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# Ending an Internet Auction: Is eBay's Approach Optimal?

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**ABSTRACT.** Internet auctions can be ended in different ways. EBay auctions, for example, end at a predetermined time while Amazon auctions do not. The auctions at Amazon are extended by ten minutes if a bid is submitted within the last ten minutes of an auction. EBay's hard closing rule induces bidding strategies that can produce inefficient results. Nevertheless, a hard close ending rule is more efficient than the automatic extension rule used by Amazon. EBay's hard closing rule can be modified to resemble a Vickrey second-price auction. The modifications would make auctions on eBay more efficient.

## I. Introduction

Going once, going twice, sold. The phrase is synonymous with the word auction. The phrase describes the auction-ending procedure with which most people are familiar. The proliferation of internet auctions is changing the way auctions are ended. The primary advantage of internet auctions is that they have lower transaction costs than traditional auctions. From the bidder's perspective the amount of time and effort spent bidding is a major component of the transaction costs of an auction. The time spent bidding is heavily influenced by the way an auction is ended. Klemperer [2002, 19] said that "the most important features of an auction are its robustness against collusion and its attractiveness to potential bidders". Which ending rule performs best under these criteria?

EBay auctions end at a set time, a rule which is called a hard close. An auction's ending rule affects the auction's attractiveness to bidders through the transaction cost of bidding. The transaction cost of bidding increases in importance as the sale price of the good decreases. Items auctioned on eBay do not usually have a high value, so transactions cost matter.

Collusion and cheating will also be shown to be dependant upon the auction's ending rule. A hard close has lower transaction costs of bidding, and is more robust against collusion than an auction that does not have a set ending time. Altering eBay's hard close to resemble a Vickrey auction would improve the auction's robustness against collusion. The change would decrease the transaction cost of bidding, which would

attract more bidders.

## II.  The Auction Structure on eBay

The bidding process on eBay is straightforward.  The bidder who submits the highest bid before the auction ends wins.  The auction appears to be a traditional English ascending price auction, and many naïve bidders act as though it is.  In an English auction bidders sequentially outbid one another until only one bidder is willing to bid higher than anyone else.  EBay auctions end when time runs out.  Bidders cannot continually raise their bids like they could in an English auction.  The "hard" closing time has given rise to a practice known on eBay as "sniping".  Sniping occurs when a bidder submits a bid with only minutes or seconds remaining in the auction.  The sniper attempts to successfully submit a bid such that another bidder does not have sufficient time to respond with a higher bid.

Sniping is likened to a Vickrey auction.  In 1961 William Vickrey analyzed the revenue generated from different auction formats.  The formats were the English auction, the Dutch descending auction, the first-price sealed bid auction, and the second-price sealed bid auction.  Vickrey showed that the four formats are revenue equivalent under some circumstances [1961, 20].  Auction theorists incorrectly recognized Vickrey as the creator of the second-price sealed bid format [Lucking-Reiley, 2000, 3].  The second-price sealed bid format is known as the Vickrey auction.  In a Vickrey auction bidders submit one value to the auctioneer.  When time expires the item is awarded to the bidder with the highest bid.  The price the winner pays is equal to the second highest bid.  A sniper pays one increment above the highest submitted bid, but less than he is willing to pay.

Roth and Ockenfels [2002, 2] show that Amazon auctions deter sniping by ensuring that the last ten minutes of an auction are free of bidding.  Sniping is deterred by extending the closing time of an auction by ten minutes whenever a bid is placed during the last ten minutes of an auction. Amazon auctions are pure English auctions.  EBay has implemented a proxy bidding system to combat sniping.  The proxy resembles a Vickrey auction.  A bidder inputs a maximum valuation and the proxy will outbid any other bid lower than the maximum.  If the proxy bidder wins, the price will be one increment above the next highest bid.  Unlike a Vickrey auction the maximum valuation is not sealed.  The

bidder always has the option to raise the valuation, and can lower it to the level of the last submitted bid. Potential inefficiencies are created by the coexistence of a hard closing time and a non-sealed bidding format. The hard close guarantees the opportunity to snipe. The most efficient outcome of sniping resembles a Vickrey auction. The efficiency of an eBay auction will be equal to or less than the efficiency obtainable by using a pure Vickrey auction format.

## III.  Cheating

A discussion of the fear and effect of cheating is necessary when analyzing bidding behavior. Cheating can take two forms. In the first form the seller gains an unfair advantage against the bidders. In the second form the bidders collude against the seller. Cheating or the fear of cheating is one of the two reasons why Vickrey auctions are not more common [Rothkopf, 1990, 14]. The second reason is that bidders do not want to disclose their valuation when it can be used against them in future auctions. When there are post-auction negotiations a seller gains from knowing the true valuation of the buyer. The true valuation of a bidder is valuable information in markets for goods that are identical and frequently auctioned. A seller must cheat to take full advantage of the bidder's true valuation.

Collusion against the seller in an Internet auction is rare because it is unlikely that all potential buyers can meet before an auction begins. Roth and Ockenfels [2002, 3] describe an equilibrium in which bidders collude against an eBay seller using snipe bids. Collusion occurs without communication prior to the auction. Bidders with high valuations decide to snipe bid. The expected benefit of winning the auction at a low price outweighs the probability of not submitting a winning bid. The bidders are implicitly colluding against the seller to keep the price of the item low. Collusion against the seller is more likely to occur when valuations are interdependent, but may also occur when valuations are strictly private.

Sellers have a greater opportunity to cheat in Vickrey auctions. The dominant strategy of a bidder in a Vickrey auction is to bid his highest valuation because he will only pay an increment above the second highest bid. When seller and facilitator are one entity it is easy to inflate the second highest bid or solicit a higher losing bid from a friendly third party. Even if the seller is not running the auction the facilitator may

have an incentive to inflate the price of the item. Portions of a facilitator's commissions are usually based on the final sale price. Some sellers may have the power to pressure the facilitator to inflate the second highest price. Lucking-Reiley's [2000, 7] paper, "Vickrey Auctions in Practice" contains the confession of a stamp auctioneer who left the business because the temptation to artificially raise the second highest bid was too great for him. EBay as a facilitator has a small stake in the selling price of an item. Most of the fees eBay collects are independent of the final sale price. It is assumed that eBay is rational and does not have enough incentives to artificially raise sale prices.

Shill bidding is the most common form of seller cheating. A shill bid occurs when the seller bids on her own item or employs someone to do so. The purpose of the shill bid is to raise the second highest price. If the bidder with the highest valuation were incrementally bidding he would have to raise his bid to beat the shill bid. If the bidder is using the proxy bidding system, the proxy will automatically raise the bid. In either instance the shill bid creates artificial competition for the item. If the shill bid is higher than the highest valuation of the true bidders then the seller buys her own item. The seller must pay the transaction costs again to sell the item. High transaction costs discourage the practice of shill bidding. EBay initially encouraged sellers to bid in their own auctions if they did not like the highest bid [eBay, 2004, para. 12]. They have since realized the implications of shill bidding, and have banned it. EBay relies on the diligence of its bidders to report shill bidding. Bidders discover shill bidding by analyzing the bid history of a seller's auctions. First time violators are suspended. A second violation will result in a lifetime ban. Detection of shill bidding is difficult when items are of low value or the sellers rarely perform shill bidding. The U.S Department of Justice has successfully prosecuted a few high profile cases of shill bidding. One of the more infamous examples involved the auction of a fake Richard Diebenkorn painting that sold for just over $135,000 [United States Department of Justice 2001, 2].

Buyers have their own defense against shill bidding. Shill bidders need to know that an individual values the item being auctioned. If a bidder bids early or enters a proxy bid the seller will see that the bidder values the item. As others bid against the early bidder, the early bidder or his proxy will react with a higher bid. Shill bidding will occur when only the early bidder remains. The shill bidder will provide artificial competition for the early bidder until the price has reached an acceptable

level. The early bidder is better off if he hides his valuation. By snipe bidding in the closing seconds the seller will not have time to enter a shill bid. A seller could shill bid before the snipe bid is placed. If all bidders are snipers, then the shill bidder can place only one bid. Submitting one shill bid is equivalent to legally setting a reserve price. The shill bidder needs a legitimate incremental bidder or a second shill bidder to bid against. As shill bidding becomes more pervasive more bidders will become snipe bidders. Actual shill bidding does not even need to occur to induce bidders to snipe. The fear of shill bidding alone makes sniping a rational bidding strategy.

## IV. Market Depth

As auction participation increases, ceteris paribus, auction efficiency increases [Swinkels, 1999, 17]. The competition added by new bidders increases the revenue generated by an auction. For example, a sniper will enter a bid of a magnitude related to the number of bidders he believes will enter a snipe bid. If he expects many competing snipe bids he will bid slightly higher. Any auction structure will be inefficient if the number of bidders does not create a sufficient level of competition.

What aspects of eBay's auctions attract bidders to the market? Lower transaction costs attract entrants. It will be shown that the hard closing rule and proxy bidding option lower the cost of bidding on eBay. Some bidders that snipe say that it provides a kind of thrill or excitement that is missing in other auctions [Steiner, 2002, para. 5]. The thrill could attract risk-seeking bidders that normal auctions do not. Roth and Ockenfels [2002, 4] showed that many more antique auctions take place on eBay than on Amazon. Antique buyers prefer to use eBay's auction structure because it is more likely to afford them a higher profit. As of December 31, 2003 eBay had over 28 million users who had been active in the previous twelve months [eBay, 2002b, para. 10]. The auction structure of eBay is attractive to bidders.

### A. INTERDEPENDENT VALUATION

The most transparent breakdown of the Vickrey Auction format is when valuations are interdependent [Perry, 2002, 1]. Interdependent valuation occurs when any individual's valuation is affected by the bids of others. Common valuations are a special case of interdependent valuations.

Common values occur when each buyer's valuation is so extremely dependent upon the valuation of others that all buyers will have equal valuations. In a Vickrey auction the maximum valuation of each bidder is sealed. Bidders are unable to learn from the bids of others. Perry [2002, 10] suggests that an auction with multiple rounds can assure that bidders reveal valuations before the final bids are made. Multiple round auctions hinge on the bidder's incentives to reveal their valuations in the early rounds. Crèmer [1985, 11] and Dasgupta [2000, 25] suggest that bidders submit a valuation distribution that is conditional on other bidders' valuations. In reality the bidders themselves may not know how they will react to the bids of others.

The valuation of antiques is usually interdependent. One type of interdependent valuation occurs when some bidders are known to have knowledge that other bidders do not. The insider has more information about the true value of the antique. A bidder who is not an insider is called a naïve bidder. The bidding behavior of identified insiders provides information to other bidders. When an insider continues to bid, naïve bidders learn of the insider's higher valuation. The naïve bidders will then raise their valuation to match the signal they receive from the insider's bid. When an insider ceases to bid, other bidders learn that the current bid is greater than or equal to the insider's valuation. Naïve bidders will then lower their valuation so as not to pay more for the antique than it is truly worth to them. The amount by which each naïve bidder's valuation changes is unique, but is directly related to the bidding behavior of the insider.

A second instance of interdependent valuation in antique auctions is associated with the theory of a Veblen Good. A Veblen Good's high price increases the status of its owner. A collector in search of a Veblen Good obtains utility from winning an auction over bidders who were capable of paying a high price for the antique. The presence of high bids for an item may increase the value of the item in the minds of collectors who desire Veblen Goods. A collector who seeks a Veblen Good will value an item higher if it has received high bids.

Surely there is value in knowing the bids of others. A standard Vickrey auction is inefficient because it is impossible to obtain information about other bidders' valuations. A buyer who realizes there is value in his bid will snipe bid on eBay to protect the value of his information. The insider's true valuation is never revealed because he only bids enough to beat the current price. If the insider wins, the price

paid will be equal to an increment above the second highest bid. All buyers with valuable information will rationally bid in this manner. Due to the lack of information all bidders will be uncertain about their valuations. Insiders will attempt to submit a last second bid based upon their imperfect knowledge of other insiders' valuations.

EBay's proxy bidding system cannot overcome inefficiency caused by interdependent valuations. The proxy does not allow a buyer to enter a maximum valuation that is dependent upon the bids of others. Experienced bidders will submit bids late on eBay and will submit bids early on Amazon [Roth, 2002, 7]. The difference could be due to a self-selection of buyers and sellers to different auctions. Roth and Ockenfels conclude that:

> The clear difference observed in the amount of late bidding on eBay and Amazon is strong evidence that, as predicted both at equilibrium and when some bidders are unsophisticated, the hard close gives bidders an incentive to bid late, in both private- and common-value auctions. This evidence is strengthened by the observations that (i) the difference is even clearer among more experienced bidders, and (ii) there is more late bidding for eBay Antiques than for eBay Computers [2002, 9].

The assumption is that antiques are more unique than computers. The value of the antique is more uncertain. The uncertainty makes the information of the insiders, or experienced bidders, more valuable. Bidders perform sniping in order to protect the value of their information. Sniping transforms the auction into a Vickrey auction with interdependent values. A Vickrey auction will generate less revenue than an English auction under interdependent values [Lucking-Reiley, 1999, 3]. Buyers bid in a manner that reflects a Vickrey auction rather than bidding incrementally because it minimizes the price they may pay for the item.

B.  TRANSACTION COSTS

The main advantage of Internet auctions and the Internet in general is that it reduces transaction costs. Traditional auctions like those held at Sotheby's require a bidder to be present at the auction. Bidders incur the implicit and explicit costs of travel. Of course an agent can be hired to bid in place of the buyer. The agent will collect a fee for his services and

may or may not be as effective as the buyer would have been. William Vickrey's second price sealed auction does not require buyers to meet for the auction. The bid merely consists of a maximum value that is mailed, phoned, faxed, or otherwise communicated to the auctioneer anytime before the auction closes. A Vickrey auction has a lower transaction cost of bidding than an English auction.

Like typical auctions, Internet auctions have different transaction costs of bidding. Internet auctions do not require bidders to gather in a single room. Different auction formats require the buyer to spend more or less time bidding. EBay, in its best form, requires as much effort as any sealed bid auction. The least cost way to submit a bid on eBay is to utilize the proxy bidding system. Submitting a proxy bid may not be the best strategy to win the item at a low cost. If the strategy of the bidder is to snipe, then the bidder must be signed onto eBay at the close of the auction. Companies have formed that specialize in sniping for their customers. Sniping has a slightly higher transaction cost of bidding than a Vickrey auction or proxy bid.

Amazon's ending rule creates higher transaction costs of bidding than eBay. Bidders must be signed onto Amazon for the last scheduled ten minutes of the auction. The bidder must stay at the auction site until the going, going, gone period is over. The auctioning of the "Bartman Ball" or "Infamous Cubs Ball" is a recent example. The ending rule of the auction was identical to Amazon. MastroNet Inc. [2003, 1], the auctioneer and owner of the ball, scheduled the auction to end at 10:00 P.M. on Thursday December 18, 2003. At 3:00 A.M. the next morning, ten minutes passed without a new bid and the auction ended. The ball was sold for over $106,000. This extreme example is only likely to occur in instances where the auction item has an exceptionally high value.

A sealed bid auction has the lowest transaction cost of bidding. EBay has a slightly higher transaction cost of bidding because sniping can be a dominant strategy. Amazon's transaction cost of bidding is vaguely higher than eBay's. Transaction costs of bidding are usually small, but they can be significant when the value of the auctioned good is also small. The differences in transaction costs of bidding among auction formats are usually overshadowed by other factors, such as the cost or benefit of collusion.

## V.  The Future of Sniping on eBay

There are three plausible, mutually exclusive ways that eBay can handle

sniping in the future. Option one is that eBay will do nothing. Bidders will continue to snipe on their own, through third party servers, or with third party software. No change is optimal if eBay feels that the hard close rule attracts buyers and has positive net effect on auction revenue. EBay has been profitable under the "hard" close structure, and is unconcerned with the efficient allocation of the auctioned goods. Making major changes to a business that is profitable is an option that is rarely chosen by a public corporation. The two other alternatives require eBay to adopt rules that will make their auctions resemble either a pure English ascending auction or a pure second-price Vickrey auction.

Automatically extending the closing time of an auction when a snipe bid is placed has been shown to curtail sniping [Roth, 2002, 2]. Automatic extension is a change commonly suggested by opponents of sniping. The resulting auction would be nearly identical to Amazon's auction structure. A replication of Amazon's structure is not likely for a couple of reasons. First, eBay has been much more successful with auctions than Amazon. EBay will not emulate a weak competitor without legal or financial pressure. Second, English auctions strictly favor the bidder with the highest valuation. The low value bidder has little incentive to bid in an auction he cannot win. Predatory bidding by high value bidders against lower value bidders may push competition below an efficient level. Third, English auctions have high transaction costs of bidding because of the uncertain length of the auction.

If change is to take place, eBay will likely adopt a bidding structure that resembles a Vickrey auction. Vickrey auctions have low transaction costs of bidding. Bidders only need to commit time to privately valuing the item and placing a bid. Vickrey auctions on eBay would not inspire the fear of cheating that occurs in other Vickrey auctions. Bidders are likely to believe that eBay will not collude with sellers to shill bid. EBay can strengthen the confidence of bidders by lowering the revenue that is based on the final sale price. It is more difficult for a seller to shill bid in a Vickrey auction because they do not have information on bidders' valuations until after the auction.

Auction theory is supportive of Vickrey auctions, but theory is not the main reason why eBay would change to a Vickrey format. Companies sell software and services that will place a snipe bid for the bidder. Some software is free but most of the companies are compensated for their services and software. A survey of the sniping industry by AuctionBytes.com [2003] shows that in 2002 these companies had at least

410,000 customers that placed at least 351,000 bids per week. The numbers do not include snipers who use software or services that did not report figures. None of the sniping companies can guarantee that a snipe bid will even be submitted. Assuming that each of the snipe bids cost an industry low of $0.25 per bid, 351,000 snipe bids per week will generate annual revenue of $4.5 million [AuctionBytes.com, 2003]. The heads of two sniping services companies claimed that 5% of all auctions on eBay in 2002 involved sniping [Glasner, 2002, 18]. There were 638 million auctions on eBay in 2002 [eBay, 2002a, 1]. Assuming only one snipe bid occurred in each of the sniped auctions, there would have been 32 million snipe bids in 2002. At $0.25 per snipe bid, annual revenue would have been $8 million. The revenues are small compared to eBay's total revenue, but it is still a significant amount of money. In 2002 the additional revenue would have increased earnings per share of eBay's stock by 2 to 3.5 cents and would likely have a high net margin [eBay, 2002c].

EBay can easily capture sniping revenue. If eBay were to provide its own sniping software it would eliminate all competition because it will be directly connected with the auction. Snipe bids placed through an eBay sniping service would always be submitted successfully. EBay could couple its proxy-bidding agent to the sniping service so that a winning bidder will only pay the second highest bid. If this change occurred valuations would be submitted based solely upon the valuation of each bidder. The valuations would not be revealed until the auction is over, and the bidder would pay the second highest price. The auction would be a pure Vickrey auction.

## VI. Conclusion

A hard closing rule is optimal in Internet auctions of low value items in order to keep transaction costs low. Low transaction costs of bidding enable more bidders to participate, which increases competition, efficiency, and revenue. Sniping is a rational response to a hard closing time and fear of collusion. The structure of eBay auctions is not likely to change. If change does occur it will likely be a move towards a pure Vickrey auction because it will allow eBay to capture rents that sniping agents have been earning. The "hard" close auction and pure Vickrey auctions are inefficient formats for auctioning items that have strong interdependent values.

Auctions of similar goods are commonly held concurrently or sequentially. Timing can alter the conclusions of some research that has been utilized in this paper. The effects of timing would be a useful extension of this paper.

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