An Investigation of Willingness to Spend Dynamics in Simultaneous Online Auctions

In this paper, we investigate the dynamics of WTS of a simultaneous online auction of a specific genre of fine art called modern Indian art and compare it with the dynamics of cumulative Willingness to Pay (WTP), using an innovative statistical method called Functional Data Analysis. Functional Data Analysis, which is fundamentally considered to recover the underlying WTS and cumulative WTP function curves of each bidder, is further used to examine the effects of current number of bids, current number of lots winning, pre-auction low estimate of the lots they are currently winning, bid time, and number of proxy bids on WTS and cumulative WTP dynamics. Result suggests that only current number of bids and bid time have significant positive effect on the bidder WTS, whereas only current number of bids have influence on cumulative WTP.
AN INVESTIGATION OF WILLINGNESS TO SPEND DYNAMICS IN SIMULTANEOUS ONLINE AUCTIONS

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ABSTRACT

Willingness to spend (WTS), as defined by the amount a bidder is willing to spend in a particular auction event, is a crucial component for an auction’s success. This paper investigates the dynamics of WTS of a simultaneous online auction of a specific genre of fine art called modern Indian art and compare it with the dynamics of cumulative Willingness to pay (WTP), using an innovative statistical method called Functional Data Analysis. Functional Data Analysis, which is fundamentally considered to recover the underlying WTS and cumulative WTP function curves of each bidder, is further used to examine the effects of current number of bids, current number of lots winning, pre-auction low estimate of the lots they are currently winning, bid time, and number of proxy bids on WTS and cumulative WTP dynamics. Results suggest that only current number of bids and bid time have significant positive effect on the bidder WTS, whereas only current number of bids have influence on cumulative WTP. Implications for auction house managers are further discussed in the paper.

Keywords: willingness to spend, functional data analysis, dynamic modeling, simultaneous online auctions, online fine art auctions

1. Introduction

With the growing popularity of online auctions and easy availability of detailed bidding information, we now have a greater prospect in micro-analyzing various online auction bidding behaviors in different auction settings that were not possible earlier. To a greater extent, we have capitalized on this opportunity by addressing a wide range of online auction topics, including, for example, auction formats [Jap 2002; Jap 2003; Lucking-Reiley 1999; Spann and Tellis 2006], price dynamics and forecasting [Jank and Shmueli 2006; Reddy and Dass 2006; Dass, Jank and Shmueli 2010], bidders’ willingness to pay [Park and Bradow 2005; Chan, Kadiyali and Park 2007], reference points [Dholakia and Simonson 2005; Kamins, Drenze and Folkes 2004], buyer and seller reputation [Melnik and Alm 2002], herding behavior [Dholakia, Basuroy and Soltyssinski 2002], forward-looking behavior [Zeithammer 2006], bidder experience [Borle, Boatwright and Kadane 2006], bidder heterogeneity and auction design [Bapna et al. 2004]. Although these studies have expanded our understanding of online auctions, other bidder behavioral phenomena are still not examined. One such topic is bidders’ willingness to spend in a simultaneous online auction.

Most of the prior researches in auctions examining bidders’ purchase decision and values have focused on their willingness to pay (WTP). These studies investigated what drives bidders’ WTP [Noussair, Robin and Ruffieux 2004; Chan, Kadiyali and Park 2007] and how it is different from bidders’ willingness to accept (WTA) [Shogren et al. 1994; Plott and Zeiler 2005]. Interestingly, most of these studies assume that bidders are involved in purchasing only one product at a time in the auction. This assumption is not sufficient while examining bidders’ purchase decisions in simultaneous online auctions where bidders typically tend to purchase more than one item simultaneously. In such cases, Willingness to Spend (WTS) is the most appropriate bidder metric to consider while examining success of auction houses. From the extant literature, we find examination of WTS mostly in the context of multi-product bundles [Gaeth et al. 2004]. We adopt their definition and define WTS in the context of online auctions as the amount a bidder is willing to spend in a particular auction event. In this paper, we define WTS as the total amount a bidder is required to pay at a given time period during the auction if he/she wins all the items at the current highest bid amount where he/she is currently the highest bidder. Therefore, by the above definition, WTS is the superset of Willingness to Pay (WTP) of bidders for the items they wish to purchase, as it is the sum of the WTP of all items. If a bidder is interested on only one item, then WTP = WTS. Although a bidder’s WTP for an item is not disclosed by the bidder to others, the bidder’s bidding pattern can be considered as a proxy for this unobserved...
factor. As the auction progresses, bidders reveal more about the amount he/she desire to pay for a particular item. In this paper, our goal is to examine the dynamics of this gradual revealing of the private value of the bidders.

One of the factors that affect bidder behavior in multi-item auctions is budget constraints [Benoit and Krishna 2001]. Park and Bradlow [2005] and Chan, Kadiyali and Park [2007] showed that budget constraints has a significant influence on how bidders choose items they want to bid, and when they bid on them. They used data from common value auctions of personal computer to illustrate this phenomenon. Such results do not hold true in case of private value auctions [Klemperer 2004] where bidders’ private information is considered affiliated information. This means that a bidder’s high bid value will generate higher bids from other bidders [Milgrom and Weber 1982]. As bidders have different level of attractiveness and different WTP for the items in his/her wish list, the items are rank ordered in the bidders’ bidding strategy. During the auction process, a bidder will bid on items until his/her preset WTP. If the value of the item gets more than the bidder’s WTP, the bidder may increase his/her WTP of the current item due to influence of other bidders [Ariely and Simonson 2001; Heyman, Orhun, and Ariely 2004], may increase the WTP of the other items in his/her wish list, or may change their consideration set and bid on a new item which was not previously considered. Further, prior studies in private value online auctions have also shown that bidders update their private value as auction progresses [Dass, Seymour and Reddy 2010] suggesting that budget constraint is not fixed in such auctions. Based these findings to our study, we conceptualize that bidders’ WTS will be less influenced by budget constraints in private value auctions.

Extant literature on WTP is focused on common value single-item auctions. They suggest that if a bidder intends to purchase multiple items, summing WTP (cumulative WTP) of the interested items will give the total WTP of the bidder. This assumption may not hold in case of private value auctions as discussed above. Therefore, from the theoretical perspective, it is not only important to examine the dynamics of WTS in private value auctions, but also compare it with cumulative WTP to investigate the difference between them. This will essentially provide insight on how the relative valuation of the items in the bidders’ consideration set changes and how it is affected by the auction related factors during the auction process.

From the auction house’s perspective, this information is a key driver of bidder competition, which leads to higher prices and thus, profit generation for the auction firms. Therefore, reputable brick and mortar and online auction houses selling private value items, including Christie’s, Sotheby’s and Artnet.com generally spend a fortune before an auction event in advertising and promoting their auction item line-up to prospective buyers. Understanding the dynamics of bidders’ WTS during an auction is particularly important for online auction houses that conduct simultaneous auctions such as Artnet.com, SaffronArt.com and so on. In simultaneous auctions, a large number of heterogeneous items are sold concurrently to the same group of bidders over an extended period of time. Compared with single-item auctions held at eBay or Ubid.com, simultaneous online auctions give rise to a unique competitive environment as bidders participating in these auctions typically bid on one or more items at the same time. As individual bidders have unique budget constrained or depth of pocket, and desire to purchase a unique set of item/s at a specific price level, the underlying distribution of WTS varies widely among them. In this paper, we investigate the dynamics of WTS of a simultaneous online auction of a specific genre of fine art called modern Indian art using an innovative statistical method called Functional Data Analysis and compare it with the dynamics of cumulative WTP of all the items the bidders are bidding.

From the modeling perspective, online auction data present challenges that make application of traditional econometric/regression methods difficult. The data consist of records of bid sequence placed at unevenly spaced intervals, thus making traditional time series methods inappropriate for analysis. Functional Data Analysis (FDA) [Ramsay and Silverman 2005], which at its core is the analysis of curves rather than points, is well suited to analyze this type of data. FDA is an emerging statistical methodology that operates on functional observations such as the WTS curves in online auctions. While it has received a lot of enthusiasm within the statistics literature, it is only slowly entering the e-commerce and information systems literature. In online auctions, FDA has been shown to be useful as a graphic tool for advanced data visualization of electronic commerce data [Jank et al. 2008] and as a mechanism to capture price dynamics in online auctions [Bapna, Jank and Shmueli 2008; Jank and Shmueli 2006; Reddy and Dass 2006]. Using this technique, we analyze the WTS and cumulative WTP dynamics (velocity and acceleration) in online auctions after recovering the underlying WTS and cumulative WTP curves of each bidder using a non-parametric curve-fitting technique such as splines [Simonoff 1996]. Whereas the traditional regression methods are useful in modeling the final amount spent by bidders in the auctions, FDA provides the required tool to model the WTS and cumulative WTP dynamics and determine their relationship with the strategic variables during the entire auction. The underlying idea is to represent the bidders’ WTS/ cumulative WTP path during an auction as a continuous curve. Then, following functional principles, we “recover” (i.e., estimate) the WTS/ cumulative WTP

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1 Auction event managers from Artnet.com, Christie’s and Sotheby’s were interviewed prior to this study.