

## I. Introduction to Rent-Seeking (from Congleton, Hillman and Konrad 2008)

- A. Rent-seeking activities include a far broader range of activities than lobbying the government for special favors, although that is the most studied form of rent seeking, and the activity that the term is most often used to describe.
- Rent-seeking activities can be thought of (more generally) as a class of negative sum games in which the “negative sum” applies to players inside the game and outside the game or contest of interest.
  - To the extent that market activities can be represented using similar contests, many of those activities are negative sum for the players (firms) but positive sum when you include the benefits that consumers get from the competitive efforts of firms (price competition, product development, locational competition, informative advertising, innovation in production technologies, etc.).
  - At least a subset of political activities by interest activities can be regarded in the same way, insofar as they produce significant benefits for the average citizen by improving public policies.
  - Unfortunately, not all political contests have such benign properties.
- B. In the introduction to our 2008 collection of the best papers on rent-seeking, we put it as follows:
- i. The quest for rents has always been part of human behavior. People have long fought and contended over possessions, rather than directing abilities and resources to productive activity.
    - a. The great empires and conquests were the consequences of successful rent seeking. Resources were also expended in defending the rents that the empires provided.
    - b. The unproductive use of resources to contest, rather than create wealth, also occurred within societies in attempts to replace incumbent rulers and in seeking the favor of rulers who dispensed rewards and indeed often determined life and death.
    - c. Sacrifices made by early peoples to their deities were instances of rent seeking; valuable possessions were given up with the intent of seeking to influence assignment of other rewards. In contemporary times, rent seeking takes place within democratic institutions and also under conditions of autocracy that are akin to the circumstances of the earlier rent-dispensing despots.

- d. Incentives for rent seeking are present whenever decisions of others influence personal outcomes or more broadly when resources can be used to affect distributional outcomes.
- ii. The search for rents, defined as rewards and prizes not earned or well above competitive market returns, is, thus, clearly ancient.
  - a. Efforts to understand how wealth, status, and other rewards can be acquired, and how contests for such prizes can be designed to reduce losses associated with unproductive conflict and encourage productive forms of competition, are also likely to have begun at the dawn of social life.
  - b. The academic rent-seeking literature, however, is relatively new and emerged from papers by Gordon Tullock, Anne Krueger, and Richard Posner published during the course of some 10 years in the 1960s and 1970s (reprinted in these volumes, e.g. Congleton, Hillman, and Konrad 2008).
- iii. The early rent-seeking analyses attempted to develop more accurate measures of social losses from public policies and monopoly.
  - a. Tullock, Krueger, and Posner argued that the resources used to establish, maintain, or eliminate trade restrictions and monopolies are part of the social cost of those policies, but had previously been neglected.
    - The early models assumed that there was complete dissipation of the “profits” or “rents” created by the rent-seekers.
    - After 1980, this result (assumption) was no longer taken for granted, although there were more sophisticated models of the contests that reached the same conclusion as these classic treatments (Hillman and Samat 1987).
- iv. The core idea has also been formalized and analyzed more rigorously, using the tools of modern game theory.
  - Most of the rent-seeking literature analyzes the rational decision to invest in contesting pre-existing wealth or income, rather than undertaking productive activity.
  - Such activities have an opportunity cost, which tends to imply that such contests are negative sum games overall.
  - Bagwatti calls such activities: Directly UnProductive Efforts: DUPE.
- v. As noted above, the idea that resources are unproductively used in rent-seeking contests has much broader application than the initial rent-seeking papers suggested.
  - See for example Robert Frank, including his book on positional games and winner take all games.

- The rent-seeking logic has been applied to issues in history, sociology, anthropology, biology, and philosophy
- vi. Although many researchers think of rent-seeking as an effort to secure transfers of one kind or another, this language is not the best one for thinking about all contests that resemble rent-seeking contests.
  - a. Rather, rent seeking contests can be thought of as competitive (or conflict) settings in which resources are invested to “win” some price or increase one’s “relative” payoff or position.
  - b. In general, **rent-seeking models characterize resource-intensive forms of competition.**
  - c. The transfer approach tends to make (or limit) rent-seeking contests to a particular class of “negative sum” games. The prize is simply redistributed, the effort, thus, is the measure of dead weight loss.
  - d. However, many rent-seeking contests affect the size of the prize and at least a few such contests create (external) benefits for persons outside the game of interest.
    - For example, when economists and other groups lobby to have trade barriers reduced, this tends to “transfer” social surplus from firms to consumers.
    - So the “redistributive” language can be used to describe this lobbying activity as well as efforts to establish such barriers in the first place.
    - There is competition between those wanting the trade barriers down and those wanting trade barriers maintained.
    - However, neoclassical models imply that social surplus (profit + consumer surplus) is increased by the success of the “free trade” special interest groups (trade liberalization groups).
    - This contest consumes resources, but increases social surplus, as long as the net costs of lobbying are less than the surplus increase generated by trade liberalization.
    - [Draw a diagram to illustrate this, noting that demand can be used as SMB and supply as SMC (in the absence of externalities).]
  - e. All rent-seeking contests consume consumer resources, but not all such contests produce net losses.
- vii. After **four decades of research** following the publication of Tullock’s first paper on rent seeking, the literature expanding on the rent-seeking idea is substantial.

- a. The JStor data base of academic journals reports that 74 papers include the term “rent seeking” in their titles.
- b. The Scopus on-line search reports 170 papers.
- c. The more representative *EconLit* data base of academic journals and books reports 401.
- d. The still broader *Google Scholar* search engine reports that the **titles** of more than 2,500 papers on the Web include the term “rent seeking.”
  - Moreover, not every paper on rent seeking includes those words in its title. *EconLit*’s data base reports that more than 8,000 published papers and books use the terms “rent seeking” or “rent seeker” somewhere within their pages.
  - Initiation of the rent-seeking research program is thus one of the major contributions of Gordon Tullock and the Virginia school of political economy.

## II. On the Contest Success Function and Institutions: “the Rules of the Game” and Rent-Seeking Losses

- A. The rent-seeking literature uses various game theoretic representations of contests for rents (or similar prizes and privileges).
  - i. Most rent-seeking contests have common properties:
    - a. Normally a “prize” of some kind is assumed to exist, which can be given to any of a number of potential rivals.
      - The special favor that may be obtained from the government--tax breaks, protection from foreign competition, contracts at above market rates etc.--are the prize sought by rent seekers.
      - Many other contests have similar properties such as R&D, status seeking, sports competition, and academic publication contests.
    - b. The prize itself may also be at least partially endogenous, although this is less common in most rent-seeking models.
  - ii. Potential recipients of the prize attempt to influence how the prize is allocated by investing scarce resources in a contest, often regarded as a political influence game.
    - a. How one most effectively competes for the prize is partly a consequence of the implicit “rules of the games,” that is of the institutions that determine which rent seeker or rent seekers receive the prize.

- The production of “influence” (e.g. the manner in which one increases one’s probability of winning or share of the prize) varies among contests--in large part because the “rules of the game” differ.
  - Not all rent-seeking contests resemble lottery contests.
  - Not all rent-seeking contests call forth the same sorts of competitive activities.
  - Not all rent-seeking games are “winner take all” games, as in the case of Tullock’s monopoly examples.
  - Not all rent-seeking games are “all pay” auctions.
- b. For example, the investments made to seek political favors differ from those which one would make to obtain status from mountain climbing or publishing academic papers.
- c. It bears noting that **competition in most rent-seeking contests tends to be resource intensive**, in contrast to price competition in competitive market models.
- Competition in these models consists of specific investments in specific contests to increase one’s share or probability of winning a specific prize.
- B. The **process by which these prizes are awarded** in real world rent-seeking contests is often both **complex and subtle** in that a wide variety of unpredictable personalities and events ultimately determine who gets which prize.
- i. **These “idiosyncratic” and “unpredictable” factors cause many researchers to adopt a probabilistic representation** of the process through which rents are awarded or distributed among rent seekers.
- a. In such models, the **more resources are devoted** to securing preferential treatment **the more likely** it is that a particular rent-seeker will be successful, or the larger is their expected share of the “prize.”
- (The better prepared and more widely heard are the "rationalizations" for special preference, the more likely they is to succeed.)
  - [Other non-stochastic models are also used, as will be developed below.]
- b. Contrariwise, the greater the efforts of other rent-seekers, the less likely a particular rent-seeker is to win the prize..
- ii. **To account for that complexity, most, but not all, rent seeking models assume that the process of obtaining special privileges is a somewhat is analogous to lotteries: a random, but statistically analyzable process.**
- What is important for the lottery representation of rent-seeking contests is that it provides a clear model of how the probability of getting “the prize” is affected by one’s investment in the rent-seeking contests and that of other players in the contest of interest.
  - The amounts invested in the contest (the ticket revenue) may be larger or smaller than the prize awarded according to various “rules of the game” and the number and types of players that participate in the contest.
  - Lotteries are often profitable for those organizing them, because the tickets sold more than pay for the prizes awarded.
- C. The effects of the “rules of the rent-seeking contest” (**institutions**) on the extent of the investments in rent-seeking contests is (implicitly) the main focus of the theoretical work on rent seeking.
- Most papers focus on relatively narrow aspects of the rules of the game, such as number of players, differences in the success functions, and so forth.
  - Other papers focus on differences among the players themselves (informed or not, rational or not.)
  - Others focus on the timing of the contests (one-shot or not, two-stage or one-stage, etc.)
  - Others focus on the manner in which prizes are allocated (one person allocation, committee allocation, winner take all, sharing rules, etc. ).
  - Others, focus on finding new applications of the the rent-seeking approach to phenomena in the real world.
  - (During the 1990s, it could be said that the generalized game theoretic approach to contests in general more or less broke off from the rent-seeking literature and became a separate field--or vice versa).

### III. The Tullock Contest Success Function

- A. The basic Tullock Success Function can be used to demonstrate that **rules that affect the number of competitors** in the contest **affect both individual and total investment levels** and, thereby, the (maximal) extent to which “rents” are dissipated by the overall investments of those seeking the “prize” of a particular contest.
- i. Suppose that N risk neutral competitors participate in a rent seeking game with a fixed prize,  $\Pi$ .
- a. Each player may invest as much as he wishes in the political contest, although those investments have an opportunity cost.

- b. The prize is awarded to the player whose name is "drawn from a barrel" containing all of the political lottery "tickets."
- c. The expected prize for player  $i$  is  $\Pi [ R_i / (R_i + R_o) ]$ , where  $R$  is the value of the prize,  $R_i$  is the investment in rent seeking by player  $i$ , and  $t_o$  is the investment by all other players.
- d. If the rent seeking resource(s),  $R$ , cost  $C$  dollars each, the expected net benefit or profit of player  $i$  is  $\Pi_i^e = \Pi [ R_i / (R_i + R_o) ] - CR_i$
- e. The expected profit maximizing investment in rent seeking (political influence or lottery tickets) can be found by differentiating expected profits with respect to  $R_i$  and setting the result equal to zero.
- $\Pi [ 1 / (R_i + R_o) - R_i / (R_i + R_o)^2 ] - C = 0$ , simplifying yields
  - $\Pi [ R_o / (R_i + R_o)^2 ] - C = 0$ , or
  - $\Pi R_o / C = (R_i + R_o)^2$
  - This can be solved for  $R_i^*$ , the expected profit maximizing investment in rent seeking by player  $i$ .
- ii. This solution,  $R_i^* = -R_o \pm (\Pi R_o / C)^{1/2}$ , is player 1's **best reply function**. It describes his or her optimal investment in rent-seeking as a function of the prize and the investments of other players in the game. (Only the positive root will be relevant here, because  $R_i$  has to be greater than zero.)
- a. In a symmetric game, each player's best reply function will be similar, and at least one equilibrium will exist where each player engages in the same strategy.
- b. Thus, if there are  $N-1$  other players, at the Nash equilibrium,  $R_o^{**} = (N-1)R_i^{**}$ . which implies that  $R_i^{**} = -(N-1)R_i^{**} \pm [\Pi (N-1)R_i^{**}/C]^{1/2}$ .
- c. which implies that  $NR_i^{**} = (\Pi (N-1)R_i^{**}/C)^{1/2}$  or squaring both sides, dividing by  $R_i^{**}$  and  $N^2$  and gathering terms, that:
- $$R_i^{**} = [(N-1)/N^2] [\Pi/C] = [(1/N) - (1/N^2)] [\Pi/C]$$
- d. So for example, with  $N = 2$  and  $C = 1$ ,  $R_i^{**} = (\Pi/4)$
- (This result was worked out directly in the previous lecture.)
- iii. Total rent seeking effort is  $N$  times the amount that each player invests
- a. For example, in the two person cost case, the expected net benefit maximizing rent-seeking expenditure by each player is  $R_i C = \Pi/4$ , so the total expenditure is twice this amount or  $2R_i C = \Pi/2$ .
- Half of the value of the prize is consumed by the process of rent seeking.
  - [Illustrate the 2-person Nash equilibrium.]
- iv. In the more general  $N$ -player case, the total expenditures is
- $NR_i C = [(N-1)/N] [\Pi] = [1 - 1/N] [\Pi]$
- v. The **effect of entry** on individual and total rent seeking expenditures can be determined by inspection (or by differentiation) with respect to  $N$ .
- a. It is clear that individual contributions fall as the number of rent seekers increase, but also the total amount of rent seeking "dissipation" increases.
- b. In the limit, as  $N \Rightarrow \infty$ ,  $[1 - 1/N] \Rightarrow 1$ , so the total rent seeking investment approaches the value of those resources,  $RC$ .
- In the limit, the entire value of the prize,  $R^{**} C = [\Pi/C] C = \Pi$ , is invested by the players that participate in the contest.
  - The entire prize can be said to be exactly dissipated in such cases.
- vi. The **effect of increases in the cost of participating in a political influence game** and/or changes in the value of the regulation to the rent-seeker can also be readily determined in this game.
- B. This basic model of contests can be generalized to cover cases where the prize is endogenous, where the probability of securing the prize varies, to cases where the prize is shared rather than awarded to a single "winner take all" winner, and to cases in which the players differ in their skill at (or cost for) rent seeking.
- a. For example, a generalized probability of winning function or rent-sharing function,  $P$ , and reward function,  $\Pi_i(\mathbf{R})$ , can be used to represent a variety of possibilities by making different assumptions about derivatives.
- $R_i^e = P(R_1, R_2, \dots, R_N) \Pi_i(\mathbf{R})$
- b. The affects of economies of scale may also be examined in this general framework and in the earlier explicit one (as was done in Tullock 1980).

#### IV. Institutions, Competitive Process, and Competitive Waste

- A. The previous analysis should make it clear that the main losses of rent seeking activities arise for three reasons:
- a. The **process used to influence policy is costly**. The resources invested in the contest have an opportunity cost. (They could have been used to produce

new goods and services, rather than to reduce net benefits or redistribute existing resources.)

- b. **There is an externality among players**, in that as each player increases his or her investment the expected net prize (returns) diminish for other players.
  - It is the competitive nature of the contest that produces both the investments and the rent-seeking costs.
- c. The **assumed rent seeking activities do not themselves create value** in excess of their opportunity cost
  - Normally, spillover effects on those outside the contest are ignored except in applied research.
  - In principle, however, such contests can have positive or negative externalities, as noted above.
- i. Much of the rent-seeking literature stresses the redistributive consequences of such political games.
  - a. The rent-seeking literature suggests that the efforts of interest groups may not only produce inefficient public policies, but wastes resources doing so.
  - b. It is also possible, as noted above, that lobbying (rent-seeking) may also improve public policies, as for example when barriers to trade are reduced or eliminated, infrastructure is improved, etc.
  - c. Costly forms of competition in markets are not necessarily “efficient” and have to be analyzed on a case by case basis. Resources may be “over invested” in R&D for example.)
    - Price competition in markets, however, is essentially costless and produces external benefits for consumers.
    - So, “rent-seeking” in markets may increase rather than reduce social net benefits.
    - (Buchanan 1980, for example, distinguishes between profit-seeking and rent-seeking activities.)
- ii. The extent of the dead weight losses from rent seeking are determined by the rules of the rent seeking game.

#### B. **The rules of rent-seeking contests can be interpreted as institutions.**

- i. For example, the distributional rules, the process of making decisions about who will receive the prize can all be considered to be political institutions in the usual context of a rent-seeking contest (e.g. lobbying or elections).

- ii. These institutions substantially determine the rates of return from alternative forms of influence.
  - Institutions, thereby, *implicitly* determine the type of activities that must be undertaken by potential rent seekers, and the extent to which persons are free to compete in a particular contest.
  - The rules of the game thereby encourage the use of particular rent-seeking techniques.
  - These may, in some cases, induce forms of competition that benefit third parties outside of the contest. (Awarding the king's daughter to the Knight that wins an entertaining tournament.)
- iii. The rules also determine who is eligible to participate in a given rent-seeking contest.
  - In many cases, the extent of dissipation will increase as the number of competitors increases.
  - Eligibility, also tends to determine who can win contests. Such rules can, for example, protect elite claims to the fruits of government regulations and positions.

#### C. Some of the main results from the theoretical literature are:

- i. Losses from games where the rents are shared are below those in games where the rents all go to a single victorious group or individual (Congleton 1980, Long and Vosen 1987).
  - Stochastic payoffs have similar effects, as in the usual lottery representation of rent-seeking contests.
- ii. The losses from rent-seeking games tend to be smaller in cases in which majority rule is used to determine winners (Congleton 1980, 1984).
- iii. The logic of rent-seeking contests applies to nongovernmental settings as well as governmental ones.
  - See various works by Robert Frank, including his book on positional games and winner take all games. See also Congleton (1989) and Glazer and Konrad (1996).
  - Bhagwati (1982) tried to rename such activities: Directly Unproductive Efforts: DUPE.
  - (Indeed, one can argue that much of modern contest theory consists of extensions of various rent-seeking models.)



- iv. Note that a good deal of market competition can also be regarded as a contest for rents (e.g. profits) in which the rules of the game are such that the efforts of competing firms tend to benefit consumers.
- Thus, the resource intensive parts of competitive markets that are largely neglected in mainstream neoclassical models (which tend to focus narrowly on price competition) may be examples of contests that dissipate profits for firms, but which produce considerable external benefits for consumers.
  - Similar claims might be made regarding the academic competition--insofar as it adds (at least occasionally) useful information and knowledge to society's stockpile.

### V. Non-stochastic Representations of Rent-Seeking Contests: "All Pay Auctions"

- A. An Overview: in an "all-pay auction," unlike normal auctions, both winners and losers pay.
- In winner take all versions of those auctions (the kind most often analyzed, there is a tendency to escalate.
  - Such contests lack a Nash equilibrium in pure strategies (Congleton 1980).
- B. Hillman and Samat (1987) demonstrate the existence of a Nash equilibrium in mixed strategies. In cases in which players are free to distribute their investments among a variety of contests, they show that such "auctions" can produce exact dissipation, when players are risk neutral, even if there are small numbers of players.
- C. Anderson Goeree and Holt (1998) incorporate a type of bounded rationality into winner take all all pay auctions and show that with such players, investments (dissipation) increases with the number of players, and that over investment in rent-seeking contests may occur.

### VI. Rent Extraction

- A. An Overview: the rent-extraction literature notes that rent-seeking contests may not be accidents of public policy, but rather may be designed by policy makers (and others) in order to attract efforts by rent seekers.
- Those who design rent-seeking contests do so because they expect to benefit from the efforts of rent seekers.

- (This is, for example, true of lotteries in both the public and private sectors.)
  - The analytical results of the rent-seeking literature implies that contests can be design to elicit all kinds of effort.
  - Rent-seeking contests may, for example, be used to partly pay for government (monopolies may be auctioned off, via all pay auctions).
  - Rent-seeking contests may be used to attract campaign contributions or bribes.
- B. McChesney (1987, 1991, 1997) suggests that politicians create regulatory games (those analyzed by Stigler and Peltzman) as a method of obtaining campaign resources. In some cases, the mere threat of such regulations can call forth regulations.
- C. Appelbaum and Katz (1987): develop the mathematics of the McChesney model (more or less simultaneously with McChesney's first paper). They model the contest as a two stage game (analogous to a Stackelberg contest) in which regulators take account of the responses of consumers and firms when they propose regulations (the creation of monopolies in their model).
- D. Hillman and Katz (1987) note that such considerations should be taken into account when designing the institutions of bureaucracy. If lower level regulators have discretion over regulations and can be influenced by rent-seeking, they may be able to use their authority as an additional source of income.
- Insofar as their supervisors have authority to hire such persons, there will be contests for employment in which their supervisors can profit (e.g. can profit from the rent-seeking efforts of those seeking to be low level regulators).
  - This rent-extraction / rent-seeking process continues throughout the hierarchy.
  - In the end, competition within the organization tends to dissipate all the rents from regulatory authority.
- E. Congleton and Lee (2009) note that rent-seeking contests can be constructed for the purposes of raising state revenue (or elite government official income). Insofar as the problems noted by Hillman and Katz (1987) are avoided, the rent-seeking contests adopted will take account of their burden on society and effects on rates of innovation.

- Well informed rent-extracting governments that are able to overcome problems of corruption will construct rent-seeking contests that produce revenue similar to what would be obtained from an efficient Ramsay tax system
- (Rates will be set somewhat higher than optimal for growth in cases in which elites can take some of the revenue for personal income.)
- (Their model of government is an extended form of the Olson-Buchanan&Brennan's Leviathan model.)

## VII. Applications

- A. To Status Seeking (Congleton 1989, Frank and Cook 1995).
- B. To Public Finance (Kornai 1980, Buccola and McCandlish 1999, Congleton and Lee 2009)
- C. To Merchantilism (Tollison and Ekelund, 1981, Congleton and Lee 2009)
- D. To Legal Contests in Court (Tullock 1975, Buchanan 1980, Parisi 2001)
- E. To Economic and State Development (Murphy, Schliefer and Vishny 1993, Volckart 2000)
- F. To the theory of the firm (Edlin and Stiglitz 1995, Scharafstein and Stein 2000)
- G. See Congleton, Hillman, and Konrad (2008) Vol 2 for many more applications.

## VIII. Empirical Evidence of the Magnitude of Rent-Seeking Losses

- A. Early Estimates
  - i. Several early studies tried to **quantify the extent to which losses (might) have been generated by rent seeking for trade protection and for monopoly privileges.**
  - ii. In the study where the term rent-seeking was invented, Ann Krueger, 1974, argues that up to 7.3% of GNP in India (1964) and about 15% of GNP in Turkey (1968).

iii. Posner, 1975 estimates the DWL of monopoly in the US to be 3.13% of GNP.

- This estimate is significantly higher than Harberger's estimate deadweight losses of 0.1% of GNP and that of Schwartzman (1960) 2.209% of GNP.
- Cowling and Mueller (1978) estimate total (H+T) losses from monopoly to be as high as 7% of GNP in the US and as high as 3% of GNP in the UK.

B. Perhaps the most ambitious of the efforts to estimate the cost of "transfer seeking" activities is the study of Laband and Sopholeus (1992 *QJE*).

- i. They attempt to use an GNP accounting method to characterize all of the activities which are under taken in order to secure or prevent transfers from taking place.
  - a. This include such things a the court system, trade protection, national defense, locks, etc.
  - b. To this they add actual transfers realized.
  - c. **They estimate that approximately 25% of GNP (950 million dollars) is involved in the transfer industry.**
    - [Congleton (1980, 1988) examine the logic of **calculations to determine rent-seeking losses** from a more or less utilitarian perspective (as is adopted by most of the rent-seeking literature). Only avoidable losses should be counted and benefits generated by the rent-seekers cannot be ignored.]
- ii. Sobel and Garret (2002) attempt to estimate the size of the political rent-seeking "market" by looking at increases in various kinds of market activities likely to be associated with political rent-seeking (lobbying). They focus on activities in US state capitals.

### Abstract:

- Utilizing 4-digit industry data by county, we compare the allocation of resources across industries in state capital areas with noncapital areas.
- We are able to identify which industries are expanded and contracted relative to noncapital areas.
- Our results provide the first direct evidence and measurement of the forgone productive activity resulting from resources being reallocated toward rent seeking and interest group activity.
- Our data also allow us to measure total rent seeking, and also to isolate the extent of indirect and in-kind rent seeking, which can account for part of the Tullock paradox.

## C. Experimental Evidence

- i. Tullock's classroom experiment: take a twenty dollar bill and auction it off to one's class through an all-pay auction. The amount collected is normally quite a bit above 20 dollars.
- ii. Shogren and Baik (1990) conduct a two person experiment in which payoffs from the Tullock contest success function (with exponents). The average payoff (net of rent-seeking costs) is consistent with the Nash equilibrium (e.g. were not statistically different at a 10% significance level).
- iii. Potters, De Vries, and van Winden (1998) further explore the case in which the contest success function has exponents but focus on the simple case (exponent = 1) and the extreme case (where the exponent is infinite). Nash equilibria are calculated for these games (the former has an equilibrium in pure strategies the latter only in mixed strategies (it is an all pay auction in which the high bidder wins). Equilibrium play was more or less found (on average) in both series of experiments. although there was somewhat greater dissipation than predicted in the simpler case.
- iv. Vogt, Weinmann, and Yang (2002) allow open ended participation in rent-seeking contests. They find that investments and dissipation approach predicted levels (e.g. those of the Nash equilibrium) when participants are given time to learn how the games operate.