The All-pay Auction with Non-monotonic Payoff

BACKGROUND

- An 'all-pay auction' is one in which bidders simultaneously bid for prize/s and pay the amounts they have bid irrespective of the outcome. Examples may include patent races, innovation tournaments, electoral contests, rent-seeking activities and legal disputes.
- In many situations, the value of the prize in an all-pay auction is affected by the bid. For example, if a firm earns a patent because it is able to produce an innovative new product before its rivals, then the firm's expected payoff from the patent is greater if the product is of higher quality due to higher R&D expenditures.
- In analysing these situations, it is often assumed that the winning payoff decreases with the size of the bid. However, an all-pay auction with a 'non-monotonic' payoff is one in which this assumption is relaxed. For example, in a patent race, the payoff may first increase and then decrease with the bid as a result of diminishing returns to R&D expenditure.
- In several real-life all-pay auctions there is the possibility that no-one wins. For example, two firms can make costly investments in R&D, but neither of them may be successful in producing an innovative new product.

METHODOLOGY

- The author constructs a 2-bidder single-prize all-pay auction model where (i) there is the possibility that no bidder wins the prize, and (ii) the prize value is directly affected by the bid. The bidders place costly bids to win the prize and the lowest bidder never wins.
- This is one of the first attempts to analyse an all-pay auction with a non-monotonic payoff. It is also the first attempt to analyse an all-pay auction where it is possible that none of the bidders wins the prize. These features are consistent with several real-life phenomena.

KEY FINDINGS

- The results show that monotonicity of the payoff is not necessary for the existence of any type of equilibrium, either in pure or mixed strategies.
- The results also show that bidders' equilibrium strategies are strikingly different from those of the standard all-pay auction with monotonic payoff.
- The analysis partially explains several real-life observations such as why, even in a two-firm industry, one or both firms might stay out of a patent race, and why in some situations only a single large firm invests in R&D and small firms do not.

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