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'Wave riding' or 'Owning the issue':  
How do candidates determine campaign agendas?

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# Wave riding or Owing the issue: How do candidates determine campaign agendas?

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## Abstract

In this paper I address the question of how the agendas for political campaigns are determined, which issues candidates discuss, and whether or not candidates discuss similar issues. Two candidates compete for the votes of four groups of voters by choosing how to allocate their time across two different issues. Candidates' positions are fixed, and their most preferred policies will be implemented after the candidate is elected. Each candidate has a unit of time to clarify his position on both issues. The amount of time spent by a candidate discussing an issue will affect the level of uncertainty regarding a candidate's policy on that issue among the voters.

Both voter distribution and issue importance affect the outcome of the election. Voter distribution determines which candidate will have an advantage in the election, and issue importance determines the minimum amount of time that a candidate with the advantage has to devote to the most important issue in order to win the election. I find that in most cases, candidates are willing to discuss both issues to a certain degree, and dialogue between candidates is possible. Only when candidates disagree on both issues, which are equally important to the voters, each candidate discusses the issue upon which he agrees with the decisive group of voters.



## 2 Related literature

A broad range of existing literature on elections and campaigns is mainly con-

themes that increase his advantage by informing voters on his position, instead of defending himself on the losing position. The possibility of dialogue arises when one of the candidates is lying or has close to unlimited amount of resources. One of the major assumptions in such a framework is that the importance of each issue is determined by the total spending on that issue. In this paper, instead of assuming that candidates' budget allocation is the determinant of issue importance, I assume that issue importance is an exogenous variable, which affects the time spent by the candidate on each issue.

The second theory, also known as the "wave riding" theory states that instead of focusing on the issues traditionally "owned" by their party, candidates concentrate on the issues that voters consider to be of the greatest importance. Sides (2006) analyzed 1998 House and Senate campaigns and argued that issues identified by voters as the most important influence candidates' agendas, but do not fully explain the differences in the campaigns of the two candidates within a given election. Sigelman and Buell (2004) in their study showed the existence of issue convergence in political campaigns. Kaplan et. al., (2006) examined the issue convergence in candidates' television advertising and found that competing candidates adopt similar campaign agendas, and when more money is allocated for the campaign, more similar issues are being discussed by competing parties. Another finding of the study showed that regardless of issue ownership, both candidates devote more resources to the issues that are more important to the public. This finding coincides with that of Ansolabehere and Iyengar (1994), who argue that during the campaign, candidates address the issues with which the public is concerned the most. The authors show that candidates gain by addressing the issues of the most concern, and are penalized if they fail to do so.

RePass showed that voters Belanger and Meguid 2004, argued that issue ownership plays an important role in voters' decision making process, but only for the voters who think that issue is important. had similar

Finally, this paper relates to the literature on ambiguity in electoral competition. Most authors assume that ambiguity is created by candidates in order to appeal to a broader range of voters by using a one-dimensional framework. Alesina and Cukierman (1990) assumed that candidates are office and policy motivated and might take an ambiguous policy in order to hide their true preferred policy. Aragonés and Postlewaite (2002) analyzed how candidates use ambiguity to their advantage in an election with rational voters. The authors consider a one issue election with several alternatives, where voters' beliefs are affected by the campaign statements. They define the conditions under which candidates choose to deliver ambiguous statements and by doing so increase the number of voters to whom they appeal. Laslier (2003) proposed a model that explains why ambiguity is present in the elections with voters that dislike ambiguity. Berliant and Konishi (2005) moved away from the one dimensional election and developed a model where office motivated candidates freely choose their positions on any of the issues and simultaneously announce them. Candidates are not aware of voter preferences at the stage of platform announcement, and voters are not aware of the candidates' positions on the issues that were



The issue intensity can be treated as the indicator of relative issue importance to the voters. As  $\alpha_i \rightarrow 1$  the difference between utility from best alternative and worst alternative ( $1 - \alpha_i$ ) is minimal, and as a result the voter might not care about the issue as much, as both alternatives are equally satisfying to him. If  $\alpha_i \rightarrow 0$ , the difference between the best and next best alternative increases and voter will care more about his most preferred policy to be implemented.

The issue  $Z_i$  is more important than the issue  $Z_{-i}$  if  $\alpha_i < \alpha_{-i}$ : Parameter  $\frac{\alpha_{-i}}{\alpha_i}$  represents relative issue importance. It shows by how much one issue is more important than the other. When  $\frac{\alpha_{-i}}{\alpha_i} \rightarrow 1$ , issues become more equal in their importance to the voters.

The specification of the utility function might seem restrictive, but even when the upper bound of utility function is not limited by 1 the model produces exactly the same results. This states that the absolute importance of the issue is not important, it is the relative issue importance that drives the results of this paper.

I assume that all voters are alike in terms of issue intensities, or in other words all voters agree on which issue is more important and which issue is not, or everyone agrees that two issues are similarly important.

Candidates know the voters' most preferred policies, but the voters are not aware of candidates' positions and learn about candidates' most preferred policies from candidates' speeches. By discussing issues candidates clarify their position on those issues and reduce the uncertainty observed by the voters. If candidate spends  $p$  time discussing issue  $Z$  voters believe that that candidate will implement his most preferred policy with probability  $f(p) > 0.5$ .

Assumption 1 The belief function  $f(p)$  is strictly increasing function with  $f(0) = 0.5$  and  $f(1) = 1$ :

Assumption 2 The belief function  $f(p)$  is concave,  $f'(p) < 0$ :

The first assumption is a standing assumption for the rest of the paper. It says that if a candidate spends more time discussing one of the issues, voters learn more about candidate's true position on that issue and update their beliefs accordingly. If candidate spends no time at all discussing the issue, voters have no information regarding the candidate's position on the issue and believe either policy can be implemented with equal probability. The second assumption im-

The game is divided into two stages. In the first stage, both candidates simultaneously decide how much time to devote to each issue. In stage two voters update their beliefs and vote for their most preferred candidate.

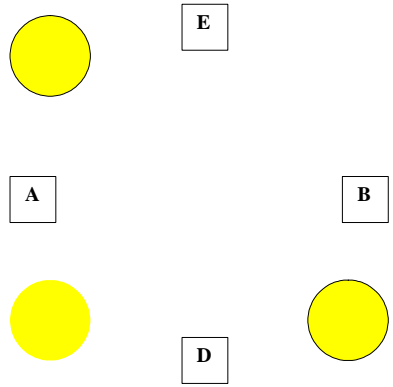
The first part of the analysis is devoted to the elections where candidates have completely different issue preferences. This assumption contradicts the classical Downsian model of political competition (Hotelling 1929, Downs 1957, Black 1958), but some scholars (Glaeser et al. 2005,) have showed that candidate's convergence is not guaranteed under assumptions different from median voter theorem.

In the second part, candidates agree on one of the issues, but disagree on the other one. I refer to the issues upon which candidates agree as a common issue. Each part is further divided into two cases with different voter distribution.

### 3.1 Candidates have opposite issue preferences

Assume that candidates' positions are different in every dimension. More specifically, if elected, candidate C will implement policy set (A; E) and candidate C will implement policy set (B; D). When candidate C spends  $p$  time discussing issue Z, the voters believe that policy A will be implemented with probability  $f(p)$  and that policy B will be implemented with probability  $1 - f(p)$ . At the same time, candidate C has  $1 - p$





Note that voters from groups 1 and 3 never vote for the same candidate, unless they get exactly the same utility from voting for candidates  $C_1$  and  $C_2$ . Then the voters from those groups are indifferent between candidates. The same holds for voters from group 2 and group 4.

There is a continuum of possible voter distributions, but all those cases can be divided into four groups. First, I consider the distribution in which one group of voters decides the outcome of the election. Consider the following example. In an election with two competing candidates (a Democrat and a Republican), and four groups of voters, candidates disagree on whether or not taxes should be increased and whether or not gay couples should be allowed to marry. Each candidate has a partisan group of voters, and each one of those groups has a

C implements the policy set (B; D). Voters are distributed in such way that  $f_1 + f_2 > 0.5$  and  $f_3 + f_4 > 0.5$ .

To win the election, a candidate must obtain more than a half of all the votes. Candidates have no preferences over voters, thus they do not care which group of voters vote for them. All they care about is winning the election so they can implement their most preferred policies. As previously stated, group 1 always votes for candidate C, and voters from group 3 unconditionally vote for candidate C. Thus, whichever candidate obtains the votes from group 2 wins the election. For example, if fraction of voters from group 1 and group 2 is larger than one half (which means total voter fraction from groups 3 and 4 is smaller than one half) and at the same time fraction of voters from group 2 and group 3 is larger than one half (which means total voter fraction from groups 1 and 4 is smaller than one half), each candidate can win the election by obtaining the votes from group 2.

Define  $p$ , such that  $\frac{f_1 + p f_2}{f_1 + f_2}$



time more evenly and discuss different issues.

Now assume that voters are distributed in such manner that if either voters from group 2 or group 4 vote for candidate C, he wins the election. The voter distribution is described in the following case.

Case 2 If elected, candidate C implements the policy set (A; E) and candidate C implements the policy set (B; D). There are four groups of voters who determine the outcome of the election. Voters are distributed in such way that  $\alpha_1 + \alpha_4 > 0.5$  and  $\alpha_2 + \alpha_3 > 0.5$ .

As in previous case, in order for the candidate to win the election, he needs to obtain more votes than his rival. With this voter distribution, candidate C will have an advantage as he can win the election by obtaining votes from either group 2 or group 4 (recall that voters from group 1 always vote for candidate C). Candidate C wins the election if and only if voters from both groups, 2 and 4, vote for him. But this is not possible, unless they get exactly the same utility from voting for candidate C and C, in which case the voters from those groups are indifferent between candidates. The following proposition describes the strategies of candidates in this case.

Proposition 2. Assume Case 2. In the equilibrium:

- (a) if  $\frac{\alpha_1}{\alpha_2} < 1$ , then  $p^C < p^D$ ,  $p^C \in [0; 1]$ , and voters from groups 1 and 4 vote for candidate C, who wins the election;
- (b) if  $\frac{\alpha_1}{\alpha_2} > 1$ , then  $p^C > p^D$ ,  $p^C \in [0; 1]$ , and voters from groups 1 and 2 vote for candidate C, who wins the election;

Example 1 Suppose that issue  $Z$  is more important to voters than issue  $Z$  and also assume that voters are distributed in such manner where

disagree with candidate C on both issues. Now, voters from group 4 believe that issue that they care the most about will not be implemented by candidate C with greater probability than by candidate C, as position of candidate C on the issue Z is more ambiguous. Thus, voters from group 4 will vote for candidate C rather than for candidate C, even though they do not agree with that candidate on any of the issues.

Even though the possibility of partisan voters voting for another candidate or possibility of voters voting for the candidate with opposite preferences exists, such strategies are not the equilibrium strategies. If a candidate spends certain minimum time discussing the issue that both candidates disagree upon, a partisan voter will realize which candidate he is aligned with and vote for that candidate. Thus, it is a weakly dominated strategy for both candidates to obtain the vote from their partisans, and in equilibrium partisans always vote for their candidate.

Define  $p$  such that  $f(p) + \frac{a_2}{a_1} f(1-p) = \frac{a_2}{a_1}$ , and  $\hat{p}$ , such that  $\frac{f(\hat{p}) - p}{f(\hat{p}) - p} = \frac{a_1 - 1}{a_2}$ .

Proposition 3 Assume Case 3. Given Assumption 2, in the equilibrium:

- (a) If  $\frac{a_1 - 1}{a_2} < 1$ , then:
  - if  $\hat{p} < p$  then  $\hat{p} < p^* < p$ ,  $p^* \in [0; 1]$  and voters from groups 1 and 4 vote for candidate C, who wins the election;
  - if  $\hat{p} > p$  then the equilibrium does not exist;
- (b) If  $\frac{a_1 - 1}{a_2} > 1$ , then  $p^* > 0$ ,  $p^* \in [0; 1]$  and voters from groups 1 and 4 vote for candidate C, who wins the election;
- (c) If  $\frac{a_1 - 1}{a_2} = 1$ , then  $0 < p^* < 1$ ;  $p^* \in [0; 1]$  and voters from groups 1 and 4 vote for candidate C, who wins the election;

The proof of Proposition 3 is in Appendix C.

Proposition 3 shows that when in election with a common issue, one of the candidates will have an advantage and win the election. Note, that in equilibrium the winning candidate never spends all of his time discussing the common issue.

When the common issue is more important to the public, two outcomes are possible. If common issue is just slightly more important than non common issue, candidate C will discuss both issues and win the election. By discussing the common issue, ( $p^* < p$ ) candidate C makes voters from group 1 realize that he will implement the policy that is most important to them, but at the same time he needs to discuss the non common issue ( $\hat{p} < p^*$ ) in order to show voters from group 4 that he is different from the other candidate, and will implement their most preferred policy on the other issue. When the common issue is much more important than the non common issue, it is harder for candidate C to convince his partisan voters that he has the same preferred policy on the issue that is more important to them, thus he needs to spend a lot of time discussing



## 4 Conclusion and discussion

The purpose of this paper is both to develop a model that explains the behavior of candidates in a political campaign and to characterize the conditions which determine the focus of campaign participants. Candidates cannot reveal their true positions on every issue, and thus they have to choose how much time to devote to each issue proposed for the discussion.

When candidates disagree on both issues and support for both issue ownership and wave riding theories. If issues are equally important to the public, candidates will spend all their time discussing different issues, and no dialogue between candidates will exist. Both candidate will devote all of their time to the issue upon which they agree with a group of voters that decides the outcome of the election. If one issue is more important than the other, one candidate will be a favorite in the election but he cannot win the election, unless he spends certain amount of time discussing the issue that is more important to the group of voters that determine the outcome of the election. The minimum amount of time a candidate with the advantage would have to spend on the issue will depend on how important that issue is to the deciding group of voters.

In the case where candidates agree on one of the issues, voter distribution determines which candidate has an advantage and can win the election. In most cases the candidate with advantage has to devote some of his time to both issues in order to win the election and the dialogue between candidates will exist. In all cases, the winning candidate has to spend some minimum time discussing the non common issue. Issue intensities determine candidates' strategies, but it is not possible to conclude that candidates will either devote most of their time to the salient issues or to the other issues.

Taken together, the results demonstrate that both, issue importance and voter distribution play an important role in determining the equilibrium strategies and the winner of the election. The mass of a single group of voters is not as important as its mass combined with the other groups, that have similar preferences over one of the issues, thus in order to win the election, favorite candidate might not always try to obtain the votes from the biggest group of voter, but rather from the group of voter that can committed to that candidate.

There are several limitations to this work. First, it was assumed that all voters share the same issue preferences, which is probably not the case in the real life. Some people might believe that economic issues are more important, and some people think that religious issues are of greatest importance. Thus, future work can investigate how the equilibrium changes if voters do not share the same issue intensities. Second, the paper investigates the cases where each issue is at least somewhat important to the voter ( $\alpha_i < 1$ ), and even if the candidate with opposite issue preferences is elected, the voter still gets some utility out of it ( $\alpha_i > 0$ ). If issue intensity bounds were extended, candidates' strategies might be quite different. Finally, it was assumed that each issue has only two alternatives, which is rarely seen in real life. Most issues require more complex thoughts than simply 'yes' or 'no' answers. Allowing candidates and voters to locate anywhere in between extreme alternatives will help answer the



questions raised by Fiorina (2005) regarding voters and candidates polarization.

## 5 Appendix A

Proof of Proposition 1. Voters from group 1 vote for candidate C if  $E_U > E_U$  :

$$f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) > f(p) + (1 - f(p)) +$$

note that  $(1 - \alpha)(1 - f(p)) - (1 - \alpha)(1 - f(1 - p)) \geq 2 [0.5(1 - \alpha); 0.5(1 - \alpha)]$   
 and is strictly decreasing function. Now assume that  $(p; p)$  are candidates'  
 equilibrium strategies, and  $p > p_1$ , where  $p$  is s.t.  $\frac{p - 1}{2} = \frac{f(p) - f(1 - p)}{f(p)}$  and further  
 assume that under strategies  $(p; p)$  candidate C wins the election. In this case  
 $E U_C > E U_D$  or  $(1 - \alpha)(1 - f(1 - p)) - f(1 - p) < (1 - \alpha)(1 - f(p)) - f(p)$   
 or  $(1 - \alpha)f(p) - (1 - \alpha)f(1 - p) < (1 - \alpha)(1 - f(p)) - (1 - \alpha)(1 - f(1 - p))$ .  
 But if  $p > p_1$ , then  $f(p) > f(1 - p)$ :

or  $p < 1$ . Now, assume that  $(p; p)$  are candidates' equilibrium strategies, where  $p = 0$ , and  $p = \hat{p}$ . In this case voter is indifferent between candidates and each candidate wins election with certain probability. But candidate C could deviate to  $p = \hat{p} > \hat{p}$ , then  $(1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p}) < 0.5(1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p}) < 0.5(1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p}) > (1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p}) > (1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p})$  which means that  $(1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p}) > (1 - p)f(1 - \hat{p}) - (1 - p)f(\hat{p})$  holds for any  $p$ , so candidate C wins the election. Thus, in equilibrium, candidate C strategy is  $p \in [0; 1]$ , and candidate C strategy is  $p > \hat{p}$ :

Part (c). Let  $p = \hat{p}$ . Suppose that  $(p; p)$ , where  $p_k \in (0; 1)$  are candidates' equilibrium strategies. Also, assume that candidate C wins and candidate C loses the election. Thus for voters in group 2  $f(p) - f(1 - p) < f(1 - p) - f(p)$ . Candidate C would want to deviate in order to reverse the sign of inequality and win the election. If candidate C chooses  $p = \hat{p} = 1 - p + \epsilon$ , s.t.  $\epsilon \in (0; p)$ , then  $f(p) - f(1 - p) > f(1 - \hat{p}) - f(\hat{p})$  and candidate C wins the election. But  $(p; \hat{p})$  cannot be equilibrium strategy, because if candidate C can deviate from  $p$  to  $\hat{p} = 1 - p + \epsilon$ , s.t.  $\epsilon \in (0; 1 - p)$ , then  $f(\hat{p}) - f(1 - \hat{p}) < f(1 - p) - f(p)$  which makes candidate C a winner of the election. But then again, candidate C can depart from  $\hat{p}$  to  $\hat{p}$  where  $\hat{p} = 1 - p + \epsilon$ , s.t.  $\epsilon \in (0; p)$ , and win the election. Candidate C in this case would be better off by selecting  $\hat{p} = 1 - p + \epsilon$ , s.t.  $\epsilon \in (0; 1 - p)$ .

Thus, set of strategies  $(p; p)$ , where  $p_k \in (0; 1)$  cannot be an equilibrium, as losing candidate always has an opportunity to win the election by deviating from the equilibrium. Now, suppose  $(p; 1)$ , where  $p \in [0; 1]$  are candidates' equilibrium strategies, and candidate C wins the election, as  $f(p) - f(1 - p) > f(0) - f(1) = 0.5$ . Now candidate C would want to deviate from  $p$ , reverse the sign of inequality, and win the election. But if  $p \in [0; 1]$  then  $f(p) - f(1 - p) \in [0.5; 0.5]$ , and thus  $f(p) - f(1 - p) < 0.5$  is not possible. Thus the best candidate C can do is to select  $p = 0$ , which, given strategy of candidate C, makes voters indifferent between candidates, as  $f(p) - f(1 - p) = f(1 - p) - f(p)$ . Thus, given candidate's C strategy  $p = 1$ , candidate's C strategy is  $p = 0$ , the voter is indifferent between candidates, and each candidate wins the election with certain probability. Candidates' equilibrium strategies are  $p = 0$  and  $p = 1$ . Each candidate loses the election with probability 1 when deviating from the equilibrium.

## 6 Appendix B

Proof of proposition 2. Each candidate wins the election if he gets more votes than his rival. It was previously shown that voters in group 1 always vote for candidate C, thus if either voters in group 2 or voters in group 4 vote for candidate C, he wins the election. Voters from groups 2 and 4 never vote for the same candidate unless both groups are indifferent between candidates and vote for each candidate with equal probability. Thus, candidate C can never win the election, the best he can do is to win with some probability (which depends on the size of his partisan group), when voters from group 2 and voters

from group 4 are indifferent between candidates.

election, and thus either voters from group 2 or group 4 voted for candidate C. But now candidate C can deviate to  $\underline{p} = 1 - \bar{p}$ , which will make voters from groups 2 and 4 indifferent between candidates, and candidate C no longer wins the election with probability 1. Now assume that  $(\bar{p}; \underline{p})$  are candidates' equilibrium strategies, and each candidate wins the election with certain probability. But candidate  $C_1$  can deviate to  $\underline{p} = \bar{p} + \epsilon$ ,  $\epsilon > 0$ , and win the election, as  $f(1 - \underline{p}) - f(\bar{p}) = f(\bar{p}) - f(1 - \bar{p})$  no longer holds and either voters from group 2 or group 4 vote for candidate C. But  $(\bar{p}; \underline{p})$  cannot be an equilibrium strategy either as candidate C can deviate to  $\bar{p} = 1 - \underline{p}$ , which will make voters from groups 2 and 4 indifferent between candidates. In this case candidate C is better off with his original strategy  $\bar{p}$  as  $f(1 - \bar{p}) - f(\underline{p}) = f(\underline{p}) - f(1 - \underline{p})$  no longer holds. But now, candidate C would be better off with  $\underline{p} = 1 - \bar{p}$ , but it was already proved that  $(\bar{p}; \underline{p})$  is not an equilibrium. Thus, the equilibrium does not exist.

## 7 Appendix C

Proof of proposition 3. Voters from group  $j$  vote for candidate C if  $E U_j > E U_j$ . When candidate C spends  $p$  time discussing issue Z, the voters believe that policy A will be implemented with probability  $f(p)$  and policy B will be implemented with probability  $1 - f(p)$ . At the same time, he has  $(1 - p)$  time left to discuss issue Z, and thus voters believe that policy E will be implemented with probability  $f(1 - p)$ , and policy D will be implemented with probability  $1 - f(1 - p)$ .

Each voter maximizes his utility and vote for candidate C if  $E U_j > E U_j$ .

Voters from group 1 vote for candidate C if:

$$f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) > f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) :$$

Voters from group 2 vote for candidate C if:

$$f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) > f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) :$$

Voters from group 3 vote for candidate C if:

$$f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) > f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) :$$

Voters from group 4 vote for candidate C if:

$$f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) > f(p) + (1 - f(p)) + f(1 - p) + (1 - f(1 - p)) :$$

After simplification of voters' expected utility function was obtained that:

Voters from group 1 vote for candidate C if:

$$1 - f(p) - \frac{2}{1} f(1 - p) < f(p) - \frac{2}{1} f(1 - p) ;$$

Voters from group 2 vote for candidate C if:

$$1 - f(p) - \frac{2}{1} f(1 - p) > f(p) - \frac{2}{1} f(1 - p) ;$$

Voters from group 3 vote for candidate C if:

$$1 - f(p) - \frac{2}{1} f(1 - p) > f(p) - \frac{2}{1} f(1 - p) ;$$

Voters from group 4 vote for candidate C if:

$1 - f(p) - \frac{\partial}{\partial p} f(1-p) < f(p) - \frac{\partial}{\partial p} f(1-p)$ :  
From now on I will refer to the function  $1 - f(p)$

and 4 vote for candidate C :But  $p < \hat{p}$  and thus  $h(p) < h(\hat{p})$  which implies that there exist  $\tilde{p} \in (p; 1]$  such that  $g(\tilde{p}) = h(\tilde{p})$  and candidate C can deviate to  $\tilde{p}$ , and voters from groups 2 and 4 will be indifferent between candidates, group 1 still votes for candidate C and group 3 votes for candidate C and each candidate could win the election with certain probability. Now, assume that  $(p; \hat{p})$  is an equilibrium, but in this case candidate C could deviate to  $\tilde{p} \in (\hat{p}; 1]$  which implies that  $h(\tilde{p}) > g(\tilde{p})$  group 4 votes for candidate C. But now, if  $\tilde{p} > p$ , then  $g(\tilde{p}) > 0.5 \frac{\alpha_2}{\alpha_1}$  and thus, there exist  $\tilde{p} < \hat{p}$  such that  $g(\tilde{p}) > h(\tilde{p})$  and candidate C could deviate to  $\tilde{p}$  and win the election as now voters from groups 1 and 2 vote for him. But then  $(\tilde{p}; \hat{p})$  cannot be an equilibrium either, as candidate C can deviate to  $\tilde{p} < p$  thus  $g(\tilde{p}) < 0.5 \frac{\alpha_2}{\alpha_1}$  and such that  $g(\tilde{p}) < h(\tilde{p})$  which makes voters from group 1 and either group 2 or 4 vote candidate C who in this case wins the election. But then again,  $\tilde{p} < \hat{p}$  and thus  $h(\tilde{p}) < h(\hat{p})$  which implies that there exist  $\tilde{p} \in (p; 1]$  such that  $g(\tilde{p}) = h(\tilde{p})$  and candidate C can deviate to  $\tilde{p}$ , and voters from groups 2 and 4 will be indifferent between candidates, group 1 still votes for candidate C and group 3 votes for candidate C and each candidate could win the election with certain probability. And we already showed that  $(\tilde{p}; \hat{p})$  where  $\tilde{p} < p$  and  $\tilde{p} \in (p; 1]$  cannot be an equilibrium, thus, the equilibrium does not exist. The proof where  $p < 0$  is very similar to the proof where  $p > 0$ , as there is no strategy for any of the candidates that will guarantee them votes from two groups of voters with mass greater than 50%.

Part (b). Let  $\alpha_2 > \alpha_1$ , and thus  $\frac{\alpha_2}{\alpha_1} > 1$ . Function  $f(p)$  is concave and  $f(p) \in [0; 1]$  which implies that  $g(p)$  is convex and  $g(1) < g(0)$ . Thus, for any  $p \in (0; 1]$  and  $\tilde{p} \in (0; 1]$ ,  $g(p) < h(p)$ . This implies that  $g(p) < h(p)$  holds for  $\tilde{p}$ .





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