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Auctions with toeholds: An experimental study of company takeovers

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ABSTRACT

We run experiments on English Auctions where the bidders already own a part (toehold) of the good for sale. The theory predicts a very strong ("explosive") effect of even small toeholds. While asymmetric toeholds do have an effect on bids and revenues in the lab, which gets stronger the larger the asymmetry, it is not nearly as strong as predicted. We explain this by analyzing the flatness of the payoff functions, which leads to large deviations from the equilibrium strategies being relatively costless. This is a general fundamental weakness of this type of explosive equilibria, which makes them fail when human players are involved. Our analysis shows that a levels of reasoning model explains the results better where this equilibrium fails. Moreover, we find that although big toeholds can be effective in a takeover battle, the cost to acquire them might be higher than the strategic benefit they bring.

1. Introduction

The control of a company or asset typically changes hands several times over its lifetime. For example, worldwide mergers and acquisitions of companies have exceeded 3 trillion Euros in four of the last five years. Auction theory can contribute to the study of some of these transactions.

Competition for the control of a company can be essentially viewed as an ascending auction, with the various bidders sequentially submitting bids that have to be higher than the previous ones of their competitors. The bidders in such an auction have more or less similar valuations for the contested company. This leads to the literature often viewing such takeover battles as common value auctions. While there is a strong common value element in these auctions there very often exist small asymmetries which can radically change the strategic interplay between the bidders and the outcome of the contest.

If the asymmetries are due to some private control benefits or idiosyncratic synergies then we can speak of *almost common value auctions* (Klemperer, 1998), auctions where one of the bidders has a small payoff advantage, a value that is slightly higher than the common value. The asymmetries can also arise when some bidders already own a part of the company that is being sold. Ownership of such a part is called a *toehold* and is quite common in takeover battles (Betton and Eckbo, 2000). This paper presents results from experiments on auctions with toeholds and compares these results with the theory and other experimental results in almost common value auctions.

In theory ownership of a toehold can deter competitors from bidding for the company and can give its owner a strong strategic advantage. Bulow et al. (1999) give a good illustration of how toeholds can be useful in takeover battles. The authors use an English auction framework, where bidders for a company have similar restructuring plans but differing estimates of the expected returns. Under this setup, the buyers have common values but imperfect signals. The analysis proceeds to find that with common values, toeholds can have a profound effect on players' optimal strategies. Players with a toehold bid more aggressively as they know they will not have to pay the full price and in the case they lose they will get part of this payment. On the other hand players facing an opponent who owns a toehold, have to play less aggressively than if the playing field were level. In equilibrium, even with a small toehold of 5% or 10% the bidder who owns it will get the company for a much lower price than without toeholds. Thus, theory gives strong reasons for bidders to acquire toeholds. The empirical findings however are not in full support of this idea. Betton and Eckbo (2000) find that only about half of the bidders acquire toeholds before trying to buy a majority stake.

Our paper addresses the conflict between this observation and theoretical results. Although theory predicts that the toeholds should have a big effect on the players' predicted strategies, the effect could be much smaller when human players participate in this game, for reasons that will become clear in the analysis. Thus we designed and ran a series of experiments to test this idea. We choose an English auction with two players and common values, similar to the Bulow et al. (1999) setup. The major simplification is that we let the total

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value simply be the sum of the signals the players receive. This is to keep the setup simple and to avoid understanding problems on behalf of the players. What we found is indeed that although toeholds give bidders an advantage, it is not nearly as strong as theory predicts. Thus, under some circumstances it is not advisable for an agent planning a takeover to acquire toeholds. Moreover, we find that the players' deviation from the theoretical prediction is not unreasonable, but rather has deep roots in the structure of the equilibrium proposed by Bulow et al. (1999) and all other explosive equilibria of this type. The equilibrium payoff functions are in some cases extremely flat, meaning that large deviations from equilibrium are practically costless. In particular, we find that when the ratio of the two players toeholds is larger than 10 (e.g. 1% and 10%), the strong bidder can deviate almost 50% from his optimal bid with a negligible loss in expected payoff. Consequently, there is no reason to believe that human agents – be it in the lab or in real markets – would play their exact best responses. Thus, convergence to the theoretical equilibrium is very unlikely. We show that a levels of reasoning model (Nagel, 1995; Stahl and Wilson, 1995; Crawford and Iriberri, 2008) which assumes bounded rationality of the players generates more intuitive predictions and fits the observed behavior more precisely.

The study of auctions with toeholds does not only apply to company takeovers but also to the case of regulators selling "stranded assets", banks selling foreclosed properties and other bankruptcy auctions. Experienced auction experts constitute only a fraction of the bidders in such auctions, while many bidders are participating for the first time. Thus, a study of auctions with toeholds in the laboratory with human subjects can yield results relevant to many real life situations.

To our knowledge there is just one other experimental study focusing on toeholds, recent independent work by Hamaguchi et al. (2007). There also exist a few studies on auctions with almost common values that as mentioned above lead to similar theoretical results (see for example Kagel and Levin, 2003). When a player is known to enjoy a payoff advantage in a common value auction, theory predicts an explosive effect in the bidding strategies, similarly to the effect of toeholds. The player with the advantage bids more aggressively, his opponents less, which leads to the strong player winning almost all the time. Avery and Kagel (1997) have sought to test this theory and they found that the differences in common values have a linear and not explosive effect. Moreover, they find advantaged bidders' behavior resembles the best response to the behavior of disadvantaged bidders. The latter bid much more aggressively than in equilibrium, which leads to negative average profits. Experienced players bid consistently closer to the Nash equilibrium than inexperienced bidders, although these adjustments towards equilibrium are small.

In a recent paper with a similar setup, Rose and Kagel (2008) again find that the Nash prediction fails to prognose the subjects' behavior. They find rather that behavior is characterized by a behavioral model where the advantaged bidders simply add their private value to their private information signal about the common value, and proceed to bid as if in a pure common value auction. The model they chose is actually, as we shall see later, a special case of the more general toehold framework. The main theoretical difference between their model and ours is that the high types should win the auction with probability one in the almost common value setting, while in our experiments the effect is predicted to be much weaker.

While our paper finds no explosive effect of small asymmetries, similarly to the above papers, our design has the advantage of varying toehold differences which allow us to see if the comparative statics predicted by theory hold, even when subjects are not following exactly the equilibrium strategies. Our finding is that in general weak types tend to bid less aggressively the higher the toehold difference, which is only partially in accordance with the theory but much more consistent with the predictions of the levels of reasoning model.

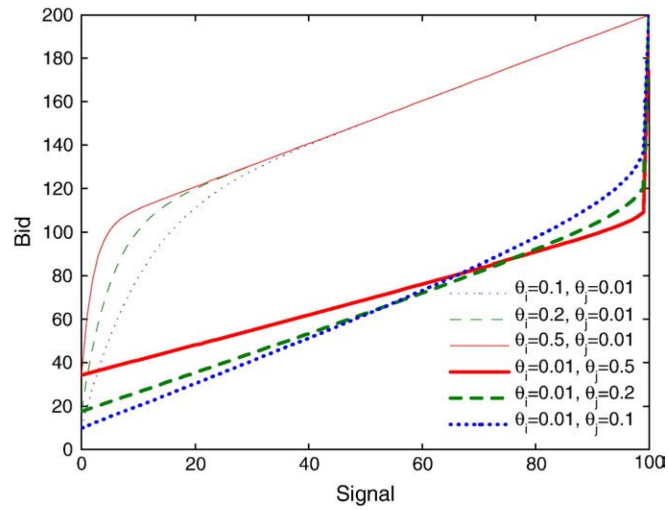

Fig. 1. The equilibrium bidding functions for $\theta_i = 0.01$ and $\theta_j = 0.05$; 0.2 and 0.5. The lower thick lines represent the bids of the low toehold type, the upper thin lines are the bids of the high type.

Section 2 introduces the model. Section 3 presents the experimental setup and Section 4 analyzes the data. Section 5 concludes.

2. The model

Two risk neutral bidders i and j bid in an English auction for one unit of an indivisible good. Bidders' signals t_k are independently drawn from the uniform distribution in [0,1]. The value of the good to every bidder is then just the sum of these signals. Additionally the bidders already own a share of the company θ_k, which we will call a *toehold*. Ownership of a toehold means that in case the company is sold the owner will get θ_k times the sale price, thus if she wins she only pays $1-\theta_k$. Bidder's shares are exogenous and common knowledge.

The unique symmetric equilibrium is calculated in Bulow et al. (1999).

Proposition 1. *The equilibrium bidding functions of the game are given by*

$$b_i(t_i) = 2 - \frac{1}{1+\theta_j}(1-t_i) - \frac{1}{1+\theta_j}(1-t_i)^{\frac{\theta_i}{\theta_j}}$$

A discussion and the proofs can be found in the aforementioned paper.

The proposition is true for all $\theta > 0$. For $\theta = 0$ we would have a usual English auction with common values, with the well known equilibria. That is, in the absence of toeholds the equilibrium bidding functions would be just symmetric, straight lines[1] through the origin with slope 2. Even when players have toeholds, if they are symmetric, the bidding functions are still symmetric straight lines with a slope that depends on θ.

Now, when the toeholds are asymmetric there is the explosive effect described in the introduction. The bidding functions of the two players grow apart very rapidly. In Fig. 1 you can see the shapes of the equilibrium bidding functions, separately for the low and high types. It can be observed that for toehold differences greater than 10 percentage points, the functions have parts with extremely high slopes. For signals close to zero the high types' bids rise very steeply and similarly for signals close to 100 the low types' functions are rising very fast.

[1] This can be seen by the standard methods used in the literature. There is however a more straightforward way to see what happens for very small toeholds, by taking the limit of the bidding function in Proposition 1 with the toeholds being equal and tending to zero. The function then reduces to just $b(t) = 2t$.