Games and Economic Behavior 67 (2009) 315–330

Contents lists available at ScienceDirect

Games and Economic Behavior

www.elsevier.com/locate/geb

Efficiency and competition in the long run: The survival of the unfit

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ARTICLE INFO

Article history:
Received 24 October 2007
Available online 6 November 2008

JEL classification:
C73
D44
D82

Keywords:
Dynamic contests
Rent dissipation
Dynamic auctions
Dynamic efficiency

ABSTRACT

In a dynamic contest the current incumbent competes against a randomly assigned entrant in a private value all pay auction each period. We focus on equilibria where the beliefs about the incumbent's type and the employed strategies are stationary. We show that inefficient types survive, even if the entrants arrive very frequently, because the entrant plays more aggressively than the incumbent, allowing a low type entrant to win against a high type incumbent. In an example we show that if the incumbent is challenged more often, then the equilibrium type of the incumbent is higher on average. When the value of the prize is the same for all players (the case studied in the public choice literature), the equilibrium rent of the bidders is fully dissipated as the incumbent is challenged infinitely often. The technical contribution lies in showing the existence of stationary equilibrium in an incomplete information game.

1. Introduction

In this paper we analyze whether competition leads to the elimination of inefficient players in the long run. A stylized model of competition is proposed where in each period an incumbent is challenged by an entrant. The player that expands a higher effort wins, receiving a type dependent utility, and becoming the new incumbent. Since even the loser has to bear the cost of his effort, the stage game is formally identical to an all pay auction. Our interest lies in the long run distribution of the type of the winner. Therefore, we study stationary equilibria where the distribution of the type of the incumbent is the same as that of the winner, and in each period the players follow the same strategies.

The main result of the paper is that in a stationary equilibrium players with lower types may win with a positive probability, and thus some inefficient types are not eliminated in the long run. The intuition is that if the entrant and the incumbent have equal types (valuations), then the entrant plays more aggressively. This feature is "inherited" from asymmetric static all pay auctions (studied by Amann and Leininger, 1996, among others) where a weaker bidder (in the sense of first order stochastic dominance) sometimes bids more aggressively than the stronger one. This leads to the entrant winning even in some cases where the incumbent has higher type than the entrant. As a consequence, in the stationary equilibrium some inefficient types remain in the support of the type distribution of the winner. We also show that the extent to which the stationary equilibrium is inefficient is affected by the frequency of offers. In an example in Appendix B we show that increasing the frequency of offers improves efficiency: a lower type expects to be replaced quickly and thus his option value from winning becomes low inducing him to behave less aggressively, while a high type may survive even if offers arise more often. However, we show that even if the incumbent is challenged very frequently, inefficient types still survive with non-vanishing probability.

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0899-8256/$ – see front matter
doi:10.1016/j.geb.2008.10.008

The inefficiency result also holds under alternative forms of competition as long as the entrant is more aggressive than the incumbent. A prime example is a first price auction that is studied by Virág (2006). However, if a second price auction is held, then the higher type always wins and, in the long run, inefficient types are eliminated. To assess the role of information, it is instructive to consider the case of complete information as well. In the all pay format the results do not change qualitatively, and long run inefficiency remains an equilibrium outcome even under complete information. However, if the competition takes the form of a first price auction, then the results change dramatically compared to the case of incomplete information: it is always the higher type that wins and in the long run all inefficient types are eliminated. One can conclude that incomplete information may prevent long run efficiency for some form of competition, and in general it reduces the chance of an efficient player to survive. We can also extend the model to the case where the entrant can observe how many times the incumbent had won before. In this case, the inefficiency result is unchanged compared to the baseline case.[1]

A common value variant of the baseline model is considered as well, assuming that the incumbent knows the value of the prize, but the entrant does not. If the challengers arrive infinitely frequently, then in equilibrium the (expected) rents of the bidders are fully dissipated. This result is in stark contrast with the case of a static contest and shows that more rent may be dissipated when the future becomes important.

In the evolutionary literature it is also a central question which (behavior) types survive in the long run, but our approach differs in many ways. In particular, we assume that players are fully rational and forward looking and do not simply maximize the probability of survival, but instead maximize profits. Moreover, in this paper we identify survival not with mere participation, but with winning the prize with positive probability: there are some low types of the entrant who are present with positive probability, but since they never win in equilibrium, we do not consider this as survival. Our main result is that if survival is not the only concern for the players and players can increase their profits by taking a higher risk of elimination, then inefficient types can survive even in the long run.

Stephan and Ursprung (1998) consider a similar setup with two modifications: they assume complete information and, more importantly, that in the stage game the contest success function is the so called Tullock function and thus the winner is not necessarily the player who exerted higher effort. Then it is hardly surprising that in their framework less efficient types win sometimes. Mehlum and Moene (2005) consider a model where there is an incumbent and a challenger every period, but they are both long run players. In their model being the incumbent yields advantages in the contest and thus incumbency is valuable itself. Since both players are long run, fixed players and new entrants do not arise, the framework provided is different from ours. Among others, Amann and Leininger analyzes asymmetric all-pay auctions under incomplete information, which is an important building block of our analysis. Our paper is also related to the extensive literature on dynamic auctions (e.g. Jofre-Bonet and Pesendorfer, 2000, and Katzman, 1999). To the best of our knowledge, ours is the first work asking what happens if the players play the game for a very long time. The paper is also related to the rent dissipation literature in public choice. Baye et al. (1999) provides an excellent analysis and lists several works in that literature. Our main contribution to this literature is the dynamic feature of our analysis and the resulting new insights on rent dissipation and dynamic efficiency.

Finally, our work is also related to random matching models in evolutionary game theory. These models assume that players are myopic and they change their strategies according to how well the current strategy worked in the past. A branch of this literature analyzes whether dominated strategies may survive in the long run, which is analogous to our question whether inefficient types may survive in the long run. However, as we commented above, the exact questions asked and the employed methodology are quite different from ours.[2]

The rest of the paper is organized as follows: Section 2 describes the model, Section 3 shows the existence of an equilibrium and Section 4 provides the results and considers some extensions. Section 5 concludes.

2. Model

Each period j there are two competitors, the incumbent (I), the winner of period $j-1$ and the entrant (E), who is drawn randomly from an infinite pool of ex-ante identical bidders. Competitors I and E choose their effort level e_I^j and e_E^j simultaneously and the competitor with the higher effort level is the winner in period j. The entrant does not observe the history of the game when choosing her effort level in period j.

The entrant's value of winning is independent of the value for the incumbent and it is distributed according to a distribution function F, that admits a strictly positive and continuous (and thus bounded) density function on support $[0,1]$. The valuation for each competitor is constant over time when they compete. The expected instantaneous utility of player $i \in \{I, E\}$ in period j is

$$U_i^j(e_i^j, e_{-i}^j) = \pi_i^j(e_i^j, e_{-i}^j)v_i - e_i^j,$$

[1] See Virág (2006) for an analysis of that case.

[2] For this literature see, for example, Hofbauer and Sandholm (2007) and the references therein. Interestingly, they also provide a negative result: even strictly dominated strategies may survive in the long run.