D I S S E R T A T I O N   D E F E N S E

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"Innovation and Crowdsourcing Contests"

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This thesis studies contests (also called tournaments) wherein a contest organizer seeks solutions to a problem from independent agents. The seeker employs a subset of these solutions, and awards the best solution(s). For example, since 2012, Samsung has organized an innovation contest, called the Smart App Challenge, that invites independent programmers to develop novel applications for its mobile products. Samsung awards the best few apps, and uploads a larger number of apps to its on-line store. Three chapters of this PhD thesis provides managerial insights that can assist organizations in designing an optimal contest. The first chapter studies an innovation contest in which an organizer seeks solutions to an innovation- related problem from a number of independent agents. While agents exert efforts to improve their solutions, their outcomes are unknown a priori due to technical uncertainty and subjective taste of the organizer. I call an agent whose ex-post output contributes to the organizer's utility a contributor, and consider a general case in which the organizer seeks any number of contributors. I show that a *winner-takes-all* award scheme is optimal to the contest organizer for a large class (but not all) of distributions for agents' uncertain outputs. In this case, when the spread of the output distribution or the number of contributors is sufficiently large, an *open contest* that does not restrict entry of participants is optimal. Finally, I compare the organizer's payoffs under different compensation rules that award participants based on their relative ranks, absolute performance or a combination of both.

The second chapter studies impact of agent heterogeneity in a contest. In a contest in which heterogeneous agents make efforts to develop solutions, existing theories predict different outcomes about how agents will change their effort levels as more participants compete for a prize. Specifically, one theory prescribes that when agents are heterogeneous in their initial expertise, every agent will reduce effort with more participants due to a lower probability of winning the contest. In contrast, another theory prescribes that when agents are heterogeneous in their costs of exerting efforts, high-ability agents raise their efforts with more participants, while low-ability agents reduce their efforts; but it does not provide an explanation for such a prescription. Yet, a recent empirical study corroborates the prescription of the second theory. This paper presents a unifying model that encompasses both types of heterogeneity in agents, and proves that the result prescribed by the second theory holds in the unifying model, suggesting that the first theory is problematic. Thus, I present the correct analysis of the first theory, and identify a second (positive) effect of increased competition on agents' incentives: More participants in a contest raise the expected performance of a runner-up, and therefore agents need to make higher efforts in order to win the contest. Due to this positive effect that has been neglected in prior literature, I find that a free-entry open contest is more likely to be optimal to a contest organizer than what prior literature asserted.

The third chapter analyzes time-based crowdsourcing contests. In a crowdsourcing contest, a contest organizer delegates a large population of agents to solve a certain problem while determining how to compensate agents. Each Agent's solution time depends on the agent's effort level, heterogeneous expertise level, and a stochastic shock. I call an agent whose ex-post output contributes to the organizer's objective a

contributor, and consider a general case in which the organizer minimizes the solution time of any number of contributors. I establish that although the common practice in time-based contests is to offer fixed prizes, the seeker can do better by compensating contributing agents based on their solution times. I show that the compensation may be increasing or decreasing in solution time depending on the observability of agents' efforts by the organizer. Finally, I show that it is optimal for the organizer to screen agents with the highest expertise levels, and compensate only these agents when the agents' outputs are deterministic, and compensate a larger group of agents when their outputs are stochastic.