Time Allocation on electoral issue(s)

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Preliminary Version

Abstract

We analyze a game of electoral campaign between a representative voter and two candidates in which each of them has to decide the amount of time she devotes to an issue. In order to study the communication strategies of candidates on issues during an electoral campaign, we assume that the voter has priors about candidates' competence on issues and preferences for issues. Candidates are endowed with fixed level of competence on each issue and may affect voter's priors by discussing the issues. The level of time spending by candidates on an issue affects the voter in two ways. First, the more candidates spend time on an issue, the more this issue becomes salient in voters' mind. Second, the time a candidate devotes to an issue increases the precision of the information he sends to voters about his true issue-competence. The voter updates his beliefs according to the information he received from candidates on each issue.

Candidates tend to talk about an issue as soon as their true issue-competence is better than the voter's priors ; the more competent candidate stressing more the issue, the time devoted by the less competent candidate increasing with his competence and his capacity to induce a competence update in voters' mind stronger than the increase of the weight voters give to the issue. This result differs from the literature which generally justifies that two candidates have never interest to talk about the same issue. We determine also conditions under which only one candidate talks about an issue as well as conditions under which candidates remain silent on an issue.

By extending the analysis from one to several issues, and by taking into account a global time constraint, the probability of "dialogue" decreases as candidates discuss more issues on which they are more competent than what voters a priori believe and than their opponent.

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1 Introduction

The key question of the electoral campaign that has been mostly studied is «where to stand ?», that means which position to defend or announce on a given issue (*cf.* Downs, 1957). Answering to this question implicitly assumes that candidates volontary decide to discuss some common issues during the electoral campaign. But, is that assumption verified ? In other words, if candidates are allowed to raise the issues they want, do they decide to spend time on the same issues ? Or do they specialize their electoral campaign on specific issues, only raised by a sole candidate ? And if candidates have the opportunity to spend time on a specific issue, do they both decide to spend a positive amount on it ? Answering to those questions is important to appreciate the relevance of the « downsian » assumption first, but also to understand the strategies that govern time allocation on issues by candidates. For which conditions (if any), two candidates may decide to devote time (or not) on a same issue ?

Before answering to the «where to stand ?» question, it seems therefore relevant to adress the «what to talk about ?» question ; this last question being prevalent to the former one. This paper thus intends to study the conditions under which two candidates may decide to devote a positive amount of time on the same issues.

Such a question has already been adressed by some scholars. Amoros & Puy (2012), Aragonès, Castanheira & Giani (2013) propose studies in which candidates endowed with a positive amount of time, have to decide how to allocate it on different issues. They consider that the time devoted to an issue increases the weight voters assign to this issue. The idea is that the more a candidate adresses an issue, the more this issue becomes important in voters' mind. This psychological mechanism according to which candidates' time spendings emphasize the weight voters give to the discussed issues is called the *priming effect*. According to this effect, candidates have then interest to devote positive amount of time on issues on which they benefit from a comparative advantage relative to their opponent ; a candidate benefiting from a comparative advantage on an issue when a majority of voters prefer this candidate if this sole issue is considered. On the contrary, candidates have interest to mute issues on which their opponent is better valued by voters. By muting such issues, candidates avoid to increase voters' salience for those 'defavorable' issues.

In these studies, voters are supposed to perfectly know candidates' platforms. The time devoted by candidates on issues only affects voters' issue saliences and not their knowledge of candidates' platforms. But, considering that time has no affect on voters' knowledge is quite surprising. This assumption seems indeed to contrast the political science tradition of ignorant or ill-informed voters (Campbell 1960, Downs 1957). According to this tradition, voters have little incentives to devote efforts to learn relevant knowledges about the stakes of elections. Before the campaign starts, voters would only have beliefs on candidates' characteristics. The electoral campaign allows them to acquire information in order to revise their beliefs. Assuming that voters know the true platform of candidates on different issues even when candidates refuse to adress some of those issues contradicts theorefore the fact that electoral campaigns are a mean for voters to learn about candidates' platforms.

Electoral campaign are a mean for voters to learn about candidates' platform because by adressing issues, candidates transmit some information on their platforms. Therefore, as soon as a candidate refuses to adress an issue, voters receive no information allowing them to know with certainty the position or quality of the candidate. The time devoted by candidates on a variety on issues may then affect the way voters assess them.

In this paper, we propose a game of electoral campaign between a representative voters and two candidates in which each of them has to decide the amount of time he allows to an issue, among a set of relevant issues. Each candidate is characterized by a fixed level of competence on each issue, the level of competence being positively valued by the representative voter (notion of vertical differenciation).

At the beginning of the game, the voter has preferences about the issues that can be discussed during the campaign : some issues are considered as important, others less. We assume also that the voter has *a priori* beliefs regarding the levels of competence of each candidate on the different relevant issues. He is ready to update these beliefs when he gets new information from the campaign.

During the electoral campaign, candidates decide how much time they allocate to each issue. The time devoted by a candidate on an issue affects the voter by two ways. First, time affects voter's issues saliences by a priming effect : the more an issue is discussed by candidates, the more this issue becomes important in voter's mind at the voting stage, whatever the identity of the candidate. Second, the time a candidate spend on an issue affects the quality of the information he transmits to the voter. This latter is assumed to be naive : he takes at face value the message sent by a candidate, without deciphering his strategy. He then uses the information a candidate has sent to him during the electoral campaign to update his a priori beliefs about his competence (updating effect). The more a candidate devotes time on an issue, the more precise is the information he transmits to the voter and then the more the voter update his a priori beliefs. Specifically, candidates' speeches are modeled as noisy and unbiased signals about their true level of competence, the precision of which positively depends on the time the candidate spends on the issue. In that sense, the precision of the signal is under full control of the candidates. The received information allows then the voter to revise his beliefs about the true competence of candidates by the updating effect.

Allocated time plays then on the way a voter value an issue (priming effect) and the candidates (updating effect). Each candidate chooses his time allocation strategy to maximize his probability of winning. The voter votes for the candidate who gives him the higher level of (expected) utility, this one being the sum of the updated competence of a candidate on each issue, weighted by the ex-post importance voters give of the issues.

Taking into account priming and updating effects leads to optimal time strategies that differ from those obtained when only one of the effect is considered.

When only the priming effect is considered, the candidate's strategy is determined by the difference between his competence and the one of his opponent. A candidate has then interest to devote a positive amount of time on the sole issues on which he has a comparative advantage, that means on the issues on which he is more competent than his opponent. And a candidate has interest to mute the issues for which he is less competent

than his opponent. Priming effect leads then to issue-divergence : when a candidate has interest to spend time on an issue, his opponent has interest to mute it (Riker 1993, Petrocik 1996).

When only the updating effect is considered, the candidate's strategy only depends on the difference between his true competence and the voter's a priori belief on it. Indeed a speech conveys information on the level of competence of a candidate, which may be beneficial to him when he is more competent that what the voter a priori believes, but which may be detrimental when his true level of competence is less than the voter's prior. Then, as soon as a candidate is more competent than what the voter a priori believes, he has interest to send him a precise information in order to lead him to discover his true competence and revise his prior. This effect may then lead to situations in which both candidates develop the same strategy (speaking when both are better than what the voter a priori believes ; muting issues on which both candidates are less competent than voter's priors) and different ones when a candidate is more competent than the voter's prior and his opponent benefits from a more favorable prior than his true competence.

As our model consists in mixing both effects, candidates' time strategies on an issue will depend on four parameters : voter's priors on the competence of both candidates as well as the difference between candidates' true competences. We obtain situations of :

· issue-convergence, i.e. both candidates devotes a positive amount of time on an issue, when the updating effects are positive for both candidates, that means on issue on which voter's a priori beliefs are lower than the true competence of both candidates. For this kind of issue, the more competent candidate has interest to discuss the issue because the updating and priming effects are positive for him. His opponent has a comparative disadvantage in terms of competence but still has interest to talk. As his opponent spends time on the issue, he increases the voter's salience for this issue. In order to minimize his opponent's advantage on this issue, the less favored has then interest to talk in order to transmit information to the voter and induce a belief updating on his true competence.

The level of time allocated to such an issue depends on the marginal priming versus learning effects of time on voters' utility. As soon as the marginal (positive) benefits of precision exceeds the marginal (negative) priming effects in absolute value, a candidate has interest to speak.

· issue-divergence, i.e. a candidate devotes time on an issue but his opponent not, when the priming and updating effects are both positive for a candidate and both negative for his opponent. In other words, a candidate devotes time when he is more competent than what the voter a priori believes about him (updating effect) and more competent on the issue than his opponent (priming effect) who is in fact less competent than voters' a priori (such that he has interest to say nothing on the issue).

· issue-muting, i.e. both candidates refuse to devote time on the issue, when the updating effects are both negative for both candidates.

This model may then help to shed some light on the empirical findings on the content of electoral campaigns that we briefly review in the next section.

This paper is organized as follows. We briefly review some related literature in section 2. Section 3 presents a simple electoral campaign model, where candidates are facing one representating voter. Section 3 solves the model for boundedly rational voters when

candidates face a time constraint per issue. Section 4 provides a number of discussion about the model. A last section concludes.

2 Related Literature

This contribution is build on several strands of the literature : the issue-ownership litterature, the debate between issue-divergence versus issue-convergence, and the one on learning.

Issue-ownership.

Many scholars have directed their attention to the study of electoral campaign, answering to the question of how candidates allocate their time (or money) to different issues during an electoral contest.

As mentionned by Aragonès, Castanheira & Giani (2014), Riker (1993) exhibits two principles to understand candidates' time allocation on issues. A party devotes time on issues where it dominates its opponent and its opponent abandons them (Dominance Principle). Parties mute issues for which neither of them dominate the issues (Dispersion Principle). But as highlighted by Aragonès, Castanheira & Giani, « Riker does not identify what allows a party to dominate an issue ».

The issue-ownership theory developped by Petrocik (1996) allows to fill this gap. The dominance of a party would be due to its « reputation for greater competence in handling the issue ». A party dominates an issue beacuse it benefits from a better reputation on it than its opponent.

A consequence of Riker and Petrocik's proposals is then issue-divergence. Candidates will focus their campaign communication on issues that they own or dominate and mute others. Therefore, « as no theme can work to the advantage of both candidates, they will never allocate resources to the same theme. Dialogue is defined as candidates discussing the same dimensions, so rational candidates should never and will never dialogue » (Simon, 2002).

However, these proposals do not always allow to understand candidates' strategies during electoral campaigns. We can observe that candidates may decide to spend time on issues, a priori perceived as owned by their political opponent. Damore (2004) admits thus that « the 2000 campaign is an outlier that does not comport with my theoretical expectations ».

In order to explain issue-divergence, Amoros & Puy (2011) and Aragonès, Castanheira & Giani (2014) propose to found candidates' time allocation strategies not on candidates' reputation but on the policy position defended by candidates on the relevant issues. A candidate benefits therefore from an advantage on an issue because the policy position he defends is preferred by a majority of voter to the one of his opponent. This may be due to the fact that the announced position is closer to the median voter's bliss point relative to the one defended by the opponent (horizontal differenciation in Amoros & Puy) or to the fact that policy proposed has a better quality (vertical differenciation in Aragonès, Castanheira & Giani).

Taking into account candidates' announced policy rather than their reputation allow to theoretically grounded Riker's intuition. However, it does not allow to completely explain

Petrocik's one as it is based on reputation.

Aragonès, Castanheira & Giani use a reputation parameter. Candidates may develop policy proposals to a certain cost. Candidate's level of reputation on an issue allows then him to decrease his cost of new proposal. However, what determines the time strategies is the difference of quality between the policy of both candidates. Moreover, as previously mentionned, voters are supposed to perfectly know candidates' policy whatever the time devoted by candidates.

On the contrary to Aragonès, Castanheira & Giani, our paper does not explain candidates' level of true competence. But it proposes to understand the impact of candidates' reputation on their time strategies ; one of the key element being the difference between the true competence and the one a priori believed by voters.

The notion of reputation may indeed be captured by voters' a priori beliefs about the competence of candidates. By the learning effect, a candidate has interest to adress an issue only if his true competence is higher than the voters' a priori. In that sense, our model may allow to understand why a candidate, supposed to own an issue, may decide to spend little or no time on this issue and why a candidate may place large emphasis on an issue a priori owned by his opponent.

Issue-divergence versus issue-convergence.

The issue-ownership theory argues in favor of issue-divergence : candidates have interest to emphasize different issues. However, although there exist empirical evidence supporting these strategies (Simon (2002) and Kaplan, Park, and Ridout (2003)), there also exist evidence contradicting these principles. According to Sigelman and Buell (2004), for example, both candidates regularly emphasize the same issue. But as noted by the authors, « there is no shortage of explanations for why issue convergence is such a rare commodity in American campaigns. Perhaps surprisingly, though, there is a shortage of convincing evidence that issue convergence really is a rare commodity."

Amoros & Puy (2011) offer an explanation of issue-convergence. By further exploring Simon's two-issues model, they show that when a candidate has a clear-cut advantage on both issues (absolute advantage), he spends time on both issues. His opponent randomizes between spending all his time on one issue or the other (issue-convergence if and only if equilibrium in pure strategies fails to exist, i.e. dialogue occurs in equilibrium in mixed strategies). Issue-convergence is therefore a particular case.

In our paper, we are able to obtain situation in which both candidates decide to spend positive amount of time on an issue. And such situations are not due to absolute advantage (or fixed positions) but to the fact that the defavored candidate has interest to spend time on an issue in order to minimize his relative disadvantage on the issue.

An important difference between our paper and the one of Amoros & Puy is that in our model candidates face time constraint issue by issue. In Amoros & Puy, candidates face a global time constraint. However, in Amoros & Puy, if candidates would face a time constraint issue by issue, the absolute disadvantaged candidate would choose to mute both considered issue. It is not the case in our model.

The closer paper from ours is the one of Denter (2014). As him, we consider that candidates may influence voters on their issue-salience as well as on the perceived level of competence. However, Denter considers that the time or the TV ads of a candidate on an issue increases voters' issue salience (as we do) but also candidate's perceived competence.

In our paper, the effect of time on voters' beliefs is not always positive. Our model offers therefore richer results.

Moreover, the literature analyzes the conditions under which candidates will talk or not about the same issues, considering always a global time constraint. It is therefore difficult to disantengle the reasons for which a candidate talks or not about an issue. We will distinguish two time constraint : a time-constraint issue-by-issue and a global one. The analysis of the strategies under the time-constraint issue-by-issue allows us to determine the absolute motivations for talking or not about an issue. The analysis of the strategies under a global time-constraint allows us, then, to distinguish the absolute motivations for talking or not about an issue from the relative one (a candidate does not spend time on an issue because he can have more interest to talk about other issues).

Updating.

Many scholars have studied how candidates use electoral campaign to transmit information to voters in order to lead them to increase their evaluation of their platforms. The difference between the paper relies on the kind of information a candidate may send to voters. Do candidates' messages contain commitments about what candidates would do if elected ?

Demange & Van der Straeten (2013) analyze a communication game in which a candidate decides the level of precision of the message he may send to voters. This message contains information on the political position the candidate will implement if elected. Voters have a prior about this policy. Increasing the precision of the message allows to reduce the uncertainty of voters but may lead to increase the political distance between the candidate and the median voter when the prior is closer to it than the true position. Candidate may then face a trade-off between reducing voters' uncertainty but increasing ideological distance.

Our updating effect is build on a bayesian beliefs' revision as in Demange & Van der Straeten. We differ from their paper by adding a priming effect to the updating one (they study a one-dimensional choice) and by considering an electoral competition between two candidates (Demange & Van der Straten are interested by the communication strategy of a candidate facing voters : there is no electoral competition).

3 The electoral campaign model

We propose a model of communication in which two candidates $C = \{J, K\}$ facing a representative voter have to allocate their time on two political issues during the electoral campaign. Candidates are endowed with an amount of time $t_C \in [0; T]$ for $C = \{J, K\}$.

The electoral campaign game has four stages.

(1) At the beginning of the campaign, Nature randomly draws competences for each candidate on each issue.

(2) Each candidate decides simultaneously how much communication time he devotes to each issue, knowing his own competences as well as those of his opponent. Talking about issues means that candidates send messages to the voter.

(3) At the end of the campaign, after receiving messages from each candidate, the representative voter updates her beliefs on candidates' competence.

(4) The voter votes after the realization of a random variable (probabilistic voting) for the candidate who maximizes her utility level.

We explain the main assumptions on each stage of the game.

3.1 Beginning of the campaign - Candidates' type and the voter's evaluation function.

Before the electoral campaign starts, Nature randomly draws competences for each candidate on the both issues A and B. Denote by $q_J = (q_{AJ}, q_{BJ})$ candidate J's competence and similarly for K, with $q_{iC} \in R_+$ for $i = \{A, B\}$ and $C = \{J, K\}$. We take those competence levels as fixed and each candidate knows his competence on each issue as well as that of his opponent.

At this stage, the representative voter only has *a priori* beliefs on candidates' competences. Voter's *a priori* belief on candidate C's true competence on issue i is a random variable denoted M_{iC} independant across candidates and following a normal distribution

$$M_{iC} \sim N\left(m_{iC}, 1/(\delta_{iC})\right)$$

with $m_{iC} \in R_+$ and $\delta_{iC} \in [0; +\infty[$ where δ_{iC} is the precision of the prior.

Those beliefs may come from past campaign or from observing the competences of members of the parties.

The voter is also characterized by the weight $s_i\,(\geqslant 0)$ she assigns to issue i, with $\sum_{i=A}^{B} s_i = 1$. She evaluates candidate C according to his competence on the issues weighted by the importance she gives to these issues, i.e.

$$u\left(\alpha, M_C\right) = \sum_{i=A}^{B} \alpha_i . M_{iC}$$

3.2 Electoral campaign stage.

At the beginning of the electoral campaign, each candidate decides how much time he wants to devote to each issue. Candidate C's strategy set is represented by a non negative vector $t_C = (t_{AC}, t_{BC})$. We consider two types of time constraint.

(i) An issue-by-issue time constraint: candidates are constrained by the time to devote on each issue but the time devoted on an issue has no influence on the time they can potentially spend on other issues. The strategy space for candidate C writes as $t_{iC} \in [0, T]$ and $t_C = [0, T]^2$.

(ii) A global time constraint: candidates are constrained by the time to devote on all issues. The time devoted on an issue decreases the time a candidate can spend on the other one. The strategy space for a candidate writes then as $t_C \in [0, T]$ with $\sum_{i=A}^{B} t_{iC} \leqslant T$.

By talking about an issue, candidates send some information to the voter about their competences. The communication strategy of a candidate determines the law of the signal that the voter receives about the candidate's competence. Signals are constrained to be unbiased (that is, centered on the true competence), but can be noisy, with a variance that is assumed to be fully controlled by the candidates. Specifically, when candidate C spends an amount of time t_{iC} speaking on issue i, the voter receives a message $Y_{iC} \in R_+$ on the candidate's competence on issue i, where Y_{iC} is normally distributed with distribution $N\left(q_{iC}, 1/\left[\beta_C\left(t_{iC}\right)\right]\right)$ where the function $\beta_C\left(.\right)$ is defined over $[0, +\infty[$ and satisfies : $\beta_C\left(0\right) = 0$ (no precision or pure noise if there is no speech) and $\left(\beta_C\right)'\left(t_{iC}\right) > 0$ for all $t_{iC} > 0$ (additional speech always makes signals more precise).

3.3 End of the campaign - Voter's treatment of information.

The time devoted by candidates on the issues during the electoral campaign has an impact on *(i)* the voter's beliefs about the competence of the candidates as well as on *(ii)* the importance the voter gives to the issues.

We are first interested by voter's *posterior* beliefs regarding the candidates competences after reception of the signals. Using signals received during the campaign, the voter updates her beliefs regarding candidates' competences. The voter receives signals from each candidate on each issue, i.e. $Y_J = (Y_{AJ}, Y_{BJ})$ from candidate J and $Y_K = (Y_{AK}, Y_{BK})$ from candidate K. The voter also perceives the time spent by both candidates $(t_J, t_K) \in T \times T$ on the various issues.

Consider candidate C and the voter who perceived a vector of signals Y_C on candidate C's competence, with an emphasis vector $t_C \in T$. The conditional distribution on candidate C's position on issue i follows $N\left(E\left[M_{iC}\left|Y_{iC}\right.\right]; Var\left[M_{iC}\left|Y_{iC}\right.\right]\right)$, where

$$Var\left[M_{iC}\left|Y_{iC}\right.\right] = \frac{1}{E\left[\delta_C\left|y_{iC}, t_{iC}\right.\right]} = \frac{1}{\delta_C + \beta_C\left(t_{iC}\right)}$$

and

$$E\left[M_{iC}\left|Y_{iC}\right.\right] = \frac{\delta_{iC}}{E\left[\delta_C\left|y_{iC}, t_{iC}\right.\right]} m_{iC} + \frac{\beta_C\left(t_{iC}\right)}{E\left[\delta_C\left|y_{iC}, t_{iC}\right.\right]} q_{iC} = m_{iC} + \frac{\beta_C\left(t_{iC}\right)}{\delta_C + \beta_C\left(t_{iC}\right)}\left(q_{iC} - m_{iC}\right)$$

To simplify the notational baggage, during the remainder of the paper, I will denote $h_C\left(t_{iC}\right) = \dfrac{\beta_C\left(t_{iC}\right)}{\delta_C + \beta_C\left(t_{iC}\right)}$ so that $E\left[M_{iC}\left|Y_{iC}\right.\right] = m_{iC} + h_C\left(t_{iC}\right)\left(q_{iC} - m_{iC}\right)$

Time devoted by candidates on each issue affects also the weight the voter gives to issues : the more an issue is discussed during the campaign, the higher will be the weight the voter assigned to this issue at the time of voting. The process by which the political exposure of issues affects the way voters prioritize issues is a psychological effect known as priming.

At the beginning of the campaign, the weight the voter gives to issue i is denoted $s_i\left(\geqslant 0\right)$ with $\sum_i s_i = 1$. This weight is affected by the quantity of time, candidates devote to the issue so that at the end of the campaign, the posterior issue i's weight becomes $\alpha\left(s_i, t_{iJ}, t_{iK}\right)$ with

- $\partial\alpha/\partial s_i > 0$
- $\partial\alpha/\partial t_{iC} > 0$

The representative voter with initial weights s_i and prior M_{iJ} about the competence of candidate J updates her belief and issue's weight after the campaign so that her expected utility if J is elected is

$$\begin{aligned} Eu_J\left(Y_{iJ}, t_{iJ}, M_{iJ}\right) &= \sum_i \alpha\left(s_i, t_{iJ}, t_{iK}\right).E\left[M_{iJ}\left|Y_{iJ}\right.\right] \\ &= \sum_i \alpha\left(s_i, t_{iJ}, t_{iK}\right).\left(m_{iJ} + h\left(t_{iJ}\right)\left(q_{iJ} - m_{iJ}\right)\right) \end{aligned}$$

3.4 Voting stage.

We model the voter's behavior using a "probabilistic voting" model. Candidates do not only differ with respect to their competences, but also in some other dimension, unrelated to the policy issues at stake, which candidates do not influence through the campaign stage. It may involve some other attributes of the candidates, such as personal characteristics (gender, race, age,...), on which the voter also has preferences. Assume that the voter with parameter χ votes for candidate J upon receiving signals $Y_{i,J}, Y_{i,K}$ and given candidates' emphasis $t_{i,J}, t_{i,K}$ if and only if $Eu_J\left(Y_{iJ}, t_{iJ}, M_{iJ}\right) - Eu_K\left(Y_{iK}, t_{iK}, M_{iK}\right) > \chi$ where χ is an individual specific bias in favor of candidate K.

Individual bias is supposed to be *iid* with an uniform distribution on $\left[-\frac{1}{2\nu}; \frac{1}{2\nu}\right]$. Candidates know the distribution of the bias but they do not know its realized values when they have to choose their emphasis strategies.

3.5 Candidates objectives.

On issue i, each candidate is characterized by voter' s a priori on his competence m_i and by his true competence q_i and has to determine the time t_i he wants to devote to this issue in order to maximize voter's utility (and then be elected). Candidate choose their time strategy in order to maximize their expected probability of winning :

$$E\left[\Pi_J\right] = \tfrac{1}{2} + \nu\left\{Eu_J\left(Y_{iJ}, t_{iJ}, M_{iJ}\right) - Eu_K\left(Y_{iK}, t_{iK}, M_{iK}\right)\right\}$$

So that, candidate J's objective is to choose the amount of time $t_{iJ} \in [0, T]$ that maximizes

$$\sum_i \left[\underbrace{\alpha_i\left(s_i, t_{iJ}, t_{iK}\right)}_{\text{posterior weight}} . \underbrace{\left(m_{iJ} + h_J\left(t_{iJ}\right)\left(q_{iJ} - m_{iJ}\right) - m_{iK} - h_K\left(t_{iK}\right)\left(q_{iK} - m_{iK}\right)\right)}_{\text{distance between updated competence of } J \text{ VS } K.} \right]$$

under two possible constraints :
· $t_{iJ} \in [0, T]$ $\forall i$ and $t_J = [0, T]^2$ (issue-by-issue time constraint)
· $t_{iJ} \in [0, T]$ s.t. $\sum_i t_{iJ} \leqslant T$.(global time constraint).

We analyze candidates' optimal communication strategy by considering first that candidates are subject to a time constraint issue-by-issue, then to a global time-constraint.

4 A time constraint per issue

Candidates $C = \{J, K\}$ are constrained to devote an amount of time $t_{iC} \in [0; T]$ on each issue $i = \{A, B\}$. Candidates' objective being separable across issues, in the absence of a global time constraint, the game can be analyzed issue by issue.

Candidates' strategies depend on the voter's *a priori* beliefs about their competences and we assume that the voter has the same *a priori* belief about the competence of each candidate, i.e. $m_{iJ} = m_{iK} = m_i$. We concentrate our analysis on a sole candidate, say J, the strategy of K being subject to symetrical conditions.

4.1 Optimal communication strategy

Candidate J's objective is to choose the amount of time $t_J \in [0; T]$ such that

$$\begin{array}{l} \underset{t_J}{Max} E\left[\Pi_J\right] = \alpha\left(s, t_J, t_K\right).\left[h_J\left(t_J\right)\left(q_J - m\right) - h_K\left(t_K\right)\left(q_K - m\right)\right] \\ s.t. \quad t_J \in [0, T] \end{array}$$

We can then write the first order conditions (FOC) of the maximisation problem to determine equilibrium behavior.

$$\frac{\partial E\left[\Pi_J\right]}{\partial t_J} = \underbrace{\frac{\partial \alpha}{\partial t_J}\left[h_J\left(t_J\right)\left(q_J - m\right) - h_K\left(t_K\right)\left(q_K - m\right)\right]}_{(1)} + \underbrace{\alpha\left(s, t_J, t_K\right)\frac{\partial h_J}{\partial t_J}\left(q_J - m\right)}_{(2)}$$

This FOC exhibits the channels through which time influences the way the representative voter evaluates candidate J.

$\dfrac{\partial \alpha}{\partial t_J}$ is the marginal effect of time on the evaluation of the issue through the priming channel. By talking about the issue, candidate J increases the weight the voter assigns to the issue. Whether the priming effect (1) is positive or negative depends on the difference of the voter's posterior belief about the competence of candidate J versus K. This difference is endogenously determined by the time each candidate spends on the issue.

$\dfrac{\partial h_J}{\partial t_J}\left(q_J - m\right)$ is the marginal effect of time on the voter's evaluation of the competence of candidate J, weighted by the issue's importance $\alpha\left(s, t_J, t_K\right)$. This updating effect (2) is positive if candidate J is more competent than what the voter a priori believes about him, i.e. $q_J - m > 0$. By talking about the issue, candidate J increases the quality of the information he transmits to the voter, which leads her to update her a priori belief about the competence of the candidate. A candidate has then interest to talk about an issue by the updating effect as soon as he is more competent than the voter's prior.

From the FOC, we can first observe that:

1. if both effects are positive, J has interest to devote the maximal amount of time on the issue, $t_J = T$. This is the case when J is more competent than his opponent ($q_J \geqslant q_K$) and more competent than the voter's prior ($q_J \geqslant m$). By talking about the

issue, J increases the weight the voter gives to J's comparative advantage, as well as his comparative advantage (by increasing the voter's posterior belief about his competence). As each of these effects increases with the time candidate J devotes to the issue, J has interest to devote the maximal amount of time on it so that $t_J = T$.

2. if both effects are negative, J has interest to remain silent on the issue, $t_J = 0$. This is the case when J is less competent than his opponent ($q_J \leqslant q_K$) and less competent than the voter's prior ($q_J \leqslant m$). Being unable to reduce his comparative disadvantage $[h_J(t_J)(q_J - m) - h_K(t_K)(q_K - m)]$, J has no interest to increase the weight of it and has then to remain silent on the issue.

What happened when the effects have opposite signs ? To answer, we need to completly study the form of the objective function by notably writing the Second Order Condition (SOC).

4.1.1 Existence of interior solution

The Second Order Condition can be written as

$$\begin{aligned}\frac{\partial^2 E[\Pi_J]}{\partial t_J^2} &= \frac{\partial^2 \alpha}{\partial t_J^2}[h_J(t_J)(q_J - m) - h_K(t_K)(q_K - m)] + 2\frac{\partial \alpha}{\partial t_J}\frac{\partial h_J}{\partial t_J}(q_J - m) + \alpha(s, t_J, t_K)\frac{\partial^2 h_J}{\partial t_J^2}(q_J - m) \\ &= \frac{\partial h_J}{\partial t_J}(q_J - m)\left\{\alpha(s, t_J, t_K)\left[\frac{\partial^2 h_J/\partial t_J^2}{\partial h_J/\partial t_J} - \frac{\partial^2 \alpha/\partial t_J^2}{\partial \alpha/\partial t_J}\right] + 2\frac{\partial \alpha}{\partial t_J}\right\}\end{aligned}$$

The objective function is concave, i.e. the SOC is negative, and an interior solution exists if and only if

$$SOC < 0 \Leftrightarrow \begin{cases} \dfrac{\partial h_J}{\partial t_J}(q_J - m) > 0 \quad and \quad -\dfrac{\partial^2 h_J/\partial t_J^2}{\partial h_J/\partial t_J} - \left(-\dfrac{\partial^2 \alpha/\partial t_J^2}{\partial \alpha/\partial t_J}\right) > 2\dfrac{\partial \alpha/\partial t_J}{\alpha(s, t_J, t_K)} > 0 \\ \dfrac{\partial h_J}{\partial t_J}(q_J - m) < 0 \quad and \quad -\dfrac{\partial^2 h_J/\partial t_J^2}{\partial h_J/\partial t_J} - \left(-\dfrac{\partial^2 \alpha/\partial t_J^2}{\partial \alpha/\partial t_J}\right) < 2\dfrac{\partial \alpha/\partial t_J}{\alpha(s, t_J, t_K)} \end{cases}$$

When J is more competent than the voter's prior $(q_J - m) > 0$ but less competent than his opponent K $(q_J < q_K)$, J faces a trade-off. By talking, he reduces his comparative disadvantage but increases the weight the voter puts on it. By remaining silent, he avoids to increase the weight the voter puts on his comparative disadvantage but can not reduce it. J can solve the tradeoff by using intermediate amount of time if and only if by talking he is more able to reduce his comparative disadvantage than to increase the weight the voter puts on it. And this is possible if and only if the updating function $h_J(.)$ is sufficiently more concave than the priming one $\alpha(.)$.

On the opposite case, when J is less competent than the voter's prior $(q_J - m) < 0$ but more competent than his opponent K $(q_J > q_K)$, J faces a similar trade-off. By talking, he increases the weight the voter puts on his comparative advantage but reduces it. By remaining silent, he avoids to decrease his comparative advantage but does not increase the weight the voter puts on it. J may have interest to talk if and only if by talking

he is more able to increase the weight the voter puts on the issue than to decrease his comparative advantage. And this is possible if and only if the priming function $\alpha(.)$ is sufficiently more concave than the updating one $h_J(.)$.

The sign of the SOC allows us to highlight the effect of the time on the objective function. The priming function depends on the quantity of time candidates devote to the issue. The updating function represents in a sense the quality of the time a candidate devotes to an issue. The more the function is concave, the more the candidate is able, with a small amount of time, to induce a high belief updating. The candidate devotes a few amount of time on the issue, but he is able with this few amount to transmit a quite precise information on his platform so that the voter updates her belief.

4.1.2 Best Response Strategies

Candidate J chooses the time $t_J \in [0,T]$ he spends discussing the issue, knowing his level of competence and the prior belief of the voter on it. Proposition 1 describes the optimal amount of time J has to spend on the issue as a function of his level of competence, the level of competence of his opponent as well as the time spent by this latter.

Proposition 1 *Candidate J's optimal strategy is characterized by three thresholds $a(t_K), b(t_K)$ and $c(t_K)$ such that :*

· if $q_J - m \leqslant \min\{a(t_K), b(t_K)\}(q_K - m)$, candidate J remains silent on the issue ($t_J = 0$)

· if $q_J - m \geqslant \max\{b(t_K), c(t_K)\}(q_K - m)$, candidate J spends the maximal amount of time on the issue ($t_J = T$)

· if $\min\{a(t_K), b(t_K)\}(q_K - m) \leqslant q_J - m \leqslant \max\{b(t_K), c(t_K)\}(q_K - m)$, candidate J uses an interior level of time, which increases with q_J ($t_J \in]0;T[$)

The three thresholds are :

$$
\begin{aligned}
a(t_K) &= \frac{\left.\frac{\partial \alpha}{\partial t_J}\right|_{t_J=0} h_K(t_K)}{\left.\frac{\partial \alpha}{\partial t_J}\right|_{t_J=0} h_J(0) + \alpha(t_K)\left.\frac{\partial h_J}{\partial t_J}\right|_{t_J=0}} \\
b(t_K) &= T\frac{\frac{\partial \alpha}{\partial t_J}}{\alpha(T+t_K)} h_K(t_K) \\
c(t_K) &= \frac{\left.\frac{\partial \alpha}{\partial t_J}\right|_{t_J=T} h_K(t_K)}{\left.\frac{\partial \alpha}{\partial t_J}\right|_{t_J=T} h_J(T) + \alpha(T+t_K)\left.\frac{\partial h_J}{\partial t_J}\right|_{t_J=T}}
\end{aligned}
$$

where $a(t_K) < b(t_K) < c(t_K)$ iff $CSO_J < 0$ and $a(t_K) > b(t_K) > c(t_K)$ otherwise.

As $a(t_K) \in [0;1[$, $b(t_K) \in [0;1[$ and $c(t_K) \in [0;1[$, we can deduce that

Proposition 2 *Candidate J's optimal strategy is such that :*

1. if $q_J \leqslant m \leqslant q_K$,or $q_J \leqslant q_K \leqslant m$ then candidate J remains silent on the issue ($t_J = 0$)

2. if $q_J \geqslant m \geqslant q_K$ or $q_J \geqslant q_K \geqslant m$ then candidate J spends the maximal amount of time on the issue ($t_J = T$)

1. When J is less competent than the prior ($q_J \leqslant m$) and his opponent ($q_J \leqslant q_K$), priming and updating effects are both negative, so that J has no interest to devote time on the issue, $t_J = 0$. Being unable to reduce his comparative disadvantage $[h_J(t_J)(q_J - m) - h_K(t_K)(q_K - m)]$, J has no interest to increase the weight of it and has then to remain silent on the issue.

2. When J is more competent than his opponent ($q_J \geqslant q_K$) and more competent than the voter's prior ($q_J \geqslant m$), priming and updating effects are both positive so that J has interest to devote the maximal amount of time on the issue, $t_J = T$. Indeed by talking about the issue, J increases the voter's posterior belief about his competence, his comparative advantage $[h_J(t_J)(q_J - m) - h_K(t_K)(q_K - m)]$ on the issue as well as the weight the voter gives to it. As each of these effects increases with the time candidate J devotes to the issue, J has interest to devote the maximal amount of time on it so that $t_J = T$.

3. When J is more competent than his opponent K ($q_J > q_K$) but less competent than the prior ($q_J < m$), the priming effect is positive but the updating one is negative. J may have interest to talk about the issue if and only if by talking he increases more the weight the voter gives to the issue than he decreases his comparative advantage. This is possible if and only if the updating technology is sufficiently convex, i.e. if and only the precision of the voter's prior is sufficiently high.

4. If the priming effect is negative but the updating one is positive, i.e. J is less competent than his opponent K ($q_J < q_K$) but more competent than the prior ($q_J > m$), J may have interest to talk about the issue if and only if by talking he reduces more his comparative disadvantage than he increases the weight the voter gives to the issue. This is possible if and only if the updating technology is sufficiently concave, i.e. if and only the precision of the voter's prior is sufficiently low.

The concavity of $h_J(.)$ is appreciate relatively to the function $\alpha(.)$. There exists an interior solution in t_J such that $t_J^* \in]0, T[$ if and only if the sign of the Second Order Condition (SOC) is negative. The SOC is such that

$$\begin{aligned}\frac{\partial^2 \Pi_J}{\partial t_J^2} &= \frac{\partial^2 \alpha}{\partial t_J^2}\left[h_J(t_J)(q_J - m) - h_K(t_K)(q_K - m)\right] + 2\frac{\partial \alpha}{\partial t_J}\frac{\partial h_J}{\partial t_J}(q_J - m) + \alpha(t_J + t_K)\frac{\partial^2 h_J}{\partial t_J^2}(q_J - m) \\ &= \alpha(t_J + t_K)\frac{\partial h_J}{\partial t_J}(q_J - m)\left[2\frac{\partial \alpha / \partial t_J}{\alpha(t_J + t_K)} + \frac{\partial^2 h_J / \partial t_J^2}{\partial h_J / \partial t_J} - \frac{\partial^2 \alpha / \partial t_J^2}{\partial \alpha / \partial t_J}\right]\end{aligned}$$

In this way,

$$SOC < 0 \text{ for } q_J > m \quad iff \quad \frac{\partial^2 h_J / \partial t_J^2}{\partial h_J / \partial t_J} < \frac{\partial^2 \alpha / \partial t_J^2}{\partial \alpha / \partial t_J} - 2\underbrace{\frac{\partial \alpha / \partial t_J}{\alpha(t_J + t_K)}}_{>0}$$

The more the priming function $\alpha(.)$ is concave, the more the updating function $h_J(.)$ should also be.

Indeed, when a candidate talks about an issue, he increases the weight the voter gives to the issue as well as the quality of the information he transmits to the voter. If the candidate is less competent than his opponent, he faces then a trade-off and decides to talk to the issue if by talking he increases more the voter's belief updating function than he increases the weight the voter gives to the issue. And this is possible if and only if the updating function is more concave than the priming one. Otherwise, there exists no interior solution.

The determination of candidate J's strategies allows us to characterized different equilibria.

4.2 Equilibria

Different communication configurations may occur, configurations for which :
· only one candidate talks about the issue (issue-divergence) ;
· both candidates remain silent on the issue (issue-muting) ;
· both candidates talk about the issue (issue-convergence).

Proposition 3 *There is* ***issue-divergence****, i.e. only one candidate, say* K*, talks about the issue* ($t_K = T$)*, his opponent remaining silent on it* ($t_J = 0$)*, iff candidate* K *is more competent than his opponent* ($q_K > q_J$) *and more competent than the voter's prior* ($q_K > m$)*, while his opponent is, at more, weakly competent than the voter's prior,*

$$t_J = 0 \text{ and } t_K = T \quad iff \quad \begin{array}{l} q_J - m \leqslant \min\{a(T); b(T)\} \\ and \quad q_K - m \geqslant 0 \end{array}$$

If a candidate is more competent than his opponent and the voter's prior, he has interest to spend the maximal amount of time on the issue in order to increase his competence advantage in the voter's mind (updating effect) and in order to increase the importance the voter gives to the issue (priming effect).

The opponent has interest to remain silent on the issue in order to avoid to increase the importance the voter gives to the issue (as the opponent is disadvantaged on the issue). The opponent could have interest to reveal to the voter that he is in fact more competent than what the voter a priori believes about him. But, if the opponent is only weakly more competent than the voter's prior, the marginal effect to reveal the true competence is too weak to compensate the negative priming effect.

Proposition 4 *There is* ***issue-muting****, i.e. no candidate talks about the issue* ($t_K = t_J = 0$)*, if both candidates are less competent than what the voter a priori believes about them* ($q_K < m$ *and* $q_J < m$)*.*

$$t_J = 0 \text{ and } t_K = 0 \quad iff \quad \begin{array}{l} q_J - m \leqslant \min\{a(0); b(0)\} = 0 \\ and \quad q_K - m \leqslant 0 \end{array}$$

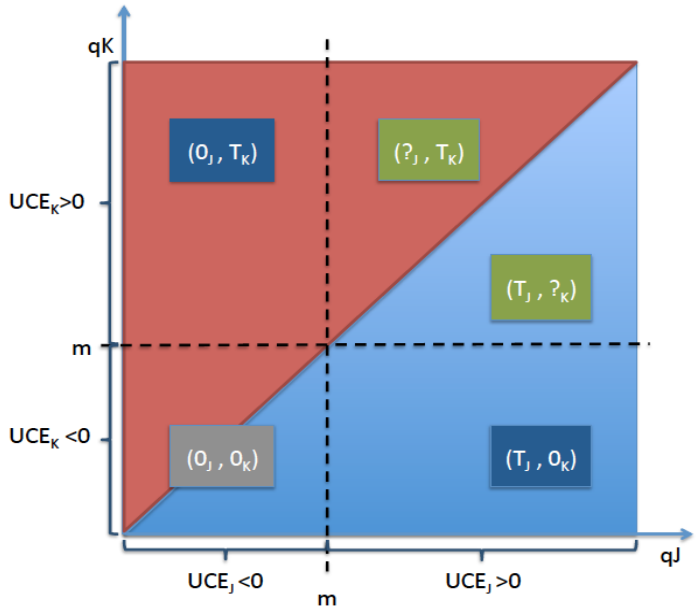
At least one candidate has interest to mute the issue because he is less competent than the voter's prior and less competent than his opponent (priming and updating effects are negative). By remaining silent on the issue, this candidate avoid to increase his competence disadvantage and the importance the voter gives to his disadvantage. His opponent could have interest to talk as he is more competent. However, as the voter is naive and as the less competent candidate remains silent on the issue, the voter keeps his prior concerning the competence of the silent candidate. Therefore, the more competent candidate stays silent on the issue also in order to avoid to reveal that he is less competent than the prior, and then less competent that what the voter believes about the competence of the silent candidate.

Proposition 5 *There is* ***issue-convergence****, i.e. both candidates devote positive amount of time on the issue, if both candidates are sufficiently more competent than the voter's prior about their competences. At least one of the candidate spends the maximal amount of time on the issue* ($t_C = T$)*, the time devoted by the other increases with his level of competence.*

$$q_J - m \geqslant \min\left\{\frac{\phi\bar{t}}{\alpha\left(2\bar{t}\right)}\left(q_K - m\right); \frac{\phi}{\phi + \alpha\left(2\bar{t}\right)\left.\frac{\partial h_J}{\partial t_J}\right|_{t_J=\bar{t}}}\left(q_K - m\right)\right\} \text{ and } \left(q_K - m\right) \geqslant \min\left\{\frac{\phi\bar{t}}{\alpha\left(2\bar{t}\right)}\left(q_J - m\right); \frac{\phi}{\phi + \alpha\left(2\bar{t}\right)\left.\frac{\partial h_J}{\partial t_J}\right|_{t_J=\bar{t}}}\left(q_J - m\right)\right\}$$

By assumption, both candidates are more competent than the voter's prior, one of them being more competent than the other. The more competent candidate has then interest to devote the maximal amount of time on the issue to increase his advantage in terms of competence and increase the weight the voter gives to this (positive) distance. The less competent candidate talks about the issue in order to decrease his competence disadvantage, as he is more competent than the voter's prior. However, by talking he increases also the weight the voter gives to the issue. The candidate has then interest to talk if the (positive) updating effect is stronger than the (negative) priming effect, and it is the case as soon as the candidate is sufficiently more competent than the prior and/or the updating technology is more concave than the priming one.

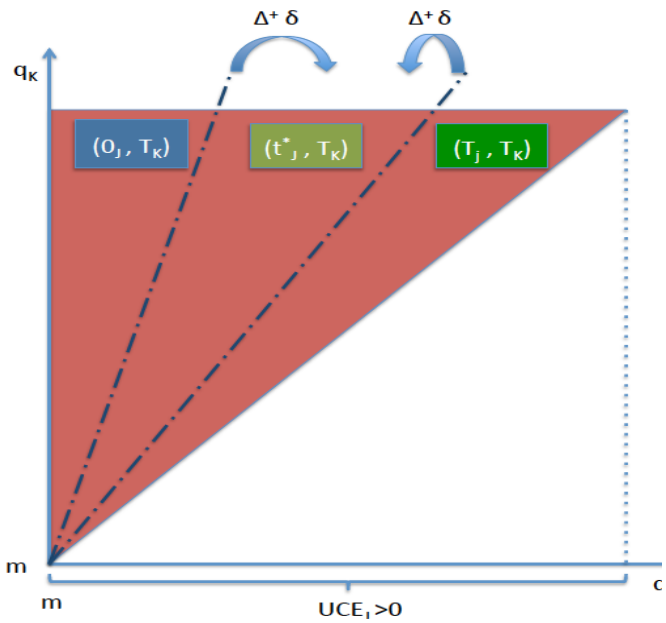
We can summarize the different equilibria in the two following graphs.



We represent on this figure the level of competence of candidate J (on the horizontal axis) and candidate K (on the vertical one). m denotes the a priori belief of the voter about the level of competence of candidates. The red triangle corresponds to the couple of candidates' competence levels for which K is more competent than J (K enjoys a positive priming effect), the opposite being true in the blue triangle.

Candidates remain silent on the issue when they are less competent than the voter's prior. A candidate spends the maximal amount of time on the issue when he is more competent than his opponent and more competent than the prior. As a consequence, there is issue-muting for $q_J < m$ and $q_K < m$ (south-west square). There is issue-divergence when $q_J > m > q_K$ (south-east square) and $q_K > m > q_J$ (north-west square).

In the north-east square, one candidate benefits from positive priming effect and positive updating effect : this candidate spends the maximal amount of time on the issue. What does his opponent ? We can summarize it in the next figure.



This figure represents the north-east square of the first graph. Candidate K devotes the maximal amount of time on the issue. The candidate J's time strategy depends on his level of competence. He remains silent if he is too weakly competent, devotes the maximal amount of time if he is sufficiently competent. There exists an interior solution if by talking he decreases more his comparative disadvantage than he increases the weight the voter gives to the issue. And this is possible if and only if the updating technology is sufficiently concave, i.e. notably if the precision of the prior of the voter concerning his competence δ_J is sufficiently low such that by spending a little amount of time on the issue, J induces a stronger belief's updating than a salience increasing.

5 A global time constraint

Candidates $C = \{J, K\}$ are constrained to devote an amount of time $t_{iC} \in [0; T]$ on each issue $i \in N$ such that $\sum_i t_{iJ} \leqslant T$. We assume that there are two important issues $i = \{1, 2\}$ and that the voter has the same a priori beliefs about the level of competence of each candidate on each issue i, that means $m_{iJ} = m_{iK} = m_i$. The aim of candidate J's objective is then to choose the amount of time t_{iJ} for $i = \{1, 2\}$ such that

$$\begin{array}{ll} & \underset{t_{1J},t_{2J}}{Max} E\left[\Pi_J\right] = \sum_{i=1}^{2} \left[\alpha_i\left(s_i, t_{iJ}, t_{iK}\right).\left(h_{iJ}\left(t_{iJ}\right)\left(q_{iJ} - m_i\right) - h_{iK}\left(t_{iK}\right)\left(q_{iK} - m_i\right)\right)\right] \\ & s.t. \quad t_{1J} + t_{2J} \leqslant T \\ \Leftrightarrow & \underset{t_{1J},t_{2J}}{Max} E\left[\Pi_J\right] = E\left[\Pi_{1J}\right] + E\left[\Pi_{2J}\right] \\ & s.t. \quad t_{1J} + t_{2J} \leqslant T \end{array}$$

We want to know how the global time constraint affects candidates' time allocation strategies on the issues.

First, note that the global time constraint does not modify candidates' strategies if at least one of the two issues is such that both candidates remain silent on it. This concerns issues for which the updating effect of both candidates is negative.

Second, the global time constraint affects candidates' strategies if at least one of them saturates the constraint. We are then interested by the following combination of issues:

1. Each candidate has a comparative advantage on an issue (and then a comparative disadvantage on the other), both are more competent than the voter's prior. That means $q_{1K} > q_{1J} > m_1$ and $q_{2J} > q_{2K} > m_2$

2. Each candidate has a comparative advantage on an issue (and then a comparative disadvantage on the other), only one is more competent than the voter's prior. That means $q_{1K} > q_{1J} > m_1$ and $q_{2J} > m_2 > q_{2K}$

3. A candidate has a comparative advantage on both issues, his opponent being more competent than the voter's prior on both issues. That means $q_{1K} > q_{1J} > m_1$ and $q_{2K} > q_{2J} > m_2$

4. A candidate has a comparative advantage on both issues, his opponent being more competent than the voter's prior on a sole issue. That means $q_{1K} > q_{1J} > m_1$ and $q_{2K} > m_2 > q_{2J}$

5.1 Both candidates are subject to the time constraint

We are first interested by a situation in which both candidates are subject to the time constraint, this is the case when each candidate has a comparative advantage on an issue (and then a comparative disadvantage on the other), both being more competent than the voter's prior. That means $q_{1K} > q_{1J} > m_1$ and $q_{2J} > q_{2K} > m_2$.

As soon as the updating function $h(.)$ is sufficiently concave in the time devoted by candidates, interior solutions can exist. We can then use first order conditions to determine equilibrium behavior. From candidates' maximisation problem, the following system of first order conditions is

$$\begin{aligned}
\frac{\partial E[\Pi_{1J}]}{\partial t_{1J}} &= \frac{\partial \alpha_1}{\partial t_{1J}}\left[h_J(t_{1J})(q_{1J}-m_1) - h_K(t_{1K})(q_{1K}-m_1)\right] + \alpha_1(t_{1J},t_{1K})\frac{\partial h_J}{\partial t_{1J}}(q_{1J}-m_1) - \lambda_J = 0 \\
\frac{\partial E[\Pi_{2J}]}{\partial t_{2J}} &= \frac{\partial \alpha_2}{\partial t_{2J}}\left[h_J(t_{2J})(q_{2J}-m_2) - h_K(t_{2K})(q_{2K}-m_{12})\right] + \alpha_2(t_{2J},t_{2K})\frac{\partial h_J}{\partial t_{2J}}(q_{2J}-m_2) - \lambda_J = 0 \\
\frac{\partial E[\Pi_{1K}]}{\partial t_{1K}} &= \frac{\partial \alpha_1}{\partial t_{1K}}\left[h_K(t_{1K})(q_{1K}-m_1) - h_J(t_{1J})(q_{1J}-m_1)\right] + \alpha_1(t_{1J},t_{1K})\frac{\partial h_K}{\partial t_{1K}}(q_{1K}-m_1) - \lambda_K = 0 \\
\frac{\partial E[\Pi_{2K}]}{\partial t_{2K}} &= \frac{\partial \alpha_2}{\partial t_{2K}}\left[h_K(t_{2K})(q_{2K}-m_{12}) - h_J(t_{2J})(q_{2J}-m_2)\right] + \alpha_2(t_{2J},t_{2K})\frac{\partial h_K}{\partial t_{2K}}(q_{2K}-m_2) - \lambda_K = 0
\end{aligned}$$

where λ_J and λ_K are the Lagrange multipliers.

As in the time constraint per issue, these first order conditions exhibit the different channels through which the time of speech influences the voter's assessment of candidates. The left-hand part is the marginal effect of time on evaluation through the issue priming channel. The right-hand part is the marginal impact of candidate's time spending on voter's evaluation of his competence, weighted by the issue's importance.

From the first order conditions, we can derive the following condition which holds in any interior equilibrium:

$$\begin{aligned}
&\alpha_2(t_{2J},t_{2K})\frac{\partial h_J}{\partial t_{2J}}(q_{2J}-m_2) - \alpha_1(t_{1J},t_{1K})\frac{\partial h_J}{\partial t_{1J}}(q_{1J}-m_1) \\
= \\
&\alpha_1(t_{1J},t_{1K})\frac{\partial h_K}{\partial t_{1K}}(q_{1K}-m_1) - \alpha_2(t_{2J},t_{2K})\frac{\partial h_K}{\partial t_{2K}}(q_{2K}-m_2)
\end{aligned}$$

or equivalently

$$\alpha_2(t_{2J}, t_{2K})\left[\frac{\partial h_J}{\partial t_{2J}}(q_{2J} - m_2) + \frac{\partial h_K}{\partial t_{2K}}(q_{2K} - m_2)\right] = \alpha_1(t_{1J}, t_{1K})\left[\frac{\partial h_J}{\partial t_{1J}}(q_{1J} - m_1) + \frac{\partial h_K}{\partial t_{1K}}(q_{1K} - m_1)\right]$$

Lemma 6 *In any equilibrium it must hold that* $sign[t_{1K} - t_{2K}] = -sign[t_{1J} - t_{2J}]$

Either each candidate spends more time on one issue than his opponent and less than his opponent on the other, or both spend an identical amount of time on each issue.

Candidates spend the same amount of time on a same issue (complete convergence) if and only if candidates do not have comparative advantages, i.e. $q_{2J} = q_{2K}$ and $q_{1J} = q_{1K}$.

Moreover if $s_1 = s_2$ then each candidate devotes identical amount of time on each issue $t_{1C} = t_{2C}$ for $C = \{J, K\}$.

Proposition 7 *The stronger his comparative advantage, the more a candidate devotes time on the issue.*

A candidate which benefits from a comparative advantage on an issue de votes time on it in order to increase his advantage and increase the weight the voter gives to the issue.

Proposition 8 *The lower his comparative disadvantage, the more a candidate devotes time on the issue.*

A candidate devotes time on the non favorable issue in order to decrease his comparative advantage. As soon as the updating function is sufficiently concave in relation with the priming function, devoting time allows to more reduce the disadvantage than increasing the weight.

Proposition 9 *The higher the voter's prior for an issue, the more candidates devote time on it.*

To be completed.

6 Extensions

Extensions of the model are several and concern :

1. Positive and negative campaign.

Here, we assume that the time a candidate devotes to an issue only affects the precision of the signal this candidate sends to voters. But we could also assume that the time devoted by a candidate also affects the learning process of voters about the competence of the opponent. The question is how ? The increasing literature on negative and positive campaign may then be explored trough this model.

2. Sequential rather than simultaneous allocation of time on issues.

7 Appendix

To be completed.

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