.<sup>4</sup> While it is clear that the targets of negative campaigning think that there is too much negative campaigning (and their competitors, of course, think that this is all fair game), our framework allows to analyze whether there is too much or too little negative campaigning from the point of view of the voter.

The paper proceeds as follows. Section 2 discusses which type of information candidates can reveal about themselves and the time structure of the model. In Section 3, we present our model of informative campaigning. The equilibrium is derived in section 4, and compared to stylized facts from the empirical literature in Section 5. Section 6

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<sup>4</sup>In this instance, McAuliffe decided not to intervene against negative campaigning.

analyzes, from a normative point of view, the optimal degree of negative campaigning, and Section 7 discusses previous literature on negative campaigning and places our results in relation to this literature.

## 2 Information transmission by candidates

**Informative campaigning.** Before we introduce the formal model, it will be helpful to discuss the possibilities of information revelation by candidates in campaigns more thoroughly. First, let us clarify what we mean in our model by “informative campaigning”: All relevant information that candidates transmit to voters is verifiable and truthful.

Looking to campaign ads in the real world, this may not appear as the most realistic assumption. Candidates often distort their own or their opponent’s record so that campaign ads might seem to decrease rather than increase the level of information about relevant facts in the electorate.

However, there are two countervailing forces that ensure that campaign spots have some informative role in the real world, provided that voters are rational. First, suppose that voters expect that candidates exaggerate and distort in their ads to the extent that ads are not directly informative. However, even if nobody takes the *information content* of ads serious, candidates can *define the debate* by their ads: They can induce newspapers and other media to cover the issues raised by the candidates and hence to provide the electorate with independent and therefore more reliable information.

Second, while candidates often stretch the truth in their ads, at least some information can be credibly revealed through them. Being caught in an outright lie would be very costly for the sponsor of an ad, so that candidates tend to avoid it. If voters discount information given in a campaign commercial appropriately, then even information presented in an exaggerated form may be helpful for the voters’ decision problem.

**Which type of information can be transmitted by candidates?** We will argue that there are some qualities of a politician that the candidate himself cannot reveal to voters while his opponent can provide this information much more easily. Essentially, the idea is that it is easy for a candidate to reveal certain hard information, while positive information about the politician’s character or the absence of corruption is much harder if not impossible to transmit.

Suppose that the voter ideally wants a candidate who is educated and has office-related experience, has a policy platform that would benefit the voter and does not have an embarrassing past and is not corrupt. The problem is that the voters initially have incomplete information on all these characteristics for all candidates. Some of the relevant

information is very simple to provide by the candidate himself, like his education and work experience. Information on the candidate's platform is usually more complex and will take a longer time to explain, but generally speaking, there is no intrinsic credibility problem for the candidate, so this information could be provided by the candidate.

The most difficult case is for the candidate to credibly reveal that he is *not* corrupt or that he does *not* have an embarrassing past in any respect. This is true even if we assume that all information is in principle available and verifiable, because there are just so many possible indications of an embarrassing past or corruptibility that it would be extremely difficult to reveal that they are all (or almost all) absent.

As an example, consider the electorate's estimate of General Wesley Clark's valence after he entered the 2004 Democratic presidential nomination race. Clark himself could reveal that he had a distinguished military record, which is somewhat informative for the electorate, since it may be correlated with some of the qualities which the electorate really cares about (like intelligence/ability, national security experience, integrity). Still, history abounds also of generals who would be less than perfect as political leaders, both ability- and integrity-wise. There is a limit to how much more a candidate can successfully reveal about these relevant characteristics. For example, General Clark displayed on his campaign website his military records and a number of quotations from people who say nice things about him and his ability and integrity while in the military.<sup>5</sup>

However, that is hardly convincing additional information. If a man reaches the rank of a 4-star general, it appears very likely that there have been superiors during his career who appreciated him, at least at the time. The really interesting question for the electorate is how many people there were who had a negative opinion on the candidate (and how good their arguments are). Are there embarrassing quotations from the past (like the one commending the Bush national security team that surfaced later during the campaign)?

Since nobody can force a candidate to reveal bad information about himself, a candidate cannot credibly communicate, beyond a certain point, his true integrity. On the other hand, Clark's competitors clearly have the possibility to dig out some unfavorable pieces of information, provided they exist, and their research therefore enables them to communicate to the electorate if Clark is actually bad (provided that this is the case).

For these reasons, there is an efficiency rationale for *negative campaigning*: Opponents are just more able to transmit information about these aspects of a candidate's valence than he is himself. Even if a candidate's opponents fail to provide information on these aspects, there is at least partial information conveyed through this, as the electorate can infer that the information cannot be too detrimental, otherwise the opponents would have revealed it.

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<sup>5</sup>See <http://www.clark04.com/records/> for details.

We capture the difference between these categories as follows: There is one category of characteristics in which a candidate can inform the electorate about himself. The best way to think about this category is as policy platform-related. Second, there is another category in which only the opponent is able to credibly inform the electorate. Think of this as related to character issues, corruption, and more generally as valence related.<sup>6</sup>

**Limits to information transmission.** The second main ingredient in the model is the idea that candidates cannot inform the electorate about all pertaining information, but rather have to make a choice about what issue they want to focus on. Fundamentally, the reason why it is difficult to reveal all information that is relevant for voters is that voters have a bounded attention to the campaign, perhaps because each voter’s probability of being pivotal in the election is very small and therefore it is rational for voters to stop consuming information once that creates significantly positive costs.

Whatever the reason, we assume that candidates are constrained in the number of messages that they can send to voters. When candidates have a limited number of messages available, then special attention has to be paid to which messages are most helpful for the voter. The simplest model in which candidates have to make a decision as to which emphasis to make is when there are two possible messages and only one can be transmitted.

More generally, one could think of a setting in which there are several categories of positive and negative information that candidates could send, but the number of messages that candidates can send is strictly smaller than the number of categories in which candidates have information. In such a setting, the qualitative features of our model would very likely remain intact, while the notation would become more burdensome, so in the interest of clarity, we restrict our model to two dimensions of information of which one can be transmitted.

### 3 The model

Two politicians compete against each other in an election. Each politician is characterized by two parameters  $(v_i, w_i)$ . Here,  $v_i$  stands for the valence associated with that category of informations that only the opponent can credibly reveal, while  $w_i$  stands for value components that can be revealed by politician  $i$  himself. As explained in the last section,  $v$  should be thought of as integrity and other character components, while  $w$  should be thought of as previous experience and the candidate’s platform, on which the candidate can transmit credible information.

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<sup>6</sup>In addition to these two categories, there could be a third category of information about the candidate that he has to provide (and can do so credibly), say, the candidate’s education or work history; because this category is not a *choice* for the candidate, we will neglect it in the formal model.

There is a decisive voter who is interested in the sum of the value components. The decisive voter framework can be thought of as a shorthand for a full-fledged model with ideologically differentiated voters who also care about valence; in such a model, the preference of the voter with the median ideology decides which candidate wins, and so we focus exclusively on this decisive voter.

Specifically, the decisive voter votes for candidate 1 if and only if

$$E(v_1 + w_1) + z \geq E(v_2 + w_2). \quad (1)$$

Here,  $E(\cdot)$  is the expectation operator (since the voter will generally not have perfect information on  $v_i + w_i$ ), and  $z$  is an additional shock before the election with expected value  $E(z|v_1, v_2, w_1, w_2) = 0$ , whose role is more technical and will be discussed at the appropriate place in the next section.

The main topic of the model is the candidates' choice of "positive" and "negative" advertising. We capture this as follows in the model: The decisive voter does not know the precise values of the parameters, but only the ex-ante distribution from which they are drawn. (Some of our results hold for arbitrary ex ante distributions, but eventually, we will focus on the case that the initial distribution is uniform on  $[\underline{v}_i, \bar{v}_i]$  for  $v_i$ , and similarly for  $w_i$ .)

The candidates know all the parameter values and can inform the electorate on one of them. Specifically, Candidate 1 can inform the electorate on  $w_1$  or  $v_2$ . Similarly, Candidate 2 can inform on  $w_2$  or  $v_1$ . Informing on  $w_1$  is interpreted as "positive campaigning": Candidate 1 emphasizes that he has positive qualities and will be a good office holder if elected. On the other hand, informing on  $v_2$ , the valence of the other candidate, is considered "negative campaigning" by candidate 1 in the following sense: Candidate 1 will more likely resort to campaigning on candidate 2 if he knows that candidate 2 is weaker than the electorate thinks; we will show that this is in fact the case in equilibrium.

The assumption that candidates have to decide whether to lead a positive or a negative campaign is certainly very stark; in reality, these can certainly be mixed (with different levels of emphasis), but the decisive point is that our model forces candidates to make some choice. In reality, candidates *are* constrained in the number of issues that they can stress; it should be relatively clear that they cannot transmit all information that they hold to the electorate, possibly because each individual voter has only a limited incentive to become informed (because the probability of being pivotal is very small for each voter). We argue later that, qualitatively, the results of our model are robust to the generalization that there are  $n_P$  categories in which positive campaigning is feasible,  $n_N$  categories in which negative campaigning is possible, and the maximum number of signals that can be transmitted is less than  $n_P + n_N$ .



## 4 Results

### 4.1 The model without information constraint

We start our analysis by looking at the simpler case that candidates can inform the electorate on all relevant features: Assume, for example, that voters *know* the  $v$  component of both politicians ( $\underline{v}_i = \bar{v}_i \equiv v_i$  for  $i = 1, 2$ ), but only know the ex ante distribution from which the  $w_i$  are drawn.

Each politician can now decide whether to inform the electorate on his  $w_i$ , or choose not to send any meaningful information (perhaps by just sending feel-good commercials showing the candidate with his family). In other words, candidates have a choice between positive campaigning and not campaigning.

Candidate 1 wins the election if and only if

$$v_1 + E(w_1) + z \geq v_2 + E(w_2), \quad (2)$$

where  $E(w_1)$  equals the realized value of  $w_1$  if Candidate 1 chooses to inform, and a rational, updated expectation of  $w_1$  otherwise. Candidate  $i$ 's objective when deciding whether to inform the electorate is therefore to maximize  $E(w_i)$ .

The presence of the additional shock  $z$  guarantees that actions that maximize  $E(w_i)$  are the *unique* actions played in equilibrium; if there were no residual uncertainty, then one candidate would be certain to lose the election and therefore his actions would be indeterminate (i.e., given that he loses anyway, he might as well choose an action that does not maximize  $E(w_i)$ , and this would still be a Nash equilibrium). However, with the additional random shock  $z$ , both candidates have a positive chance of winning at the time the campaigning decisions are made, and thus these strange equilibria can be excluded.

The question is now when a candidate will choose to inform the electorate on his valence, versus leaving this information unclear. It might seem that it is in a candidate's interest to inform the electorate on his valence only if this valence is higher than expected by the electorate ex ante. However, given these incentives, the electorate knows that the absence of positive revelations on a candidate means that this candidate must actually be pretty bad, otherwise he would have furnished the favorable information. We will now show that this argument eventually implies that each candidate will *always* inform the electorate on his valence.

When searching for the equilibrium behavior of candidates, it is natural to look for a cutoff equilibrium of the following form: Candidate  $i$  informs on  $w_i$  if and only if  $w_i \geq w_i^*$ . Consequently, if the candidate chooses not to inform the electorate, the expected value of  $w_i$  is therefore

$$E(w_i) = \frac{\int_{\underline{w}_i}^{w_i^*} w f_{w_i}(w) dw}{F_{w_i}} < w_i^* - \varepsilon \quad (3)$$

for some  $\varepsilon > 0$ . But then, Candidate  $i$  would strictly benefit from revealing his valence if  $w_i \in (w_i^* - \varepsilon, w_i^*)$ , a contradiction to the assumption that  $w_i^*$  is the threshold below which a candidate does not inform on his valence. Hence, it cannot be true that  $w_i^* > \underline{w}_i$ , and the only possible equilibrium is that  $w_i^* = \underline{w}_i$ .

Similar arguments also show that, if the electorate knows the value of  $w$  but does not know  $v$ , then, in the unique equilibrium, both candidates will inform on each others valence.

**Proposition 1.** *Suppose that the voter knows either  $v_1$  and  $v_2$ , or  $w_1$  and  $w_2$ . In the unique equilibrium, both candidates always choose to inform the electorate on the unknown parameters.*

Hence, although candidates could in principle choose not to reveal information to the electorate, they will do so in equilibrium and therefore equilibrium information aggregation is efficient.<sup>7</sup> The key condition to this result is the assumption that candidates in the election campaign are able to reveal all relevant information (either about themselves or about their respective opponent, whichever is the relevant information).

## 4.2 Choosing between positive and negative campaigning

Let us now turn to the main focus of this paper, when candidates have to make a choice between a “positive” and a “negative” campaign, i.e. informing on their own  $w$  versus informing on the opponent’s  $v$ .

Since Candidate 1’s winning probability is increasing in  $E(w_1) + E(v_1) - E(w_2) - E(v_2)$ , Candidate 1’s objective is to maximize  $E(w_1) - E(v_2)$  (he cannot affect the expectations of the other variables), and Candidate 2’s objective is to maximize  $E(w_2) - E(v_1)$ . Since the candidates’ problems are separable in this way, we will, in what follows, focus on the equilibrium behavior of Candidate 1 and just note that the equilibrium behavior of Candidate 2 is qualitatively identical.

Consider Candidate 1, who can inform the decisive voter on either  $w_1$  or  $v_2$ . We are looking for a pure strategy Bayesian Nash equilibrium strategies that map, for each candidate, the state of the world (i.e.,  $(w_1, v_2)$  for Candidate 1 and  $(w_2, v_1)$  for Candidate 2) into an action for the candidate. Formally,

**Definition 1.** *We say that the equilibrium strategy for Candidate 1 is characterized by a partition  $(\mathcal{W}, \mathcal{V})$  of the parameter space  $\mathcal{P} = [\underline{w}_1, \bar{w}_1] \times [\underline{v}_2, \bar{v}_2]$  if*

1. *Candidate 1 informs on  $w_1$  if  $(w_1, v_2) \in \mathcal{W}$ , and informs on  $v_2$  if  $(w_1, v_2) \in \mathcal{V}$*

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<sup>7</sup>This result is somewhat reminiscent of Dewatripont and Tirole (1999) in which the optimal organization of information provision is for the principal to create two antagonistic “advocates” who have incentives to only provide the principal with information that favors their standpoint.

2. If  $(w_1, v_2) \in \mathcal{W}$  and Candidate 1 informs on  $w_1$ , the decisive voter updates his beliefs on  $v_2$  using Bayes' rule, and similarly for  $(w_1, v_2) \in \mathcal{V}$ .

3.  $\mathcal{W} \cap \mathcal{V} = \emptyset$ ,  $\mathcal{W} \cup \mathcal{V} = \mathcal{P}$

(The equilibrium strategy for Candidate 2 is defined symmetrically.)

The following lemma shows, if  $w_1 = \underline{w}_1$ , then Candidate 1 necessarily informs on Candidate 2's valence, and similarly, if  $v_2 = \bar{v}_2$ , then Candidate 1 will lead a positive campaign.

**Lemma 1.** *In any equilibrium, for any  $w_1 > \underline{w}_1$ ,  $(w_1, \bar{v}_2) \in \mathcal{W}$ . Similarly, for any  $v_2 < \bar{v}_2$ ,  $(\underline{w}_1, v_2) \in \mathcal{V}$ .*

*Proof.* Suppose that the first claim is false. Let  $v'_2 < \bar{v}_2$  be the lowest value of  $v_2$  such that  $(\underline{w}_1, v'_2) \in \mathcal{W}$ . If Candidate 1 plays the supposed equilibrium action at  $(\underline{w}_1, v'_2)$ , the electorate's estimate of  $E(w_1) - E(v_2)$  is  $\underline{w}_1 - E(v_2|\underline{w}_1) < \underline{w}_1 - v'_2$ . On the other hand, if Candidate 1 informs (out of equilibrium) on  $v_2$ , the electorate's estimate is  $E(w_1|v'_2) - v'_2 \geq \underline{w}_1 - v'_2$ , and hence more than with the supposed equilibrium action, a contradiction.

The proof of the second claim proceeds analogously and is omitted.  $\square$

Note that, in particular, Lemma 1 implies that neither  $\mathcal{W}$  nor  $\mathcal{V}$  are empty sets. Graphically, it shows that the boundary line between  $\mathcal{W}$  and  $\mathcal{V}$  must start from the upper left corner of the parameter space  $\mathcal{P}$ ,  $(\underline{w}_1, \bar{v}_2)$ . Note that this point is the worst case scenario for Candidate 1, where neither a positive campaign nor a negative campaign will help much.

A reasonable requirement for an equilibrium is that the utility of candidate  $i$  should not decrease if his own quality  $w_i$  increases, or when his competitor's valence  $v_j$  decreases. This appears a very intuitive restriction and is necessarily true if politicians can hide information that is favorable (for example, they are able to not use all of the negative information that they have on their opponent). In addition, it is reasonable to assume that a candidate's equilibrium utility goes up *strictly* if the parameter that the candidate reports to the electorate becomes more favorable for the candidate.

**Definition 2.** *We call a perfect Bayesian Nash equilibrium a **monotone equilibrium** if*

1. *the equilibrium utility of Candidate 1 (2) is non-decreasing in  $w_1$  ( $w_2$ ) and non-increasing in  $v_2$  ( $v_1$ ), and*
2. *if both  $(w_1', v'_2) \in \mathcal{W}$  and  $(w_1'', v'_2) \in \mathcal{W}$  and  $w_1'' > w_1'$ , then the equilibrium utility of Candidate 1 is strictly greater at  $(w_1'', v'_2)$ . Similarly, if  $(w_1', v'_2) \in \mathcal{V}$  and  $(w_1', v''_2) \in \mathcal{V}$  and  $v''_2 > v'_2$ , then Candidate 1's utility is greater at  $(w_1', v''_2)$ .*

Proposition 2 shows that any monotone equilibrium must be characterized by sets  $\mathcal{W}$  and  $\mathcal{V}$  that are both connected and separated from each other by a downward sloping boundary in a  $(w, v)$  space.

**Proposition 2.** *In any monotone equilibrium, if  $(w_1^0, v_2^0) \in \mathcal{W}$ , then  $(w_1', v_2') \in \mathcal{W}$  for all  $w_1' \geq w_1^0$  and  $v_2' \geq v_2^0$ . Similarly, if  $(w_1^0, v_2^0) \in \mathcal{V}$ , then  $(w_1', v_2') \in \mathcal{V}$  for all  $w_1' \leq w_1^0$  and  $v_2' \leq v_2^0$ .*

*Proof.* See Appendix. □

Proposition 2 is intuitive: Candidate 1 will campaign positively if either the information about his self-reportable quality is good ( $w_1$  is high) or his opponent is relatively good ( $v_2$  is high), so that a negative campaign would not be very effective. On the other hand, we will observe Candidate 1 campaigning negatively if either his own self-reportable valence is low ( $w_1$  is small) or if Candidate 2 is bad ( $v_2$  is low).

Proposition 3 characterizes the essentially unique monotone equilibrium in the primary campaign stage. Essentially unique means that all equilibria share the same boundary between  $\mathcal{W}$  and  $\mathcal{V}$ , i.e. equilibria differ only in different assignments of points on the boundary to  $\mathcal{W}$  and  $\mathcal{V}$ . Since the probability that the parameters drawn are exactly on the boundary line is zero, the equilibrium *actions* are the same with probability 1 in all different equilibria.

**Proposition 3.** *Assume that  $w_1$  and  $v_2$  are uniformly distributed over  $[\underline{w}_1, \bar{w}_1]$  and  $[\underline{v}_2, \bar{v}_2]$ , respectively. In any equilibrium, the boundary between  $\mathcal{W}$  and  $\mathcal{V}$  is given by*

$$\{(w_1, v_2) | (\bar{v}_2 - v_2) = (w_1 - \underline{w}_1)\}$$

*If  $(\bar{v}_2 - v_2) > (w_1 - \underline{w}_1)$ , then  $(w_1, v_2) \in \mathcal{V}$ . If  $(\bar{v}_2 - v_2) < (w_1 - \underline{w}_1)$ , then  $(w_1, v_2) \in \mathcal{W}$ .*

*Proof.* Lemma 1 and Proposition 2 imply that  $\mathcal{W}$  and  $\mathcal{V}$  are both non-empty and separated by a single, downward sloping boundary. Suppose, for concreteness that  $\bar{v}_2 - \underline{v}_2 < (\bar{w}_1 - \underline{w}_1)$ .<sup>8</sup>

If Candidate 1 informs on the value of  $v_2$ , the voter's estimate of  $w_1$  is

$$E(w_1 | v_2) = \frac{\underline{w}_1 + (\underline{w}_1 + \bar{v}_2 - v_2)}{2} = \underline{w}_1 + \frac{1}{2}(\bar{v}_2 - v_2) \quad (4)$$

If Candidate 1 informs on the value of  $w_1$ , the voter's estimate of  $v_2$  is

$$E(v_2 | w_1) = \begin{cases} \bar{v}_2 - \frac{1}{2}(w_1 - \underline{w}_1) & \text{if } w_1 \leq \underline{w}_1 + (\bar{v}_2 - \underline{v}_2) \\ \frac{\bar{v}_2 + \underline{v}_2}{2} & \text{otherwise} \end{cases} \quad (5)$$

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<sup>8</sup>The proof for the case that  $\bar{v}_2 - \underline{v}_2 > (\bar{w}_1 - \underline{w}_1)$  is analogous and omitted.

The relative benefit of negative campaigning over positive campaigning is

$$w_1 - E(v_2|w_1) - E(w_1|v_2) + v_2. \quad (6)$$

Substituting (4) and (5) into (6), for the case that  $(\bar{v}_2 - v_2) > (w_1 - \underline{w}_1)$ , and rearranging gives

$$\frac{3}{2} [w_1 - \bar{v}_2 - \underline{w}_1 + v_2], \quad (7)$$

which is positive for  $(\bar{v}_2 - v_2) > (w_1 - \underline{w}_1)$ . Hence, Candidate 1 prefers negative campaigning, as claimed.

For  $(\bar{v}_2 - v_2) < (w_1 - \underline{w}_1)$ , the relative benefit of negative campaigning is less than the expression in (7), and hence negative. Consequently, if  $(\bar{v}_2 - v_2) < (w_1 - \underline{w}_1)$ , Candidate 1 prefers to campaign positively.

For (essential) uniqueness of the equilibrium, note that the boundary line in any equilibrium must start at  $(\underline{w}_1, \bar{v}_2)$ , by Lemma 1, and the slope of the boundary line must be  $-1$  (by applying the implicit function theorem to (6) and substituting).  $\square$

Figure 1 below illustrates Proposition 3. By Lemma 1, the upper left corner of the parameter space must be on the boundary between both sets, and by Lemma 2, the boundary must be downward sloping. In the case of a uniform distribution over  $w_1$  and  $v_2$ , the boundary between  $\mathcal{W}$  and  $\mathcal{V}$  must be a straight line with a slope of  $-1$ .

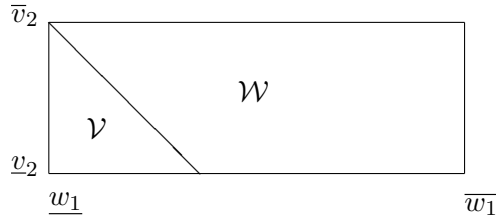


Figure 1: Parameter space with a boundary line partitioning  $\mathcal{W}$  and  $\mathcal{V}$

What parameter values make it likely that there is a negative campaign? Given that we assume a uniform distribution of  $w_1$  and  $v_2$ , the likelihood of Candidate 1 carrying out the negative campaign is

$$\begin{cases} \frac{1}{2} \frac{(\bar{v}_2 - v_2)^{\frac{1}{2}} (\bar{v}_2 - v_2)}{(\bar{v}_2 - v_2)(\bar{w}_1 - \underline{w}_1)} = \frac{(\bar{v}_2 - v_2)}{2(\bar{w}_1 - \underline{w}_1)} & \text{if } (\bar{v}_2 - v_2) \leq (\bar{w}_1 - \underline{w}_1) \\ 1 - \frac{\frac{1}{2}(\bar{w}_1 - \underline{w}_1)(\bar{w}_1 - \underline{w}_1)}{(\bar{w}_1 - \underline{w}_1)(\bar{v}_2 - v_2)} = 1 - \frac{(\bar{w}_1 - \underline{w}_1)}{2(\bar{v}_2 - v_2)} & \text{if } (\bar{v}_2 - v_2) > (\bar{w}_1 - \underline{w}_1) \end{cases}. \quad (8)$$

The likelihood of negative campaigning against Candidate 2 goes up when the electorate is uncertain about the valence of Candidate 2, or when  $w_1$  is more or less known. Hence, if there is more uncertainty about a parameter, it becomes more likely that information is

transmitted on this parameter. In particular, this implies that, if the electorate has already quite good information on a candidate, he is less likely to attract a negative campaign by his competitors than a candidate whose political record is not well known in the electorate.

A final comment is in order here related to Proposition 3. Throughout our paper, we assume for simplicity that candidates have two different types of information (which we identify as positive and negative information), and of which they have to choose one for transmission to the voters. Consequently, a campaign is either totally positive or negative in our model.

More generally, one could think of a setting in which there are several categories of positive and negative information that candidates could send, but the number of messages that candidates can send is strictly smaller than the number of categories in which candidates have information. In such a setting, the qualitative features of our model would remain intact: Each candidate will choose to inform the electorate on those categories where the information is most beneficial for the candidate or most detrimental for his opponent. In this generalized setting, voters would interpret signals in the same way as here: A campaign in which Candidate 1 concentrates on transmitting many pieces of information concerning Candidate 2 would also be interpreted as bad news about Candidate 1 (who doesn't have much positive to tell about himself), while a largely positive campaign by Candidate 1 would also indicate the absence of too negative information about Candidate 2.

## 5 Relation to stylized facts of negative campaigning

In this section, we will discuss how properties of the equilibrium correspond to stylized facts about negative campaigning known in the literature.

**Effects of negative campaigning on attacker and target.** Lau, Sigelman, Heldman, and Babbitt (1999) summarize a large number of papers analyzing the effects of negative political advertising on both the attacker (the “sponsor”) and the attacked (or “target”). A large majority of these studies finds that respondents like the sponsor of a negative add less than before (19 studies versus only 3 studies in which the sponsor was liked more than before). With respect to the target of a negative ad, 9 studies find that the target of a negative add is liked less, while 5 find that the target is actually liked more than before.

At first sight, these results raise the question: Why would rational candidates ever go negative on their opponent? While the effect on the sponsor of a negative add is very likely to be negative, the effect on the target appears much more ambiguous.

Note that such effects arise as equilibrium effects in our model, in which candidates make the optimal choice regarding their campaign strategy. First, if a candidate chooses

to go negative on his opponent, this will reveal negative information on the sponsor, as the voters can infer that the sponsor has a low  $w$  and hence not much positive to reveal about himself: The expected value of the sponsor’s  $w$  usually drops in our model if voters see a negative ad.<sup>9</sup>

On the other hand, the effect of a negative add on the perception of the target is ambiguous in our model: Given the shape of the  $\mathcal{V}$  set in our equilibrium, the revealed value of  $v$  in a negative ad is more likely to lie below the ex ante expected value of  $\frac{v+\bar{v}}{2}$  than above it, but it is entirely possible that a negative ad actually conveys *positive* information about the target, leading the voters to revise upward their estimate of the target’s valence. In practice, we would think that ads that are just mean without conveying any relevant negative information about the target should increase the esteem in which the target is held, as rational voters will likely think: “That’s all his opponent can say against him??”

Note that, if negative campaigning leads to an increase in the affect for the target, this effect is not an “accident” for the sponsor in our model, i.e., a move that unexpectedly turned out not to work as planned. Rather, it is the best the sponsor can do, given the equilibrium expectations and the fact that a positive add would be even more harmful to him.

**Who chooses to campaign negatively?** The most direct prediction from our model (candidates are more likely to choose to campaign negatively if their opponent is bad and if they themselves are bad, always relative to the electorate’s ex-ante expectation) is unfortunately difficult to test, because of limited observability. The focus of existing empirical studies that address the question of who campaigns negatively focuses on distinguishing the behavior of front-runners versus trailing candidates, see e.g. Haynes and Rhine (1998), Theilmann and Wilhite (1998), Damore (2002) and Sigelman and Buell (2003).

Haynes and Rhine (1998) study daily data on candidate commentary collected during the 1992 democratic primary election and find that the front-runner is not likely to attack other candidates unless attacked, and the trailing candidates are more likely to attack.<sup>10</sup> Another interesting result from Haynes and Rhine is that the level of negative campaigning increases with the amount of media coverage. Their interpretation is that when the stake is high the media and public is more attentive, candidates can most effectively lodge negative attacks.

With respect to the more frequent attacks on front-runners, our model suggests that

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<sup>9</sup>The only exception to this is if  $\bar{v}_2 - v_2 > \bar{w}_1 - w_1$ . In this case, Candidate 1 will choose to campaign negatively, no matter what his  $w_1$  value is, and hence the updated expectation of  $w_1$  in the electorate is the same as the ex-ante expected value.

<sup>10</sup>Similar results are found by Sigelman and Buell (2003): they present evidence from presidential election between 1960 and 2000 that trailing candidates consistently exhibit higher propensities to attack.

the reason is *not* that the distribution of valence is simply shifted to more favorable values for the frontrunner, as a simple shift that leaves  $\bar{v} - \underline{v}$  unaltered would not change the probability of negative campaigning in our model. However, it is plausible that the electorate is also *more uncertain* about the front runner than about lagging candidates.

Suppose, for example, that valence is generated by two components, a candidate's integrity and his rhetorical ability/likeability. Furthermore, assume that these two components are complements, i.e. the marginal effect of rhetorical ability is larger when the candidate has a high value of integrity (or, equivalently, if the candidate is a crook, being a good talker does not help much). Now suppose that it is easy for the electorate to find out about the rhetorical talent of the candidate (simply by listening to him), and this observation defines the initial distribution of valence for the two candidates, and makes the rhetorically more talented candidate the frontrunner. If the electorate observes a rhetorically talented candidate, then the highest possible valence level is substantially higher than for a candidate who has a lower rhetorical ability. However, the lowest possible valence level is still pretty similar for the two candidates, and hence the electorate is *more uncertain* about the frontrunner's valence, which again makes it more likely that the frontrunner attracts negative campaigning.

**Do voters resent negative campaigning?** There is substantial evidence that voters in focus groups declare that they “do not like” negative political advertising. Prinkleton (1997), Hitchon and Chang (1995), and Thorson, Christ, and Caywood (1991) show that negative ads (or attack ads) received a less favorable evaluation from participants than positive ads.

Still, political candidates continue to use negative ads, presumably because they “work”. For example, Susan Estrich, campaign manager for Dukakis in 1988, states that “no matter how much people say they dislike it, negative campaigns continue to move voters from one column to the other”.<sup>11</sup> Similarly, Republican consultant Roger Stone claims that “voters will tell you in focus groups that they don't like negative ads, but they retain the information so much better than the positive ones”.<sup>12</sup>

All these observations are consistent with our model in which negative campaigning conveys important information to voters. Note that, while voters are not *per se* opposed to negative campaigning in our model, negative campaigning conveys on average unfavorable information about the candidates, which could be interpreted as the reason why people react disappointedly when observing negative ads. Still, this does not mean that voters suffer from *the institution* of negative campaigning in our model, as we will see in Section 6.

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<sup>11</sup>Quoted by Lau and Pomper (2002), 48

<sup>12</sup>Lau and Pomper (2002), p. 48



**Negative campaigning and turnout.** Negative political ads are often accused by political pundits and politicians of contributing to low voter turnout. For example, 3 days after the 1996 presidential election, both Bill Clinton and Bob Dole listed negative campaigning as one reason for the low turnout.<sup>13</sup> There is a notion that negative campaigning may turn off voters and hence negatively affect the level of participation in the democratic process.

This conventional wisdom is supported, for example, in the studies by Ansolabehere, Iyenger, Simon, and Valentino (1994), Ansolabehere and Iyenger (1995) and Ansolabehere, Iyenger, and Simon (1999). They use both experimental analysis and data from actual elections, for example the 1992 Senate races, to show that participation is lowered by negative ads. On the other hand, Thorson, Christ, and Caywood (1991), Geer and Lau (1998), Finkel and Geer (1998), Freedman and Goldstein (1999) and Kahn and Kenney (1999) find either a negative but not significant or even a positive effect of negative campaigning on turnout.

If negative campaigning were indeed found to depress turnout in the election (and one views voter participation as positive), it is tempting to infer from this positive statement the normative statement that there is “too much” negative campaigning from a social point of view.

The contribution of our model to this question is to caution against this interpretation. There is a difference between the following two statements: “Voters don’t like it when they see candidates campaigning negatively” and “Voters would be better off, if candidates could not campaign negatively”. The first of these statements is true in our model, as voters expected utility is smaller if candidates choose to campaign negatively than if the campaign is positive. In this sense, we would expect that, in our model, voters are disappointed when they see that candidates resort to negative campaigning.

However, in our model, the first statement by no means implies the second statement, as we formally show in Section 6. Negative campaigning provides valuable information to voters and allows them, on average, to make better decisions concerning which candidate to elect. So, in our model, the observation that voters say that they do not like *to see negative campaign ads* is perfectly consistent with the fact that the *institution* that negative campaigning is feasible is beneficial for voters.

Looking at voter participation, even if we find that participation rates decrease with negative campaigning, this would not necessarily mean that if the possibility of negative campaigning is abolished, participation rates would increase: Suppose that the turnout depends positively on the perceived quality of the candidates (or of the leading candidate); perhaps, the voters have lower voting costs if they think that the candidate they vote for

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<sup>13</sup>Cited by Wattenberg and Briens (1999), p. 891.

is a good candidate rather than just the lesser evil. As argued above, if both candidates choose to campaign positively, voters infer that both candidates (and in particular the winner) are likely to be good, while a negative campaign indicates a lower quality.

Suppose now that we could in fact enforce that candidates can only campaign positively and that this is common knowledge, so that voters do not believe that it provides a positive signal about the candidates' qualities. In this case, voter turnout (assuming that it is still positively related to the winning probability in the general election) would be lower than in our setting (where negative campaigning is allowed), if candidates *choose* to campaign positively. The overall expected effect of banning negative campaigning would be ambiguous.

**Timing of negative campaigns.** Damore (2002) studies presidential elections from 1976 to 1996 and finds that candidates in the early phase of the election campaign tend to focus on positive campaigning. He interprets this as an attempt by candidates to reduce uncertainty and gain credibility in the early phase of the campaign.<sup>14</sup> Later however, candidates shift their focus to negative campaigning, which is interpreted as an attempt to undermine the opponent's support. Damore (2002) also reports that negative campaigning is used more often when the race is close.

Since our model is static (in the sense that there is only one time when candidates make the decision whether to campaign positively or negatively), dynamics are difficult to analyze in our model. However, one could extend our model to a dynamic setting in which candidates have several different moments when they can choose to go negative (or positive).

For primary elections, one can combine this dynamic setup with the quite plausible assumption that there are (utility) costs for a candidate if he goes negative towards an opponent for the nomination. Suppose for example that, if the other candidate wins, he is probably less likely to consider his competitor for any benefits or jobs (like the vice-presidency slot), if the competitor used negative campaigning.

If negative campaigning is associated with utility costs, then it makes sense for candidates to wait with the negative ads until late in the campaign; at that time, they see whether the race is close, in which case the effect of negative campaigning on the probability of winning is likely to be big, or whether their advantage (or disadvantage) in the race is sufficiently big that it is not worthwhile to incur the costs of negative campaigning.

**More than two candidates.** While in most general elections in the U.S. there are only two serious candidates, primaries often have more than two serious contenders (at least

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<sup>14</sup>See Austin-Smith (1987) for a formal model of campaigning as reducing the uncertainty of voters about candidate positions.

initially). It is therefore interesting to analyze what happens in our model if there are three or more candidates rather than just two.

While we do not provide a formal analysis of this extension, it is clear that a new free-riding aspect arises in negative campaigning: Consider the three candidate case, where there are always two candidates, say 1 and 2, who are capable of revealing the third candidate’s valence. If either 1 or 2 reveals negative information about candidate 3, *both* of candidate 3’s competitors benefit, making negative campaigning effectively a public good for them. Each candidate then has too big a private incentive to emphasize his own positive aspects (because this only benefits his own electoral prospects) rather than the negative information about any of his his competitors (which also benefits some other candidates).

In such a setting, negative campaigning is likely to be undersupplied from the point of view of the voters.<sup>15</sup> The public good effect is greater when there are more candidates around, and to the extent that some candidates drop out over time in presidential nomination races, we would expect more negative attacks at a time when the field has already narrowed down than initially when there are still many candidates around. Again, this may be a reason why negative campaigns tend to occur near the end of the campaign rather than at its start.

## 6 Welfare analysis

In this section, we look at the efficiency of the equilibrium in terms of delivering information to voters. One of the advantages of our rational choice approach to negative campaigning is that we can analyze the effects of changes in the signaling system on voters’ utility (and consequently, we can analyze whether there is too much or too little negative campaigning from the voters point of view).

### 6.1 Banning negative campaigning

Let us call a partition  $(\mathcal{W}, \mathcal{V})$  (the areas in which candidates campaign positively and negatively) a “signaling system”. The equilibrium from Proposition 3 is just one example of a signaling system. For any set of two competitors, a signaling system determines which information is transmitted to the electorate and hence, after the rational updating about the information that is not transmitted takes place, it determines who wins the election.<sup>16</sup>

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<sup>15</sup>Note that the claim here is that voters get too little information in aspects that only a candidate’s competitors can credibly inform on. It still would not be the case that voters “like” to see negative attacks, because they still contain negative information about all (or some) candidates’ valence.

<sup>16</sup>For simplicity, we will assume in this section that the shock  $z$  (which occurs immediately before the election) is almost always negligible, so that the candidate for whom  $E(w + v)$  is larger, wins with

Every signaling system, together with an initial distribution for the two candidates (i.e., a distribution of  $(w_1, w_2, v_1, v_2)$ ) therefore generates a distribution of  $w$  and  $v$  for the winning candidate. Changing the sets  $\mathcal{W}$  and  $\mathcal{V}$  of positive and negative campaigning may in general influence who wins the election, and hence the expected value of  $v + w$  of the winning candidate.

Let us consider the following cases and their effect on the expected quality of politicians in each case.

**Case 1: The equilibrium signaling system.** The candidates follow the equilibrium behavior of negative and positive campaigning analyzed in Section 4.

**Case 2: Only positive campaigning.** In this case, candidates have to reveal their own  $w$  and cannot campaign negatively.

**Case 3: Perfect information.** In this case, the voter knows  $(v_1, v_2, w_1, w_2)$  and chooses Candidate 1 if and only if  $v_1 + w_1 > v_2 + w_2$

A comparison between Case 1 and Case 2 will therefore show the welfare effect of negative campaigning. The comparison to Case 3 is useful as a benchmark, because it shows how well a *perfect* information system (relative to one that only uses negative campaigning) performs.

In all scenarios, we analyze ex-ante symmetric candidates and normalize the variable  $w$  to be drawn from a uniform distribution on  $[0, 1]$  for each candidate. The variable  $v$  is drawn from a uniform distribution on  $[0, \bar{v}]$ , where we analyze the cases for  $\bar{v} = 0.5, 1, 2, 5$ . Higher values of  $\bar{v}$  hence correspond to scenarios where the valence information that the opponent can reveal during the campaign becomes more and more important.

Table 1 gives the expected quality of the winning candidate in all cases and for different values of  $\bar{v}$ . For Cases 1 and 2, we also show as a percentage in brackets how the quality of the winning candidate compares to the best possible result (Case 3, perfect information). Details about the computations in Table 1 are available in the appendix.

For all values of  $v$ , the equilibrium in which candidates choose between positive and negative campaigning (Case 1) leads to a higher expected quality of the elected politician than Case 2, in which candidates only campaign on their own  $w$  dimension.

It is intuitive that the difference between these two cases is bigger, the more important the quality dimension that only the opponent can reveal is, i.e. the higher  $\bar{v}$  is. When  $\bar{v} = 0.5$ , information transmitted by candidates in the equilibrium is also mostly on the  $w$  dimension, because that is the more important dimension for voters and so it is usually more interesting to know this dimension. The higher  $\bar{v}$  becomes, the more important probability near to 1. Changing this assumption is unlikely to qualitatively affect the results.

	Case 1 (equilibrium)	Case 2 (only positive campaigning)	Case 3 (perfect information)
$\bar{v} = 0.5$	0.9208 (98.4%)	0.9166 (98.0%)	0.9354
$\bar{v} = 1$	1.200 (97.3%)	1.166 (94.6%)	1.233
$\bar{v} = 2$	1.842 (98.4%)	1.666 (89.1%)	1.871
$\bar{v} = 5$	3.835 (99.6%)	3.166 (82.3%)	3.849

Table 1: Expected quality  $v + w$  of the winning candidate (percent of full information quality)

is information that only the opponent can credibly transmit. Therefore, the enforced positive campaigning in Case 2 conveys more and more irrelevant information, and hence the difference to the equilibrium utility becomes larger and larger.

As  $\bar{v}$  grows, the quality that can be achieved in equilibrium approaches the perfect information benchmark. This is intuitive: Equilibrium information is almost always on  $v$ , and so in equilibrium it is very likely that the candidate with the higher  $v$  wins, and with a very high probability, this is also the better candidate overall.

## 6.2 The efficiency of the equilibrium signaling system

In the last subsection, we have seen that abolishing negative campaigning completely will decrease the expected quality of the winning candidate. In this subsection, we ask whether the equilibrium signaling system is (constrained) efficient, i.e. whether a different signaling system could transmit on average better information (lead to the selection of better candidates), subject to the constraint that only 2 signals can be transmitted. It turns out that the answer is affirmative: In the class of all possible signaling systems, the equilibrium signaling system is not efficient.

Consider first the problem of a social planner who knows all parameters and can send out 2 pieces of information about the 4 variables of interest, and does this in a way to maximize the voters' expected utility. It is fairly obvious that the social planner can transmit all relevant information (i.e., for whom people should vote) with even just one signal. However, this is, in a certain sense, defining away the problem.

The problem becomes more interesting if we restrict the planner to send one signal on  $w_1$  or  $v_2$ , and one on  $w_2$  or  $v_1$ ; in addition, the choice between sending information on  $w_1$  and  $v_2$  may only depend on  $(w_1, v_2)$ . Another way of describing this problem is as follows: Suppose that, instead of the two candidates who decide on information transmission, we had two social planners. Each planner observes 2 variables only ( $w_1$  and  $v_2$  for the first planner,  $w_2$  and  $v_1$  for the second one). Voters then update their beliefs and vote for the candidate with the higher expected quality.

Consider the following signaling system (see Figure 2). If  $\bar{v} - \underline{v} > \bar{w} - \underline{w} = 1$  (i.e., there is more uncertainty about  $v$  than about  $w$ ), a square area at the top is divided into 4 smaller squares of equal size, and 2 of them are assigned to  $\mathcal{W}$ . The two other small squares and the rest of the area is assigned to  $\mathcal{V}$ .

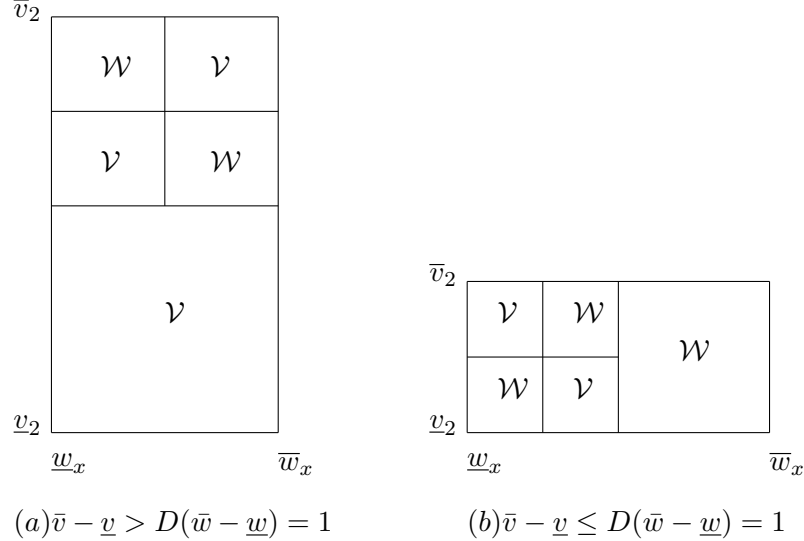


Figure 2: Parameter space under an alternative signaling system

The advantage of this alternative signaling system, in comparison to the equilibrium one, is that it reduces the expected mistake on the dimension that is not reported. To see this intuitively, consider a parameter combination that is somewhere in the area of the 4 small squares. The reported parameter enables voters in the alternative signaling system to recognize in which square we are, and hence the average mistake on the unreported parameter is just  $1/8$ . For example, if we are in the upper left square where  $w$  is reported, the estimate of  $v_2$  is  $\bar{v}_2 - 1/4$ . Since the true value of  $v_2$  is between  $\bar{v}_2 - 1/2$  and  $\bar{v}_2$ , the average mistake made (i.e., the absolute value of the distance between the true value of  $v_2$  and the voter's expectation) is  $1/8$ . Now consider what happens in the equilibrium signaling system when the parameters are in the same area as before. Voters can infer whether they are above or below the boundary. The mean mistake varies, but on average, the unknown parameter is in an interval of width  $1/2$ , and hence the average mistake is  $1/8$  in the equilibrium signaling system.

The resulting expected quality of the winning candidate in this alternative signaling system is reported in Table 2. Again, we also provide the expected quality in equilibrium and, in brackets, how many percent of the full information quality are achieved.

The alternative signaling system improves the expected quality of the elected politician. For higher values of  $v$ , the effect of switching to the alternative signaling system is smaller. This is quite intuitive, as in any case information is almost always transmitted on  $v$  in both the alternative and the equilibrium signaling structures, and so the difference between

	Case 1 (equilibrium)	Case 4 (alternative signaling system)
$\bar{v} = 0.5$	0.9208 (98.4%)	0.9212 (98.5 %)
$\bar{v} = 1$	1.200 (97.3%)	1.219 (98.9%)
$\bar{v} = 2$	1.842 (98.4%)	1.847 (98.7%)
$\bar{v} = 5$	3.835 (99.6%)	3.837 (99.7%)

Table 2: Expected quality  $v + w$  of the winning candidate (percent of full information quality)

these structures cannot be too big. Moreover, as  $v$  goes to infinity, expected utility in both structures converges to the full information utility.

Note that, while the alternative structure is more efficient in transmitting information, the probability of negative campaigning is exactly the same under the equilibrium signaling structure and under the alternative structure. In this sense, one cannot say that there is *too much* (or too little) negative campaigning in the equilibrium, just the parameter combinations in which negative campaigning is used is not optimal in the equilibrium signaling structure.

## 7 Previous literature

In this section, we discuss the relationship between our work and a number of theoretical studies of campaigning.

**The reduced form approach to negative campaigning.** Skaperdas and Grofman (1995) present a model of negative campaigning, in which each candidate is endowed in the beginning with a number of supporters, and there are also undecided voters. Positive campaigning attracts undecided voters, and negative campaigning reduces the support of one’s opponents by shifting some of his initial supporters to undecided voters. Negative campaigning is also costly for the initiator in the sense that it turns off a percentage of the attacking candidate’s initial supporters. The strategy of a candidate is to choose the level of positive and negative campaigning simultaneously (both are continuous variables in their model) in order to maximize the votes.

Given their assumptions, the frontrunner chooses a lower level of negative campaigning, as he has both smaller benefits (in terms of supporters of his opponent becoming uncommitted) and higher costs (in terms of own supporters lost) when campaigning negatively. Under multicandidate competition, attacks are usually aimed at the frontrunner, and if the frontrunner attacks negatively, it will be aimed at the top ranked opponent.

In a related study, Harrington and Hess (1996) use a spatial model and treat campaigning as a tool to skew voters' perceptions of candidates' ideologies. A candidate's (perceived) ideology position is directly influenced by the amount of opponent's negative campaign advertisement. Hence, negative campaigning is used in a sense to drive the opponent's ideology position away from that of the median voter's.

The main difference between the black-box approach and our model consists in the way how the effects of negative campaigning are modeled. In Skaperdas and Grofman (1995), the primitive assumption is that there is a functional relationship how candidates can use two different forms of campaigning into votes on election day. While the functional specification of the effects of "positive" and "negative" campaigning are plausible, no causal relationship for how these forms of campaigning work is modeled. Moreover, there is no uncertainty in the electorate about the candidates, and hence no role for campaigning in providing information. In Harrington and Hess (1996), voters can be fooled by negative campaigning into thinking that a candidate's position is more extreme than it actually is. In contrast, our model provides a framework in which all players including the voters behave completely rational. Politicians can partially suppress information (by choosing not to stress certain aspects relevant for the electorate), but they cannot fool voters in the area in which they decide to campaign. In our setting, both positive and negative campaigning, serve the role of providing essential information to the electorate, which votes for the candidate that is thought to be better after the campaign.

Our model also provides a framework in which we can analyze normative questions, in particular whether there is too much or too little negative campaigning. Similar question could not be asked within the black box approach of Skaperdas and Grofman (1995) and Harrington and Hess (1996), since voters there are modeled as passive rather than optimizing by choosing from among the set of available candidates, as in our model.

**Models of informative advertising.** Outside the context of positive versus negative campaigning, there exist several models of informative advertising in the literature. In many of these models, the main focus is on the interplay between the information transmission role of campaigning and the influence of lobby groups that provide the candidates with the financial means necessary. None of the models reviewed in the following distinguishes negative and positive campaigning.

There are essentially three different approaches: In Baron (1994), there are "informed" and "uninformed" voters. Informed voters vote for candidates based on their policy positions, while uninformed voters (who are ignorant of candidates' positions) may be swayed by campaign advertising, financed by interest groups.<sup>17</sup> Baron's main focus is not how

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<sup>17</sup>Baron (1994) does not distinguish between negative and positive campaigning.



candidates inform voters through campaign advertising, but rather how they to choose a position on an issue to win votes from informed voters while, at the same time, collecting money from interest groups in order to solicit more votes from uninformed voters.

In the second approach, campaign advertising is modeled as providing information indirectly (Potters, Sloof, and van Winden (1997), Prat (2002b), Prat (2002a)). These papers assume that interest groups are able to observe a signal of candidates' valence before the campaign starts. Interest groups can give money to candidates, in exchange for a favorable policy position; candidates use the money for campaigning. Since interest groups have a stake in giving to likely winners, and a competent candidate is more likely to win, the amount of campaign money that a candidate collects signals his valence to voters. Hence, although campaign advertising is assumed to not convey information directly, it does so indirectly as good candidates are more able to raise money than bad ones.

Lastly, Coate (2003) analyzes a model in which campaign advertising is directly informative about a candidate's ideological position, which can be either moderate or extreme. Lobby groups are ideologically motivated and give money to their party's candidate if and only if this candidate is moderate. Since candidates in Coate (2003) can only engage in positive campaigning, indicating their own platform to voters, contributions to extremist politicians are pointless and do not occur in equilibrium. Coate analyzes a model that integrates parties' nomination decisions, the decision of lobbies to contribute to candidates, and advertising that informs on a candidate's preferred policy. His main focus is on the implication of the model for campaign finance regulation.

Our model is most related to the second and third branch of literature in that we also have a model in which campaigning transmits valuable information to voters and a framework in which welfare questions can be studied. Our model is complementary to the existing literature in this area: On the one hand, we study additionally choice between positive and negative campaigning. On the other hand, we take as given the ability of candidates to wage either a positive or a negative campaign, so that there is no role for campaign contributions in our model.

## 8 Conclusion

This paper set out to provide a formal model of an election in which candidates campaign to convey truthful information to voters, and voters rationally update their prior beliefs when casting their votes. In particular, our paper addresses the strategic choice of candidates between positive and negative campaigning.

In our model, an essentially unique monotone equilibrium exists in which a candidate resorts to negative campaigning if either his opponent has a low valence or the candidate

himself is weak in the dimension that he can credibly inform voters on. Negative campaigning against a candidate becomes the more frequent, the more insecure the electorate is about that candidate.

The predictions of our model are broadly consistent with various stylized facts that have been reported about negative campaigning in the literature. In particular, in contrast to previous literature the model is able to explain why the electorate's opinion about the *sponsor* of a negative ad decreases and why it is possible (as an equilibrium phenomenon) that the electorate's opinion about the target may increase.

An advantage of our model is that it allows to analyze the optimal level of negative campaigning from the voters' point of view. Here, we show that there is an efficiency rationale for negative campaigning, as it leads to more informed decisions than would be feasible if candidates would only campaign positively. However, given that two instruments are available, the equilibrium signaling structure is not the most efficient one from the voters' point of view.

## 9 Appendix

### 9.1 Proof of Proposition 2

Let

$$VB = \{(\alpha, v_2) | v_2 \in [v_2, \bar{v}_2] \wedge \alpha = \inf_{\tilde{w}}(\tilde{w}, v_2) \in \mathcal{W}\} \quad (9)$$

and

$$WB = \{(w, v_2) | v_2 \in [v_2, \bar{v}_2] \wedge \alpha = \sup_{\tilde{w}}(\tilde{w}, v_2) \in \mathcal{V}\} \quad (10)$$

To the left of  $VB$ , all points are elements of  $\mathcal{V}$ , and to the right of  $WB$ , all points are elements of  $\mathcal{W}$ . If the claim of the proposition is false, then  $VB$  and  $WB$  do not coincide (see Figure 3 below).

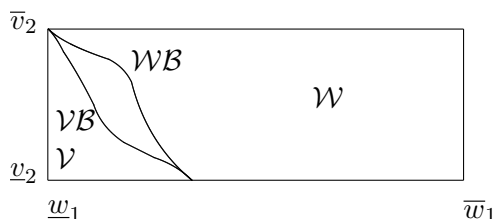


Figure 3: Parameter space with boundary lines  $WB$  and  $VB$

Pick a point  $(w_1^0, v_2^0) \in \mathcal{W}$  on (or within  $\varepsilon$  of)  $VB$  and strictly to the left of  $WB$ . Moreover, there exists  $(w_1', v_2^0) \in \mathcal{V}$  within  $\varepsilon$  of  $WB$ , so that  $w_1' \geq w_1^0$ .

Since candidate 1 informs on  $w_1^0$  at  $(w_1^0, v_2^0)$ , it must be true that

$$w_1^0 - E(v_2 | w_1^0) \geq E(w_1) - v_2^0 \quad (11)$$

On the other hand, by monotonicity, the equilibrium utility at  $(w_1', v_2^0) \in \mathcal{V}$  must be at least as large as the equilibrium utility at  $(w_1^0, v_2^0)$ :

$$E(w_1 | v_2^0) - v_2^0 \geq w_1^0 - E(v_2 | w_1^0). \quad (12)$$

Moreover, all points  $(w_1'', v_2^0)$  with  $w_1'' \in (w_1^0, w_1']$  must be elements of  $\mathcal{V}$ . (Suppose there was a point  $(w_1'', v_2^0) \in \mathcal{W}$ ; then candidate 1's equilibrium utility at this point would be higher than at  $(w_1^0, v_2^0)$ .)

Now, take any point  $(\tilde{w}_1, \tilde{v}_2) \in \mathcal{V}$  within  $\varepsilon$  of  $WB$ . By a similar argument as above, all points  $(\tilde{w}_1, v_2'')$  with  $v_2'' \in [v_2', \tilde{v}_2)$  must be elements of  $\mathcal{W}$ . Hence, all points that are strictly between  $WB$  and  $VB$  must be elements of both  $\mathcal{W}$  and  $\mathcal{V}$ , the desired contradiction.  $\square$

### 9.2 Derivation of results in Section 6

For simplicity, we show here only how to calculate the values if  $\bar{v} - v \geq 1 (= \bar{w} - w)$ . The other case is proceeds analogously.

**Table 1, Case 1 (equilibrium).** We calculate the expected quality of candidate 1, given that he wins. Since candidates are ex-ante symmetric, this is also the expected quality of the winning candidate.

For a given  $(w_1, v_2) \in \mathcal{V}$  where  $v_2 \leq \bar{v} - 1$ , Candidate 1 wins if and only if  $1/2 - v_2 \geq \max(1/2 - v_1, w_2 - (\bar{v} - \frac{1}{2}w_2))$ . The left hand side is the voters expectation of  $w_1 - E(v_2)$ , while the right hand side is the optimal  $E(w_2 - v_1)$  that Candidate 2 can achieve. It turns out that, if  $v_2 \leq \bar{v} - 1$ , Candidate 2 can only win if he uses negative campaigning and  $v_1 < v_2$ , since with positive campaigning by candidate 2  $1/2 - v_1$  is always larger than  $(3/2)w_1 - \bar{v}$ . Hence, in this case, the probability that A wins for  $(w_1, v_2) \in \mathcal{V}$  where  $v_2 \leq \bar{v} - 1$  is

$$\Pr(A|(w_1, v_2) \text{ s.t. } v_2 \leq \bar{v} - 1) = \frac{\bar{v} - v_2}{\bar{v}} \quad (13)$$

The conditional expectation of Candidate 1's quality in this case is

$$E(w_1 + v_1|(w_1, v_2) \text{ s.t. } v_2 \leq \bar{v} \text{ and C1 wins}) = w_1 + \frac{v_2 + \bar{v}}{2} \quad (14)$$

Consider now  $(w_1, v_2) \in \mathcal{V}$  where  $v_2 \leq \bar{v} - 1$ . Candidate 1 wins if and only if both  $v_1 \geq v_2$  and  $w_2 \leq (\bar{v} - v_2)$ , hence with probability

$$\Pr(A|(w_1, v_2) \text{ s.t. } v_2 \in (\bar{v} - 1, \bar{v})) = \frac{(\bar{v} - v_2)^2}{\bar{v}} \quad (15)$$

The conditional expectation of Candidate 1's quality in this case is

$$E(w_1 + v_1|(w_1, v_2) \text{ s.t. } v_2 \in (\bar{v} - 1, \bar{v}) \text{ and C1 wins}) = w_1 + \frac{v_2 + \bar{v}}{2} \quad (16)$$

Last, if  $(w_1, v_2) \in \mathcal{W}$ , Candidate 1 wins if and only if both  $v_1 \geq \bar{v} - w_1$  and  $w_2 \leq w_1$ , hence with probability

$$\Pr(A|(w_1, v_2) \in \mathcal{W}) = \frac{w_1^2}{\bar{v}} \quad (17)$$

The conditional expectation of Candidate 1's quality in this case is

$$E(w_1 + v_1|(w_1, v_2) \in \mathcal{W} \text{ and C1 wins}) = w_1 + \bar{v} - \frac{w_1}{2} \quad (18)$$

Integrating over the respective parameter areas and summing up gives

$$\begin{aligned} E(v_1 + w_1 | A \text{ wins}) \Pr(A \text{ wins}) &= \int_0^{\bar{v}-1} \left(\frac{\bar{v} - v_2}{\bar{v}}\right)^2 \left(\frac{1}{2} + \frac{\bar{v} + v_2}{2}\right) dv_2 \\ &+ \int_0^1 \int_{\bar{v}-1}^{\bar{v}-w_1} \left(\frac{\bar{v} - v_2}{\bar{v}}\right)^2 \left(w_1 + \frac{\bar{v} + v_2}{2}\right) dv_2 dw_1 + \int_0^1 \int_{\bar{v}-w_1}^{\bar{v}} \left(\frac{w_1}{\bar{v}}\right)^2 \left(\bar{v} + \frac{w_1}{2}\right) dv_2 dw_1 \\ &= \frac{1}{4} + \frac{1}{3}\bar{v} + \frac{1}{60\bar{v}^2}. \end{aligned} \quad (19)$$

Dividing both sides by  $1/2$ , the probability that A wins, gives the expected quality of the winning candidate in equilibrium

$$\frac{1}{2} + \frac{2}{3}\bar{v} + \frac{1}{30\bar{v}^2}. \quad (20)$$

**Table 1, Case 2 (only positive campaigning).** This case is straightforward. The electorate chooses the candidate with the better  $w$  and gets a random draw from the  $v$  distribution. Since

$$E(\max(w_1, w_2)) = 2 \int_0^1 \int_{w_2}^1 w_1 dw_1 dw_2 = \frac{2}{3} \quad (21)$$

and  $E(v) = \bar{v}2$ , the expected quality of the winning candidate with only positive campaigning is

$$\frac{2}{3} + \frac{\bar{v}}{2} \quad (22)$$

**Table 1, Case 3 (perfect information).** For this, we derive first the cumulative distribution function for  $v + w$ , given that  $v$  is uniformly distributed on  $[0, \bar{v}]$  and  $w$  is uniformly distributed on  $[0, 1]$ . We get

$$G(x) = \begin{cases} \frac{x^2}{2\bar{v}} & \text{for } x \leq 1 \\ \frac{x - (1/2)}{\bar{v}} & \text{for } x \in (1, \bar{v}) \\ x - \frac{\bar{v}}{2} - \frac{(x-1)^2}{2\bar{v}} & \text{for } x \geq \bar{v} \end{cases} \quad (23)$$

The cdf of  $\max(v_1 + w_1, v_2 + w_2)$  is simply  $G^2$ . This allows us to calculate

$$E(\max(v_1 + w_1, v_2 + w_2)) = \int_0^{\bar{v}+1} (1 - G^2(x)) dx = \frac{1}{2} + \frac{2}{3}v + \frac{5\bar{v} - 1}{60\bar{v}^2} \quad (24)$$

**Table 2, Case 4 (alternative signal system).** Exact calculations are very unpleasant in this case. Instead, these results are based on numerical simulations. For each value of  $v$ , we have draw 800,000 pairs of candidates. For each pair, we find which candidate would be chosen under the alternative signaling system and record that candidate's quality. We sum over all chosen candidates and divide by the number of candidates (800000) to find the expected quality of the winner under the alternative signaling structure.

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