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# Ranking alternatives by a fair bidding rule: A theoretical and experimental analysis

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ABSTRACT

We apply a procedurally fair rule to a situation where people disagree about the value of three alternatives in the way captured by the voting paradox. The rule allows people to select a final collective ranking by submitting a bid vector with six components (the six possible rankings of the three alternatives). We test experimentally the robustness of the rule to subsidies and taxes as well as to tie-breaking assumptions. We have two main results. First, the most frequently chosen ranking is the socially efficient one when ties are broken in favor of the alternative generating the highest social welfare, but not when ties are broken randomly. Second, subsidies slightly enhance overbidding. Furthermore, an analysis of individual bid vectors reveals interesting behavioral regularities that result from selfishness, other-regarding preferences, and indifference.



## 1. Introduction

Imagine three individuals who have to assign land to three competing uses or alternatives, say a park, a sport center, and a residential building area. Specifically, suppose that they have to devote half of the land to one use, one third of it to another use, and the remaining one sixth to the third use. Thus, there are six possible land allocation plans, which differ in the rank order of its three uses. The land allocation plan is a collective good, affecting all individuals. The three individuals rank the uses of the land differently in the way captured by the well-known Condorcet's voting paradox. Nonetheless, they must agree on a collective ranking which establishes how much land will be allocated to each alternative. This example introduces the scenario that we shall analyze in the present paper. More generally, we are interested in situations where a collectivity has to settle for a common ranking of alternatives which are evaluated differently by different members and in a way that renders majority voting cyclic.

In the literature, collectivity members are typically required to cast votes for the several alternatives in order to obtain a final collective ranking (see, e.g., Kelly, 1974a,b; for more recent work see Brams and Sanver, 2009, and references therein). We allow instead each member to bid for each feasible ranking. Bids express the maximum amount that a member is willing to pay for implementing a certain ranking. While we acknowledge that attaching monetary values to outcomes in, e.g., the health sector may be a demanding process, we feel that there are arguments that support the applicability of a bidding approach.

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First, our approach just goes a step further than the direct democracy referenda on public expenditures, which require voters to have an opinion about how to allocate public resources.[1] Second, placing a bid for an alternative is consistent with existing mechanisms based on storable votes, which allow committee members to express the strength of their preferences. In the storable votes mechanism (Casella, 2005; Casella et al., 2006), committee members can allocate freely a given budget of votes over consecutive decisions. Hence, by providing incentives for voters to cast more votes over the decisions they care more about, storable votes function as fiat money. Finally, assigning monetary values to alternatives is surely possible when the alternatives are desirable and generate payoff effects. Voting mechanisms where players must tender bids (rather than cast votes) for implementing a certain project are available since the 1970s (Smith, 1977),[2] and have more recently been used by Pérez-Castrillo and Wettstein (2002) and Pintér and Veszteg (2010).[3] Our idea, here, is that if there is a value that each member places on the selected ranking, he should pay some money in order to implement it.

The bids submitted by all collectivity members determine which ranking is finally selected, and the resulting individual payments. Drawing on Güth (2011), we derive axiomatically the bidding rule governing the selection process. The reason for using an axiomatic approach is twofold. First, we are interested in a general rule that is widely applicable and, as such, does not require knowledge of certain aspects of proper games like the true valuations of the bidders and their beliefs about the others' true valuations.[4] In game theoretic terminology, the proposed bidding rule defines a game form but not a proper game.[5] Second, we want the rule to be appealing from an ethical point of view. In particular, the rule we study is procedurally fair. Procedural fairness is insured by a basic equality axiom requiring that all involved parties are treated equally according to an objective criterion, namely their maximal willingness to pay. This holds even if the selected ranking is not ex post valued the same by all collectivity members. In this way, our approach differs from previous works that define fairness with respect to the final outcome (so-called allocative fairness).[6] Our procedurally fair bidding rule only guarantees that everyone (a) has the same opportunity to influence the selected collective ranking via his voluntary bids, and (b) receives an equal share of the sum of bids submitted for the selected ranking by the collectivity. The proposed bidding rule can be somewhat related to the rule of law that "can be defined as a system in which the laws are public knowledge… and apply equally to everyone" (Carothers, 1998), independently of wealth, social status, and other idiosyncratic traits.

Having provided a procedurally fair bidding mechanism, we deem important to assess, via an experiment, whether and how the selected ranking and the bidding behavior are affected by changes in some features of the bidding contest whose game form is procedurally fair.[7] The exploration of this issue in the laboratory requires experimentally induced valuations of the ranking. We consider a simple scenario with three alternatives and three individuals. As in the introductory examples above, each ranking of the three alternatives can be viewed as a collective good: none of the three individuals is excluded from enjoying the selected ranking, even though each distinct individual may assign a different value to it. Assuming cardinal utilities for each alternative (Güth and Selten, 1991), we obtain the individual valuations of each ranking by weighting and summing up the utilities associated with the three alternatives. The sum of all individual induced valuations of a certain ranking identifies the welfare that society (i.e., the group of three individuals) derives from that ranking. Since the three individuals are heterogeneous with respect to the (cardinal) utility they derive from the alternatives, the feasible rankings differ in the level of social welfare they generate. This allows us to study the effects of procedural fairness in situations where preferences are cyclic and the feasible rankings can be ordered with respect to their social welfare.

A key design feature of our experiment is that we vary the sum of individual payments associated to the selected ranking, keeping the game form procedurally fair. In one treatment individual payments add up to zero, i.e., the selected ranking is supposed to be self-financing. In another they add up to a positive amount, resembling a situation in which the three individuals pay a "tax" for bringing about the selected ranking. Finally, there is a treatment where individual payments add up to a negative amount, corresponding to a situation in which the individuals receive a "subsidy" for implementing the selected ranking. Through these treatments, where ties are broken in favor of efficiency, we can examine whether variations in the sum of required payments impinge on the selected collective ranking and the individual bids for the six possible rankings.

We observe slightly more overbidding (i.e., bids above induced valuations) in the treatment with the subsidy than in the other two. Yet, we find that the introduction of a tax or a subsidy does not affect our main result: in all three treatments with an efficiency-based tie-breaking rule, the most frequently chosen ranking is the one generating the highest social welfare.

To check whether the used tie-breaking rule is responsible for the observed relatively large frequency of the socially efficient ranking, we implement as a robustness check a control treatment where ties are broken randomly. We find quantitative differences in the percentages of groups selecting the socially efficient ranking, although statistical tests reveal that the distributions of selected rankings are not significantly different under the two tie-breaking rules.

[1] As noted by Romer and Rosenthal (1979, p. 564), in the United States these referenda represent political institutions of considerable economic importance, which are used to decide on the budgets for education, fire protection, flood control, and water resources.

[2] In Smith's (1977) Auction Election mechanism for public goods provision, players submit a bid and a proposed quantity of the public good. Then each player is given the right to veto or agree to the cost share allocated to him by the other players. The good is provided only if there is unanimous agreement among all players. Players can also request compensation if they believe they are being hurt.

[3] The standardized bids' mechanism proposed by Pintér and Veszteg (2010) is especially relevant to our study because, in a fashion similar to ours, such a mechanism allows voters to place a bid for each available project; bids are then standardized before being aggregated to choose the winning project.

[4] Common knowledge of all such aspects is, for example, necessary for applying the revelation principle (Myerson, 1979).

[5] To give an example of a game form, think of the acquisition of goods or services by a public authority. The laws regulating the procurement process apply to a wide range of contracts. The definition of the proper game clearly necessitates additional information.

[6] A recent work highlighting the distinction between procedural and allocative fairness is by Chassang and Zehnder (2013).

[7] Most of the experimental literature on the voting paradox has tested whether people vote sincerely or strategically, and focused on the effect of information about the distribution of preferences on voting strategies (see, e.g., Tyszler and Schram, 2011; for an overview of experimental results see Palfrey, 2009).