Motivating Participation and Effort in Innovation Contests

1. Introduction

The rise of open innovation and crowdsourcing has allowed firms to involve large communities of external users in their innovation process. Unfortunately, user (solver) participation in such innovation contests is not guaranteed. Solvers, who have different skill or ability levels, may find the cost to participate prohibitive. If and when they decide to participate in a contest, the solvers must be induced to exert effort that delivers the output needed by the firm (seeker). To alleviate possible conflicts of interest that may arise when incentivizing both participation and effort (as opposed to just effort), the seeker offers the solvers an incentive plan defined by a number of awards to induce the solvers to act in the seeker’s best interest. Most papers in the existing literature focus on incentives for effort alone and they largely find that a winner-takes-all award scheme is optimal. In contrast, we establish that multiple awards are needed to balance the trade-off between participation and effort in settings where solver participation is voluntary.

In practice, crowdsourcing a task to outside solvers comes with two main challenges related to the incentive design of the award scheme. First, solver participation cannot be guaranteed because each solver faces a non-negligible external opportunity cost. For instance, driver participation in a ride-sharing platform is voluntary and is largely affected by the alternative options available for work or pleasure. Second, contests can differ widely in structure depending on the degree to which ability and effort (together) determine output, a characteristic we refer to as contest specialization. In competitive settings with low contest specialization, solver output depends mainly on the amount of effort exerted (e.g. everyone who is capable of driving and owns a car can become an Uber driver and compete for available demand). Conversely, ability or expertise is the key determinant of solver performance in settings with high contest specialization (e.g. a scientific contest offered on InnoCentive or, at an extreme, competing with the best nuclear physicists in the world to develop the first atomic bomb, as was the case in the Manhattan Project (Lenfle and Loch, 2010)). Other popular contests, such as choosing the best Chinese interpreter for a business meeting in UpWork.com, or logo design contests typically found on 99designs.com, offer settings that are characterized by performance that depends on a combination of solver skill and effort.

In studying innovation contests, the existing literature often finds that a winner-take-all (WTA) award scheme is optimal. This is due to the fact that they either consider contests in which effort alone determines performance, or they neglect the strategic participation decision of solvers and analyze only the case when
solvers have zero participation cost. Moldovanu and Sela (2001) consider a setting where effort (alone) is observable by the seeker and they show that WTA is optimal when the cost of effort is linear or concave. In contrast, in our paper, solver effort is unobservable and the output of each solver is a function of both effort and (privately known) ability. In addition, the solvers in our setting face a strictly positive participation cost and a linear cost of effort. Our setting leads to multiple awards rather than WTA. Kalra and Shi (2001) do consider non-negative participation costs and account for unobservable effort, but they consider homogeneous solvers. Because all solvers are homogeneous, either all solvers participate or none participate. The result is, once again, a WTA award scheme. Our setting allows for heterogeneity among solvers due to their intrinsic ability. Depending on the award structure offered, only a subset of the solver population chooses to participate and exert effort. Terwiesch and Xu (2008) and Körpeoğlu and Cho (2017) also study contests with ability and effort, however, they do so normalizing solver participation cost to zero, leading to a WTA award scheme. The seemingly innocuous assumption regarding participation cost fails to address solvers’ endogenous participation choice, which is central in large crowdsourcing platforms. As a consequence, all solvers enter the contest and the firm does not face a trade-off between how many solvers and of what skill level to encourage to enter, and how to motivate those solvers that do enter to work hard. Conversely, we demonstrate how the trade-off between participation and effort forces the seeker to provide multiple awards.

2. The Set up

We develop a game-theoretic model of incomplete information in which each solver first chooses whether to participate and then how much effort to exert in the innovation contest. A solver’s intrinsic ability (e.g. skill or expertise level) and effort together determine output. Working harder (i.e. choosing a higher effort) increases the chances of a solver to receive an award but effort is costly and it is more costly for solvers with less ability. Further, in order to take a rational participation decision, each participating solver has to cover his outside opportunity cost which is a utility he can derive by using his effort or time elsewhere. This external opportunity cost is a critical component of our model, and one of the key differences between our model and the existing research in this area.

3. Results

Our results offer guidelines for innovation contest designers depending on their objectives and whether the characteristics of the innovation contest require greater incentives for participation or effort. Specifically, our analysis yields three main results. First, we prove that any monotone reward allocation induces a
(unique) threshold ability participation strategy for the solvers in which their equilibrium performance is strictly increasing in ability. Interestingly, while solver performance is strictly increasing in ability, effort exhibits a non-monotone behavior (i.e. solvers with high expertise substitute ability for effort, compared to solvers of average or low ability who work the hardest). We demonstrate that in contests requiring a sufficiently high degree of specialization, the solvers substitute ability for effort to the extent that all participating solvers exert zero effort in equilibrium.

Second, we find that the contest designer can mitigate these adverse effects by providing multiple awards. In particular, we show that the celebrated winner-takes-all result of Moldovanu and Sela (2001), which maximizes total effort, extends to the case where solver participation is endogenous. In contrast, when the performance of a submitted solution is affected by solvers' ability and effort, then the seeker may find it optimal to offer multiple awards. All of our equilibrium results are distribution-free, are obtained imposing a linear cost of effort, and use structural properties of order statistics. The presence of a convex cost of effort would only strengthen our arguments in favor of offering multiple awards. In fact, we find that offering a single award can potentially be quite damaging - we present a numerical experiment in which a WTA scheme performs a startling 20% worse than the optimal (multiple) award allocation.

Third, our analysis shows that offering multiple awards is beneficial in a general objective of optimizing a weighted combination of the total performance of the best candidate solutions, i.e. when the contest designer seeks more than one solution (but not all). The optimal allocation of multiple awards balances a novel trade-off to maintain a desirable participation level while at the same time provide incentives for solvers to exert effort. Our previously obtained results remain robust in this general objective; the optimal awards allocation contains no more than an upper bound of awards, which depends on the structural properties of the contest and the candidate solutions that the seeker optimizes over.

References


