RENT SEEKING TECHNOLOGY AND LONG TERM SUSTAINABILITY OF PLURALISTIC CONTEST

Dr. Teng, Jimmy
School of Economics
University of Nottingham
Malaysia Campus
Email: Jimmy.Teng@nottingham.edu.my
Tel: 603 8924 8745

ABSTRACT

This paper analyzes an infinitely repeated game of contest for resources. It studies how rent seeking technology affects the long term sustainability of pluralistic competition where there is more than one contestant to resources. If there is over dissipation of rent, pluralistic competition is unsustainable. The paper uses the ratio form of Tullock-Hirshleifer contest success function. It focuses its analysis on the steady state equilibrium of continuing contests where key variables such as contest effort and share of contested resources captured and secured by the respective contestants are time invariant. The paper finds out that greater economies of scale in contest result in greater dissipation of rent and, if the economies of scale in contest are large enough, then there will be either over dissipation of rent (when contestants are about equally powerful) or the stronger contestant will overwhelm the weaker one (when contestants are very unequal in power). In either case, pluralistic competition is not sustainable in the long run. It then applies the insights to understand dissipation of rent in competition for market share, domestic electoral politics and military contest. The major findings of the paper are: Anti trust laws and international trade regimes (such as GATT and WTO) achieve efficiency gains through the two mechanisms of promoting market competition and reducing rent seeking efforts to gain market share; The European great constituency electoral system (which has smaller economies of scale in contest) encourages the efforts of small parties while the Anglo American small constituency electoral system (which has larger economies of scale in contest) facilitates the dominance of major parties and, the American system has large dissipation of rent given that it has the largest economies of scale in contest; Military technological changes that reduced economies of scale in contest led to collapse of great empires and emergence of state systems and revolutions in the techniques of violence that increased economies of scale in contest eliminated pluralistic state system and ushered in great empires.

Key Words: pluralistic competition, economies of scale, rent seeking, dissipation of rent, infinite periods

INTRODUCTION

Many rent seeking contests are repeated over many periods of time that they should be best modeled as ongoing activities with infinite period time horizon. Examples of such contests include the competition between two major parties in the democratic electoral systems, the fight for market share and power between major firms in an industry and, arms races and military contests between nations. While there have been many researches studying rent seeking activities and their structures with formal models, so far, none has specifically been devoted to the studying of rent seeking contest and its sustainability with an infinite period model. This paper endeavors to fill in this gap.

Among the current works that studies rent seeking and its structure are Hirshleifer (1988, 1989, 1991a, 1991b, 1995, 2000, 2001), Baik and Lee (2001), Baik (2004), Nti (1999) and Skaperdas (1996). Hirshleifer (1995), for instance, analyzes the sustainability or breaking down of anarchy under the condition of steady state equilibrium of continuing conflict. Anarchy means a pluralistic rent seeking contest structure where there is more than one contestant to resources. In the steady state equilibrium of continuing conflicts, the ratio of resources captured and secured by the contestants is decided by their relative power and remains time invariant. So far these researches have been making extensive use of one shot game model in their studies. For example, although Hirshleifer (1995) proposes the concept of the steady state of continuing conflict, he studies it with a one shot game model. Given its one shot game nature, these models are not appropriate for studying very long term ongoing repeated rent seeking activities.

This paper builds on the above works and analyzes an infinite period model of contest for resources that has analytical solutions under the steady state equilibrium of continuing conflicts as proposed by Hirshleifer (1995). The infinitely repeated rent seeking game framework allows more realistic and complicated modeling of many renting seeking contests, especially with the incorporation of time discounting factor in the framework. It allows the analysis of how economies of scale in contest and the time discount rate affect the pluralistic rent seeking contest equilibrium and the long term sustainability of such a contest structure. Furthermore, an infinitely repeated rent seeking game also allows the analysis of the determination of the respective initial resource endowments of the contestants. This is a topic hardly touched upon by current rent seeking literature although it is very important for understanding very long term changes in rent seeking contest structure. This paper finally applies the insights generated by the models to the topics of competition for market power and share, domestic electoral politics and international military contests.

THE MODEL

Hirshleifer (1988, 1989) introduces the Tullock-Hirshleifer ratio form of contest technology function or contest success function or power function.[1] The ratio form of power function is:

$$p = \frac{F_1^{\,m}}{F_1^{\,m} + F_2^{\,m}} \tag{1a}$$

F_1 and F_2 are the fighting effort of contestant one and two respectively. p is the probability of victory of contestant one and $(1-p)$ the probability of victory of contestant two in a contest between contestant one and two . Alternatively, p is the share of the stake of the contest that is captured by contestant one and $(1-p)$ is the share of the prize that is captured by contestant two. m is the parameter for economies of scale in contest. The concept of the economies of scale in contest is best seen through the odd ratio of victory:

$$\frac{p}{1-P} = \left(\frac{F_1}{F_2}\right)^m \tag{1b}$$

If $m > 1 (m < 1)$, then doubling the ratio of military capacity between contestant one and two more than (less than) doubles the odd ratio of victory between contestant one and two.

Hirshleifer (1995) introduces the concept of steady state equilibrium of continuing contest. In the steady state equilibrium of continuing contest, the distribution of resources between the contestants is determined by their respective probability of victory in the contest and is time invariant. Making use of the concept of steady state equilibrium of continuing contest, this paper proposes the following infinitely repeated game model:

$$\begin{aligned}\max_{F_1} \pi_1 &= \sum_0^\infty Y_{1,t} = \sum_1^\infty \delta_1 a_1 \left(Rp_t - b_1 F_{1,t}\right)^h + a_1 \left(R_{1,0} - b_1 F_{1,0}\right)^h \\ &= \left(\frac{\delta_1}{1-\delta_1}\right) a_1 \left(Rp - b_1 F_1\right)^h + a_1 \left(R_{1,t=0} - b_1 F_1\right)^h\end{aligned} \tag{2}$$

In equation 2, π_1 is the discounted sum of utility of contestant one over infinite periods and $Y_{1,t}$ is the single period utility of contestant one at time period t. δ_1 is the time discount factor of contestant one, a_1 is the production efficiency parameter of contestant one and b_1 is the rent seeking cost efficiency parameter of contestant one. h is the production technology scale factor. The resource endowment of contestant one (and two) at $t = 0$ is given, $R_{1,0}$ and $R_{2,0}$. By the assumption of steady state equilibrium of continuing contest, $R_{1,t} = pR$, $R_{2,t} = (1-p)R$ and $p_t = \left(\frac{F_{1,t}^{\,m}}{F_{1,t}^{\,m} + F_{2,t}^{\,m}}\right) = p = \left(\frac{F_1^{\,m}}{F_1^{\,m} + F_2^{\,m}}\right)$ for all periods. Note that $R_{1,0} = pR$ as a condition of steady state equilibrium of continuing contest is to be imposed ex poste of the optimization exercise of contestant one and not ex ante, for at period zero when the contestants are making decisions, their respective share of resources are fixed and determined by earlier decisions and their current decisions could only affect the size of their future resources.[2] As the ensuing analysis will deal with only the steady state where the variables are time invariant, the t subscripts are dropped for period one and later periods.

The first order condition is:

$$\begin{aligned}\frac{\partial \pi_1}{\partial F_1} &= \left(\frac{\delta_1}{1-\delta_1}\right) h a_1 \left(R\left(\frac{F_1^{\,m}}{F_1^{\,m} + F_2^{\,m}}\right) - b_1 F_1\right)^{h-1} \left(Rmp(1-p)F_1^{-1} - b_1\right) \\ &- h a_1 \left(R_{1,0} - b_1 F_1\right)^{h-1} b_1 = 0\end{aligned} \tag{3}$$

At the steady state equilibrium of continuing contests $R_{1,0} = Rp$. The first order condition is thereby simplified to:

[1] Skaperdas (1996) axiomatizes the contest technology functions.
[2] This formulation achieves the derivation of analytical results. See Hirshleifer (1995) for an alternative treatment which relies on numerical simulations to generate insights.

$$\frac{\partial \pi_1}{\partial F_1} = ha_1\left(Rp - b_1F_1\right)^{h-1}\left[\left(\frac{\delta_1}{1-\delta_1}\right)\left(Rmp\left(1-p\right)F_1^{-1} - b_1\right) - b_1\right] = 0 \quad (4)$$

Through routine manipulations we have

$$\frac{F_1}{F_2} = \frac{\delta_1}{\delta_2}\frac{b_2}{b_1} \quad (5)$$

The relative military efficiency as represented by $\frac{b_2}{b_1}$ and relative patience $\frac{\delta_1}{\delta_2}$ dictates the ratio of fighting efforts, the odd ratio of victory and the relative share of resources captured and secured in the steady state equilibrium of continuing contests. The more patient and militarily efficient contestant exerts more fighting effort and secures more resources. For notational convenience, let $Q \equiv \frac{\delta_1}{\delta_2}\frac{b_2}{b_1}$ and name it the relative composite efficiency and therefore

$$p = \frac{Q^m}{Q^m + 1} \quad (6)$$

Proposition 1:

Over dissipation of rent occurs when $1 < \delta_1 m\frac{1}{Q^m+1}$ and $1 < \delta_2 m\frac{Q^m}{Q^m+1}$.

Proof:

$$\pi_1 = \left(\frac{1}{1-\delta_1}\right)a_1\left(Rp - b_1F_1\right)^h = \left(\frac{1}{1-\delta_1}\right)a_1\left(Rp\left(1-\delta_1 m\frac{1}{Q^m+1}\right)\right)^h \quad (7)$$

$$\pi_2 = \left(\frac{1}{1-\delta_2}\right)a_2\left(R\left(1-p\right) - b_2F_2\right)^h = \left(\frac{1}{1-\delta_2}\right)a_2\left(R\left(1-p\right)\left(1-\delta_2 m\frac{Q^m}{Q^m+1}\right)\right)^h \quad (8)$$

Q.E.D.

In the symmetrical steady state equilibrium of continuing contests, $\delta_1 = \delta_2 = \delta, a_1 = a_2 = a, b_1 = b_2 = b, F_1 = F_2 = F, p = \frac{1}{2}, R_1 = R_2 = R$ and therefore $F_1 = F_2 = F = \frac{\delta mR}{4b}$ and $\pi_1 = \pi_2 = \pi = \left(\frac{1}{1-\delta_1}\right)a\left(\frac{R}{2}\left(1-\frac{\delta m}{2}\right)\right)^h$. Proposition 1 then becomes "when $1 < \frac{\delta m}{2}$ there is over dissipation of rent."

If there is over dissipation of rent, then pluralistic rent seeking contest is unsustainable. In the long run, there would be only a contestant that survives.

The result is different from the observation of Baik (2004) that 'less than complete dissipation of the contested rent almost always occurs in two-player asymmetric rent-seeking contests with ratio-form contest success functions. This under dissipation-of-rents results is also obtained in, for example, Tullock (1980), Hillman and Riley (1989) and Baik and Lee (2001).'[3] If under dissipation of rent almost always occurs, then pluralistic rent seeking contest for resources would be a near universal phenomenon. However, in industry and commerce, monopoly is quite frequently the case; in domestic politics, single party dominance or authoritarian regime was the norm in history and is still present in the contemporary world; and, in international politics, continental size universal empires often ruled for very long periods of time.

The source of this difference is that Baik (2004) and those cited by him study one shot contest games while the model of this paper is an infinitely repeated game of continuing contest. In this model, exerting greater fighting effort sacrifices present consumption but results in the capturing and securing of a greater share of contested resources in the future. Therefore, as the

[3] Baik (2004, p. 685).

contestants value the future more, that is, as δ_1 and δ_2 become larger, contestants invest in greater contest effort and there are greater or even over dissipation of rent.[4]

Proposition 2:

The necessary and sufficient condition for a (locally) strategically stable interior solution is $1 > \left| m(1-2p) \right|$.

Proof:

The second order conditions are

$$\frac{\partial^2 \pi_1}{\partial (F_1)^2} = \left(\frac{\delta_1}{1-\delta_1} \right) h a_1 \left(Rp - b_1 F_1 \right)^{h-1} Rm \left(\left((1-2p)m - 1 \right) p(1-p) F_1^{-2} \right) < 0 \quad (9)$$

$$\frac{\partial^2 \pi_2}{\partial (F_2)^2} = \left(\frac{\delta_2}{1-\delta_2} \right) h a_2 \left(R(1-p) - b_2 F_2 \right)^{h-1} Rm \left(\left((1-2(1-p))m - 1 \right) p(1-p) F_2^{-2} \right) < 0 \quad (10)$$

The second order conditions are satisfied if $1 > \left| m(1-2p) \right|$. The cross derivatives are

$$\frac{\partial^2 \pi_1}{\partial F_1 \partial F_2} = -\left(\frac{\delta_1}{1-\delta_1} \right) h a_1 \left(Rp - b_1 F_1 \right)^{h-1} Rm^2 \left((1-2p) p(1-p) F_1^{-1} F_2^{-1} \right) < 0 \quad (11)$$

$$\frac{\partial^2 \pi_2}{\partial F_2 \partial F_1} = \left(\frac{\delta_2}{1-\delta_2} \right) h a_2 \left(R(1-p) - b_2 F_2 \right)^{h-1} Rm^2 \left((1-2p) p(1-p) F_2^{-1} F_2^{-1} \right) < 0 \quad (12)$$

$\frac{\partial^2 \pi_1}{\partial F_1 \partial F_2}$ and $\frac{\partial^2 \pi_2}{\partial F_2 \partial F_1}$ have opposite signs. That ensures $\frac{\partial^2 \pi_1}{\partial (F_1)^2} \frac{\partial^2 \pi_2}{\partial (F_2)^2} - \frac{\partial^2 \pi_1}{\partial F_1 \partial F_2} \frac{\partial^2 \pi_2}{\partial F_2 \partial F_1} > 0$ if the second order conditions are satisfied. In that case, the solution is interior and locally strategically stable. For necessity notes that if the condition $1 > \left| m(1-2p) \right|$ is violated, then the second order conditions are violated and the equilibrium is not an interior solution.

Q. E. D.

For pluralistic structure of rent seeking contest to be sustainable, it is also necessary that there is interior solution. Corner solution would mean contestants invest all resources into rent seeking contest and that is not sustainable in the long run. To avoid corner solution and over dissipation of rent it is also necessary that the interior equilibrium be stable and so that small perturbations would not drive the system to corner solutions.

Please note that when $p = \frac{1}{2}$ the condition $1 > \left| m(1-2p) \right| = 0$ is satisfied for whatever value of m. From proposition 2 it is observed that to maintain an interior and strategically stable solution, an increase in the economies of scale in contest has to be compensated by a decrease in the level of asymmetry in relative composite efficiency between the two contestants and vice versa.[5] Both large economies of scale in contest and a great asymmetry of power among the contestants are detrimental to the sustainability of pluralistic structure of contest. Greater economies of scale in contest lead to greater dissipation of rent. On the other hand, huge disparity in power puts the weaker contestant in a desperate situation and could lead to violation of the second order condition and strategic instability and corner solution.

Proposition 3:

$m \le 1$ is sufficient but not necessary for an interior and (locally) strategically stable equilibrium.

Proof:

If $m \le 1$, then $\frac{1}{m} \ge 1$ and therefore $\frac{1}{m} \ge \left| 1-2p \right|$ is satisfied.

Q. E. D.

[4] Refer to Powell (1993 and 1999, chapter 2) for similar insights.
[5] Nti (1999) has similar observation.

Decreasing or constant returns to scale in contest lead to an interior and locally strategically stable equilibrium.[6] Proposition 1 to 3 all points to the importance of smaller economies of scale in contest for a pluralistic rent seeking contest structure to be sustainable.

Proposition 4:

Fighting efforts are at their greatest when the two rivals are equally powerful.

Proof:

$$\frac{\partial F_1}{\partial Q} = \frac{\delta_1}{b_1} Rm^2 (1-2p)\, p(1-p) Q^{-1} \tag{13}$$

$$\frac{\partial F_1}{\partial Q} > 0 \text{ for } p < \frac{1}{2}, \frac{\partial F_1}{\partial Q} = 0 \text{ for } p = \frac{1}{2} \text{ and } \frac{\partial F_1}{\partial Q} < 0 \text{ for } p > \frac{1}{2}$$

Q.E.D.

If contestant one is the weaker (stronger) of the two parties, then a greater relative efficiency on his part makes the two contestants more (less) equally powerful and he thereby puts in a greater (smaller) rent seeking contest effort. Contest efforts peak when the contestants are equally matched.[7]

Proposition 5:

If the rivals are about equally powerful, then greater economies of scale in contest cause the rivals to invest in greater contest effort. If the rivals are far apart in their power, then greater economies of scale in contest cause the rivals to invest in lesser contest effort.

Proof:

$$\frac{\partial F_1}{\partial m} = \left.\frac{\partial F_1}{\partial m}\right| p + \frac{\partial F_1}{\partial p}\frac{\partial p}{\partial m} = \frac{\delta_1}{b_1} Rp(1-p) + \frac{\delta_1}{b_1} Rm(1-2p)\, p(1-p) \ln Q \tag{14}$$

Q. E. D.

The first term on the RHS is the direct effect. It is positive. Increase in the economies of scale in contest enhance the advantage of the player with a higher rent seeking effort and cause the contestants to invest more in rent seeking effort. The second term on the RHS is the indirect effect through changes in the relative power between the contestants. It is negative. Greater economies of scale in contest strengthen the stronger player and undermine the weaker contestant. The greater asymmetry between the contestants dampens the contest and the contestants invest less in rent seeking contest effort. The absolute size of the second term is zero when both contestants are equal in power and gets larger when the players become more unequal in power.[8]

Together propositions 1 to 5 reveal that in a contest among equals, an increase in the economies of scale in contest intensifies the rent seeking contest and lead to greater dissipation of rent and the possible collapse of pluralistic rent seeking contest structure. On the other hand, in a contest among parties greatly unequal in power, an increase in the economies of scale in contest accentuates the disparity of power and possibly perturbs a pluralistic structure towards monopoly or hierarchy (through strategic instability and violation of second order conditions). In sum, greater economies of scale in contest make pluralistic contest structures less sustainable.

APPLICATIONS

1. MARKET COMPETITION

Anti trust laws limits the possibility of mergers, acquisition and monopoly power.[9] The economies of scale in contest for monopoly rent and market power become smaller. Consequently, anti trust laws help to reduce rent seeking contest for monopoly rent and lower the expenses invested in hostile acquisitions for earning greater profits through greater market power. Therefore, besides the benefits of increases in market efficiency due to greater competition as a result of smaller market power, anti trust laws also reduce dissipation of rents.

[6] Hirshleifer (1995) has similar insight.
[7] Baik (2004, p. 681) has similar observation for a one shot game contest: 'The prize dissipation ratio for each player, each player's equilibrium effort level, and the equilibrium total effort level are maximized in the contest in which both players have equal "composite" strength.'
[8] Refer to Nti (1999) for similar result in the context of a one shot game. The analysis here improves upon that of Nti (1999) by breaking down into the direct and indirect effects.
[9] Refer to Tirole (1988).

International trade regimes such as GATT and WTO help to avoid the rise of protectionism and competitive beggar thy neighbor policy. Consequently, size of national market matters less for economic performance and national power. The international trade regimes therefore help to lower the economies of scale in contest for market share. The high costs of over dissipation of rent in the contest for economic market were seen in the competitive protectionism of interwar period, the ensuing rise of extremism and the resulting world war two. The failure of the interwar world trade regime to prevent over dissipation of rent ultimately led to the collapse of not only the international trade and economic order but the world political order of the period.[10]

2. DOMESTIC ELECTORAL CONTESTS

Democratic electoral systems and associated check and balances lower the decisiveness of political contests. Democracy prevents the winners from taking all and driving the losers to desperation. It therefore helps to lower the dissipation of rent by preventing or lowering the resort to political violence and civil war.

Compare to their European counterparts, the British and American electoral systems have larger economies of scale in electoral contests. UK and USA has the small constituency system whereby only a single winner got elected from an electoral district. Such a system favors the larger party. Alternatively, most European nations have large constituency system where multiple representatives are elected from an electoral district. The numbers of representatives from each party elected into the legislature are proportionately closer to the numbers of votes the parties received. Therefore, the economies of contest are larger for the British and American system and are smaller for the continental European system. Consequently, very small parties which represent small minorities abound in the European system. This agrees with the insight of proposition 5 that large economies of scale in contest encourage the smaller and marginal players.

The American political system has greater economies of scale in electoral contests compare to the British system. In the American system, electoral contest is an ongoing process which requires a lot of financial resources. The size of the election coffer determines victor or defeat to a very large extent. Therefore, there is a larger dissipation of rent in the American system. Partly because of this, compare with the British parliamentary system, the American system when transplanted overseas (especially to Latin America) also had a higher chance of degenerating into dictatorship or authoritarian regime with a plutocratic bent. The parliamentary system has lower frequency of election contest and for each contests, the process is far shorter, usually lasting weeks. On the other hand, electoral contests in the American system usually last months or over a year or two. Consequently, financial resources matter less in the parliamentary system. Therefore, there are lower chances of degenerating into dictatorship or plutocracy due to over dissipation of rent.[11]

3. MILITARY TECHNOLOGY AND GEOPOLITICS

Dudley (1990, 1991, 1992) observes that military technological changes that reduced economies of scale in contest led to collapse of great empires and emergence of state systems. On the other hand, revolutions in the techniques of violence that increased economies of scale in contest eliminated pluralistic state system and ushered in great empires. The following paragraphs give a brief overview of the major military technological changes and their effects on geopolitics.

The use of bronze weapons since around BC 2900 increased the economies of scale in warfare. Dense formations of infantry wielding bronze weapons and protected by bronze armors and aided by archers with composite bows resulted in a considerable increase in the decisiveness of battles. Egypt was unified under one empire around BC 3300 - 3100. In Mesopotamia, the greater economies of scale in conflicts led to territorial expansion of the political units which finally culminated in the establishment of a series of empires: the Akkadian Empire (2334-2193 BC), the Empire of Third Dynasty of Ur (2112-2004 BC), the Babylonian Empire (ca. 1900-1595 BC) and the Old Assyrian Empire (ca 1830-1741 BC).[12]

The heavy infantry military revolution of the classical era increased the economies of scale in contest. Macedonian Phalanxes and Roman legions dominated battle fields with their great mass. Consequently, Greek city state system gave way to the Macedonian Empire and the Hellenistic state system in turned gave way to the Roman Empire. This same process of empire building by heavy infantry legions happened elsewhere too. The heavy infantry revolution ushered in the unification of China under the First Emperor and ended the classical state system of China of the Spring and Autumn Era and the Era of the Contending States.

The medieval ascendancy of cavalry relative to infantry reduced the economies of scale in contest as cavalry relies less on the superiority of number to win battles.[13] The rise of cavalry led to the more or less simultaneous collapse or retreat of the classical universal empires around A.D. 300---600. The Roman Empire was divided into two and the Western part totally disappeared under incessant assaults from nomads. Nomadic assaults from Central Asia also weakened the Gupta Empire of India. The Jin Empire of China conceded the central plain of North China, which had the dominant share of resources and population, to nomads and retreated to South of Yangtze River where the military superiority of cavalry was neutralized by natural barriers. In place of the massive classical empires came myriad tiny states or state-like force wielding organizations.

The gunpowder military revolution raised the economies of scale in warfare by making battles more deadly and defensive walls less effective.[14] In China, Japan, India, Central Asia and Middle East, massive gunpowder empires of the early modern era emerged and dominated the political landscape. Medieval fragmentation gave way to the Ottoman Empire in Middle East and

[10] Refer to Rothermund (1996)
[11] Refer to Colomer (2004) and Farrell (2001).
[12] Refer to Dudley (1991, p. 47-76) and Haywood (1997, p. 42-43).
[13] Refer to Dudley (1991, 1990, 1992) and Keegan (1993).
[14] Refer to Parker (1996).

Eastern Mediterranean region, the Ikhanate-Timurid-Saffavid Empire and Afshar-Zand-Qajar Dynasties in Persia and Central Asia, the Delhi Sultanate and Mughal Empire in India, the Yuan-Ming-Ching Empire in China and the Tokugawa Shorgunate in Japan. In the more fragmented Europe, the greater economies of scale in warfare led to the dismantling of feudalism and the rise of national states but failed short of creating a lasting pan European gunpowder empire. As a result of the keen contests among equally matched rivals, size of the military, both in terms of military expenditures and manpower, increased tremendously, evidence of greater dissipation of rent.[15]

CONCLUSIONS

The infinitely repeated rent seeking game model of this paper shows that over dissipation of rent is possible and likely given a large mass factor. Yet, much remains to be done. In the present model, the scale factor in production has no impact on the steady state equilibrium of continuing conflict. One important task for the future is to investigate the steady state equilibrium of continuing contests with endogenized production and investment decision. This will help to understand the effects of production technology on rent seeking.[16]

REFERENCES

Baik, K. H. and Lee. S. (2001). Strategic Groups and Rent Dissipation, *Economic Inquiry* 39, 672-684.

Baik, K. H. (2004). Two-Player Asymmetric Contests with Ratio-Form Contest Success Functions, *Economic Inquiry* 42, 679-689.

Buchanan, J. M., Tollison, R. D., and Tullock, G. (Eds.) (1980). *Toward a Theory of the Rent Seeking Society*, College Station, TX: Texas A & M University Press.

Colomer, J. M., Ed. (2004). *Handbook of Electoral System Choice*, London and New York: Palgrave Macmillan.

Dudley, L. (1990). Structural change in interdependent bureaucracies: was Rome's failure economic or military? *Explorations in Economic History*, 27, 232 248.

Dudley, L. (1991). *The Word and the Sword: How Techniques of Information and Violence Have Shaped Our World*, Basil Blackwell Inc., Cambridge, Massachusetts.

Dudley, L. (1992). Punishment, reward and the fortunes of the states, *Public Choice*, 74, 293, 1992.

Farrell, D. M. (2001). *Electoral Systems: A Comparative Introduction*. New York: St. Martin's Press.

Haywood, J. (1997). *The Complete Atlas of World History: Prehistory and the Ancient World, 4,000,000 Years Ago - AD 600*, Sharpe Reference, Oxford.

Hillman, A. L., and Riley, J.G. (1989). Politically Contestable Rents and Transfers, *Economics and Politics* 1, 17-39.

Hirshleifer, J. (1988). The Analytics of Continuing Conflict, *Synthese* 76 (August), 201 233.

Hirshleifer, J. (1989). Conflict and rent seeking success functions, *Public Choice* 63 (2): 101-112.

Hirshleifer, J. (1991a). The technology of conflict as an economic activity, *A. E. R. Papers and Proceedings* 81 (2), 130-134.

Hirshleifer, J. (1991b). The paradox of power, *Economics and Politics* 3 (November), 177-200.

Hirshleifer, J. (1995). Anarchy and its breakdown, *Journal of Political Economy*, 103 (1),26-52.

Hirshleifer, J. (2000). The macrotechnology of conflict, *Journal of Conflict Resolution*, 44(6), 773-792.

Hirshleifer, J. (2001). *The Dark Side of the Force: Economic Foundations of Conflict Theory*, Cambridge: Cambridge University Press.

Howard, M. (2001). *War in European History*, Oxford University Press.

Keegan, J. (1993). *A History of Warfare*, Vintage Books, Canada.

McNeill, H. W. (1982). *The Pursuit of Power: Technology, Armed Forces, and Society since A.D. 1000*. Chicago: University of Chicago Press.

McNeill, H. W. (1990). *The Age of Gunpowder Empires, 1450-1800*, American Historical Association.

Nti, K. O. (1999). Rent-seeking with asymmetric valuations, *Public Choice* 98, 415-430.

Parker, G. (1996). The Military Revolution, 1560-1660---A Myth? *Journal of Modern History*.

Powell, R. (1993). Guns, Butter, and Anarchy, *American Political Science Review* 87, 115-32.

Powell, R. (1999). *In the Shadow of Power: States and Strategies in International Politics*, Princeton University Press, Princeton, New Jersey.

Rothermund, D. (1996). *The Global Impact of the Great Depression 1929-1939*, Routledge, London.

Skaperdas, S. (1996). Contest success functions, *Economic Theory* 7, 283-290.

Tirole, J. (1988). *The Theory of Industrial Organization*. Cambridge, MA: MIT Press.

Tullock, G. (1980). Efficient rent seeking, in: James. M. Buchanan, Tollison, R. D., and Gordon Tullock (Eds.) *Toward a Theory of the Rent Seeking Society*, College Station (TX): Texas A & M University Press: 97-112.

[15] Refer to Howard (2001) and McNeill (1982, 1990).
[16] Refer to Dudley (1991) for a treatment by an economic historian.