



# The theory of contests: A unified model and review of the literature

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## ABSTRACT

This paper is a brief review of the literature on contests, with focus on rent-seeking. A fairly general contest model is presented. We show that the Tullock contest model and the first-prize sealed-bid auction model are obtained as special cases. Some important modifications of the basic model are reviewed: hierarchical rent-seeking, rent-seeking under risk aversion, insecure rents, sabotage in rent-seeking contests, contest design, commitment and endogenous order of moves, and dynamic rent-seeking.

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## 1. Introduction

Contests are a pervasive fact of life, both in the human and the non-human spheres. Frank Knight (1935, p. 301) saw games of contest as an essential feature of economic life:

“The activity which we call economic, whether of production or of consumption or of the two together, is also, if we look below the surface, to be interpreted largely by the motives of the competitive contest or game, rather than those of mechanical utility functions to be maximized.”

In a similar fashion, Veblen (1924) emphasized the pervasiveness of emulation, which he defined as “the stimulus of an invidious comparison which prompts us to outdo those with whom we are in the habit of classing ourselves.” He believed that “with the exception of the instinct for self-preservation, the propensity for emulation is probably the strongest and most alert and persistent of economic motives proper.” Emulation can lead to direct contests, and to wasteful use of resources.

Contests may serve socially useful functions such as the selection of the best candidate for a position. Quite often, however, contests give rise to processes whereby individuals or groups try to influence political or bureaucratic decisions in their favor. As Congleton (1980, p. 154) put it, “if one’s opportunity set is not entirely determined externally by forces beyond the influence of an individual actor, situations are very likely to arise in which an economically rational individual will use the resources at his disposal to influence his range of options at the expense of others.” The theory of rent-seeking views contests as an inevitable feature of political discretion.

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This paper reviews the theory of contests, with a primary focus on the relationship between the rent and the efforts to capture rent. In particular, we will identify situations where rent dissipation is, or is not, complete. One of the main reasons for investigating special features of rent-seeking contests is to establish guidelines for estimating the value of wasted resources in various rent-seeking situations. As Tullock (1967), Krueger (1974) and others have argued, estimates of national income should in principle be adjusted to deduct the wasteful use of real resources.<sup>1</sup>

Since the publication of an excellent survey of the literature on contests (Nitzan, 1994), the economic profession has continued to add new insights to the analysis of rent-seeking, some of which are reported in the present paper. For a complementary and insightful survey with greater emphasis on conceptual issues, see Hillman (2013). A recent volume of readings on the theory of rent-seeking edited by Congleton et al. (2008a,b) also contains a useful guide to the literature. Readers interested in greater technical details are referred to the beautifully crafted monograph by Konrad (2009).

In Section 2, a fairly general contest model is explained. We show that the Tullock contest model and the first-prize sealed-bid auction model are obtained as special cases, and their implications are explored. Section 3 deals with some important modifications of the basic model: hierarchical rent-seeking, rent-seeking under risk aversion, insecure rents, and sabotage in rent-seeking contests. Section 4 discusses further extensions of the model: contest design, commitment and endogenous order of moves, and dynamic rent-seeking. Section 5 offers concluding remarks.

## 2. The basic model

In this section we introduce the basic setting and show how two main contest models can be obtained from it: the first-prize sealed-bid all-pay auction, and the standard Tullock contest.

### 2.1. The basic setting and some general results

Consider a simple setting. There are  $n$  contestants. A prize will be awarded to the winner of the contest.<sup>2</sup> Let  $V_i$  be contestant  $i$ 's valuation of the prize. Without loss of generality, we can index the contestants such that  $V_1 \geq V_2 \geq V_3 \geq \dots \geq V_n > 0$ . The contestants expend efforts (or outlays) in order to influence their probability of winning. Let  $y_i$  denote contestant  $i$ 's effort. The cost of effort is  $C(y_i) = y_i$ .

Since contestants' efforts are not necessarily equally effective, to make them comparable, we assume that a contestant's effort is turned into *effective effort*, denoted by  $z_i$ , under an "effective effort production function"  $f_i(y_i)$ , which in general may differ across individuals:

$$z_i = f_i(y_i)$$

We assume that  $f_i(y)$  is a monotone increasing function, with  $f_i(0) = 0$  and  $f_i'(y_i) > 0$ .

The sum of the effective efforts is  $Z = \sum_{j=1}^n z_j$ . We call  $Z$  the aggregate effective effort. Assume that if  $Z > 0$ , then the probability that contestant  $i$  wins the contest,  $\pi_i$ , is equal to the ratio  $z_i/Z$ . We suppose that in the case where  $Z = 0$ , then all the contestants have an equal probability of winning,  $1/n$ .

Formally,

$$\pi_i = \begin{cases} \frac{z_i}{Z} = \frac{f_i(y_i)}{f_i(y_i) + \sum_{j \neq i} f_j(y_j)} & \text{if } Z > 0 \\ \frac{1}{n} & \text{if } Z = 0 \end{cases}$$

Let  $Z_{-i}$  denote the sum of the effective efforts of all contestants except that of  $i$ . Contestant  $i$  takes  $Z_{-i}$  as given, and chooses  $y_i \geq 0$  to maximize her expected payoff:

$$\max_{y_i} \left( \frac{f_i(y_i)}{Z_{-i} + f_i(y_i)} V_i \right) - y_i$$

All contestants must choose their efforts simultaneously. The solution concept is Nash equilibrium. A pure strategy Nash equilibrium is an action profile  $(y_1, y_2, \dots, y_n)$  such that no contestant can improve her expected payoff by deviating from it. A mixed strategy Nash equilibrium is a profile of cumulative probability distributions  $(F_1, F_2, \dots, F_n)$  such that no contestant can

<sup>1</sup> Krueger (1974) calculated that in India in 1964, total rents amounted to 7.3% of GDP. Two thirds of these rents were associated with import licenses. She found that in 1968, quota rents in Turkey were about 15% of GDP. By including other distortions, Mohammed and Whalley (1984) obtained a much higher estimate of contestable rents in India: around 30% to 45% of GDP. See also Angelopoulos et al. (2009), and Laband and Sophocleus (1992).

<sup>2</sup> Here we assume that the prize is awarded to the winner of the contest. In a more general context, an interesting issue that may arise is: can contestants refuse to contest and, instead, opt to share the prize among themselves, through bargaining? If so, when would they prefer contesting to bargaining? For a model of contested water rights with possibility of bargaining, see Ansink and Weikard (2009). They show that if there is the possibility of third party intervention in the event of contest, and contestants have different expectation of the success of third party intervention, they might prefer contesting to bargaining.

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