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Optimal favoritism in all-pay auctions and lottery contests☆

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A R T I C L E I N F O	A B S T R A C T
	We analyze the revenue-enhancing potential of favoring specific contestants in complete-information all-pay auctions and lottery contests with several heterogeneous contestants. Two instruments of favoritism are considered: head starts that are added to the bids of specific contestants and multiplicative biases that give idiosyncratic weights to the bids. In the all-pay auction, head starts are more effective than biases while optimally combining both instruments even yields first-best revenue. In the lottery contest, head starts are less effective than biases and combining both instruments cannot further increase revenue. As all-pay auctions revenue-dominate lottery contests under optimal biases, we thus obtain an unambiguous revenue-ranking of all six combinations of contest formats and instruments. © 2018 Elsevier B.V. All rights reserved.

1. Introduction

Contests are frequently and increasingly used to allocate scarce resources among competing agents when other allocation mechanism like markets, matching, or bargaining protocols are not feasible, impractical, or not desired. A characteristic feature of contests is that participating agents exert effort or pay non-refundable bids to win an indivisible prize such that all agents incur their respective costs of effort exertion irrespectively of winning the prize or not. Examples range from promotion tournaments within firms to lobbying, from public procurement to rent-seeking, from high school admission to crowdsourcing, and from the allocation of research grants to innovation contests; see Konrad (2009) and Vojnović (2016) for excellent textbooks on contest theory and their applications as well as Frank and Cook (2010) and English (2005) for popular approaches regarding the related phenomenon of winner-take-all-markets and the ubiquity of contests in arts and culture.

As the organizer of a contest typically has substantial discretionary power in designing the contest rules, there is a tendency for explicit or implicit favoritism with respect to specific agents. Consider, for instance, the preferential treatment of internal or external candidates in hiring decisions or of domestic or small business firms in public procurement, handicap

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systems in sports, affirmative action in high school admission, or simply discrimination in the sense that the contest organizer favors specific contestants which is manifested by tailoring the conditions of the contest to the advantage of the preferred contestants. In all these cases agents are treated asymmetrically, which might have profound implications for the underlying incentive structure of the contest. Hence, contest organizers should be aware of the consequences of different types and designs of preferential treatment.

In this paper, we consider two different types of preferential treatment, bias and head starts, that alter the respective incentives induced in the contest in a fundamentally different way: Agents that are favored by head starts benefit from an additive bonus on their chosen bid or effort level in the sense that their rivals must first pass the head start to be able to compete on equal footing. In contrast, agents that are favored by a multiplicative bias enjoy a higher weight on their effort in the process of determining the winner of the prize. Both types of favoritism are frequently observed in real world contests: The University of Michigan, for example, added a head start of 20 (out of 150) points to the score of minority applicants for their undergraduate program, while other elite universities seem to (at least implicitly) apply similar policies, see Espenshade et al. (2004). In public procurement, small businesses or domestic firms are often favored through a multiplicative bias in the form of a bid preference or subsidy, see Krasnokutskaya and Seim (2011) and Marion (2007). There are also instances where both instruments, head start and biases, are applied at the same time. Kirkegaard (2012) reports on a Canadian research promotion program where researchers with excellent past performance receive a head start while the research proposals of junior scientists get a higher weight in the evaluation process.

Naturally, not only the type but also the extent of favoritism affects incentives, having strategic implications for favored agents, their respective rivals, and therefore also on the efforts expended by all contestants. A contest organizer who has the option to fit bias and/or head starts to the underlying heterogeneity of the contestants can therefore influence the aggregate amount of effort, that is, the revenue generated in the contest. Hence, finding the optimal design of those instruments of favoritism becomes the crucial task for a contest organizer who is interested in contest revenue.[1]

Focusing on bias and head starts, we analyze and compare the potential of these two instruments to generate additional revenue in contest games with several heterogeneous contestants. From the perspective of a revenue-interested contest organizer, our analysis provides insights with respect to questions that typically arise in competitive environments with heterogeneous contestants: Should the playing field be leveled by favoring weak contestants to increase competitive pressure? Should preferential treatment induce more contestants to actively participate in the contest or is it better to exclude weak contestants and concentrate only on strong contestants? What type of favoritism, bias or head start, is more effective in generating additional revenue? Our analysis will not only allow us to answer these questions but also identify the limits and dependencies with respect to the respective instruments and the nature of the competitive process.

To model the competitive process, we concentrate on two frequently used frameworks with complete information: lottery contests and all-pay auctions. Both models are sufficiently tractable and have been extensively used in various contest applications.[2] The fundamental difference between the two frameworks lies in their decisiveness, that is, the amount of noise in the process that determines the winner. An all-pay auction is highly decisive as the player with the highest effort is deterministically chosen to be the winner. In contrast, the outcome of a lottery contest is probabilistic and therefore less decisive because the probability of a player to win the contest is proportional to her relative effort contribution. From an applied perspective it is ultimately an empirical question whether the respective competitive situation is more appropriately captured by a more noisy lottery contest or a highly decisive all-pay auction. For this reason we provide an analysis of both frameworks to be as comprehensive as possible and to allow an applied researcher to refer to the appropriate framework based on the specific application at hand. Moreover, including both frameworks into our analysis allows us to investigate how the revenue-enhancing potential of the two instruments of preferential treatment depends on the decisiveness of the underlying contest.

Whereas revenue-maximizing biases have been studied extensively in the literature (which we discuss below), much less is known about the optimal use of head starts. In this paper, we provide a general analysis of revenue-maximizing head starts, both in isolation and in combination with bias. Combined with the existing findings on optimal biases by Franke et al. (2013) and Franke et al. (2014) our results enable us to show, among other things, that head starts are unambiguously more effective than biases in increasing revenue in all-pay auctions, whereas the opposite is true in lottery contests. Hence, the usefulness of the instruments depends on the underlying framework, which may explain why both instruments are frequently observed in practice.

For the lottery contest framework, we find that depending on the heterogeneity of contestants the revenue-maximizing head starts (in absence of bias) are either zero or such that only the strongest player actively invests effort (competing only against the head starts of the other players). Moreover, we show that an optimal bias without head starts revenue-dominates any combination of bias and head starts. Intuitively, one reason why head starts are less effective in inducing additional revenue is that a favored player uses his head start to substitute for own effort, whereas for a player who is

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[1] Arguably, in some of the applications mentioned above, asymmetric treatment of agents is (at least officially) not implemented to increase contest revenue but rather for some normative reasons. However, even if normatively derived deviations from symmetric treatment are applied, the forgone revenue should be an important evaluation criterion for these policies. Our paper provides this benchmark of comparison by deriving the maximal revenue that can be obtained through optimally designing asymmetric treatment of agents.

[2] Lottery contests were introduced by Tullock (1980) and an early analysis of all-pay auctions with complete information can be found in Hillman and Riley (1989). See the two text books mentioned above and Corchón (2007) for surveys.