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DECIDING ON WHAT TO DECIDE*

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We study two-stage collective decision-making procedures where in the first stage, part of the voters decide what issues will be put in the agenda and in the second stage, the whole set of voters decides on the positions to be adopted regarding the issues that are in the agenda. Using a protocol-free equilibrium concept, we show that essentially any set of issues can be obtained as an equilibrium agenda under two salient classes of voting procedures. Moreover, the chair may manipulate a sequential voting rule such that certain issues do not get to the floor.

1. INTRODUCTION

Legislative bodies in charge of elaborating legal texts on a broad subject typically narrow down the set of issues that will go to the floor for a vote, whereas leaving others out of the text, for later resolution. The decision whether to submit an issue to vote is often delegated to a subcommittee, whereas in other cases any legislator may have a say regarding the list. But the final stand on those issues that get to the floor is in the hands of the plenary. Similarly, the present members of clubs or learned societies vote on the admission or rejection of candidates to new membership, who end up being on the ballot. Prior to that, a nominating committee may be in charge of selecting who will be in the ballot, or all members may be able to propose names. These are two examples of situations that we model and analyze in this article.

Let us briefly point at the specific questions that we address and the reasons why we believe our study improves upon previous knowledge. We state them in terms of legislative bodies, but similar remarks apply in the case of elections in clubs. One can hardly think about any piece of legislation that treats all potential issues regarding the matter it regulates. There are many reasons for that. Even private contracts are most often incomplete, leaving room for interpretation and later resolution of aspects that are not explicitly contemplated in the initial agreement. This is also the case for laws approved in parliaments, including the most fundamental ones: the constitutions of different countries refer to a highly variable number of issues. Indeed, constitutionalists have discussed at length the question of issue deferral, whereby the writers of constitutions refrain from giving constitutional status to certain issues,

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thus availing future generations with different levels of flexibility regarding the treatment of those issues that are not definitely stamped as being constitutional.[1] The variability in the size of agendas can be attributed to different causes, and depend on the problem at hand. In the case of constitutions, Dixon and Ginsburg (2011) discuss several important reasons for issue deferral. One good reason is the cost of reaching agreements among parties holding extreme views, another is the possibility of making errors that may impose large costs on society at later historical stages. Each one of these general reasons may be induced by a variety of considerations regarding the nature of each issue (for example, the size of the stakes it involves) or the specific political tradition of each country (for example, regarding the degree of negotiation prior to voting that can be expected among parties).

In this article, we provide a stark model that allows us to concentrate on one of the reasons why agents, in situations like the ones we described above, may prefer to leave the social position on certain issues undecided, whereas fixing the social position on others. Our model abstracts from many other considerations, and the analysis is essentially focused on the balance between two possibly conflicting forces that drive the actions of each member of the nominating committee, the "agenda setters." Their purpose is to attain a satisfactory text, where the issues on which society rules against the agenda setter's preferred positions weigh less than those on which the agenda setter's position is accepted. But their tendency to propose issues on which the agenda setter's position would be accepted by the voters must be tempered by the fact that their proposal of any issue may precipitate the addition of further issues by other agenda setters, on which the vote could have a negative effect.

Our model starts by distinguishing two separate stages in the collective decision process. In the first stage, a decision is made regarding those issues that will be voted upon, thus forming the agenda, and those that will be left out and not treated. In the second stage, a vote is taken among the different alternatives that are open after the agenda is specified. These alternatives consist in the position adopted by the voting body regarding each of the issues under consideration, along with the implicit decision to keep silent about those that were not considered. Specifically, the first stage of agenda formation describes the choice of issues to be discussed as the result of a sequence of decisions adopted by a set of agenda setters. These agenda setters may consist of the full set of members that will be involved in the second stage vote, or of a subset of the plenary.

As a result of this two-stage structure, agenda setters are assumed to engage in strategic considerations when deciding whether or not to propose the inclusion of an issue in the agenda, and when to do it. We study the process of issue inclusion in the agenda through the use of a solution concept that does not a priori impose any fixed order in the sequence of issues to be proposed or in the order of individuals who can do it. Since our model and our method of analysis are novel in several ways, let us describe where our approach differs from that of other related papers.

First of all, we introduce several elements of realism in the description of voting processes. One is to clearly differentiate between the decisions in the two periods, one of agenda setting and the second of vote. We also distinguish between the issues and the potential alternatives. The latter are the different combinations of decisions about the positions on issues in the agenda, augmented with the decision not to discuss the rest of issues. Previous models treat alternatives as the primitives of the problem, and then allow for agents to add an alternative to a previous agenda without changing the nature of those that were already in. In our model, expanding the agenda by including an additional issue completely changes the set of alternatives faced by agents, since the size of the vector of issues to be voted on is

[1] A rough additional confirmation that issue deferral is a pervasive phenomenon can also be found in constitutional ranking statistics (https://comparativeconstitutionsproject.org/ccp-rankings). For example, the percentage of 70 major topics from the Comparative Constitutions Project survey that are included in any given constitution ranges from 0.21 in New Zealand to 0.81 in Zimbabwe, and the number of human rights considered in existing constitutions goes from 2 in Brunei to 99 in Ecuador. Such divergences may partly result from idiosyncratic factors, like the different quality of democracy across countries and historical periods.

increased. An essential feature of our model is that by adding issues to an existing agenda, individuals generate irreversible changes in the sets of actions that are available to others. This facilitates the analysis, because the set of available agenda proposals shrinks along history, and the one containing all issues becomes a terminal point. We consider the distinction between issues and alternatives, and its consequences to be a realistic feature of our model, that we think was ignored in previous work. In particular, our results are not based on any cyclical pattern and differ from those obtained in the tradition of McKelvey's chaos results (McKelvey, 1979), and from recent work (see Vartiainen, 2014, and references therein) where appropriate modifications of the Banks set (Banks, 1985), and the introduction of history dependence generate predictions regarding stable agendas.

Second, we analyze the interaction between agenda setters by means of a solution concept that we borrow from the work of Dutta et al. (2004). The equilibrium concept that they proposed allows each agenda setter to add issues to agendas at any point, given those already introduced by her or by any other agenda setter. Its main strength is that, unlike in extensive form games, their concept does not assume any a priori established order of moves for the players, and yet is not based on simultaneous play either, as would be the case in normal form games.

Our model is certainly a simplified version of reality. We only admit two different positions on each issue. We postulate preferences of voters about alternatives as primitives, instead of dwelling on the different kinds of reasons why they would prefer each position to another, individually or in combination with others. Moreover, we assume that agenda setters have a precise knowledge of the attitudes of voters regarding each alternative that they can introduce in the agenda any issue they wish and that once in the agenda issues cannot be taken away from it. These stylized traits allow us to discuss the reasoning of agenda setters regarding what issues to introduce into the agenda and to make some predictions about the expected consequences of their actions. The combination of our modeling decisions and our choice of equilibrium concept allows us to compute equilibrium agendas for each specification of the voters' preferences and the voting rules adopted to decide on the positions about issues in the agenda. In addition, the order in which new issues are added to those already proposed along the agenda formation process is also established as part of the equilibrium. Multiple equilibria may arise, but it is not hard to construct situations with unique equilibria which, in addition, provide interesting remarks regarding the phenomenon of issue deferral. One first and quite expected result is that one can easily construct examples where the full agenda is no equilibrium, and instead issue deferral arises in equilibrium, under several and frequently used voting methods. More interestingly, these examples can be obtained even if we assume that the preferences of voters are constrained to satisfy natural restrictions and that the voting rule is Pareto efficient. This is in contrast with the opposite prediction that obtains in Dutta et al. (2004). In their model, full agendas would arise when Pareto-efficient voting rules are used.[2] This sharp contrast is due to our model's ability to separate the concept of an issue from that of an alternative, which are integrated into the same object in their formulation.

Another advantage of our model is that we can exhibit examples for an additional important fact. Not only, as it is natural to expect, will equilibrium agendas vary when voters' preferences change, but these changes can be dramatic, in terms of size and composition, even in response to apparently very local changes in these preferences. This remark fits well with the warnings of noted political scientists regarding the ever-present potential for instability and change in political situations (Riker, 1982, 1993; Cox and Shepsle, 2007). Our analysis also points at an additional form of manipulation that may be in the hands of a chair, as we already announced. Typically, chairs can manipulate sequential voting procedures by adding new alternatives to the list of possible ones (see Moser et al., 2009; and Moser, Fenn et al., 2016) and/or by changing the order of vote once the set of alternatives is given. What we find is

[2] More precisely, in Dutta et al. (2004) the equilibrium agendas are such that the voting outcomes are the same as under full agendas.

that, in addition, the chair may induce agenda setters to change the set of issues (hence the characteristics of the set of available alternatives) under sequential voting procedures by simply announcing the order in which alternatives will be presented for a vote. This type of manipulation could be an additional instrument in the hands of a chairperson, even of one who cannot directly determine what issues or alternatives should be discussed.

Our use of a protocol-free equilibrium concept allows us to also contrast the predictions we obtain against those that could arise under models that might study the same question under a fixed order in the agenda setter' proposals. Without judging the accuracy of each set of results if they were tested against data, we submit the idea that the difference in predictions justifies our challenge to those models that introduce the somewhat artificial assumptions implicit in any protocol.

Our hope is that our model, which lends itself to the computation of equilibria, might be a starting point for a more complex analysis of the issue deferral phenomenon, and eventually help researchers to add complexity to the study of the underlying causes for changes in the voters' preferences which drive our results.

The outline of the article is the following: Section 2 gives an overview of the related literature. In Section 3, we introduce our model and equilibrium concept. Section 4 presents some examples. In Section 5, we first study sufficient conditions for equilibrium agendas to be full agendas. Then, we investigate whether uncontroversial issues will be on the equilibrium agenda and we provide general results about the variability of agendas for two prominent voting procedures. Section 6 concludes. The appendix presents details for two examples considered in the main text. Outlines of the proofs of results are in the text, and full proofs are in the online appendix.

2. RELATED LITERATURE

The literature on agenda formation is rich, and the following overview is necessarily incomplete. The literature on political agendas as reviewed in Baumgartner (2001) is mainly descriptive. Previous theoretical work mostly considers a specific protocol for the agenda formation and the subsequent voting stage. Austen-Smith (1987), Banks and Gasmi (1987), Baron and Ferejohn (1989), Miller et al. (1990), Duggan (2006), and Penn (2008) all assume that voting takes place only after the agenda has been built. By contrast, Bernheim et al. (2006) and Anesi and Seidmann (2014) analyze the case of "real-time" agenda setting, where any proposal is put to an immediate vote against the current default. Chen and Eraslan (2017) study the timing at which the party in power decides to propose the subjects on which to legislate, one at a time, depending on their actual power and on the relative positions of the opposition and the status quo. In Eguia and Shepsle (2015), the bargaining protocol is endogenized and chosen by the members of a legislative assembly before the agenda is formed. Whereas all these papers consider the case of complete information like we do, Godefroy and Perez-Richet (2013) use an incomplete information framework to study how the majority quota used to place alternatives on the agenda affects agents' behavior and hence the likelihood to change the status quo. There are only a few papers that do not rely on a specific bargaining protocol. Among the notable exceptions is Dutta et al. (2004) who study equilibrium agendas in a model with farsighted agents. Their main result is that the set of equilibrium outcomes for Pareto-efficient voting rules coincides with the outcomes when all full agendas are considered. Unlike in their paper, and as we shall discuss later, we show that in our model equilibrium agendas may not contain all issues even if the voting rule is Pareto efficient.

Vartiainen (2014) completes a list of works including Anesi (2006) and Bernheim and Slavov (2009), that start from McKelvey's (1979) chaos theorem and add features to the model in order to avoid cycles and to identify stable agendas. The spirit of Vartiainen's work is similar to ours in different aspects, but there are substantial differences as well. His analysis, like ours and Dutta et al. (2004), is based on a protocol-free equilibrium concept that is implicitly history-dependent. However, by clearly distinguishing between issues and alternatives, we reduce the strategic possibilities of voters in a different manner. In these other papers, including Vartiainen (2014), voters can propose any new alternative that satisfies appropriate conditions, whereas we limit their actions to proposing issues, which in addition must not have been proposed before and cannot be eliminated from the floor after they have been added to the agenda. Although this makes our model specific, it also adds an important element of descriptive realism, and suggests a very different technical approach, in the line of Dutta et al. (2004), departing for good reason from the approach based on modifications of the Banks set. Another difference with Vartiainen (2014) is that we assume that individuals can, by themselves, add issues to the floor, whereas in his paper agents can only add alternatives if they reach a majority. Although we think our analysis could be modified to require the consensus of more than one agent, the difference still remains that the type of changes our voters can induce on the set of alternatives in the agenda are of a different kind. Hence, although appreciative of the existing literature, we believe our artice contributes a new dimension to previous work.

Finally, let us mention that there is also a related literature that focusses on strategic candidacy (Osborne and Slivinsky, 1996; Besley and Coate, 1997; Dutta et al., 2001, 2002). The main difference with models of agenda formation like ours is that in strategic candidacy problems, the agents who take the agenda formation decision, by choosing whether to run or not to run, are different from those who will eventually vote.

3. THE MODEL

We consider a set of voters $I = \{1, \dots, n\}$ with $n \geq 2$ and a set of issues $\mathcal{K} = \{1, \dots, K\}$ with $K \geq 2$. A nonempty subset of voters $J \subset I$ has the power to decide on which issues the group I will be silent, thus leaving the position on these issues undefined, and on which issues the group I will take a decision, in which case one of two positions will be voted upon and adopted for each one of those. The members of J are called *agenda setters*. A special case is the one with $J = I$ where all voters are agenda setters. We will describe the agenda setting process below.

We denote by "$-$" the decision to leave an issue out of the voting floor, and by 0 and 1 the two possible positions on issues that are voted upon. Social alternatives are then K-tuples indicating, for each issue, whether or not it was the object of a vote, and, if so, which stand was adopted on it. Accordingly, the set of alternatives then is given by $X = \{0, 1, -\}^{\mathcal{K}}$.

Voters are endowed with strict preference orderings on X.[3] Let $\mathcal{P}$ denote the set all strict preference orderings and let $\succ_i \in \mathcal{P}$ be voter i's preference ordering.

We consider a two-stage decision-making process. In the first stage, agents in J decide which issues to bring to the floor. The result is an agenda, which not only records the set of issues that have been proposed by the agents, but also the order in which the issues have been proposed. After that, in the second stage, agents in I cast an irreversible vote about the position on each issue of the agenda. Depending on the voting rule, agents may directly vote on the positions for all issues one after the other or they may vote simultaneously on the positions for all issues using a sequential voting procedure on the set of alternatives.[4]

Agendas

Let $1 \leq m \leq K$. An *agenda of length m* is a finite vector of issues $a = (a_1, \dots, a_m)$ with $a_k \in \mathcal{K}$ for $k = 1, \dots, m$, and $a_k \neq a_l$ for $k \neq l$. The empty agenda $\varnothing$ where no issue is put to vote is defined to have length 0. By A^m we denote the set of agendas of length m, where $0 \leq m \leq K$, and by $A = \bigcup_{m=0}^{K} A^m$ we denote the set of all agendas.

[3] A *strict preference ordering* is a complete, asymmetric, and transitive binary relation on X.

[4] In our examples and main results, we will consider voting rules that only depend on the set of issues on the agenda, but not on their specific order. Yet, our model also allows for the case where the order of issues plays a role in the second stage.

Let $a \in A$. If an issue k is not on the agenda a, that is, $k \notin a$, we call k a *free issue at a*.[5] For $a \in A^m$, where $0 \leq m \leq K-1$, and $k \in \mathcal{K}$, $k \notin a$, (a, k) denotes the agenda $a' \in A^{m+1}$ with $a'_l = a_l$ for $l = 1, \ldots, m$, and $a'_{m+1} = k$.

Once a given set of issues constitute the agenda, the only alternatives that may be attained after voting are those where society chooses either value 0 or 1 on those issues and remains noncommitted on the remaining ones. Accordingly, we define the available set of alternatives at agenda a to be the union of all those alternatives that may be potentially chosen when the agenda is a, depending on the preferences of agents. Thus, for a given agenda $a \in A$ the set of *available alternatives* at a, $X(a)$, is given by

$$X(a) = \{x \in X \mid \text{for all } k \in \mathcal{K}, x_k \in \{0, 1\} \text{ if and only if } k \in a\}.$$

Observe that $X(\varnothing) = \{(-, \ldots, -)\}$.

Voting

A voting procedure specifies what alternative is chosen as a function of the agenda and the preferences of agents over alternatives. Formally, a voting procedure on some domain of preference profiles $\mathcal{D} \subset \mathcal{P}^n$ is a mapping $V : A \times \mathcal{D} \to X$ with $V(a, P) \in X(a)$ for all $a \in A$ and $P \in \mathcal{D}$. Notice that a voting procedure, in our definition, associates a single outcome to each preference profile and each agenda a. Also, observe that the voting procedure need not be sensitive to the ordering of issues in a, and may only depend on the set of issues in the agenda. Below we will introduce two prominent voting procedures.

Agenda Formation

In the first stage, starting from the empty agenda each agent in J can unilaterally add issues to those already proposed by her or by others along the creation of the agenda that will eventually prevail. This process stops when either a full agenda $a \in A^K$ is reached or no agent in J wants to add further issues. Instead of modeling the agenda formation as an extensive or normal form game, where equilibrium agendas could potentially be very sensitive to the details of the game form, we follow Dutta et al. (2004) and consider an equilibrium collection of sets of continuation agendas. We first provide some motivating comments and then proceed more formally.

For $a \in A^m$, where $m \in \{0, 1, \ldots, K\}$, let $A(a)$ be the set of *continuation agendas*, that is,

$$A(a) = \{a' \in A \mid a'_k = a_k \quad \text{for all } k = 1, \ldots, m\}.^6$$

Equilibrium collections of sets of continuation agendas express expectations about the agendas that will result starting from any given agenda a. Accordingly, our equilibrium concept is defined recursively. Since issues are assumed to be added one after the other, expectations at agenda a have to be such that they either do not involve further additions of issues, or else are equilibrium continuations with one further issue added to a (see condition (E1)). Equilibrium continuations are not required to be unique because without a fixed protocol different agents may initiate different continuation paths. Therefore, when considering to add an issue to a given agenda an agent has to take into account all equilibrium continuations this may lead to. No further additions of issues to an agenda a are expected if and only if no agent in J would be interested in adding any additional issue after having reached a, in view of what the expected continuations would be (see condition (E2)).

Definition 1. Let $P = (\succ_1, \ldots, \succ_n) \in \mathcal{D}$. An *equilibrium collection of sets of continuation agendas* is a collection $(CE(a, P))_{a \in A}$, where $CE(a, P) \subset A(a)$ for each $a \in A$, that satisfies the following two conditions for all $a \in A$:

[5] Here and in what follows, for a given agenda $a = (a_1, \ldots, a_m) \in A$ we write, for short, $k \in a$ ($k \notin a$) whenever $k = a_l$ for some $l \in \{1, \ldots, m\}$ ($k \neq a_l$ for all $l = 1, \ldots, m$).

[6] Observe that $a \in A(a)$ for all $a \in A$, that is, any agenda is a continuation agenda for itself.

(E1) $CE(a,P)$ is a nonempty subset of $\bigcup_{k\notin a} CE((a,k),P) \cup \{a\}$.

(E2) $a \in CE(a,P)$ if and only if $V(a,P) \succ_i V(a',P)$ for all $a' \in \bigcup_{k\notin a} CE((a,k),P)$ and for all $i \in J$.[7]

In what follows, for a given equilibrium collection of sets of continuation agendas $(CE(a,P))_{a\in A}$, we will refer to the continuation agendas in $CE(a,P)$ for $a \in A$ as *equilibrium continuations*.

We record the following result which is a straightforward implication of condition (E1): If an agenda a^* is an equilibrium continuation at some agenda a, then it is an equilibrium continuation at every agenda along the path from a to a^*.

LEMMA 1. *Let $V : A \times \mathcal{D} \to X$ be a voting procedure and let $(CE(a,P))_{a\in A}$ be an equilibrium collection of sets of continuation agendas for some $P \in \mathcal{D}$. If $a^* = (a_1,\ldots,a_m) \in CE((a_1,\ldots,a_l),P)$ for some $l \le m \le K$, then*

$$a^* \in CE((a_1,\ldots,a_k),P) \quad \textit{for all } k = l,\ldots,m.$$

In particular, a^* then is an element of $CE(a^*,P)$.

Observe that (E2) is a rather weak stopping requirement because an agent is assumed to stop adding issues to the agenda only if stopping is better than all equilibrium continuations reached when one further issue is added to the existing agenda. Nevertheless, as we will show, equilibrium continuations are not necessarily full agendas, even for restricted domains of preferences and very well behaved voting procedures.

To reduce the potential multiplicity of equilibrium collections of sets of continuation agendas we impose a third condition, which we call *consistency* (cf. Dutta et al., 2004). To this end, for $a \in A$ we define an agenda $a' = (a,k,\ldots) \in A$ to be *rationalizable* (relative to a) if $a' \in CE((a,k),P)$ and there exists an agent $i \in J$ and $a'' \in CE(a,P)$ with either $a'' = (a,l,\ldots)$ with $l \neq k$ or $a'' = a$ such that $V(a',P) \succ_i V(a'',P)$. Hence, the continuation agenda $(a,k,\ldots)$ is rationalizable relative to a if it is an equilibrium continuation at (a,k) and if some agent can gain from reaching it instead of sticking to some other equilibrium continuation at a.

DEFINITION 2. Let $P \in \mathcal{D}$. An equilibrium collection of sets of continuation agendas $(CE(a,P))_{a\in A}$ is *consistent* if it satisfies the following condition:

(E3) If $a' \in \bigcup_{l\notin a} CE((a,l),P)$ is rationalizable, then $a' \in CE(a,P)$. Conversely, if $a' = (a,k,\ldots) \in CE(a,P)$ and either $a \in CE(a,P)$ or $a'' = (a,l,\ldots) \in CE(a,P)$ for some $l \neq k$, then a' is rationalizable.

Thus, consistency requires that an equilibrium collection of sets of continuation agendas contains all rationalizable continuation agendas. Moreover, it only contains rationalizable continuation agendas subject to the following two exceptions: The first is that the agenda a itself is an equilibrium continuation if all agents in J prefer to stop at a (condition (E2)). The second exception is when there is a unique equilibrium continuation $a' = (a,k,\ldots)$ at a which is then not required to be rationalizable. Observe, however, that the latter case only obtains if there is an agent who prefers continuing over stopping at a and if all agents in J unanimously prefer a' to adding an issue different from k to agenda a.

We will be mainly interested in the agendas that would result in equilibrium when agenda formation starts from the empty agenda where all issues are still free. Hence, it is convenient to introduce a terminology for the agendas that are elements of the set of equilibrium continuations at the empty agenda. We call these agendas "equilibrium agendas":

[7] Notice that $V(a',P) \neq V(a,P)$ for all $a' \in \bigcup_{k\notin a} CE((a,k),P)$ since any such agenda a' contains at least one issue $k \notin a$ which implies that $(V(a,P))_k \neq (V(a',P))_k$.

DEFINITION 3. Let $a^* \in A$ and $P \in \mathcal{D}$. Then a^* is a *(consistent) equilibrium agenda at P* if there exists a (consistent) equilibrium collection of sets of continuation agendas $(CE(a, P))_{a\in A}$ with $a^* \in CE(\varnothing, P)$.

The use of our proposed equilibrium notion poses no existence problems. Moreover, the characterization of families of equilibrium continuation agendas closely follows the steps of a backward induction argument that is quite analogous to the pruning procedure suggested by Arieli and Aumann (2015) for the case of subgame-perfect equilibria. Since any full agenda is its own continuation, we can start by asking whether an agenda a that contains all issues but one satisfies the equilibrium requirements. If it does, its continuation full agenda will be pruned. If it does not, then the expectation that a is its own equilibrium continuation is pruned. That leaves us with a family of potential equilibria regarding agendas where at most all issues but one are considered. Then we can continue a similar pruning process for agendas containing all but two issues, and proceed in a similar manner until we reach the case where the agenda is empty and no issue is put to vote. The family of continuation agendas that survives the pruning process is an equilibrium.

The order of moves of the agenda setters in our protocol-free equilibrium is endogenous and this results in equilibrium agendas that can be very different from those under a fixed order of moves. In particular, it is not true that subgame-perfect equilibrium outcomes are always selections from the set of consistent equilibrium agendas. In Appendix A.1, we present an example where the empty agenda is a subgame-perfect equilibrium outcome for some order of moves whereas any consistent equilibrium agenda contains all but one issue.

Assumptions on Preferences

For later use, we introduce specific assumptions on the domain of preferences. The first are two separability properties of preference orderings.

DEFINITION 4.

(1) A preference ordering $\succ$ on $X = \{0, 1, -\}^{\mathcal{K}}$ is *separable* if for all $k \in \mathcal{K}$, $(x_k, x_{-k}) \succ (y_k, x_{-k})$ for some $x_{-k} \in \{0, 1, -\}^{\mathcal{K}\setminus\{k\}}$ implies that $(x_k, x'_{-k}) \succ (y_k, x'_{-k})$ for all $x'_{-k} \in \{0, 1, -\}^{\mathcal{K}\setminus\{k\}}$.

(2) A preference ordering $\succ$ on X is *additively separable* on X if there exist utility scalars $u_k(z) \in \mathbb{R}$ for all $k \in \mathcal{K}$, and for all $z \in \{0, 1, -\}$ such that for $x, y \in X$,

$$x \succ y \iff \sum_{k=1}^{K} u_k(x_k) > \sum_{k=1}^{K} u_k(y_k).$$

Under separability, a voter's preference about the positions $1, 0, -$, on any given issue is independent of the positions on the rest of issues. This is a strong regularity assumption and yet we will see that is does not impose any restrictions on the set of equilibrium agendas. Additive separability is an even stronger condition that requires the trade-off between the positions on two issues k and l to be independent of the positions on all other issues.

Let $\mathcal{S} \subset \mathcal{P}$ be the set of all preference orderings that satisfy separability and let $\bar{\mathcal{S}} \subset \mathcal{S}$ denote the set of all preference orderings that satisfy additive separability.

Under the next condition, that we call *betweenness*, other things being equal, an agent strictly prefers the alternative that takes his preferred position on some issue k over leaving the position open, and she strictly prefers the latter to the alternative where the position is her worse.

DEFINITION 5. A preference ordering $\succ$ on X satisfies *betweenness* if for all $k \in \mathcal{K}$, and for all $x \in X$, either

$$(1, x_{-k}) \succ (-, x_{-k}) \succ (0, x_{-k})$$

or

$$(0, x_{-k}) \succ (-, x_{-k}) \succ (1, x_{-k}).$$

Observe that betweenness is compatible with the interpretation that agents perceive the resulting indeterminacy as creating a lottery between the competing positions, to be resolved in the future. Note that betweenness will be satisfied whenever the agent's preference ordering can be represented by an expected utility function such that the utility of $(-, x_{-k})$ is the expected utility of a lottery over the set $\{(0, x_{-k}), (1, x_{-k})\}$, where the agent assigns a positive probability to both outcomes, $(0, x_{-k})$ and $(1, x_{-k})$, that is independent of the corresponding probabilities for other open positions, if any.

Voting Rules

There are many ways in which one can specify voting rules. One of them is to propose a game form that is dominance solvable for each agenda in the sense of Moulin (1979), and to associate to each preference profile the unique Nash equilibrium outcome in undominated strategies of the game induced by that profile and the game form. Another is to associate each agenda and each profile with the result of sincere voting under a sequential rule. In both cases, it is well known that the same tree structure may lead to different outcomes depending on the order of vote on alternatives (see Barberà and Gerber, 2017, and references therein), and hence this order must be determined when defining the voting rule.

One prominent sequential voting rule is the *amendment procedure* (Farquharson, 1969; Miller, 1977, 1980) which assumes an exogenously given ordering of the attainable alternatives. If a is an agenda and $(x_1, x_2, \ldots, x_N)$ is the given ordering of the alternatives in $X(a)$, then under the amendment procedure the first vote is over x_1 and x_2, the second vote is over the winner of the first vote and x_3, and so on until all alternatives in $(x_1, x_2, \ldots, x_N)$ are exhausted. In every pairwise vote, the winner is selected according to simple majority voting and the winning alternative is the one that survives until the end. When considering the amendment procedure below we will assume that voters are *sophisticated* (Farquharson, 1969; Brams, 1975; Moulin, 1979) and thus the voting outcome under the amendment procedure is given by the alternative chosen in an undominated Nash equilibrium, which we obtain by iterative elimination of weakly dominated strategies, where all weakly dominated strategies of all agents are simultaneously eliminated at each stage. Observe that the voting outcome under iterative elimination of weakly dominated strategies is unique if there is an odd number of agents all with strict preferences (see Moulin, 1979; and Barberà and Gerber, 2017). Moreover, it is well known that the amendment procedure is Pareto efficient (Miller, 1977, 1980; Barberà and Gerber, 2017), but it is not strategy-proof on any domain containing the set of separable preferences (and on the universal domain in particular).

Another prominent voting rule that we will consider in the following is *voting by quota*.[8] For all $a \in A$ and all voters i, let $b^i(a) \in X(a)$ be the best available alternative at a according to i's preferences, that is

$$b^i(a) \succ_i x \quad \text{for all } x \in X(a), x \neq b^i(a).$$

Let $q \in \{1, \ldots, n\}$. Then, *voting by quota q* is the voting procedure $V : A \times \mathcal{P}^n \to X$, such that for all $a \in A$, for all $k \in a$, and for all $P \in \mathcal{P}^n$,[9]

$$(V(a, P))_k = \begin{cases} 1, & \text{if } \#\{i \mid b^i_k(a) = 1\} \geq q \\ 0, & \text{otherwise.} \end{cases} \tag{1}$$

[8] Voting by quota is a special case of a larger class of voting procedures, called *voting by committees* (Barberà et al., 1991).

[9] By "#" we denote the number of elements in a set.

TABLE 1
UTILITIES $u_k^i(\cdot)$ OF VOTERS $i \in \{1, 2, 3\}$ FOR CANDIDATES $k \in \{1, 2, 3\}$

i	k	$u_k^i(1)$	$u_k^i(0)$	$u_k^i(-)$
	1	0.04	4.4	3
1	2	4.1	0.01	3
	3	4.2	0.02	3
	1	4.1	0.01	3
2	2	0.04	4.4	3
	3	4.2	0.02	3
	1	4.1	0.01	3
3	2	4.2	0.02	3
	3	0.04	4.4	3

On the domain of separable preferences $\mathcal{S}^n$ voting by quota is strategy-proof, but it is not Pareto efficient (Barberà et al., 1991). Moreover, if $P \in \mathcal{S}^n$, then the voting outcome on issue $k \in a$ under voting by quota is independent of the other issues in a and on their ordering, that is, $(V(a, P))_k = (V(a', P))_k$ for any two agendas a, a' with $k \in a$ and $k \in a'$.

If preferences are additively separable, that is, $P \in \bar{\mathcal{S}}^n$, then (1) is equivalent to

$$(V(a, P))_k = \begin{cases} 1, & \text{if } \#\{i \mid u_k^i(1) > u_k^i(0)\} \geq q, \\ 0, & \text{otherwise,} \end{cases}$$

where $(u_k^i(\cdot))_{k \in \mathcal{K}}$ is the collection of scalars in an additively separable utility representation of voter i's preference ordering $\succ_i$.

4. EXAMPLES

The following examples illustrate the application of our equilibrium notion for two prominent voting rules, voting by quota and the amendment procedure. The analysis is quite detailed, in order to familiarize the reader with our equilibrium concept. In addition, the examples demonstrate the trade-off between an agent's incentives to support issues on which a vote would result in her preferred positions, and the need to take into account that adding such issues may trigger further additions to the agenda that end up being harmful to her interests. The reader will find a summary of what we learn from the examples at the end of the section.

In both examples, we consider the election of new members to a society. The set of issues $\mathcal{K}$ is the set of candidates. In this case, "$-$" means that the corresponding candidate is not nominated, "1" means that the candidate is nominated and elected, and "0" means that the candidate is nominated and not elected.

4.1. *Voting by Quota.* Let there be three candidates, that is, $\mathcal{K} = \{1, 2, 3\}$, and assume that the society currently has three members and that all members are agenda setters and voters, that is, $I = J = \{1, 2, 3\}$. Voters have additively separable preferences with utility scalars as given in Table 1.[10]

The voting rule is voting by quota $q = 2$. For each candidate $k \in \{1, 2, 3\}$, there are two voters who prefer to elect candidate k whenever she is nominated. Hence, the voting outcome is

$$(V(a, P))_k = 1 \quad \text{for all agendas } a \quad \text{with } k \in a.$$

[10] Note that the utility scalars are such that the resulting preference ordering on the set of alternatives is strict.

The remaining voter prefers not to elect the candidate and the utility for electing the candidate is so low that all voters prefer not to nominate any candidate over nominating all candidates: For all i and for all full agendas a, we have that

$$V(\varnothing, P) = (-,-,-) \succ_i V(a, P) = (1,1,1) \tag{2}$$

since

$$\sum_{k=1}^{3} u_k^i(-) = 9 > \sum_{k=1}^{3} u_k^i(1) = 8.34.$$

We now solve for the equilibrium collection of sets of continuation agendas. To do that we proceed backward starting from full agendas $a \in A^3$.[11] By (E1), we have

$$CE(a, P) = \{a\} \quad \text{for all } a \in A^3.$$

Next consider an agenda $a \in A \setminus A^3$ with $k \in a$ for some $k \in \{1, 2, 3\}$. We will show that $a \notin CE(a, P)$. By definition of the agents' utility functions, voter k gets his most preferred position on all candidates $l \notin a$. To see this, note that all candidates $l \in \{1, 2, 3\}$ are elected if nominated which is the preferred outcome for voter k if $l \neq k$. Hence,

$$V(a', P) \succ_k V(a, P) \quad \text{for all } a' \in \bigcup_{l \notin a} CE((a, l), P).$$

By (E2), this implies that $a \notin CE(a, P)$. Lemma 1 then implies that

$$CE(a, P) \subset A^3 \quad \text{for all } a \in A \quad \text{with } k \in a \quad \text{for some } k \in \{1, 2, 3\}. \tag{3}$$

We will now show that $CE(\varnothing, P) = \{\varnothing\}$. To see this, observe that any $a \in CE((k), P)$ for some $k \in \{1, 2, 3\}$ is a full agenda by (3). Since by (2) $V(\varnothing, P) \succ_i V(a, P)$ for all i and for all full agendas a (E2) implies that $\varnothing \in CE(\varnothing, P)$. Moreover, by (2) and the fact that any $a \in CE((k), P)$ with $k \in \{1, 2, 3\}$ is a full agenda by (3), we conclude that no $a \in CE((k), P)$ with $k \in \{1, 2, 3\}$ is rationalizable relative to $\varnothing$. (E3) then implies that $CE(\varnothing, P) = \{\varnothing\}$.

Summary

For the given preferences there is a unique consistent equilibrium agenda, where no candidate is nominated even though for each candidate two voters get their most preferred voting outcome on that candidate. The reason is that as soon as one candidate is nominated the other candidates will be nominated as well and the outcome of the election, namely, that all candidates are elected, is worse for all voters than not nominating any candidate.

4.2. *Amendment Procedure.* Let there be two candidates, that is, $\mathcal{K} = \{1, 2\}$, and again assume that the society currently has three members and all members are agenda setters and voters, that is, $I = J = \{1, 2, 3\}$. The voters' preference orderings on the set of alternatives are given in Table 2, where the alternatives in the table are listed in the order of decreasing preference.

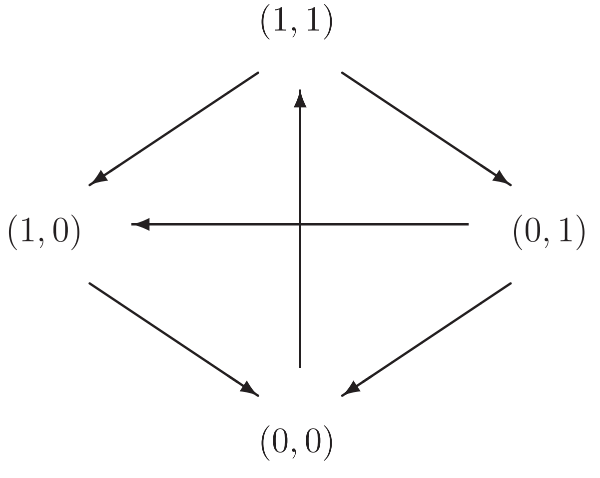
The voting rule is the amendment procedure. To solve for the equilibrium agendas we first determine the voting outcome for any agenda that contains at most one alternative. At the empty agenda the outcome is the unique attainable alternative $(-,-)$, that is,

$$V(\varnothing, P) = (-,-).$$

[11] Recall that A^m is the set of all agendas of length m, where $0 \leq m \leq K$, and $A = \bigcup_{m=0}^{K} A^m$.

TABLE 2
PREFERENCE ORDERINGS OF VOTERS 1,2,3

$\succ_1$	$\succ_2$	$\succ_3$
(0,1)	(1,0)	(1,1)
(0,−)	(−,0)	(−,1)
(−,1)	(1,−)	(0,1)
(−, −)	(−, −)	(1,−)
(0,0)	(0,0)	(−, −)
(−,0)	(0,−)	(0,−)
(1,1)	(1,1)	(1,0)
(1,−)	(−,1)	(−,0)
(1,0)	(0,1)	(0,0)



NOTES:The arrows point to the alternatives that are beaten under simple majority voting.

FIGURE 1

DOMINANCE RELATION ON $\{(0,0),(0,1),(1,0),(1,1)\}$ UNDER PAIRWISE SIMPLE MAJORITY VOTING

At agenda $a = (1)$, the outcome is

$$V((1), P) = (1, -),$$

because a majority of voters prefers $(1, -)$ over $(0, -)$, and at agenda $a = (2)$ the outcome is

$$V((2), P) = (-, 1),$$

since a majority of voters prefers $(-, 1)$ over $(-, 0)$.

It remains to determine the voting outcome at the full agendas, (1,2) and (2,1), with attainable sets

$$X(1, 2) = X(2, 1) = \{(0, 0), (0, 1), (1, 0), (1, 1)\}.$$

Figure 1 shows the dominance relation on $\{(0, 0), (0, 1), (1, 0), (1, 1)\}$ that results from pairwise simple majority voting. It follows from the characterizations in Banks (1985, Theorem 3.1) and Barberà and Gerber (2017, Theorem 3.1) that any of the attainable alternatives except for (1,0) is the outcome of sophisticated sequential voting under the amendment procedure for some ordering of the alternatives in $X(1,2) = X(2,1)$.[12] Observe that (0,0) is Pareto dominated by $(-,-)$.

Case 1: $V((1,2), P) = V((2,1), P) = (0,0)$

To solve for the equilibrium collection of sets of continuation agendas, we proceed backward starting from the full agendas (1,2) and (2,1). By (E1), it must be that

$$CE((1,2), P) = \{(1,2)\} \quad \text{and} \quad CE((2,1), P) = \{(2,1)\}.$$

Now consider agenda (1). By condition (E1), $CE((1), P)$ is a nonempty subset of $\{(1), (1,2)\}$. By condition (E2), $(1) \in CE((1), P)$ is ruled out since voter 1 strictly prefers the voting outcome under the equilibrium continuation $CE((1,2), P) = (1,2)$ over the outcome at agenda (1). Hence,

$$CE((1), P) = \{(1,2)\}.$$

Next consider agenda (2). By condition (E1), $CE((2), P)$ is a nonempty subset of $\{(2), (2,1)\}$. By condition (E2), $(2) \in CE((2), P)$ is ruled out since voter 2 strictly prefers the voting outcome under the equilibrium continuation $CE((2,1), P) = (2,1)$ over the outcome at agenda (2). Hence,

$$CE((2), P) = \{(2,1)\}.$$

Finally, consider the empty agenda. By condition (E1), $CE(\varnothing, P)$ is a nonempty subset of $\{\varnothing\} \cup CE((1), P) \cup CE((2), P) = \{\varnothing, (1,2), (2,1)\}$. Since all voters strictly prefer the voting outcome under the empty agenda over the outcome at any full agenda, (E2) implies that $\varnothing \in CE(\varnothing, P)$. We will prove that $\varnothing$ is the unique element in $CE(\varnothing, P)$. Suppose by way of contradiction that $(1,2) \in CE(\varnothing, P)$. Then, since $\varnothing \in CE(\varnothing, P)$, condition (E3) implies that (1,2) is rationalizable relative to the empty agenda $\varnothing$. However, no voter prefers the voting outcome under agenda (1,2) over the outcome at the empty agenda $\varnothing$ or the outcome at agenda (2,1). Hence, (1,2) is not rationalizable which implies that $(1,2) \notin CE(\varnothing, P)$. Similarly, one proves that $(2,1) \notin CE(\varnothing, P)$. Therefore, we conclude that

$$CE(\varnothing, P) = \{\varnothing\}.$$

Summary

If $V((1,2), P) = V((2,1), P) = (0,0)$, the unique consistent equilibrium agenda is empty and no candidate is nominated and elected.

Case 2: $V((1,2), P) = V((2,1), P) \in \{(0,1), (1,1)\}$

Observe that (0,1) is the best alternative for voter 1 and (1,1) is the best alternative for voter 3. Therefore, in this case only full agendas are equilibrium agendas because there is always one voter who is better off by adding an issue to the agenda that was a free issue before. Hence, for all agendas a, $CE(a, P)$ contains full agendas only.

Summary

If $V((1,2), P) = V((2,1), P) \in \{(0,1), (1,1)\}$ any consistent equilibrium agenda is a full agenda, that is, both candidates are nominated. However, depending on the order of vote either both candidates or only candidate 2 is elected.

Effect of a small change in preferences: Assume that voter 1's preference for (0,0) and $(-,-)$ is reversed, so that voter 1 now strictly prefers (0,0) over $(-,-)$. The preferences of voter 1 over all other pairs of alternatives as well as the preferences of voters 2 and 3 are the

[12] This can also be verified directly: The ordering ((0,0),(0,1),(1,0),(1,1)) yields outcome (0,0), the ordering ((1,1),(1,0),(0,0),(0,1)) yields outcome (1, 1), and the ordering ((0,1),(1,0),(1,1),(0,0)) yields outcome (0,1). Finally, no ordering gives outcome (1,0).

same as before (see Table 2). Then it is immediate to see that all equilibrium agendas are full agendas independent of the order of the alternatives under a full agenda because even in the case where the voting outcome under a full agenda is (0,0) there is now one voter, namely, voter 1, who prefers to add an issue to the empty agenda such that eventually a full agenda is reached.

Summary

If the ordering of the alternatives in $X(1,2) = X(2,1)$ is such that $V((1,2), P) = V((2,1), P) = (0,0)$, then no candidate is nominated under the original preferences of voter 1 whereas both candidates are nominated after the small local change in voter 1's preferences.

The examples in this section illustrate the following notable points:

(1) Even if the final position on an issue is independent on the other issues on the agenda like it is the case under voting by quota with additively separable preferences, agents may refrain from adding an issue to the agenda because this may trigger further additions of issues on which they lose.
(2) The equilibrium collection of sets of continuation agendas can be very sensitive to the details of the voting rule, and in particular to the use of a fixed order of vote under sequential voting procedures. A small change in the order of vote can have a huge effect on the set of issues that are considered in equilibrium. As a consequence, if an agent can choose the order of vote under sequential procedures, she can not only influence the outcome for a given agenda, but also the set of issues that a society may choose to leave free.
(3) The equilibrium collection of sets of continuation agendas can be very sensitive to small changes in agents' preferences. Thus, agents' preferences do not impose any structure on the set of equilibrium agendas and equilibrium agendas can be very volatile.

5. GENERAL ANALYSIS

We start our general analysis by exploring cases where all equilibrium agendas are full agendas. It turns out that this requires rather strong assumptions on voters' preferences. After that we will show that not even an uncontroversial issue is always on the equilibrium agenda. In the last part of the section, we will prove that any set of issues can be obtained as an equilibrium agenda both under voting by quota and under the amendment procedure. Apart from some minor qualifications this is even true on very restricted domains of preferences and if all voters are agenda setters.

5.1. *Full Equilibrium Agendas.* Whereas Dutta et al. (2004) have shown that Pareto efficiency of the voting rule is sufficient to guarantee that the equilibrium outcomes are equivalent to those under full agendas, Example 4.2 demonstrates that this is not the case in our model. We need additional assumptions on the preferences of agenda setters and voters in order to get full agendas in equilibrium.

One obvious case where all equilibrium agendas are full agendas is when there is one agenda setter who for all issues strictly prefers any position on the issue over not taking a position on the issue. Note that this agent's preferences violate betweenness. This agent will then keep adding issues until a full agenda is reached, that is, any equilibrium agenda is a full agenda. The following remark deals with another straightforward case. It describes a situation where some alternative that is available at a full agenda is preferred by a majority of agenda setters to all other alternatives. In this case, the opportunity of adding further issues until a full agenda is reached will be seized by some agenda setter whenever the voting rule is Condorcet consistent.[13]

[13] A voting rule V is *Condorcet consistent* if $V(a, P) = x$ whenever $x \in X(a)$ is a Condorcet winner at the preference profile P, that is, $\#\{i \mid x \succ_i y\} \geq \frac{n+1}{2}$ for all $y \in X(a)$, $y \neq x$.

REMARK 1. Let $T \subset J$ be such that $\#T \geq \frac{n+1}{2}$ and let $P = (\succ_1, \ldots, \succ_n) \in \mathcal{P}^n$ be such that there exists some $x \in \{0, 1\}^{\mathcal{K}}$ with $x \succ_i y$ for all $i \in T$ and for all $y \in X, y \neq x$. Then any equilibrium agenda at P is a full agenda if the voting rule V is Condorcet consistent. To see this note that in this case $V(a, P) = x$ for all full agendas a and $x \succ_i y$ for all $i \in T$ and for all $y \in X, y \neq x$, implies that no agenda setter in T prefers to stop at an incomplete agenda. Hence, (E1) and (E2) imply that all equilibrium agendas are full agendas.

We now look for more general conditions on the voting procedure and on voters' and agenda setters' preferences such that only full agendas obtain in equilibrium. To this end we define the set of agenda setters J to be *representative* of the set of voters I at preference profile $P \in \mathcal{P}^n$ if any disagreement about the ranking of two alternatives among the voters implies that there is also disagreement about the ranking of the alternatives among the agenda setters:

DEFINITION 6. The set of agenda setters J is *representative* of the set of voters I at preference profile $P = (\succ_1, \ldots, \succ_n) \in \mathcal{P}^n$ if for any two alternatives $x, y \in X$,

$$(4) \quad \exists\, i, i' \in I \quad \text{with}\, x \succ_i y \quad \text{and} \quad y \succ_{i'} x \iff \exists\, j, j' \in J \quad \text{with}\, x \succ_j y \quad \text{and} \quad y \succ_{j'} x.$$

Note that (4) is equivalent to

$$x \succ_i y \quad \text{for all}\, i \in I \iff x \succ_i y \quad \text{for all}\, j \in J.$$

Let $\succ_i$ be separable. Then for all $k \in \mathcal{K}$ there exists a $w_k^i \in \{0, 1, -\}$ such that

$$x \succ_i \left(w_k^i, x_{-k}\right) \quad \text{for all}\, x \in \{0, 1, -\}^{\mathcal{K}} \quad \text{with}\, x_k \neq w_k^i.$$

That is, w_k^i is the *worst outcome* on issue k for agent i. We then say that agent i has *almost nothing to lose on issue* k if no position on that issue, that is, "$-$", is either the worst outcome w_k^i on issue k or is close to that in the following sense:

DEFINITION 7. Let $\succ_i \in \mathcal{S}$. Then *i has almost nothing to lose* on issue k if either $w_k^i = -$ or $(-, x_{-k})$ and (w_k^i, x_{-k}) are adjacent for all $x \in X$, that is, there exists no $y \in X$ with $(-, x_{-k}) \succ_i y \succ_i (w_k^i, x_{-k})$.

The following two theorems show that all equilibrium agendas are full agendas under voting by quota and under a Pareto-efficient voting rule if the set of agenda setters is representative of the set of voters and in addition voters' preferences satisfy (additive) separability and voters have almost nothing to lose about any issue.

THEOREM 1. *Let $P \in \mathcal{S}^n$ and let J be representative of I at P. If all voters $i \in I$ have almost nothing to lose on all issues and $V : A \times \mathcal{S}^n \to X$ is voting by quota q for some $q \in \{1, \ldots, n\}$, then any equilibrium agenda a^* is a full agenda.*

THEOREM 2. *Let $P \in \mathcal{S}^n$ and let J be representative of I at P. If all voters $i \in I$ have almost nothing to lose on all issues and if $V : A \times \mathcal{S}^n \to X$ is a Pareto efficient voting procedure, that is, $V(a, P)$ is Pareto efficient in $X(a)$ for all $a \in A$ and all $P \in \mathcal{S}^n$, then any equilibrium agenda a^* is a full agenda and $V(a^*, P)$ is Pareto efficient in X.*

We sketch the common idea in the proofs of Theorems 1 and 2. All details are provided in the online appendix. Suppose by way of contradiction that there is an equilibrium agenda which is not a full agenda. Then using backward induction there must exist an incomplete agenda a which is an equilibrium continuation at a and such that every equilibrium continuation at (a, k) for $k \notin a$ is a full agenda. Given (E2) this is only possible if all agenda setters prefer the voting outcome at a over the outcome at a full continuation agenda. Since the agenda setters are representative of the voters this is then also true for all voters. Because all voters have almost nothing to lose about all issues they then must prefer the alternative with their worst outcome on all free issues at a over the voting outcome at the full agenda. Yet, this is impossible if the voting rule is voting by quota or if it is Pareto efficient.

5.2. *Uncontroversial Issues and Equilibrium Agendas.* One may conjecture that an uncontroversial issue, that is, an issue for which all voters prefer the same position independent of the decisions on other issues, will always be an element of every equilibrium agenda. This conjecture is true under voting by quota with separable preferences as shown by the following theorem:

THEOREM 3. *Let $P = (\succ_1, \ldots, \succ_n) \in \mathcal{S}^n$ and let $k \in \mathcal{K}$ be such that there exists some $z_k \in \{0, 1\}$ with*

$$(z_k, x_{-k}) \succ_i (1 - z_k, x_{-k}) \quad \text{and} \quad (z_k, x_{-k}) \succ_i (-, x_{-k})$$

for all $x_{-k} \in \{0, 1, -\}^{\mathcal{K}\setminus\{k\}}$ and for all $i \in I$. Let $V : A \times \mathcal{S}^n \to X$ be voting by quota $q \in \{1, \ldots, n\}$ and let $J \subset I$. If a^* is a consistent equilibrium agenda at P, then $k \in a^*$.

What drives this result is the fact that under voting by quota with separable preferences the position taken on each issue on the agenda is independent of the positions for other issues on the agenda. However, in general uncontroversial issues may not be on an equilibrium agenda even if voters' preferences satisfy separability and betweenness and even if the voting procedure is Pareto efficient (for an example, see Appendix A.2). The reason is that agenda setters may refrain from adding an uncontroversial issue to the agenda because this may trigger the addition of other issues and it may also change the final positions on issues that are already on the agenda. The example in Appendix A.2 also demonstrates that the alternative that is chosen in equilibrium need not be Pareto efficient even if the voting procedure is Pareto efficient.

5.3. *Variable Equilibrium Agendas.* We will now explore the full range of equilibrium agendas under two prominent voting procedures, the amendment procedure and voting by quota which were defined in Section 3. For both these procedures, we will show that for any subset $\mathcal{F}$ of the set of issues $\mathcal{K} = \{1, \ldots, K\}$ there exists a profile of preference orderings $P = (\succ_1, \ldots, \succ_n) \in \mathcal{P}^n$, such that $\mathcal{F}$ is the set of free issues at any consistent equilibrium agenda at P. This is true even if $J = I$ and apart from some minor qualifications also if preferences are (additively) separable and satisfy betweenness.[14] Thus, neither of the two procedures imposes any structure on the set of equilibrium agendas.

Voting by Quota

We first consider voting by quota. Notably, on the restricted domain of additively separable preferences, for any quota q and for any set $\mathcal{F}$, there exists a preference profile such that $\mathcal{F}$ is the set of free issues at some equilibrium agenda even if $J = I$.

THEOREM 4. *Let $V : A \times \bar{\mathcal{S}}^n \to X$ be voting by quota $q \in \{1, \ldots, n\}$ and $\mathcal{F} \subset \mathcal{K}$. Then there exists a preference profile $P = (\succ_1, \ldots, \succ_n) \in \bar{\mathcal{S}}^n$ such that $\mathcal{F}$ is the set of free issues at any consistent equilibrium agenda a^* at P if $J = I$. If $\#\mathcal{F} \neq 1$ and $\#\mathcal{F} \neq 2$ if n is odd and $q = \frac{n+1}{2}$ the*

[14] Note that it is easier to obtain any set of free issues if J is a strict subset of I. For example, suppose there is only one agenda setter and there are at least two other voters whose preferences over the positions for a subset $\mathcal{F}$ of issues are opposite to the preferences of the agenda setter and whose preferences over the positions for the remaining issues are the same as the agenda setter's preferences. Then the agenda setter will add an issue to the agenda if and only if it is not in $\mathcal{F}$. Hence, $\mathcal{F}$ will be the set of free issues at any consistent equilibrium agenda.

preference profile $P = (\succ_1, \ldots, \succ_n)$ *can even be chosen such that* $\succ_i$ *satisfies betweenness for all i.*

The proof of the first part of Theorem 4 is straightforward. If preferences are not required to satisfy betweenness, we can choose a profile with identical additively separable preferences for all voters such that all voters prefer to leave the issues in $\mathcal{F}$ undecided whereas they prefer to take either position 1 or 0 on the remaining issues over not taking a decision on the issue. The proof of the second part where voters' preferences are required to satisfy betweenness is more complex. The main idea is to partition the set of voters into nonempty subsets with identical preferences within each subset, such that (a) all voters have the same most preferred position on all issues not in $\mathcal{F}$, (b) for any agenda that contains at least one issue in $\mathcal{F}$ there exists a voter who is in the winning majority for all remaining issues so that any continuation equilibrium is a full agenda, and (c) all voters prefer an agenda that contains all but the issues in $\mathcal{F}$ over any full agenda. With this specification of preferences one can then show that any consistent equilibrium agenda contains all issues but those in $\mathcal{F}$.

We will now argue that the conditions in Theorem 4 are tight in the sense that if $\mathcal{F}$ and q do not satisfy the conditions then $\mathcal{F}$ can never be the set of free issues in equilibrium if the set of agenda setters is representative of the set of voters and if voters' preferences are additively separable and satisfy a condition that is even weaker than betweenness. The following proposition deals with the case where $\#\mathcal{F} = 1$ and shows that equilibrium agendas never contain all but one issue.

PROPOSITION 1. *Let* $V : A \times \bar{\mathcal{S}}^n \to X$ *be voting by quota q and let* $P = (\succ_1, \ldots, \succ_n) \in \bar{\mathcal{S}}^n$ *be such that*

$$\max\left\{u_k^i(1), u_k^i(0)\right\} > u_k^i(-) \quad \textit{for all } i \in I \quad \textit{and for all } k \in \mathcal{K}, \tag{5}$$

where $(u_k^i(\cdot))_{k\in\mathcal{K}}$ *is the collection of utility scalars in an additively separable utility representation of* $\succ_i$. *If J is representative of I at P and if* $(CE(a, P))_{a\in A}$ *is an equilibrium collection of sets of continuation agendas and* $a^* \in CE(a, P)$ *for some* $a \in A$, *then*

$$a^* \notin A^{K-1}.$$

In particular, no $a^* \in A^{K-1}$ *is an equilibrium agenda at P.*

Note that if preferences are additively separable and satisfy betweenness, then condition (5) is satisfied. The proof of Proposition 1 follows from Lemma 1 and the following result:

LEMMA 2. *Let* $V : A \times \bar{\mathcal{S}}^n \to X$ *be voting by quota* $q \in \{1, \ldots, n\}$ *and let* $P = (\succ_1, \ldots, \succ_n) \in \bar{\mathcal{S}}^n$ *satisfy (5). If J is representative of I at P and if* $(CE(a, P))_{a\in A}$ *is an equilibrium collection of sets of continuation agendas, then*

$$CE(a, P) \subset A^K \quad \textit{for all } a \in A^{K-1}.$$

The intuition for Lemma 2 is that if there is only one free issue left, then there is always one agenda setter who would get her most preferred position on that issue which by (5) is better than leaving the issue undecided. This agenda setter then is better off adding that issue to the agenda since further additions are impossible and hence nothing can deter the agenda setter from her initial move.

The following proposition deals with the other exceptional case of simple majority voting with an odd number of agents, where there can never be only two free issues at an equilibrium agenda if voters' preferences satisfy (5). The intuition is that under simple majority voting with an odd number of voters, for any two issues there exists at least one voter who is in the winning majority for both these issues. If J is representative of I there also exists an agenda setter who is in the winning majority for both these issues. Moreover, by (5) the agenda setter prefers her most preferred position on those issues over leaving the issues undecided. Hence, if a is an agenda with two free issues, then by (E2) this implies that a cannot be a continuation equilibrium at a. Hence, no continuation equilibrium can have exactly two free issues.

PROPOSITION 2. *Let there be an odd number n of voters and let $V : A \times \bar{\mathcal{S}}^n \to X$ be voting by quota $q = \frac{n+1}{2}$. Let $P = (\succ_1, \ldots, \succ_n) \in \bar{\mathcal{S}}^n$ satisfy (5). If J is representative of I at P and if $(CE(a, P))_{a \in A}$ is an equilibrium collection of sets of continuation agendas, then for all $a \in A$,*

$$CE(a, P) \subset A \setminus (A^{K-1} \cup A^{K-2}).$$

In particular, no $a^* \in A^{K-2}$ is an equilibrium agenda at P, that is, the set of free issues at an equilibrium agenda never contains two issues only.

Amendment Procedure

Suppose now that voting is according to the amendment procedure for some ordering of the alternatives and simple majority is used throughout. We then have the following result:

THEOREM 5. *Let $n \geq 3$ be odd and let $\mathcal{F} \subset \mathcal{K} = \{1, \ldots, K\}$. Then there exists a profile of preferences $P \in \mathcal{P}^n$ and some ordering of the alternatives in $X(a)$ for all $a \in A$, such that $\mathcal{F}$ is the set of free issues at any consistent equilibrium agenda a^* at P if $J = I$ and if voting is according to the amendment procedure for the given orderings of the alternatives at any agenda a. If $K > 2$ or if $K = 2$ and $\#\mathcal{F} \neq 1$ the preference profile $P = (\succ_1, \ldots, \succ_n)$ can even be chosen such that $\succ_i$ satisfies betweenness and separability for all i.*

The proof of Theorem 5 is again constructive. In Step 1 of the proof, we consider the case where all issues are free, that is, $\mathcal{F} = \mathcal{K}$. Subsection 4.2 provides a preference profile for $K = 2$ where in equilibrium all issues are free. We then construct another preference profile for $K = 3$ such that all issues are free in equilibrium and show that these two preference profiles can be extended in a lexicographic way such that for any $K \geq 4$ all K issues are free in equilibrium. In Step 2, we lexicographically extend the preferences defined in Step 1 such that voters first consider the issues not in $\mathcal{F}$ and only if two alternatives have the same positions on issues not in $\mathcal{F}$ the remaining issues are considered and preferences are given by the preferences defined in Step 1. The remaining steps of the proof deal with the case of one free issue and again use a lexicographic extension of preferences for $K = 3$ to any $K \geq 4$.

The case $K = 2$ and $\#\mathcal{F} = 1$ is special. Here, we can only provide a profile of preferences satisfying betweenness but not separability such that there is one free issue in equilibrium. In fact, if $K = 2$ then separability and betweenness impose such a strong structure on voters' preferences over the set of available alternatives at full agendas relative to their preferences over available alternatives at agendas with one issue only that there always exists one agenda setter who prefers to add the remaining issue to an agenda that already contains one issue. This implies that on the domain of preferences satisfying separability and betweenness the set of free issues is either empty or contains all issues if $K = 2$. Thus, Theorem 5 is tight as we show in the following proposition:

PROPOSITION 3. *Let $n \geq 3$ be odd and let $P \in \mathcal{S}^n$ be any profile of separable preferences that satisfy betweenness. Let $J = I$ and $K = 2$ and let the voting rule be the amendment procedure for some orderings of the alternatives at any agenda a. Then the set of free issues is either empty or contains all issues.*

6. CONCLUSION

Issue deferral is a pervasive phenomenon in the actual works of legislative bodies and other institutions resorting to vote. We have provided a stark model to analyze a basic and general reason whereby the phenomenon can arise: members of voting bodies in charge of fixing their agenda may decide to leave some issues out of it, while choosing to fix the social position on other issues. Although our model abstracts from other, possibly idiosyncratic, considerations, it focuses on a fundamental conflict about which agenda setters will have to find a balance. On the one hand, the tendency to include in the agenda those issues on which their preferred position will prevail. On the other, the eventual need to refrain from the preceding tendency when it may generate the inclusion by others of issues on which their position would be defeated.

In spite of its simplicity, our model contains differential characteristics that add elements of realism to previous works. Distinguishing between issues and alternatives clarifies the phenomenon under study. Resorting to a new equilibrium concept eliminates any arbitrariness that a fixed protocol might introduce in the analysis, and actually makes a difference in predictions.

We think of our model as a starting point for formal work on the important and complex problem of issue deferral. Even in its present form it is able to generate a variety of clarifying results, that we have presented along the article. These results are driven by preferences alone, and this suggests that the impact of additional variables on issue deferral could be studied by specifying how their consideration would affect the preferences of different types of voters.

APPENDIX A

A.1 *Consistent Equilibrium Agenda versus Subgame-Perfect Nash Equilibrium.* The following example expands the discussion that follows Definition 3. It demonstrates that consistent equilibrium agendas can be very different from agendas that obtain in a subgame-perfect equilibrium under a fixed order of moves.

Let there be three issues, that is, $\mathcal{K} = \{1, 2, 3\}$, and three voters who are also agenda setters. Voters' preferences over alternatives not containing position 0 on any issue are given in Table A.1. For all voters, the remaining alternatives which have position 0 on at least one issue are ranked below (1,1,1). The order of the alternatives below (1,1,1) does not matter. So every voter has a different top alternative where exactly two issues are addressed and position 1 is adopted on those issues. This top alternative is preferred over not addressing any issue and all other alternatives are ranked below.

Let V be a Pareto-efficient voting rule, that is, $V(a, P)$ is Pareto efficient in $X(a)$ for all $a \in A$ and all P in the domain of V, and let some preference profile P compatible with the requirements in Table A.1 be in the domain of V. Let a be an arbitrary agenda. Since all voters strictly prefer position 1 on all issues $k \in a$ over any alternative with position 0 for some $k \in a$ Pareto efficiency implies that for all agendas a

$$(V(a, P))_k = 1 \quad \text{for all } k \in a.$$

We first prove that the set of consistent equilibrium agendas consists of all agendas of length 2. We proceed backward starting from full agendas $a \in A^3$. By (E1), we have

$$CE(a, P) = \{a\} \quad \text{for all } a \in A^3.$$

Next consider an agenda $a = (k, l)$ for some $k \neq l$ and let $h \notin a$. (E1) implies that $CE((k, l), P)$ is a nonempty subset of $\{(k, l), (k, l, h)\}$. Since $V((k, l), P) \succ_i V((k, l, h), P) =$

TABLE A.1
VOTERS' PREFERENCE ORDERINGS ON $\{1, -\}^3$

$\succ_1$	$\succ_2$	$\succ_3$
(1,1,–)	(1,–,1)	(–,1,1)
(–, –, –)	(–, –, –)	(–, –, –)
(1,–,1)	(–,1,1)	(1,1,–)
(–,1,1)	(1,1,–)	(1,–,1)
(1,–, –)	(1,–, –)	(–, 1, –)
(–, 1, –)	(–, –,1)	(–, –,1)
(–, –,1)	(–, 1, –)	(1,–, –)
(1,1,1)	(1,1,1)	(1,1,1)

$(1,1,1)$ for all i (E2) implies that $(k,l) \in CE((k,l),P)$. Moreover, (k,l,h) is not rationalizable relative to a. Hence, (E3) implies that

$$CE((k,l),P) = \{(k,l)\} \quad \text{for all } k \neq l.$$

Next consider an agenda (k) for some $k \in \{1,2,3\}$. (E1) implies that $CE((k),P)$ is a nonempty subset of $\{(k),(k,l),(k,h)\}$, where $l \neq k$ and $h \neq k$. Since there exists a voter i with $V((k,l),P) \succ_i V((k),P)$ (E2) then implies that $(k) \notin CE((k),P)$. Without loss of generality, suppose $(k,l) \in CE((k),P)$. Because there exists a voter j with $V((k,h),P) \succ_j V((k,l),P)$ it follows that (k,h) is rationalizable relative to (k) and hence (E3) implies that

$$CE((k),P) = \{(k,l),(k,h)\} \quad \text{for all } k \in \{1,2,3\} \quad \text{and for all } l \neq l \quad \text{and} \quad h \neq k.$$

Finally, consider the empty agenda $\varnothing$. (E1) implies that $CE(\varnothing,P)$ is a nonempty subset of $\{\varnothing,(1,2),(2,1),(1,3),(3,1),(2,3),(3,2)\}$. Since $V((1,2),P) = (1,1,-) \succ_1 V(\varnothing,P) = (-,-,-)$ (E2) implies that $\varnothing \notin CE(\varnothing,P)$. Suppose $(k,l) \in CE(\varnothing,P)$ for some $k \neq l$ and let $h \neq k$ and $h \neq l$. Then there exists a voter i with $V((k,h),P) = V((h,k),P) \succ_i V((k,l),P)$ and a voter j with $V((l,h),P) = V((h,l),P) \succ_i V((k,l),P)$. Hence, $(k,h),(h,k),(l,h),(h,l)$ are all rationalizable relative to $\varnothing$. (E3) then implies that $(k,h),(h,k),(l,h),(h,l) \in CE(\varnothing,P)$. Repeating this argument for (k,h) instead of (k,l) we conclude that

$$CE(\varnothing,P) = \{(1,2),(2,1),(1,3),(3,1),(2,3),(3,2)\}.$$

Consider now the extensive form game with order of moves 1,2,3, which repeats until either a full agenda is reached or there were three passes in a row. We will show that in any subgame-perfect Nash equilibrium of the game no voter adds any issue to the agenda and hence the unique equilibrium agenda is $\varnothing$ which is not a consistent equilibrium agenda.

Since the game is finite we can solve for subgame-perfect Nash equilibria by backward induction. We start by considering any subgame such that the longest path in the subgame has length 1. This means that any action of the voter i who moves at the unique decision node in the subgame must lead to a terminal node. Let a be the given agenda at the decision node where i moves. Since all actions of i lead to a terminal node it follows that $a = (k,l)$ for some $k \neq l$ and all voters $j \neq i$ must have passed in their previous moves. Hence, if i passes the game ends with agenda (k,l) and if i adds issue h the game ends with agenda (k,l,h). Since $V((k,l),P) \succ_i V(k,l,h) = (1,1,1)$ i's unique best response is to pass. For a similar reason, the voters who move just before voter i (these voters are first to move in a subgame of length 2 or 3), will also pass. Hence, in any subgame-perfect equilibrium all voters will pass at an agenda that contains two issues.

Consider now a decision node where the given agenda contains a unique issue k and let voter i move at this node. If i adds issue $l \neq k$ to the agenda the unique subgame-perfect

TABLE A.2

EQUILIBRIUM AGENDAS IN A SUBGAME-PERFECT NASH EQUILIBRIUM FOR A SUBGAME THAT STARTS WITH A MOVE OF VOTER $i \in \{1, 2, 3\}$ AT AGENDA (k) FOR ALL $k = 1, 2, 3$

	Voters		
Agenda	1	2	3
(1)	(1,2)	(1,3)	(1,2)
(2)	(2,1)	(2,3)	(2,3)
(3)	(3,1)	(3,1)	(3,2)

TABLE A.3

EQUILIBRIUM AGENDAS IN A SUBGAME-PERFECT NASH EQUILIBRIUM OF THE SUBGAME THAT IS REACHED IF VOTER $i \in \{1, 2, 3\}$ ADDS ISSUE k TO THE EMPTY AGENDA $\varnothing$

	Voters		
Issue	1	2	3
1	(1,3)	(1,2)	(1,2)
2	(2,3)	(2,3)	(2,1)
3	(3,1)	(3,2)	(3,1)

equilibrium outcome in the subgame that is reached is (k, l). If i passes the game either ends at some agenda (k, h) or all voters pass and the outcome is (k). Since $V((k, l), P) \succ_i V((k), P)$ for all $l \neq k$ it follows that i will never pass if this leads to the final outcome (k). Hence, in any subgame-perfect Nash equilibrium of the subgame starting with a move of i at agenda (k) the action taken by i is such that the final agenda is (k, l) with $V((k, l), P) \succ_i V((k, h), P)$ for $h \neq l$.[15] Table A.2 shows the equilibrium agendas in a subgame-perfect Nash equilibrium for a subgame that starts with a move of $i \in \{1, 2, 3\}$ at agenda (k) for all $k = 1, 2, 3$. Note that we have used the fact that the order of moves is 1,2,3.

Finally, consider a decision node where the given agenda is empty and let voter i move at this node. If i adds issue k, the game ends with agenda (k, l) for some $l \neq k$, where (k, l) is given in Table A.3 which follows from Table A.2.[16] Again we use the fact that the order of moves is 1,2,3.

Suppose all voters $j \neq i$ have passed before. Then, if i passes, the game ends with the empty agenda. Note that i strictly prefers $V(\varnothing, P) = (-, -, -)$ over the voting outcome at any subgame-perfect equilibrium agenda that is reached if i adds some issue k to the agenda (see Table A.3).[17] Hence, the unique best response of i is to pass.

Suppose one voter $j \neq i$ has passed before and another voter $\iota \neq i$ moves after i. Then from the previous analysis we conclude that if i passes, voter ι passes as well and the game ends with the empty agenda. If instead i adds some issue k to the agenda the game ends with an outcome that is strictly worse for i than the outcome $(-, -, -)$ at the empty agenda.

Finally, suppose all voters $j \neq i$ are moving after i. Then, if i passes, both voters $j \neq i$ will pass as well and the game ends with the empty agenda. If instead i adds some issue k to the agenda the game ends with an outcome that is strictly worse for i than the outcome $(-, -, -)$ at the empty agenda.

Therefore, we conclude that $\varnothing$ is the unique subgame-perfect Nash equilibrium outcome

[15] There always exists a subgame-perfect Nash equilibrium where i adds issue l to agenda (k), but there may also exist subgame-perfect Nash equilibria where i passes and some player $j \neq i$ adds issue l to agenda (k).

[16] For example, if $i = 1$ and i adds issue 1 the next mover is voter 2 at agenda (1). From Table A.2, we see that the resulting equilibrium agenda is (1,3).

[17] For example, if $i = 1$ then according to Table A.3 the subgame perfect equilibrium agenda is either $(1, 3)$, $(2, 3)$, or (3,1) with outcomes $(1, -, 1)$ or $(-, 1, 1)$ which are all strictly worse for voter 1 than the outcome $(-, -, -)$ at the empty agenda.

TABLE A.4
PREFERENCE ORDERINGS OF VOTERS

$\succ_1$	$\succ_2$	$\succ_3$
$(1, 1, 1)$	$(1, 1, 0)$	$(1, 0, 0)$
$(1, 1, -)$	$(1, 1, -)$	$(1, 1, -)$
$(-, 1, 1)$	$(-, 1, 0)$	$(1, 1, 1)$
$(-, 1, -)$	$(-, 1, -)$	$(1, -, 1)$
$(1, -, 1)$	$(1, 0, 1)$	$(1, -, -)$
$(1, 0, 1)$	$(1, -, 0)$	$(1, 1, -)$
$(1, -, -)$	$(1, -, -)$	$(-, 1, 1)$
$(1, 0, -)$	$(1, 0, -)$	$(-, 1, -)$
$(1, 1, 0)$	$(1, 0, 0)$	$(1, 0, 1)$
$(1, -, 0)$	$(1, -, 1)$	$(1, -, 0)$
$(1, 0, 0)$	$(1, 1, 1)$	$(1, 1, 0)$
$(-, -, 1)$	$(-, 0, 1)$	$(-, 0, 0)$
$(-, 0, 1)$	$(-, -, 0)$	$(-, -, 1)$
$(-, -, -)$	$(-, -, -)$	$(-, -, -)$
$(-, 0, -)$	$(-, 0, -)$	$(-, 0, -)$
$(-, 1, 0)$	$(-, 0, 0)$	$(-, 0, 1)$
$(-, -, 0)$	$(-, -, 1)$	$(-, -, 0)$
$(-, 0, 0)$	$(-, 1, 1)$	$(-, 1, 0)$
$(0, 1, 1)$	$(0, 1, 0)$	$(0, 0, 0)$
$(0, 1, -)$	$(0, 1, -)$	$(0, 0, -)$
$(0, -, 1)$	$(0, 0, 1)$	$(0, 1, 1)$
$(0, 0, 1)$	$(0, -, 0)$	$(0, -, 1)$
$(0, -, -)$	$(0, -, -)$	$(0, -, -)$
$(0, 0, -)$	$(0, 0, -)$	$(0, 1, -)$
$(0, 1, 0)$	$(0, 0, 0)$	$(0, 0, 1)$
$(0, -, 0)$	$(0, -, 1)$	$(0, -, 0)$
$(0, 0, 0)$	$(0, 1, 1)$	$(0, 1, 0)$

A.2 *Uncontroversial Issues and Equilibrium Agendas.* The following example adds to the discussion on uncontroversial issues in Subsection 5.2. It demonstrates that uncontroversial issues are not always elements of an equilibrium agenda even if voters' preferences satisfy separability and betweenness and even if the voting procedure is Pareto efficient. Moreover, the example demonstrates that the alternative that is chosen in equilibrium need not be Pareto efficient even if the voting procedure is Pareto efficient.

Let $K = 3$ and let there be three voters who are also agenda setters, that is, $I = J = \{1, 2, 3\}$. The voters' preference orderings on the set of alternatives are given in Table A.4, where the alternatives in the table are listed in the order of decreasing preference.

Note that all preference orderings satisfy betweenness and separability, but not additive separability. Moreover, all voters prefer position 1 over 0 on issue 1: For all $i = 1, 2, 3$, and for all $x_2, x_3 \in \{0, 1, -\}$,

$$(1, x_2, x_3) \succ_i (0, x_2, x_3).$$

Consider a voting procedure that selects the following outcomes which are Pareto efficient in $X(a)$ for all agendas a:

$$V(\varnothing, P) = (-, -, -),$$
$$V((1), P) = (1, -, -),$$
$$V((2), P) = (-, 1, -),$$
$$V((3), P) = (-, -, 1),$$

$$V((1,2),P) = V((2,1),P) = (1,0,-),$$
$$V((1,3),P) = V((3,1),P) = (1,-,1),$$
$$V((2,3),P) = V((3,2),P) = (-,1,1),$$
$$V(a,P) = (1,0,1) \quad \text{for all full agendas } a.$$

We now solve backward for the consistent equilibrium collection of sets of continuation agendas. By (E1), it follows that

$$CE(a,P) = \{a\}$$

for all full agendas a.

Now consider any agenda a of length 2. By condition (E1), $CE(a,P)$ is a nonempty subset of $\{a\} \cup CE((a,l),P) = \{a,(a,l)\}$, where $l \notin a$. By condition (E2), $a \in CE(a,P)$ is ruled out since there is always one agenda setter who strictly prefers $V((a,l),P) = (1,0,1)$ over $V(a,P)$. Hence,

$$CE((1,2),P) = \{(1,2,3)\}, CE((1,3),P) = \{(1,3,2)\}, CE((2,3),P) = \{(2,3,1)\}.$$

Next consider an agenda a of length 1. If $a = (1)$, then condition (E1) implies that $CE((1),P)$ is a nonempty subset of $\{(1)\} \cup CE((1,2),P) \cup CE((1,3),P) = \{(1),(1,2,3),(1,3,2)\}$. By condition (E2), $(1) \in CE((1),P)$ is ruled out since voter 1 prefers $V((1,2,3),P) = (1,0,1)$ over $V((1),P) = (1,-,-)$. Hence,

$$CE((1),P) \subset \{(1,2,3),(1,3,2)\}.$$

In the same way, we derive that

$$CE((3),P) \subset \{(3,1,2),(3,2,1)\}.$$

If $a = (2)$, then condition (E1) implies that $CE((2),P)$ is a nonempty subset of $\{(2)\} \cup CE((2,1),P) \cup CE((2,3),P) = \{(2),(2,1,3),(2,3,1)\}$. Since all voters prefer $V((2),P) = (-,1,-)$ over $V((2,1,3),P) = V(2,3,1) = (1,0,1)$ condition (E2) implies that $(2) \in CE((2),P)$. Since neither $(2,1,3)$ nor $(2,3,1)$ is rationalizable if $(2) \in CE((2),P)$ condition (E3) implies that

$$CE((2),P) = \{(2)\}.$$

Finally, consider the empty agenda. By condition (E1), $CE(\emptyset,P)$ is a nonempty subset of $\{\emptyset\} \cup \bigcup_{l=1}^{3} CE((l),P)$. Since $CE((2),P) = \{(2)\}$ and $CE((1),P)$ and $CE((3),P)$ contain full agendas only and since all voters prefer $V((2),P) = (-,1,-)$ over $V(\emptyset,P) = (-,-,-)$ and over $V(a,P) = (1,0,1)$ for all full agendas a, conditions (E2) and (E3) imply that

$$CE(\emptyset,P) = \{(2)\}.$$

Hence, there is a unique consistent equilibrium agenda $a^* = (2)$ which does not contain issue 1. We note that $V(a^*,P) = (-,1,-)$ is Pareto dominated by $(1,1,-)$.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Data S1
Table A.1: Preference profile for $\mathcal{K} = \mathcal{F} = \{1, 2, 3\}$.
Table A.2: Preference orderings of voters 1,2,3.
Table A.3: Lexicographic extension of the preference orderings in Table A.2 to $\{0, 1\}^{\mathcal{K}}$ for $\mathcal{K} = \{1, 2, 3, 4\}$.
Table A.4: Preference orderings for $\mathcal{K} = \{1, 2\}$ and $\mathcal{F} = \{2\}$.
Figure A.1: Dominance relation on $\{(0, 0), (0, 1), (1, 0), (1, 1)\}$ under pairwise simple majority voting for the preferences in Table A.4.
Table A.5: Preference orderings for $\mathcal{K} = \{1, 2, 3\}$ and $\mathcal{F} = \{3\}$.

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