Competition and incentives☆

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ABSTRACT

We report on two experiments that identify *non-monetary* incentive effects of competition. As the number of competitors increases, monetary incentives to engage in cost reduction tend to decrease. We test the hypothesis that there are non-monetary incentive effects of competition going in the opposite direction. In the experiments, we change the number of competitors exogenously keeping the monetary incentives to spend effort constant. The first experiment shows that subjects spend significantly more effort in duopolistic and oligopolistic markets than in a monopoly. The second experiment focuses on social comparisons as one potential mechanism for this effect. It shows that competition turns the effort decisions of competing managers into strategic complements.

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1. Introduction

How does competition as measured by the number of firms in a market affect the incentives to reduce costs and to increase productivity? The theoretical IO literature finds that "increasing the number of firms tends to decrease cost reduction expenditure per firm" (Vives, 2008). However, the empirical literature on this topic is far from conclusive. Many empirical studies suggest that there is a positive or inverted U-shaped relationship between the degree of competition and measures of cost reduction and productivity. One possible explanation for these findings is that there are non-monetary incentives provided by competition that have been ignored by the theoretical literature so far.

In this paper, we use laboratory experiments to identify *non-monetary* incentive effects of competition. We focus on the incentives of the managers of the firms to invest effort in cost reduction. Our hypothesis is that the number of competitors has a direct positive incentive effect that is independent of the monetary incentives provided by competition. This countervailing effect may contribute to the explanation for why a positive association between competition and effort incentives is often observed.

We conduct two experiments in which we change the number of competitors exogenously keeping the monetary incentives to spend effort constant. In the first experiment (with simultaneous investments) we compare a monopoly to a duopoly and to an oligopoly with four firms. Competition has a highly significant causal effect on behavior. We find that our experimental subjects engage in significantly more effort in the treatments with competition than in the monopoly

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treatment. Furthermore, effort falls slightly (but non-significantly) in the oligopoly treatment as compared to the duopoly treatment. Combined with the negative effect on monetary incentives this is consistent with the sometimes observed inverted U-shaped relationship between competition and incentives.

In this experiment, the monetary incentives for a manager to invest in cost reduction are kept constant *in equilibrium*. However, because subjects do not behave as predicted by Nash equilibrium, the actual monetary incentives to provide effort are not identical across treatments. In fact, as the number of competitors changes several other dimensions of the decision environment change as well. In the monopoly treatment each subject has to choose his effort level playing against nature. This is a one-person decision problem with objectively given probabilities. In the duopoly and oligopoly treatments several players interact strategically. Thus, subjects have to form beliefs about the strategies taken by their opponents. The decision problem with competition is also more complex because it involves more possible contingencies. Furthermore, with competition there is social interaction with one or more other managers. Subjects may care about the payoffs that their opponents receive, and they may react to each other. The optimal strategy depends on the (possibly mistaken) beliefs about the strategies of their opponents and on their (possibly social) preferences. These differences are natural. In the real world an increase of the number of competitors necessarily affects all of these dimensions as well.

In our second experiment, we zoom in on the role of social interaction. We control for all differences between a monopolistic and a duopolistic market except for the scope for social comparisons. In the duopoly there is a second person (the competitor) to whom the manager can compare himself, which is not the case in a monopoly situation. The behavioral and experimental literature proposes two mechanisms by which social comparisons may affect behavior. First, models of inequity aversion (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999) and envy (Bolton, 1991) claim that people suffer a utility loss if they fall behind. Second, the literature on contests and auctions claims that there is a "joy of winning" that explains overbidding (Cox et al., 1992; Sheremeta, 2010). Both types of models predict that subjects have an incentive to invest more cost reducing effort in a duopoly than in a monopoly, but they differ in their predictions on whether effort choices are strategic complements or substitutes.

In this second experiment, we achieve control over all other factors by making investments sequential. In the duopoly treatment the second duopolist observes the effort choice of the first duopolist, so there is no strategic uncertainty at the second stage. In the monopoly treatment the monopolist also faces exogenous uncertainty about "market conditions". An increase of the effort chosen by the first duopolist in the duopoly treatment corresponds to an increase of the probability of unfavorable market conditions in the monopoly treatment. The experiment is designed such that the monopolist and the second duopolist face exactly the same decision problem with the same information structure, the same probabilities and the same monetary payoffs. In fact, they both have the same dominant strategy (i.e., their optimal strategies are independent of market conditions and of what the first duopolist does). The only difference is that in the duopoly treatment there is a second player with whom the duopolist interacts, while there is no social interaction in the monopoly treatment.

We find that the average effort level chosen by subjects in the duopoly treatment is again higher than in the monopoly treatment, but the difference is no longer statistically significant. Thus, social comparisons alone cannot explain the strong effect observed in the first experiment. However, in the duopoly treatment there is a strong (and highly significant) positive reaction of the second duopolist to the effort chosen by the first duopolist, i.e., efforts are strategic complements which is consistent with models of inequity aversion and envy, but not with a "joy of winning". In contrast, in the monopoly treatment an increase in the probability of non-favorable market conditions (which is payoff equivalent to an increase in the effort of the first duopolist) has a negative effect on the effort chosen by the monopolist. Thus, more effort of their competitors induces subjects to work harder, while more challenging market conditions in a monopoly induces them to be more complacent.

We conducted our experimental study in a lab environment which offers several advantages over field studies. First, in our experiments we can change the number of competitors exogenously. This allows us to identify causal effects. In contrast, in field studies it is difficult to identify causal effects because the number of competitors in a market is endogenous and causality can go in both directions. While the number of competitors affects the incentives to invest in cost reduction, the productivity of firms also affects entry and exit decisions. Second, by using the induced value method we can control for the monetary incentive effects of competition (the costs and the returns of the effort invested) which is much more difficult in an empirical study. Finally, we can eliminate potential selection biases that often plague empirical studies. For example, many monopolistic companies are either state-owned or tightly regulated, thus exhibiting different wage and pension systems than competitive firms. Therefore, they may attract managers and workers with different characteristics than companies acting under competitive pressure. In our experiments, subjects are randomly assigned to treatments, so there is no self-selection of individuals into more or less competitive markets.

The remainder of the paper is organized as follows. Section 2 discusses the relation to the literature. In Section 3, we set up a simple theoretical model of the monetary incentive effects of competition (as measured by the number of firms in the market) for managers to invest in cost reduction. Section 4 reports on our first experiment with simultaneous investments and strategic uncertainty. We describe the experimental design in Section 4.1, derive the theoretical hypotheses in subsection 4.2 and report the experimental results in Section 4.3. Section 5 discusses the second experiment with sequential investments that focuses on the effects of social comparisons. The experimental design, described in Section 5.1, is such that decision makers in the monopoly and the duopoly treatment face exactly the same decision problem (except for the presence of a second duopolist). The theoretical predictions are derived in Section 5.2. We report the results of this experiment in Section 5.3. Section 6 concludes.