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Manipulations in contests

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Abstract

We study the classical Tullock's model and show that by a simple non-discriminating rule the contest designer is able to manipulate the outcome of the contest such that the probabilities to win are not ordered according to the contestant's abilities.

Keywords: Contests; Tullock's model

JEL classification: D72; L83

1. Introduction

In winner-take-all contests with a single prize, independent of success, all contestants bear the cost of their effort, but only one contestant wins the prize. In these contests, the designer can choose the contest architecture that will affect the outcome of the contest. For instance, she can determine whether the contest will be simultaneous or sequential (Gradstein and Konrad, 1999), the number of prizes (Moldovanu and Sela, 2001), the number of contestants (Fullerton and McAfee, 1999) or the number of contestants at each stage of a multi-stage contest (Amegashie, 1999). In a one-stage contest where all the contestants compete against each other, if the contest rules are the same for all the contestants (non-discriminating rules), the designer is able to influence the absolute value of the winning probability of

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each contestant. However, usually she is not able to make a drastic manipulation such that the probabilities to win the contest are not ordered according to the contestants' abilities.[1]

In this paper, we adopt Tullock's model (1980) to show that by a simple non-discriminating rule, the contest designer can determine the contestant with the highest probability. In particular, we show that in a two-player contest, if the designer reimburses the winner's cost of effort, there is a unique internal equilibrium with undominated strategies where the weak contestant wins with higher probability than the stronger one. Moreover, in n player contests (n>2), each one of the $n-1$ underdogs (all the players except the strongest one) may win with the highest probability, and the strongest contestant may chose to stay out of the contest when other contestants compete against each other.

The contest designers may have other goals in addition to determining the contestants' probabilities to win the contestant. For example, in sporting contests (Szymanski, 2003), the designer may wish to maximize the total effort. On the other hand, in rent-seeking contests (Tullock, 1980), the designer may wish to minimize the total effort (total dissipation). If the contest designer wishes to maximize the total effort, it is well known that in the standard Tullock model, the designer's expected payoff is smaller than the second highest value for winning the contestant.[2] However, in our model, although the contest designer reimburses the cost of the winner's effort, her expected payoff, given that she maximizes the total effort, exceeds the second highest value. This paradox demonstrates that in some contests, depending on the designer's aim, it might be optimal to reimburse the effort cost of some contestants in order to increase the contest designer's expected payoff in the contest.

2. Two-player contests

Consider Tullock's model under complete information with two contestants. Each contestant's valuation for winning the contest is V_i for i=1,2. Assume also that $V_1>V_2$.[3] Every contestant exerts an effort x_i and the probability of winning for player i is

$$p_i(x_1,x_2) = \frac{x_i}{x_1+x_2} \qquad i=1,2$$

The designer reimburses the winner's cost of effort such that the expected payoff of contestant i is

$$\pi_i = [V_i + x_i]\left[\frac{x_i}{x_1+x_2}\right] - x_i \qquad i=1,2 \tag{1}$$

Proposition 1. *There is a unique internal equilibrium in which the weak contestant (player 2) wins with higher probability than the strong contestant (player 1).*

[1] In elimination multi-stage contests, the contestants' probabilities of winning are not necessarily ordered according to the contestant's abilities, and these probabilities depend on the contest design (see, Groh et al., 2003).

[2] See Baye et al. (1993, 1994, 1996).

[3] A player with a higher valuation can be thought of as being more able.