



Experimental evidence on the effects of innovation contests



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ABSTRACT

Economic research on innovation has long discussed which policy instruments best foster innovativeness in individuals and organizations. One of the instruments easily accessible to policy-makers is innovation contests; however, there is ambiguous empirical evidence concerning how such contests should be designed. Our experimental study provides evidence by analyzing the effects of two different innovation contests on subjects' innovativeness: a prize for the cumulative innovativeness and a prize for the best innovation. We implement a creative real effort task simulating a sequential innovation process, whereby subjects determine royalty fees for their created products, which also serve as a measure of cooperation. We find that both contest conditions reduce the willingness to cooperate between subjects compared to a benchmark condition without an innovation contest. While both contests have similar effects, the most sophisticated innovation is significantly more valuable when there is a prize for the best innovation. However, the total innovation activity is not influenced by introducing innovation contest schemes. From a policy perspective, the implementation of state-subsidized innovation contests in addition to the existing intellectual property rights system should be questioned.

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1. Introduction

Innovations are considered the driving force for economic growth in modern economies, prompting governments to stimulate private and public innovation activities. Most recently, the European Union announced increasing investment in R&D to three percent of GDP by 2020 and – in a similar effort – the United States legislated the “America COMPETES Reauthorization Act” to improve their competitiveness by boosting R&D (COM (2010) 2020; H.R.5116). Policy-makers can draw upon three categories of instruments to implement such strategies: regulatory instruments such as intellectual property rights, economic and financial regulations such as subsidies or tax exemptions and soft instruments such as voluntary agreements (Bemelmans-Videc et al., 1998; Borrás and Edquist, 2013). The determination of states to increase domestic innovativeness has initiated a large research debate, discussing how to best combine these instruments to achieve an effective policy mix (Flanagan et al., 2011; Guerzoni and Raiteri, 2015).

By the means of an experimental analysis, we further the discussion on the efficiency of innovation contests that are among the most frequently discussed financial regulatory instruments (Clancy and Moschini, 2013). We stimulate innovativeness by im-

plementing a real effort word creation task (Brüggemann et al., 2016; Crosetto, 2010). Our experimental set-up allows us to test for the specific effects of innovation contests on innovation performance. Subsequently, we examine how cooperation among innovators evolves with and without contest schemes. We focus on two specific types of innovation contests, implementing (1) a prize for the cumulative innovativeness and (2) a prize for the best innovation. Implementing a between-subjects design, the two treatments are compared to (3) a benchmark treatment without an innovation contest. All treatments enable subjects to license innovations, where chosen license fees implicitly measure cooperation. To investigate the effects of a prize for the cumulative innovativeness, we implement a contest with a relative payoff-scheme disproportionately rewarding the most innovative subject. In the treatment with the prize for the best innovation, subjects are paid proportionally for each innovation, while an additional bonus is awarded to the subject who has created the most valuable innovation. In the benchmark treatment, subjects are merely paid proportionally to their innovations.

We find that both types of innovation contests reduce the willingness to cooperate, as measured by the average royalty fees demanded. However, actual cooperation remains constant as subjects tend to accept higher royalty fees in order to build upon other subjects' previous innovations to win the innovation contest. Comparing the contest schemes, we find the most sophisticated innovation to be significantly more valuable when there is a prize for the best

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innovation. With respect to innovativeness, our results indicate that neither a prize for the cumulative innovativeness nor a prize for the best innovation yield a positive overall impact. Therefore, our behavioral evidence suggests that both types of contests investigated cannot be recommended as effective policy instruments to foster innovation activity. This becomes apparent when considering potential distortions to generate the revenue to award contest winners and potential long-term effects of diminished cooperation among innovators. In general, our results indicate that innovation contests fail to stimulate innovation performance in sectors relying on sequential innovation processes accompanied by strong cooperation among innovators. For instance, consider the high-tech industry where cutting edge technologies build upon plenty prior innovations that were sequentially developed over years of incremental innovations. In this process, many agents cooperated or at least rely on prior innovations as in open-source communities developing software or companies that reimburse competitors when using their licensed innovations. Our results indicate that introducing a contest scheme in such an economic setting will not spike innovativeness in terms of creating new technologies or products. Conversely, as the willingness to cooperate will most likely decline, the competition among agents becomes prevalent and agents will ask for higher compensations when their innovations are used by others to further the incremental innovation process. However, a prize for the best innovation (technology) might be an effective instrument to enhance the significance of the most advanced innovation path.

Furthermore, our findings hint at the difficulties of using several policy instruments simultaneously, particularly granting intellectual property rights and introducing innovations contests. The simultaneous use of policy instruments can amplify non-intended outcomes. For instance, in our setting, the decreasing willingness to cooperate transfers to higher royalty fees, which, in turn, undermines potentially positive effects of higher effort due to the additional incentives of prizes in innovation contests.

Our findings contribute to economic research that has analyzed innovation contests with respect to design specifics and their potential outcome by considering e.g. single or multiple solvers and prizes, its duration and – most prominently – its incentive structure. Williams (2012) reviews this literature with a focus on innovation prizes in the United States, emphasizing the importance of both estimating an appropriate size of prizes and considering the sequentiality of innovations for spurring subsequent innovations. Williams claims that additional research on the effectiveness of prizes and the specific construction of prize designs is required. Adamczyk et al. (2012) review the current literature on innovation contests by drawing upon the distinct perspectives from economic, management, education, innovation and sustainability research. Similar to Williams (2012), they suggest that further research should focus on the particular design of innovation contests. Clancy and Moschini (2013) provide an overview of different financial regulation instruments to foster innovation. They state that innovation contests can potentially overcome deadweight losses caused through the monopoly rights of patents and moral hazard problems of contracted research. Numerous theoretical and empirical contributions have aimed at deriving policy implications for the most efficient design of innovation contests. However, empirical research shows ambiguous findings concerning the impact of innovation contests (Boudreau et al., 2011; Brunt et al., 2012; Murray et al., 2012; Nicholas, 2013).¹ Similarly, there are mixed

results developed in theoretical contributions (Chari et al., 2012; Che and Gale, 2003; Cohen et al., 2008; Ganuza and Hauk, 2006; Moldovanu and Sela, 2001; Schöttner, 2008; Taylor, 1995; Wright, 1983).²

To overcome some shortcomings of previous research in evaluating the effects of various contest schemes on innovativeness, we follow an experimental approach. Empirical research relying on field data is bound to data availability and thus a profound analysis across contest schemes is not feasible. Economic experiments allow generating data that enables a ceteris paribus comparison of different contest schemes (Blasio et al., 2015). Therefore, we would argue along with Sørensen et al. (2010) that economic experiments are “a promising approach” (Sørensen et al., 2010, p. 313) and a fruitful methodological addition to the existing innovation research.

Based upon this notion, experimental studies can analyze the effects of different policy instruments e.g. by simulating sequential innovation processes (Buchanan and Wilson, 2014; Cantner et al., 2009; Meloso et al., 2009). Yet, there are few studies relying on a search task to imitate the innovation process (Ederer and Manso, 2013; Rijnsoever et al., 2012).

By choosing to implement such non-creative real effort search tasks, creativity required in an innovation process is widely overlooked. However, transferring this immanent feature of the innovation process to the lab might be crucial to achieve meaningful results at a satisfactory level of external validity. Only few papers implement creativity tasks to more closely simulate innovation processes to examine the influence of incentive structures on innovativeness. One example is Bradler (2015), who compares the incentives of a tournament with a fixed payment scheme for a creative task, finding support for self-selection into tournaments according to risk attitudes and self-assessments, yet no such effect for creative productivity. The most relevant setting we build up on includes the key features of actual innovation processes like risky investment choices and creativity. Crosetto (2010) investigates the effects of introducing intellectual property rights for innovations including open source. The author introduces a real effort word creation task in which subjects – similar to the board game *Scrabble* – innovate by creating and extending words. Crosetto's results suggest that open source only emerges in treatments with high royalty fees rather than low ones, although high royalty fees tend to foster anticommons effects. Following this study Brüggemann et al. (2016) introduce endogenous license fees show that overall innovativeness increases in a setting without intellectual property rights.

The remainder of this paper is organized as follows. Section two outlines our experimental design and hypotheses before section three presents our results and section four concludes.

probability of a high valued innovation increases. Nicholas (2013) examines the effectiveness of innovation prizes in Japan's Meiji era, finding strong evidence that prizes lead to a substantial boost of new patents. Relying on a similar approach, Brunt et al. (2012) estimate a substantial increase in patenting activities in the Royal Agricultural Society of England between 1839 and 1939 due to innovation prizes.

² Wright (1983) investigates patents, prizes and contracts as rewards for winning innovation contests, finding advantages of patents over prizes due to private information. Taylor (1995) models innovation contests with homogeneous contestants, showing that restricting the entry may be beneficial for the contest designer. Comparing a contest comprising multiple prizes with a contest offering a single prize, Moldovanu and Sela (2001) find that the latter leads to an optimal allocation of resources. Ganuza and Hauk (2006) study vertical and horizontal competition in contests, finding multiple equilibria. Cohen et al. (2008) analyze theoretically the design of innovation contests and their potential of maximizing either the overall or the maximum effort, finding that the optimal prize can both increase and decrease participants' effort. Comparing a first-price auction with a fixed-prize tournament in innovation contests, Schöttner (2008) suggests that the latter is superior.

¹ Murray et al. (2012) investigate the ex-ante influence of the Progressive Automotive Insurance X PRIZE as an example of a grand innovation prize. Boudreau et al. (2011) analyze the results of a computer programming contest with respect to the size of the participant pool on individual effort levels. If more competitors are permitted, the aggregate innovativeness will decrease, while the

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