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### Credibility and Duration of Political Contests and the Extent of Rent Dissipation

Kahana, N.; Nitzan, S.

*Publication date:*  
1993

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*Citation for published version (APA):*

Kahana, N., & Nitzan, S. (1993). *Credibility and Duration of Political Contests and the Extent of Rent Dissipation*. (CentER Discussion Paper; Vol. 1993-1). CentER.

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**CREDIBILITY AND DURATION OF  
POLITICAL CONTESTS AND THE EXTENT  
OF RENT DISSIPATION**

**by Nava Kahana  
and Shmuel Nitzan**

January 1993

ISSN 0924-7815

CREDIBILITY AND DURATION OF  
POLITICAL CONTESTS AND THE EXTENT  
OF RENT DISSIPATION\*

Nava Kahana      Shmuel Nitzan

October, 1992

Department of Economics, Bar Ilan University, Ramat Gan 52900, Israel

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\*This paper was completed while the second author was visiting Center for Economic Research at Tilburg University; the author is grateful to the Center for its hospitality and support.

### **Abstract**

Underdissipation of a contested rent in an imperfectly discriminating contest might be due to risk-aversion, a small number of contestants or public good characteristics of the rent. This paper shows how underdissipation is associated with imperfect government credibility. In particular we study the relationship between the extent of rent dissipation and the duration of the contest and government credibility. When the rent is preassigned to potential beneficiaries total rent dissipation is demonstrated to be less than 30%. We also obtain the combinations of contest duration and government credibility yielding the maximal rent-seeking outlays.

## 1 Introduction

This paper is concerned with the effect of incomplete government credibility and of the duration of the government ruling period on the outlays made in imperfectly discriminating rent-seeking contests, Hillman (1986). In our extended dynamic rent-seeking game the potential beneficiaries of a privately appropriable transfer attempt to influence the political allocation mechanism. This happens when the transfer is contestable, and also when the transfer is preassigned but uncertain (the government commitment credibility to award the rent during its ruling period is imperfect). In this latter situation an individual does not compete against other potential beneficiaries, but against nature trying to secure his receiving of the preassigned transfer while the government is still in office.

In imperfectly discriminating contests rent dissipation is complete when the competitors are identical risk-neutral individuals, the number of contestants is sufficiently large and the transfer is a private good transfer, Tullock (1980). Subsequent studies have shown that the contested rent is underdissipated when the contenders are risk averse, Hillman and Katz (1984), the individuals' valuations of the prize are not identical, Hillman and Riley (1989), the contested rent has public good characteristics, Katz et al. (1990), Ursprung (1990), or when groups of individuals compete on a private good rent, Nitzan (1991). In the current study we introduce another possible source of underdissipation, viz. imperfect government credibility.

Our extended rent-seeking game is presented in the following section. Section 3 which contains the results of the equilibrium analysis is divided into four subsections. In the first one we provide the conditions ensuring that the political contest is effective, namely, that the players expand resources in trying to win the rent. In the second subsection we show that the rent is underdissipated. The third part contains the comparative statics results. In the fourth subsection we study the case of preassigned or earmarked rents where the competition element is neutralized. The extent of rent dissipation in this special case is compared to that of the general case. We also derive a limit to underdissipation when the rents are preassigned. The conclusions of our study are presented in the final section.

## 2 The Framework

Consider  $n$  risk neutral identical individuals confronting the opportunity of winning a prespecified continuous transfer  $S$ . This transfer, which is allocated by the ruling government, is referred to as a contestable rent. The government stays in office for a fixed period  $T$ . In our imperfectly discriminating contest the political process cannot discriminate among the competing individuals to designate a winner at a certain time with certainty, but rather the outcome of the contest is the assignment to each individual of a probability that he wins the contest at time  $t$ ,  $t \in [0, T]$ . An individual winning the contest at time  $t$  secures the continuous transfer  $S$  from the winning time until the end of the government ruling period, i.e., his total gain will be equal to  $S[T - t]$ .

The probability that an individual is the successful contender at time  $t$  depends on his and the other competitors' continuous rent-seeking outlays  $x_j$ ,  $j = 1, \dots, n$  and on the parameter  $\delta$ ,  $\delta > 0$ , representing the credibility of the government or, alternatively, the determination of the government to respect its commitment and actually make the promised transfer. Each player in our game competes against the other contenders as well as against time. He may lose the game and irretrievably lose the outlays which he made in the attempt to influence the outcome of the contest in his favor either because some other contender wins the contest or because time is run out and nobody wins the contest.

The individual enforceable outlays commitment is made at  $t = 0$ . This implies that his total rent-seeking outlays are in fact equal to  $Tx_i$ , regardless of whether he or any other contender wins the contest at some time  $t$ ,  $t < T$ . Note that in our model the individual's rent is uncertain ranging between 0 and  $ST$  and that it is possible that nobody wins the contest. The probability that individual  $i$  wins the contest in the immediate next instant, given that no one won the contest yet, is assumed to be proportional to  $x_i$  and  $\delta$ . Formally, let  $t_i$  denote the time individual  $i$  wins the contest. Then

$$\text{prob} \{t_i \in [t, t + dt] : t_j > t_i, j \neq i\} = \delta x_i dt, \quad i, j = 1, \dots, n.$$

It can be shown that given the above conditional probability, the density function of success by individual  $i$  to win the contest at time  $t$  is  $e^{-\delta X t} \delta x_i$  and the density function

of failure by individual  $i$  to win the contest at time  $t$  is  $e^{-\delta X t} \delta X_{-i}$ , where  $X = \sum_{i=1}^n x_i$  and  $X_{-i} = \sum_{j \neq i} x_j$ . Given the individual outlay commitments  $(x_1, \dots, x_n)$ , the expected time of winning the contest is given by

$$E(t) = \int_0^{\infty} t e^{-\delta X t} \delta X dt = \frac{1}{\delta X}.^1$$

Note that  $\frac{1}{\delta}$  can be interpreted as a measure for the discredibility of the government or of the degree of difficulty of winning the contest.

Given the individual endowed wealth  $yT$  and the  $n$  individuals' rent-seeking outlays  $(x_1, \dots, x_n)$ , the expected payoff of individual  $i$  during the government ruling period  $[0, T]$  is given by  $R$ ,<sup>2</sup>

$$\begin{aligned} R &= \int_0^T S(T-t) e^{-\delta X t} \delta x_i dt + (y - x_i)T = \frac{x_i}{X} \int_0^T S(T-t) e^{-\delta X t} \delta X dt + (y - x_i)T \\ &= \frac{x_i}{X} SB(X) + (y - x_i)T \end{aligned} \quad (1)$$

where  $B(X) = [T - \frac{1}{\delta X}(1 - e^{-\delta X T})]$ .

$(1 - e^{-\delta X T})$  is the probability that the contest is won by some individual before  $T$ .<sup>3</sup>  $\frac{1}{\delta X}$  is the expected winning time. The expected time of winning the contest conditional on the termination of the contest before  $T$  is therefore equal to  $\frac{1}{\delta X}(1 - e^{-\delta X T})$ . In turn,  $B(X)$  is the corresponding conditional expected duration of the period during which the transfer  $S$  is received and  $SB(X)$  is the expected total rent (transfer) conditional on there being a winner in the contest.

Interestingly, Tullock's (1980) rent-seeking contest is obtained as a special case of our model when there is no uncertainty regarding the government's ability to stand behind its commitment. Specifically, when  $\delta \rightarrow \infty$  the total transfer is equal to  $ST$  and

$$R = \frac{x_i}{X} ST + (y - x_i)T \quad (2)$$

which is precisely the payoff function of agent  $i$  in Tullock's game. In such a case our dynamic contest reduces of course to a static one.

In the rent-seeking literature the individual is assumed to compete against other agents and therefore the number of contenders  $n$  is at least 2. In our extended model



the contest is viable even when  $n = 1$ . Furthermore, this latter extreme case is not so peculiar since in many political-economic environments the government transfer pattern is strictly constrained. Often, politicians do not have discretion regarding the manner in which they can allocate their available budgets. In particular, under earmarking of the available budgets multi-agent contests are not likely to arise. Still, the candidate recipient of the budget may need to “compete” and spend resources in order to secure his winning of the rent, i.e., receive the designated budget while the government is still in office. The special case of a single-member contest thus merits attention and is separately analyzed in the following section. We are also concerned with the comparison of the outcome of an  $n$ -member contest on budget of size  $S$  with the outcome of  $n$  single-member contests on the same total budget where in each single-member contest the individual can win a rent equal to  $\frac{S}{n}$ .

### 3 Results

#### A. Effective Contests

In a pure strategy Nash equilibrium of our rent-seeking game,  $(x_1^*, \dots, x_n^*)$ , each individual  $i$  solves the problem:

$$\max_{x_i} R(x_1, \dots, x_n; \delta, S, T) = R(x_i, x_{-i}; \delta, S, T) \quad (3)$$

$$\text{s.t } 0 \leq x_i \leq y \text{ and } x_{-i} = x_{-i}^*.$$

In a symmetric Nash equilibrium  $x_1^* = x_2^* = \dots = x_n^* = x^*$ . In such equilibrium the players may prefer to be passive and avoid spending any resources. That is, it is possible that the contest is ineffective, i.e.,  $x^* = 0$ . In the following proposition we establish that this possibility is ruled out when the government is in office a sufficiently long period  $T$ , when its credibility  $\delta$  is sufficiently high or when the contestable rent  $S$  is large enough.

**Proposition 1 :**  $x^* > 0$  if  $T > \frac{2}{\delta S}$ .

**Proof:** By the second order condition for  $x^*$  to be a solution of (3),  $\frac{\partial^2 R}{\partial x_i^2} < 0$ . To prove the proposition, we will show that  $T > \frac{2}{\delta S}$  implies that  $\lim_{x \rightarrow 0} \frac{\partial R}{\partial x_i} > 0$ .

$$\frac{\partial R}{\partial x_i} = \frac{S X_{-i} B(X)}{X} + \frac{S x_i \partial B(X)}{X \partial X} - T \quad (4)$$

where

$$\frac{B(X)}{X} = \frac{T}{X} + \frac{e^{-\delta X T}}{\delta X^2} - \frac{1}{\delta X^2} \quad (5)$$

and

$$\frac{\partial B(X)}{\partial X} = \frac{1}{\delta X^2} - \frac{T e^{-\delta X T}}{X} - \frac{e^{-\delta X T}}{\delta X^2}. \quad (6)$$

In a symmetric Nash equilibrium then,

$$\frac{\partial R}{\partial x_i} \Big|_{x_1=\dots=x_n=x} = \frac{\partial R}{\partial x} = \frac{(n-1) S B(X)}{n X} + \frac{S \partial B}{n \partial X} - T. \quad (7)$$

By l'Hospital rule,

$$\begin{aligned} \lim_{X \rightarrow 0} \frac{B(X)}{X} &= \lim_{X \rightarrow 0} \frac{T X \delta + e^{-\delta X T} - 1}{\delta X^2} = \lim_{X \rightarrow 0} \frac{T \delta - \delta T e^{-\delta X T}}{2 \delta X} \\ &= \lim_{X \rightarrow 0} \frac{\delta^2 T^2 e^{-\delta X T}}{2 \delta} = \frac{\delta T^2}{2}. \end{aligned} \quad (8)$$

$$\begin{aligned} \lim_{X \rightarrow 0} \frac{\partial B}{\partial X} &= \lim_{X \rightarrow 0} \frac{1 - \delta X T e^{-\delta X T} - e^{-\delta X T}}{\delta X^2} \\ &= \lim_{X \rightarrow 0} \frac{-\delta T e^{-\delta X T} + \delta^2 T^2 X e^{-\delta X T} + \delta T e^{-\delta X T}}{2 \delta X} = \frac{\delta T^2}{2}. \end{aligned} \quad (9)$$

Hence,

$$\lim_{x \rightarrow 0} \frac{\partial R}{\partial x} = \frac{S \delta T^2}{2} - T > 0 \Leftrightarrow T > \frac{2}{\delta S}. \quad (10)$$

□

## B. Incomplete Rent Dissipation

An interior equilibrium,  $(x^*, \dots, x^*)$ ,  $0 < x^* < y$ , is characterized by the following equation:

$$\frac{\partial R}{\partial x} = \frac{(n-1) S B(X^*)}{n X^*} + \frac{S \partial B(X^*)}{n \partial X} - T = 0. \quad (11)$$

The total rent-seeking outlays in such an equilibrium is equal to  $X^* = nx^*$ . In our dynamic setting the uncertainty regarding the commitment of the government entails underdissipation of the contested rent. That is,

**Proposition 2 :**  $X^* < S$ .

**Proof:** We show below that at  $X = S$ ,  $\frac{\partial R}{\partial x} < 0$ . By the second order condition,  $\frac{\partial^2 R}{\partial x^2} < 0$  which implies that  $X^* < S$ .

For  $X = S$ ,

$$\frac{\partial R}{\partial x} = \frac{n-1}{n} \left( T - \frac{1}{\delta S} + \frac{e^{-\delta ST}}{\delta S} \right) + \frac{1}{n} \left( \frac{1}{\delta S} - T e^{-\delta ST} - \frac{e^{-\delta ST}}{\delta S} \right) - T. \quad (12)$$

By proposition 1,  $X^* > 0$  implies that  $T > \frac{1}{\delta S} > \frac{1}{\delta S}$ . Note that  $0 < e^{-\delta ST} < 1$  and therefore,  $\frac{e^{-\delta ST}}{\delta S} < \frac{1}{\delta S}$ . Hence,

$$\frac{\partial R}{\partial x} < \frac{n-1}{n} T + \frac{1}{n} T - T + \frac{n-1}{n} \left( \frac{1}{\delta S} - \frac{1}{\delta S} \right) - \frac{T e^{-\delta ST}}{n} - \frac{e^{-\delta ST}}{n \delta S} < 0. \quad (13)$$

□

Incomplete credibility of the government generates incomplete rent dissipation. It is also detrimental to the individual welfare; The fact that  $e^{-\delta ST} < 1$  imply that the individual utility is reduced relative to the case of complete government credibility (compare (1) and (2)).

### C. Comparative Statics

In the following proposition we obtain the intuitive result that total rent-seeking outlays are positively related to the size of the contestable rent and to the credibility of the government. More surprisingly, the contest duration effect is also unambiguous; for  $n \geq 2$  the extent of rent dissipation is positively related to the duration of the contest.

**Proposition 3 :** (i)  $\frac{\partial X^*}{\partial S} > 0$  (ii)  $\frac{\partial X^*}{\partial \delta} > 0$  (iii)  $\frac{\partial X^*}{\partial T} > 0$ .

**Proof:**

$$(i) \frac{\partial X^*}{\partial S} = \frac{-\left[\frac{n-1}{n} \frac{B(X^*)}{X^*} + \frac{1}{n} \frac{\partial B(X^*)}{\partial X}\right]}{\frac{\partial^2 R}{\partial X^2}}. \quad (14)$$

Substituting the equilibrium condition (11) into (14) we obtain:

$$\frac{\partial X^*}{\partial S} = \frac{-T}{S \frac{\partial^2 R}{\partial x^2}} > 0. \quad (15)$$

$$\begin{aligned} (ii) \frac{\partial X^*}{\partial \delta} &= \frac{-\left\{\frac{n-1}{n} S \left[-\frac{e^{-\delta X^* T}}{\delta^2 X^{*2}} - \frac{T e^{-\delta X^* T}}{\delta X^*} + \frac{1}{\delta^2 X^{*2}}\right] + \frac{S}{n} \left[-\frac{1}{\delta^2 X^{*2}} + T^2 e^{-\delta X^* T} + \frac{e^{-\delta X^* T}}{\delta^2 X^{*2}} + \frac{T e^{-\delta X^* T}}{\delta X^*}\right]\right\}}{\frac{\partial^2 R}{\partial x^2}} \\ &= \frac{-\left\{\left(\frac{n-2}{n}\right) S \left[\frac{1}{\delta^2 X^{*2}} - \frac{T e^{-\delta X^* T}}{\delta X^*} - \frac{e^{-\delta X^* T}}{\delta^2 X^{*2}}\right] + S \frac{T^2 e^{-\delta X^* T}}{n}\right\}}{\frac{\partial^2 R}{\partial x^2}} \\ &= \frac{-\left\{\frac{n-2}{n} \frac{S}{\delta} \frac{\partial B(X^*)}{\partial X} + \frac{S T^2 e^{-\delta X^* T}}{n}\right\}}{\frac{\partial^2 R}{\partial x^2}}. \end{aligned}$$

Denoting  $\frac{\partial B}{\partial X}$  by  $G(T)$ , one can readily verify (see (6)) that  $G(0) = 0$  and  $\frac{\partial G}{\partial T} = \delta T e^{-\delta X^* T} > 0$ . Hence, for  $T > 0$ ,  $G(T) = \frac{\partial B}{\partial X} > 0$  which implies that, for  $n \geq 2$ ,  $\frac{\partial X^*}{\partial \delta} > 0$ .

$$(iii) \frac{\partial X^*}{\partial T} = \frac{\left\{\frac{n-1}{n} S \left[\frac{1}{X^*} - \frac{e^{-\delta X^* T}}{X^*}\right] + \frac{S}{n} \delta T e^{-\delta X^* T} - 1\right\}}{-\frac{\partial^2 R}{\partial x^2}}, \quad (16)$$

Substituting the equilibrium condition (11) into (16) we obtain:

$$\frac{\partial X^*}{\partial T} = \frac{\frac{n-2}{n} \frac{S}{T} \frac{\partial B(X^*)}{\partial X} + \frac{S}{n} \delta T e^{-\delta X^* T}}{-\frac{\partial^2 R}{\partial x^2}}. \quad (17)$$

For  $n \geq 2$  and given that  $\frac{\partial B}{\partial X} > 0$ ,  $\frac{\partial X^*}{\partial T} > 0$ .  $\square$

A longer contest implies both an increased prize and higher chances that the contest is won. The increased expected reward stimulates higher rent-seeking outlays. However, the increased likelihood of success has two contrasting effects on  $X^*$ . On the one hand, the ‘‘competition’’ effect (see the first term in the nominator of (16)) induces the players to intensify their efforts in attempting to win the contest. On the other hand, when the competition effect is disregarded, a longer contest implies that time is working harder for the individual player and for a sufficiently large  $T$ , despite the income effect, an increase in  $T$  may reduce the individual incentives to spend resources (see the second term in

the nominator of (16)). Under a viable competition,  $n \geq 2$ , the former positive effect is dominant ensuring the unambiguous relationship between the duration of the contest and the extent of rent dissipation.

#### D. Preassigned Rents: The Single Player Case

Let  $n = 1$ . In this case of minimal competition the politicians do not have discretion regarding the manner in which they can allocate their budget. Rather the budget is earmarked. The contest, which can now be interpreted as a game against nature, is still viable since the potential recipient of the budget can affect his chance of receiving the rent. To compare the extent of rent dissipation under the multi-member rent-seeking contest,  $n \geq 2$ , and the single-member competition against time, suppose that in the latter case each individual is allocated a budget which is equal to  $s = \frac{S}{n}$ . An optimal rent-seeking outlay  $x_0$  is now characterized by the following condition:

$$\frac{\partial R}{\partial x} = s \left[ \frac{1}{\delta x_0^2} - \frac{T e^{-\delta x_0 T}}{x_0} - \frac{e^{-\delta x_0 T}}{\delta x_0^2} \right] - T = 0. \quad (18)$$

It turns out that the total rent-seeking outlays in an  $n$ -member contest,  $n \geq 2$ , are larger than the resources expended by  $n$  individuals who separately compete just against the running time in attempting to receive their equal share  $\frac{S}{n}$  in the total budget distributed.

**Proposition 4** :  $x_0 < x^*$ .

**Proof:** Let  $Z(n, x) = (n-1)\frac{B}{X} + \frac{\partial B}{\partial X}$ .

The multi-player equilibrium condition (11) can therefore be rewritten as:

$$\frac{\partial R}{\partial x} \Big|_{n \geq 2} = \frac{S}{n} Z(n, x) - T = 0 \quad (19)$$

and the single-player equilibrium condition (18) can be written as:

$$\frac{\partial R}{\partial x} \Big|_{n=1} = \frac{S}{n} Z(1, x) - T = 0. \quad (20)$$

By Lemma 4.1 which is proven below,  $Z(n, x)$  is increasing in  $n$ . Hence, for  $n \geq 2$ ,  $Z(n, x) > Z(1, x)$ . This implies that for  $x = x_0$ ,  $\frac{\partial R}{\partial x} \Big|_{n \geq 2} > 0$ . By the second or-

der condition,  $\frac{\partial^2 B}{\partial x^2} |_{n \geq 2} < 0$ , which means that  $x_0 < x^*$ .

**Lemma 4.1:** 
$$\frac{\partial Z(n, x)}{\partial n} > 0.$$

**Proof:** 
$$\begin{aligned} \frac{\partial Z(n, x)}{\partial n} &= \frac{B(X)}{X} + \frac{(n-1) \left( \frac{\partial B}{\partial X} X - B(X) \right) x}{X^2} + \frac{\partial^2 B}{\partial X^2} x \\ &= \frac{B(X)}{X} + \frac{n-1}{n} \left( \frac{\partial B}{\partial X} - \frac{B(X)}{X} \right) + \frac{X}{n} \frac{\partial^2 B}{\partial X^2} \\ &= \frac{1}{n} \left[ \frac{B(X)}{X} + X \frac{\partial^2 B}{\partial X^2} \right] + \frac{n-1}{n} \frac{\partial B}{\partial X}. \end{aligned}$$

We proved earlier that  $\frac{\partial B}{\partial X} > 0$ . We therefore complete the proof of the lemma by showing that  $\left[ \frac{B}{X} + X \frac{\partial^2 B}{\partial X^2} \right] > 0$ .

$$\frac{B}{X} + X \frac{\partial^2 B}{\partial X^2} = \frac{1}{X} \left( T - \frac{3}{\delta X} + \frac{3e^{-\delta XT}}{\delta X} + 2T e^{-\delta XT} + \delta X T^2 e^{-\delta XT} \right) = \frac{1}{X} A(T).$$

Note that  $A(0) = 0$  and  $\frac{\partial A}{\partial T} = 1 - e^{-y} - y^2 e^{-y} = D(y)$  where  $y = \delta XT$ . Note that  $D(0) = 0$  and  $\frac{\partial D}{\partial y} = (1-y)^2 e^{-y} \geq 0$  ( $\frac{\partial D}{\partial y} = 0$  for  $y = 1$ ). Hence,  $\frac{\partial A}{\partial T} > 0$  and  $A(T) > 0$  for  $T \neq 0$ .  $\square$

The analysis of the effect of a change in the duration of the contest on the rent-seeking outlays does not yield an unambiguous result as in Proposition 3(iii). This is due to the fact that the positive ‘‘competition effect’’ vanishes (see the first term in the nominator of (16)). In the single-member contest,  $\frac{\partial x_0}{\partial T} = \frac{\delta T e^{-\delta x_0 T} - 1}{-\frac{\partial^2 B}{\partial x^2}}$ . By substituting (18) into  $\frac{\partial x_0}{\partial T}$  we obtain that  $\frac{\partial x_0}{\partial T} = \frac{H(k)}{-\frac{\partial^2 B}{\partial x^2}}$  where  $k = \delta x_0 T$  and  $H(k) = -1 + k^2 e^{-k} + e^{-k} + k e^{-k}$ .

The function  $H(k)$  satisfies the following properties:

- (i)  $H(0) = 0$ .
- (ii)  $\lim_{k \rightarrow \infty} H(k) = -1$ .
- (iii)  $H'(k) = k(1-k)e^{-k}$  and therefore  $H'(k) \geq 0$  if  $k \geq 1$ .

Hence, there exists  $k_0 > 1$  such that  $H(k) > 0$  for  $0 < k < k_0$  and  $H(k) < 0$  for  $k > k_0$ . Since  $x_0$  is a function of  $T$ , one needs to check that  $k = \delta x_0 T$  is not greater or smaller than  $k_0$  for any  $T > 0$ . It is clear from the sequel that these two possibilities do not occur.

That is, for any given  $\delta$  there exists  $T^*$  such that  $\delta x_0 T^* = k_0$ ,  $\delta x_0 T < k_0$  for  $T < T^*$  and  $\delta x_0 T > k_0$  for  $T > T^*$ . In turn, for  $T < T^*$ ,  $\frac{\partial x_0}{\partial T} > 0$  and for  $T > T^*$ ,  $\frac{\partial x_0}{\partial T} < 0$ . Clearly, this  $T^*$  maximizes the individual rent-seeking outlays. Our next natural question is what is the maximal degree of rent dissipation corresponding to  $T^*$ .

Clearly, this maximal level constitutes a limit to the extent of rent dissipation in the constrained environment where rent recipients compete against time but not against other recipients. The following proposition provides the answer to the above question.

**Proposition 5** : Given  $\delta$  and  $S$ ,  $\text{Max}_T \frac{x_0(T;s,\delta)}{s} = \frac{n x_0(T^*;s,\delta)}{S} = 0.298$ .

**Proof:** The government ruling period  $[0, T^*]$  maximizing the extent of rent dissipation given  $s$  and  $\delta$  satisfies the following first order condition:

$$\frac{\partial x_0}{\partial T} = \frac{s\delta T e^{-\delta x_0 T} - 1}{-\frac{\partial^2 R}{\partial x^2}} = 0 \quad (21)$$

or, equivalently,

$$e^{-cx_0/s} = \frac{1}{c} \quad \text{where } c = s\delta T, \quad (22)$$

or

$$\frac{x_0}{s} = \frac{\ln c}{c}. \quad (23)$$

To solve for  $c$ , let us substitute (23) into (18), the condition characterizing the optimal rent-seeking outlay  $x_0$ , to obtain

$$\frac{1}{\ln^2 c} - \frac{1}{\ln c} e^{-\ln c} - \frac{1}{\ln^2 c} e^{-\ln c} = \frac{1}{c}. \quad (24)$$

Let  $y = \ln c$  and so,  $c = e^y$ . (24) can then be rewritten as follows:

$$e^y = y^2 + y + 1. \quad (25)$$

The solution of (25) is given by  $y = 1.791$ . By (23),  $\frac{x_0(T^*; \delta)}{s} = \frac{\ln 6}{6} = 0.298$ .  $\square$

A government interested in the maximization of rent-seeking outlays has an optimal contest duration which is given by  $T^* = \frac{c}{s\delta} = \frac{e^y}{s\delta} = \frac{6}{s\delta}$ . Alternatively, when  $T$  is a given parameter, such a government has an optimal credibility level which is equal to  $\delta^* = \frac{6}{sT}$ . This implies that the more credible the government, the shorter its preferred ruling time. And the longer the ruling period, the lower its preferred level of credibility. In any event, by Proposition 5, the maximal extent of rent dissipation is invariant to the level of the parameters and to whether the government controls  $T$  or  $\delta$ .

## 4 Conclusions

In our simple model of rent seeking under uncertainty the identical risk-neutral potential beneficiaries of the rent recognize that the government is not perfectly credible and thus may not stand behind its commitment and actually transfer the promised rent. If government credibility  $\delta$  is sufficiently low, the period it is ruling  $[0, T]$  is sufficiently short or the rent  $S$  is sufficiently small, the potential beneficiaries have no incentive to expand resources in attempting to win the rent (Proposition 1). In an interior symmetric Nash equilibrium the rent is underdissipated (Proposition 2). The extent of rent dissipation is positively related to the size of the rent. If the number of contenders is at least two, it is also positively related to the contest duration and to the government credibility level (Proposition 3). When the rents or income transfers are preassigned to designated beneficiaries, competition among players is neutralized. That is, each potential beneficiary is the single player in a game against nature. The extent of rent dissipation in an  $n$ -member contest on  $S$ ,  $n \geq 2$ , is larger than the extent of rent dissipation in an



environment where  $n$  individuals independently compete just against nature in attempting to win their designated rent which is equal to  $\frac{\bar{r}}{n}$  (Proposition 4). In this latter case the extent of rent dissipation is no longer always positively related to the government ruling period or to its credibility. It turns out that there exists a ruling period  $T^*$  which maximizes the extent of rent dissipation. The maximal rent dissipation is equal to 0.298 and it is invariant to the parameters of the game (Proposition 5).

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## Footnotes

1. Notice that

$$\frac{\partial(e^{-\delta X t} \delta x_i)}{\partial \delta} = e^{-\delta X t} x_i (1 - \delta X t) \begin{matrix} \geq 0 \\ < 0 \end{matrix} \Leftrightarrow t \begin{matrix} \leq \\ > \end{matrix} \frac{1}{\delta X} = E(t).$$

2. For simplicity we assume that the discount factor is equal to zero. This assumption has no effect on the insight of our results.
3. Let  $F(t, x_i)$  denote the cumulative distribution of success by individual  $i$  to win the contest by time  $t$  given that his rent-seeking outlay is  $x_i$ . Then, his conditional probability to win the contest at time  $t$ , is:

$$\frac{F'}{1 - F} = \delta x_i.$$

By integration we obtain:

$$-\ln(1 - F) = \delta x_i t.$$

Hence,

$$1 - F = e^{-\delta x_i t}.$$

The probability that by  $t$  no one wins the contest is given by  $\prod_{i=1}^n (1 - F(t, x_i)) = e^{-\delta \sum x_i t} = e^{-\delta X t}$ , which means that the probability that the contest is won by some individual before  $T$  is equal to  $(1 - e^{-\delta X T})$ .

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