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Sidne G. Ward

*University of Missouri - Kansas City, wards@umkc.edu*

John M. Clark

*University of Missouri - Kansas City, clarkjm@umkc.edu*

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# Bidding Behavior in Virtual versus "Live" Auctions: An Examination of the eBay Collectibles Market

Sidne G. Ward, Business Administration Division, Bloch School of Business and Public Administration,  
University of Missouri-Kansas City, wards@umkc.edu

John M. Clark, Business Administration Division, Bloch School of Business and Public Administration,  
University of Missouri-Kansas City, clarkjm@umkc.edu

## Abstract

Over the last few years many consumer-related virtual auction sites have sprung up on the web. One of the most successful of these is eBay. Single item auctions on this site share characteristics with both English and a hybrid combination of first-price and second-price sealed bid auctions. This paper describes research in progress to determine the effects of the specific structure of eBay auctions on bidding strategies while drawing on traditional auction theory which was devised by examining "live" auctions not mediated by computers. The results of the study should have implications for bidders, sellers, and managers of auction web sites.

## The Rise of Virtual Auctions

A number of consumer-related virtual auction sites have sprung up on the web over the last few years selling everything from collectibles to automobiles and fine art. A guide to art, antique, and collectible web sites declared eBay the winning site due to the vast number of auctions and registered users (Ebeling et al., 1999). eBay, which was launched in 1995, currently has over 4 million ongoing auctions, more than 7 million registered users, and over 1.5 billion page views per month. The number of auctions handled by virtual auction sites may soon surpass those conducted by traditional "live" auction houses in many categories of goods. One art expert predicts that 90% of art auctions will move to the Internet (Klebnikov, 1999). As this new mechanism for facilitating auctions becomes more ubiquitous applying traditional auction theory to an examination of the effects of the different auction structures may provide valuable lessons for sellers, bidders, and maintainers of virtual auction sites. We propose to examine the structure of single-item auctions on a particular virtual auction site, eBay, and determine whether predictions based on traditional auction theory devised from "live" auctions not mediated by a computerized system hold true.

## Traditional Auction Theory

Much of the auction theory literature is devoted to measuring the revenue outcomes from the various types of auctions. This paper specifically looks at auction theory related to English and first-price and second-price

sealed bid auctions. English auctions in a "live" setting are the most common auction type. They entail an open outcry bidding process that involves increasing the price until the highest bidder is identified. This bidder then pays the bid price for the given item. The first-price and second-price sealed bid auctions involve accepting sealed bids and declaring the highest bidder the winner. In the case of the second-price sealed bid the highest bidder is required to pay the amount of the second highest bid for the given item.

One of the first theoretical premises in auction theory (Vickrey, 1961) resulted in a series of Nash equilibrium models which indicate English auctions, first-price sealed bid auctions, and second-price sealed bid auctions should result in the same revenue to the seller for independent private value auctions. Milgrom and Weber (1982) developed a theoretical general model which demonstrated, among other things, that for affiliated private value auctions when bidders know the value the item holds for them that bids in English and second-price sealed bid auctions should be equal to each other and higher than bids in first-price sealed bid auctions. In addition, when the value of the item is unknown to the bidder English bids result in the highest values, second-price sealed bids in the second-highest values, and first-price sealed bids result in the lowest values. Values are independent when the bidder has no information regarding the value of the item to other potential bidders. Values are affiliated if it is the case that when bidders receive information indicating their values for an item are likely to be high (or low) this indicates that other bidders' values are also likely to be high (or low).

Later, results of a series of lab experiments indicate that second-price sealed bids result in higher revenues than English bids for affiliated private value auctions (Kagel, Harstad, and Levin, 1987) suggesting that bidders behave irrationally. In a recent field experiment, Lucking-Reiley (1999) determined that English auctions resulted in the same revenues as second-price sealed bid auctions for private value auctions. At this time there have been no field studies in the auction literature that perform these equivalence tests on single-item auctions where it is possible for bidders to submit bids with the characteristics of both English auctions and sealed bid auctions. This paper addresses this issue by testing using the stricter hybrid sealed bid auctions

contained in the eBay market structure and English auctions in an affiliated private value context.

## **Characteristics of the Virtual Auction Site eBay**

Although there are a variety of virtual auction sites using many different formats to support their auctions, for the current research we have chosen to concentrate on a particular site, eBay. As noted earlier, eBay is the most popular consumer-related virtual auction site; an examination should yield sufficient data to draw well-supported conclusions that will be applicable to other auction sites with a similar market structure.

The most common type of auction in the collectibles section of eBay involves sellers listing a single item for sale specifying a minimum bid for that item. If the item receives at least one bid, the seller and the highest bidder are obligated to conclude the transaction. A variant on this auction type allows sellers to set a reserve price that is higher than the minimum bid and known only to them. The fact that the item has a reserve price and whether or not that reserve price has been met is noted in the auction description. If the item receives at least one bid at or higher than the reserve, the seller and highest bidder are obligated to conclude the transaction.

Sellers on eBay may choose to run either type of auction for three, five, seven, or ten days. Auctions close exactly at the time of day as originally posted. For example, if a seller begins a three day auction at 10:37:14 a.m. on August 10, the auction closes at 10:37:14 a.m. on August 13. eBay has a feature which allows a bidder to enter the maximum amount he or she is willing to pay for an item. The system automatically executes bids based on the current highest bid plus the minimum bid increment. eBay uses the term "proxy" bidding to describe this type of bid.

### **eBay versus "Live" Auctions**

"Live" auctions share a number of characteristics with eBay auctions, yet there are some important differences including the type of bidding used. eBay auctions for single items exhibit characteristics of both the English and sealed bid auctions.

Similar to English auctions, bids on eBay are immediately published so that anyone interested in the auction can know what the current highest executed bid on an item is. But unlike English auctions, eBay auctions end at a specific time regardless of whether there is active bidding.

In addition, the proxy bidding feature on eBay takes on some aspects of a hybrid between first-price and second-price sealed bid auctions. Bidders cannot know whether a bid will be the new high bid until after placing it; they may have already been outbid through the proxy bidding feature. Nevertheless, unlike "live" sealed bid auctions, bidders do receive immediate notification if their bid has been topped. Although high bidders on eBay do not pay the amount of the second-highest bid, but pay that plus the minimum bid increment, eBay auctions are more similar to second-price than first-price sealed bid auctions since the bidder pays only a modest increment over the second-highest bid rather than the maximum he or she is willing to bid for the item. Nevertheless, the revenue realized in an auction won by a proxy bid should be between the amounts expected for strict second-price and first-price sealed bids.

### **Research Problem**

Due to the combination of a set closing time for auctions and the proxy bidding feature, eBay bidders have devised some unique bidding strategies in an attempt to successfully win bids. In many active auctions, the bid amounts and number of bids submitted greatly escalate in the last few minutes of the auction.

The results will demonstrate the effects of the constraints established in the eBay market structure, such as the specific ending time and the availability of proxy bidding. Auctions which are won by proxy bids submitted in the earlier stages of the auction process most resemble sealed bid auctions in that bidders have minimal information regarding bids from competing bidders. Another group of auctions are those won by proxy bids submitted during the later stages of the auction process, after a great deal of information has been revealed regarding other bidders' interest in the item. Finally, there exists a set of auctions which most resemble English auctions with straight bidding at minimum bid increments. The set of auctions being examined involve very similar items. We argue that the appropriate model to follow is that of affiliated private values since bidders have information regarding the values of the items by examining other current and recent auctions.

Following the general model developed by Milgrom and Weber (1982) we propose that auctions won by proxy bids submitted during the later stages of an auction will result in higher revenues than those submitted during the early stages. Similarly, auctions won by proxy bids will result in final bids less than or equal to auctions won by English-style bids. The following hypotheses will be tested:

H1: Auctions which are won by proxy bids submitted late in the auction will result in higher

final bids than auctions which are won by proxy bids submitted early in the auction.

H2a: Auctions which are won by proxy bids submitted early in the auction will result in final bids less than or equal to those in auctions which are won by English-style bids.

H2b: Auctions which are won by proxy bids submitted late in the auction will result in final bids less than or equal to those in auctions which are won by English-style bids.

Although the preceding hypotheses follow from the theoretical model developed by Milgrom and Weber (1982), the empirical work of Kagel, Harstad, and Levin (1987) indicates that bidders behave irrationally at times. In addition, none of the referenced studies examined the effects of a set closing time for auctions. The existence of sub-optimal bidding strategies and the eBay market structure may lead to results different than those hypothesized.

## Methods

The research in progress is examining single-item auctions in the collectibles area. This allows analysis of many extremely similar auctions to look for differences in bidding strategies and revenue realized.

The results of a large number of successful and active auctions of identical collectibles will be analyzed. Successful and active auctions are defined as those auctions for which there are a minimum number of different bidders and the reserve price, if any, is met. The timing of and price of winning bids and second-highest bids will be examined to determine which auctions are won by proxy bids and which by English-style bids. Auctions which are won by proxy bids will be divided into two different categories, those in which the winning proxy bids were submitted during the earlier stages versus the latter stages of the auction.

The hypotheses will be tested using t tests comparing the amounts of the winning bids for auctions won by proxy bids versus those won by English bids and auctions won by early proxy bids versus those won by late proxy bids.

Data collection is currently underway and preliminary examination of the data indicates patterns in bidding strategies. Final results of the analysis will be presented at the conference.

## Contributions and Significance

To date, there has been little published research on the effects of virtual auction web sites on bidding strategies in single-item auctions. Lucking-Reiley (1999) examined auctions over the internet, but the structure of those auctions resembles "live" by-mail auctions and the results are not directly transferable. Bapna et al. (2000) analyzed the effects of multi-item auctions, yet bidding strategies in these auctions are very different than those in single-item auctions. The results of this study should be applicable to other auction sites with market structures similar to eBay and have implications for bidders with regard to successful bidding strategies, sellers who may wish to choose an auction site that is likely to lead to the highest bids, and managers of auction web sites who wish to design auction support mechanisms to maximize commission revenues.

Future research may include a further investigation into the dominant auction ending policy that should be adopted by auction site modelers by comparing additional auction sites with different market structures.

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