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When less is more: Rationing and rent dissipation in stochastic contests ☆

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ABSTRACT

This paper shows how to maximize revenue when a contest is noisy. We consider a case where two or more contestants bid for a prize in a stochastic contest where all bidders value the prize equally. We show that, whenever a Tullock contest yields under-dissipation, the auctioneer's revenue can be increased by optimally fixing the number of tickets. In particular, in a stochastic contest with proportional probabilities, it is possible to obtain (almost) full rent dissipation. We test this hypothesis with a laboratory experiment. The results indicate that, as predicted, revenue is significantly higher in a lottery with rationing than in a standard lottery. On the other hand, an alternative rationing mechanism that does not limit total expenditures fails to increase revenue relative to a standard lottery.

1. Introduction

Gordon Tullock (1980) famously conceived rent seeking as a lottery where lobbyists compete for a prize held by a politician. The prize could be, for instance, a monopoly privilege, favorable legislation or a government contract, while lobbyists' bids consist of non-refundable investments that could take the form of campaign contributions, gifts or explicit briberies. Each lobbyist's probability of winning is equal to her lobbying expenditure divided by total lobbying expenditure. Similarly, lotteries are commonly employed to model, for example, rivalry and conflict (see, for example, Abbink et al., 2010), R&D tournaments, or market competition (Morgan et al., forthcoming).[1]

Lotteries are part of a class of contests described by a Tullock's success function. Within this class, each contest is defined by its degree of randomness. An all-pay auction is also a Tullock contest where randomness is reduced to zero. Like lotteries, all-pay auctions have also been used extensively to model, for instance, labor tournaments (e.g. Lazear and Rosen, 1981) or lobbying (see, for instance, Che and Gale, 1998). Which type of contest is a more appropriate description of, say, rent seeking activities or political competition is an interesting empirical question which has not been fully addressed yet. It is well known, however, that rents are fully dissipated in all-pay auctions, but not in lotteries.

Despite their inefficiency, lotteries are ubiquitous as fundraising mechanisms and their origins are so old that they can hardly be traced back in time. There exist virtually innumerable examples of lotteries used to raise funds for civic or

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[1] Moreover, a number of recent papers have explored the use of proportional contests as incentive mechanisms (Cason et al., 2010; Masters, 2005; Masters and Delbecq, 2008, among others). These tournaments have interesting applications as schemes to reward workers in firms or elicit effort among suppliers. It is worth noticing that, if contestants are risk neutral, proportional tournaments are isomorphic to a lottery.

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charitable purposes.[2] Just like national lotteries today help fund charitable causes, the Great Wall of China, the Republic of Milan's ongoing war against Venice in the fifteenth century, and the bridges, canals and fortifications of Burgundian and Dutch cities were all financed through public lotteries (see Welch, 2008). However, it would be wrong to exaggerate the importance of their public good component. As reported by the historian Evelyn Welch, "after the failure of the Milanese lottery to appeal to a sense of public duty, no Italian lottery (even those run by religious organizations) referred to either civic pride or spiritual devotion when encouraging ticket purchases. Buyers were simply enticed by the chance of winning wealth" (Welch, 2008, p. 97).

Indeed, although it is perhaps less known, it was equally frequent in the past for individuals or private institutions to hold lotteries and raffles to sell objects or raise revenue for private causes. In 1446, the widow of the Flemish painter Jan Van Eyck held one of the first recorded European lotteries to sell her late husband's expensive paintings, for which buyers could not be readily found. In Venice, during the sixteenth century, private lotteries were held daily for speculative reasons to sell objects as well as silver and gold. In seventeenth-century London, lotteries were commonly used to sell "books, maps and other goods" (Welch, 2008). The "running lotteries" of the Virginia Company are perhaps one of the most notorious examples of private lotteries. Between 1612 and 1621 the Virginia Company of London, a joint stock company, funded its enterprise through a series of local lotteries throughout England (Johnson, 1960).[3]

The question we address in this paper is how an auctioneer, or a fundraiser, can maximize revenue when the contest is noisy.[4] Under-dissipation in a Tullock game is caused by randomness, as the highest bidder does not win the prize with certainty. Note that in such contests there is no *ex ante* limit to how many tickets can be bought. Setting the number of tickets that can be purchased reduces randomness, as buying an extra ticket leaves less tickets available to the other contestants. We prove that, whenever under-dissipation occurs, the auctioneer can increase rent seeking expenditures by optimally fixing the number of tickets. In the case of a lottery it is possible to obtain (almost) full dissipation. This is why less is more: in equilibrium, setting a limit to total expenditures by rationing tickets leads to an increase in revenue relative to a standard contest.[5]

This mechanism is particularly appealing if agents are budget constrained. Consider for example an indivisible good. All bidders value the good Π, but no one can afford to spend more than $\omega < \Pi$. The seller could auction the object, obtaining a revenue of ω. Alternatively, she could use a lottery and, by appropriately setting the number of tickets, raise a revenue higher than ω. House raffles are an interesting example of rationed lotteries in the presence of budget constrained bidders.[6] In a house raffle, the home owner sells her property by selling a fixed number of lottery tickets to the public, the total value of the tickets being equal to the appraisal value of the house. Once all tickets are sold, one ticket is randomly drawn and the holder wins the property prize. Such lotteries are becoming more and more popular in the US, as well as in the UK, where they are attracting the attention of the media. Their popularity is mainly due to the credit constraints faced by the buyers, who are often unable to pay a price equal to the valuation of the house.[7]

In order to define a rationing scheme, we need a rule specifying how tickets are allocated when demand exceeds supply. We consider a lottery and assume that, when the capacity constraint is binding, each player is allocated a share of the tickets equal to her share of total demand. Given this allocation rule, the most intuitive scheme is one where bidders only pay for the tickets they actually receive. We call this mechanism *fixed price rationing*. It should be noted that, although this rationing scheme may lead to an increase in revenue relative to the standard lottery, it limits the maximum revenue a seller can potentially raise off equilibrium. We therefore also consider an alternative rationing scheme where bidders pay for the tickets they demand, while only receiving a share of the tickets equal to their share of total demand. We call this scheme *variable price rationing*. This mechanism shares the features of both fixed price rationing and a standard lottery. When demand is less than supply, it is identical to fixed price rationing, but when demand exceeds supply it works just like a standard lottery. Consequently, it does not limit potential revenue. We show that both rationing schemes lead to the same dissipation rate in equilibrium. However, while in fixed price rationing there is a unique equilibrium in dominant strategies, in variable price rationing there exists a continuum of multiple equilibria.

We test these theoretical predictions with a laboratory experiment, focusing on a case where two contestants bid for a prize with a common value in a stochastic contest with proportional probabilities. Using a between-subjects design,

[2] A recent literature has analyzed the use of lotteries as fundraising mechanisms for the provision of public goods, both theoretically and through experiments (see Morgan, 2000; Morgan and Sefton, 2000; Goeree et al., 2005; Landry et al., 2006; Lange et al., 2007; Orzen, 2008; Schram and Onderstal, 2009; Corazzini et al., 2010, among others).

[3] The lotteries were extremely successful, so much so that the annual financial report for 1620 states that they brought to the company a profit of £7000. This was a very substantial sum, considering that the cost of furnishing one ship amounted at the time to about £791 (see Johnson, 1960).

[4] Although the literature on fundraising mechanisms has focused on situations where the contestants (significantly) value the public good, as we mentioned earlier, it is plausible to think of scenarios in which society values the project financed through their bids, but the bidders' valuation of it is actually zero.

[5] It should be observed that, by fixing supply, the auctioneer sets both a ceiling *and* a floor to the number of tickets. Although it is the presence of the floor that drives the result of (almost) full rent dissipation, we use the term rationing to emphasize the fact that the maximum number of tickets is fixed and there is an upper limit to potential revenue. This is in contrast to a standard lottery, where the maximum number of tickets is determined by demand and revenue is potentially unlimited.

[6] See, for example, http://winahouseraffles.com or http://www.usahomeraffle.com.

[7] A famous antecedent of these modern raffles is the case of the US President Thomas Jefferson, who attempted to sell his property, including the residence of Monticello, through a lottery with a fixed number of tickets. Only a series of unfortunate events prevented Jefferson from running the lottery (see Welch, 2008).