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Optimal prize-rationing strategy in all-pay contests with incomplete information☆

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ABSTRACT

A contest organizer (e.g., a government regulatory agency) is endowed with the capacity to provide unlimited homogeneous prizes (e.g., medals) that he can use to incentivize contestants to exert productive effort in an all-pay auction with incomplete information. Each agent, at most, wins one prize. We study the optimal number of prizes the organizer should grant in order to induce maximal expected total effort or expected highest effort from agents. Both are single peaked under mild regularity conditions. When players' abilities follow a family of beta distributions, expected highest effort maximization requires a smaller set of prizes to be awarded; for both goals, the optimal number of prizes weakly increases when the pool of contestants expands or contestant quality improves.

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1. Introduction

Contests have been widely used in practice (e.g., sports, school admissions, internal labor markets, etc.) to incentivize agents who are exerting productive effort to improve their prospects of winning a prize by pulling ahead of their rivals. The optimal design of the prize structure, i.e., the number of prizes and their values, is thus an indispensable instrument for the contest organizer to boost the performance of a contest in terms of inducing effort supply. [1] In this paper, we study the impact of the number of prizes on players' effort provision in a stylized environment in which the organizer is endowed with the capacity to provide unlimited homogeneous indivisible prizes (e.g., medals) that he can use as awards in a contest.

Situations are abundant in which contest organizers' capacity to provide additional awards is not limited. The Baldrige Awards program, which was established in 1987 by the U.S. congress, is a salient example. The program recognizes companies with outstanding achievements in quality and business performance to raise firms' awareness of the importance of quality and performance excellence as a competitive edge. The Baldrige Awards are primarily recognition prizes, with no cash prizes. Evidently, the prestige associated with the awards can be viewed as an inducement for firms' adoption of frontier quality-management techniques. According to statistics on the Baldrige Award Program website,[2] by 2011, the median growth in revenue and the median job growth for the two-time Baldrige Award winners are, respectively 92.5% and 65.5%. Anticipating these significant improvements in business performance, many enterprises are incentivized to compete for the awards by taking measures to upgrade their quality-management systems.

Military medals and Internet merit badges function similarly. Military medals boost battle effectiveness, and Internet merit badges reduce the free rider problem in the internet community.[3] Despite the lack of direct monetary incentives in these activities, the winners' gains in social status and/or improved future prospects in business and careers are the main motivation for candidates to exert costly effort.

For these incentive schemes to work properly, setting an appropriate number of awards is crucial. And the issue of the optimal number of awards can be further complicated by the contestants' information structure. When contestants' competencies/abilities are their private information, an extra prize would have different impacts on the effort provision of contestants with different abilities.

Interesting questions thus arise: how many Baldrige Awards should Congress grant annually given its imperfect knowledge about the competing firms? What factors should be taken into consideration in determining the optimal number of awards? How would the optimal number of prizes be affected by the size of contestant pool and/or their quality?

[1] In many contests, the winner selection mechanism is predetermined.
[2] Baldrige Award Program website: http://www.nist.gov/baldrige/publications/impacts.cfm.
[3] Immorlica et al. (2013) study issues on social status and badge design. We thank a referee for kindly providing these examples.