



Problem-solving effort and success in innovation contests: The role of national wealth and national culture



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ABSTRACT

Innovation contests allow firms to harness specialized skills and services from globally dispersed participants for solutions to business problems. Such contests provide a rich setting for operations management (OM) scholars to explore problem solving in global labor markets as firms continue to unbundle their innovation value chains. In this study, we examine the implications of specific types of diversity in innovation contests on problem-solving effort and success. First, we conceptualize diversity among contestants in terms of national wealth (measured as gross domestic product per capita (GDPP) adjusted for purchasing power parity) and national culture (measured using the culture dimensions of performance orientation and uncertainty avoidance) and examine how such factors influence problem-solving effort. Next, we examine how differences between contestants and contest holders in terms of the above factors influence contest outcomes. Using data from a popular online innovation contest platform and country-level archival data, we find that contestants from countries with lower levels of GDPP are more likely to exert greater problem-solving effort compared to other contestants. With regard to national culture, we find that performance orientation and uncertainty avoidance have positive and negative effects, respectively, each of which weakens with increasing levels of GDPP. Finally, our analysis provides evidence of homophily effects indicating that contestants who share greater similarities with the contest holder in terms of national wealth and national culture are more likely to be successful in a contest. We discuss the implications of the study's findings for contest holders and platform owners who organize innovation contests, and for emerging research on innovation contests.

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1. Introduction

Rapid growth in social media and the global reach of the Internet have fundamentally changed the way firms execute the various activities of their innovation value chains (Chesbrough, 2007; Billington and Davidson, 2013). Firms are seeking novel ways to collaborate and develop new products and services to meet the increasingly competitive pressures of the “flat world” (Friedman, 2005; Metters et al., 2010). To facilitate this, recent years have seen an emergence of cost-effective “innovation contests” that harness specialized skills and services from a crowd of globally distributed individuals to provide new creative ideas and solutions to

challenging business problems (von Hippel, 2005; Terwiesch and Ulrich, 2009).

While innovation contests, such as those conducted on InnoCentive.com, 99designs.com, and Logomyway.com, have seen significant growth in recent years, the notion of such contests per se is not new. A frequently cited historical example is the “Longitude Prize” contest that was held by the British Parliament in the 18th century (Jeppesen and Lakhani, 2010). Open to the general public and with a prize amount of up to £20,000, the goal of the contest was to find a practical method for accurately determining the longitude position of a ship in transoceanic voyages. As another example, in 1795 Napoleon launched a competition with a prize amount of 12,000 francs to invent a method of preserving food for his army (Wagner, 2011). Interestingly, both contests are based on important operational problems.

Notwithstanding their existence over centuries, innovation contests today differ from *traditional* contests discussed above in a fundamental way. Specifically, online platforms decentralize the

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problem-solving effort across a large, geographically dispersed group of participants from diverse economic and cultural backgrounds. Thus, today's online innovation contests provide contest holders with unprecedented access to a global workforce. The "global" nature of this workforce can be gauged by looking at some recent statistics from popular innovation contest platforms. For example, Innocentive—a science-based innovation contest platform—has a registered base of about "300,000 [participating solvers] from nearly 200 countries" (Source: innocentive.com), Logomyway.com—a logo-design innovation contest platform—has over 15,000 participating designers from more than 100 countries (Source: logomyway.com), and TopCoder—a computer programming contest platform—has about 9000 participants from 61 different countries in its algorithm development contests (Source: topcoder.com).

Although diversity of participants, including economic and cultural backgrounds, has been recognized as a defining feature of innovation contests (von Hippel, 2005; Daniel et al., 2013), we have a limited understanding from prior studies of its effects on participant engagement, and more specifically, on the problem-solving effort expended by participants. Prior research on innovation has frequently examined the role of "team" diversity (i.e., diversity among individuals within a team in terms of gender, age, educational background, functional background, etc.) in the effective functioning of new product development teams (e.g., Ancona and Caldwell, 1992; Sarin and McDermott, 2003; Narayanan et al., 2013). However, in innovation contests, the problem-solving effort is driven by individual participants who differ widely from one another in terms of economic and cultural backgrounds (Terwiesch and Ulrich, 2009; Billington and Davidson, 2013). How do these sources of diversity in innovation contests influence the problem-solving effort expended by participants?

Additionally, many innovation contests are characterized by high levels of evaluation uncertainty and the selection of the winning solution is "taste-based," depending upon the subjective preferences of a contest holder (Terwiesch and Xu, 2008; Erat and Krishnan, 2012). It remains to be understood how differences between contestants and the contest holder in terms of economic and cultural factors affect a contestant's success. That is, do innovation contest platforms provide a "level playing field" for all participants (Howe, 2006; Belsky, 2010), or does homophily effect—the propensity of individuals to associate with others with similar social, cultural, economic and/or demographic characteristics (Milliken and Martins, 1996; McPherson et al., 2001)—exist in such settings?

Our study attempts to address the above gaps in the prior literature. We conceptualize diversity in an innovation contest setting in terms of economic and cultural factors. Since these sources of diversity are inherently related to differences in nationalities among participants, we represent differences in economic and cultural factors among participants in terms of their national wealth and national culture. We measure national wealth using the gross domestic product per capita (or GDPP), adjusted for purchasing power parity (PPP) (e.g., Gefen and Carmel, 2008; Kull and Wacker, 2010). For national culture, we focus on two particular dimensions relevant to our study: *performance orientation* and *uncertainty avoidance* (House et al., 2004). Next, we develop and test hypotheses that examine the role of economic and cultural factors on problem-solving effort in innovation contests. Finally, we shed greater light on the role of homophily in such settings by examining how differences in national economic and cultural factors between contestants and contest holders influence contest outcomes.

The empirical analysis is carried out using an integrated dataset that comprises detailed data from 1024 innovation contests and 2626 unique contestants (resulting in approximately 45,000 contest-contestant observations) from Logomyway.com. This data

is matched with country-level archival data on GDPP (adjusted for PPP) and national culture dimensions. Results indicate that both national wealth and national culture influence problem-solving effort and outcomes in innovation contests. We find that contestants from countries with lower levels of GDPP are more likely to make a larger number of submissions compared to other contestants. With regards to the culture dimensions, we find that performance orientation and uncertainty avoidance have opposing effects on the problem-solving effort of contestants. That is, increasing levels of performance orientation are associated with an increase in problem-solving effort, while increasing levels of uncertainty avoidance are associated with a decrease in problem-solving effort. However, both relationships become weaker as GDPP increases. Our analysis also provides evidence of homophily effects in innovation contests, indicating that contestants that share greater similarities with the contest holder in terms of national wealth and national culture are more likely to be successful compared to other contestants. To the best of our knowledge, our study is the first of its kind to highlight the strong links between macro-level factors associated with the contest environment, individual problem-solving effort and innovation contest outcomes. These findings lead to valuable insights for the design of such contests and global labor markets.

2. Theoretical background and hypotheses

The developing literature on innovation contests has its roots in the process model of innovation in operations management (e.g., Ha and Porteus, 1995; Dahan and Mendelson, 2001; Terwiesch and Xu, 2008) and research tournaments in economics (e.g., Lazear and Rosen, 1981; Nalebuff and Stiglitz, 1983).

The process model of innovation conceptualizes problem solving as a search for the best solution from among a set of parallel experiments undertaken by the solver (Ha and Porteus, 1995; Dahan and Mendelson, 2001). The performance outcome from this search process is the highest realization from the set of parallel experiments. Building upon this idea, Terwiesch and Xu (2008) modeled problem solving in an innovation contest as a set of parallel experiments where the performance of a submitted solution (resulting from an experiment) is a function of the effort undertaken by the contestant and her prior expertise (i.e., experience and knowledge) in the problem domain. Lakhani et al. (2007) surveyed contestants on Innocentive, a science-focused innovation contest platform, and found that *winning* solvers put in twice as much problem-solving effort into their solutions, on average, compared to non-winners.

The centrality of effort measurement in problem-solving research is also evident from the extensive economics literature on research tournaments (e.g., Taylor, 1995; Che and Gale, 2003; Moldovanu and Sela, 2006). This research has largely examined how variations in tournament design characteristics (e.g., the size and the number of incentives, the number of tournament stages, and the size of the participant pool) influence problem-solving effort by a participant. For instance, Taylor (1995) found that limiting the number of participants in a contest led to an increase in their problem-solving efforts due to a greater perceived chance of winning from reduced duplication. Fullerton and McAfee (1999) further argued that it is necessary to limit entry because the evaluation of problem-solving effort is not a costless exercise. The above studies are analytical in nature, where problem-solving effort is typically represented as a stochastic variable and contestants are assumed to submit only one solution to a contest.

More recently, empirical studies on innovation contests have started to focus on contest environments that allow for multiple submissions per contestant (e.g., Yang et al., 2010; Bayus, 2013;

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