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A MEASURE OF THE FACTORS IMPACTING THE EFFECTIVENESS AND EFFICIENCY OF eBay IN THE SUPPLY CHAIN OF ONLINE FIRMS

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ABSTRACT

This research investigates the auction properties that influence eBay's effectiveness (ability to attract bidders) and efficiency (ability to maximize price and profit) as the distribution link of the supply chain. The research extends the literature pioneered by Lucking-Reiley (2000) on eBay auctions. We found that the effectiveness of using eBay is influenced by the item description in the auction heading, the initial price, the timing of the auction and the operating condition of the item, in our case an inexpensive, functional HP 12-C financial calculator. The efficiency of eBay, on the other hand, is influenced by the ability to attract bidders, the pricing factors set up by the seller, the product's description, its operating condition, the timing of the auction, and the method of payment options available to the buyer.

INTRODUCTION

More and more businesses are shifting all or major portions of their distribution operations to the Internet. Newsweek reports that as many as 200,000 businesses currently exist entirely on eBay (Adler, 2002). A search of the eBay Stores' directory finds, in addition to a plethora of small firms, that major retailers such as Dell Financial Services, Ritz Camera, KitchenAid, Sears, Sharper Image, and IBM now have online storefronts hosted by eBay. These storefronts are the only presence for some firms. For conventional retailers, eBay provides a venue for selling surplus, refurbished, or even regular inventory at auction or even fixed prices. This commercial presence has grown rapidly. Lucking-Reiley (2000) found that "the largest category by far was that of collectibles: more than 60% of all sites in the survey included auctions for collectibles" (p. 231). However, Adler (2002) finds that auctions for collectibles "now are just one third (although of a much larger whole)."

This paper analyzes the role of eBay as the distributor/retailer in the supply chain to estimate its effectiveness (ability to attract bidder customers) and efficiency (the ability to maximize profit or minimize cost) in this role. Specifically, regression analysis performed on a data set of completed auctions for Hewlett Packard (HP)12-C calculators was studied to determine the variables that attract bidders and affect price in on-line auctions. Unlike the collectible United States Indian Head pennies in Lucking-Reiley, Bryan, Prasad, and Reeves' (2000) data set, or functional, but expensive items such as the Palm Pilots used in Standifird's (2001) paper, the calculator in our study was a rather inexpensive, functional product, easily available at several national retailers and more representative of the types of products that consumers use, rather than collect.

Although the focus of this paper is on the distribution segment of the supply chain, online market makers and arbitrageurs may benefit from the procurement functions as well. These e-businesses may benefit from creating a market in specific items, such as buying seasonal items at the end of the season, holding them until the beginning of the next season, and then re-listing them at a higher price. Likewise, arbitrageurs and other market makers may take advantage of inefficient listings by procuring the items from the original seller and immediately re-listing them more efficiently and effectively than the initial seller. For example, the HP-12C was sometimes listed under the heading of *Calculators: Scientific*, rather than *Calculators: Business*. The arbitrageur could purchase the mis-categorized calculator and re-list it under the more appropriate category to attract more bidders and potentially higher bids.

The remainder of the paper is organized into the following sections: We review some of the supply chain literature, identify eBay's place in the supply chain, describe the functions/options provided by eBay that add value to the transactions for both sellers and buyers, and explain the methodology used in our research. We then present our hypotheses and results of the study and conclude with a discussion of the important findings and their implications to supply chain management.

SUPPLY CHAIN DEFINED AND EBAY'S PLACE IN THE CHAIN

According to Chopra and Meindl (2001) supply chain consists of all stages, direct or indirect, involved in fulfilling customer requests. Keskinocak and Tayur (2001) establish that the primary goal of supply chain management is to deliver the correct product to the correct place at the correct time while maintaining cost efficiencies. Lummus and Vokurka (1999) developed a summary definition of the supply chain based on the works of numerous authors. They state that supply chains consist of "all the activities involved in delivering a product from raw material through to the customer including…distribution across channels, delivery to the customer, and the information systems necessary to monitor all of these activities" (p. 11). The functions provided by eBay fit the latter part of this definition very well. Furthermore, they add, "an integral part of the supply chain is the flow of information between and among all members of the distribution network" (Vokurka and Lummus, 1998). Indeed, information flow is the primary function of eBay.

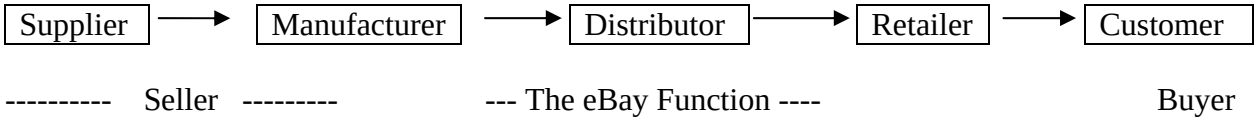
The on-line auction is a unique type of business in that each transaction is a one-time process. The seller segment of the supply chain is connected to the bidder/buyer using the on-line auction as a facilitator for this customer-to-customer (C2C) business. eBay as an on-line broker brings the seller to a host of potential buyers. Keskinocak and Tayur describe eBay's process as a proxy bidding agent, increasing the bidder's bid until the bidder wins the auction or the bidder's set maximum bid price is reached (2001). eBay serves as the middleman between sellers and bidders, facilitates the auction process, and helps to expedite the sale. Lummus, Vokurka, and Alber indicate that it is critical to manage the link between each node to synchronize the entire supply chain (1998). The numerous options eBay provides serves to smooth the link between seller and buyer. Vokurka and Zank (2001) note that user friendly websites that add value to the customer create a seamless link between internal and external processes and result in financial

gain are critical factors for e-business initiatives. As evidenced by the millions of repeat users, eBay provides an environment that links buyers to sellers and proves beneficial to all parties.

Chopra and Meindl (2001) list five typical supply chain stages: (1) components/raw materials, (2) manufacturers, (3) wholesalers and distributors, (4) retailers, and (5) customers. Keskinocak and Tayur (2001) identify three components of a supply chain: (1) sourcing/procurement, (2) manufacturing and distribution, and (3) inventory disposal. Because businesses set up primarily to provide service have little connection with a manufacturing process, their supply chains encompass only some of the traditional supply chain stages. The seller provides the item for sale, filling the initial supply chain stage. The items listed for sale may be classified as the "inventory" in the process. eBay provides sellers the wholesaler/distributor and retailer stages as its primary contribution to this selling process. The customers, the final link in this supply chain, are the bidders.

Figure 1 shows the Chopra and Meindl (2000) depiction of supply chain stages. eBay provides the distributor/retailer stage of this chain. Figure 2 gives a more detailed schematic view of eBay's function as the distribution link in the customer-to-customer supply chain. The seller lists items for sale. The eBay site provides the flow of information from seller to bidder/buyer. In addition to the information flow, eBay provides sellers and buyers with options that help smooth the business transaction. The value added to the process by eBay includes access to information from both sides of the transaction and help in processing many of the steps of the transaction. The search engines provided by eBay match the potential customer (bidder/buyer) with the products available (from the seller).

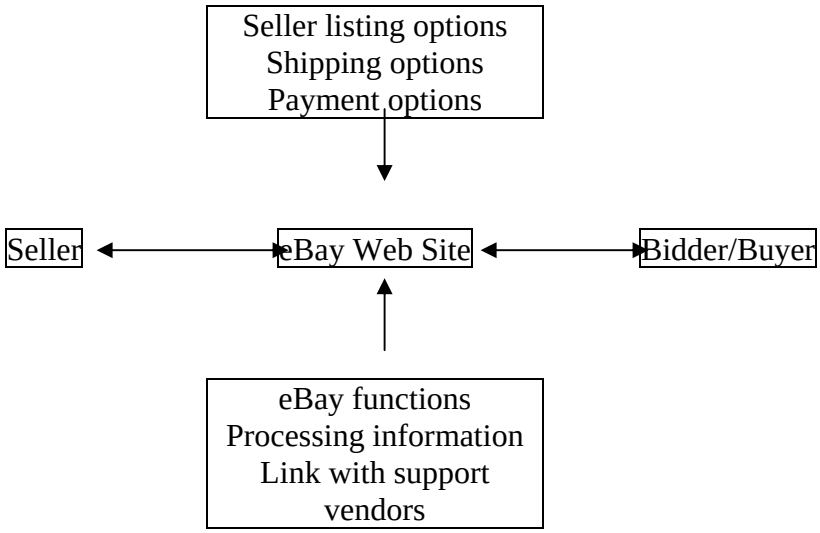
Figure 1. Chopra and Meindl Depiction of Supply Chain with eBay's placement



Chopra and Meindl (2001) list a number of supply chain transactions that e-businesses perform. Many of these types of transactions are either provided by eBay directly or facilitated by eBay. A key part of eBay's service to sellers and buyers is providing information across the supply chain. The auction format assists in the price negotiation phase of the business transaction. The eBay Web site helps facilitate order placement, order tracking, and order delivery processes by linking the buyer and seller with potential delivery agents. eBay also adds value to the transaction by facilitating credit card payments.

Figure 2. **The Supply Chain for a seller using eBay**.

The entrepreneur seller takes the risks and obtains and provides the inventory while the bidder/buyer shops for bargains and attempts to minimize risk.



VALUE ADDED BY THE eBAY SERVICE

In the auction format the seller selects from a number of options for providing information. The aim of this information is to attract bidders, ultimately increasing the winning auction price and profit to the firm. The information conveyed by eBay in the form of seller options brings value to this type of transaction. Some of these options include establishing the initial or minimum bid price, shipping options, payment options, the product description, the heading or title, the duration of the auction, and the quantity of units for sale (i.e., a regular auction vs. a Dutch auction).

The seller must determine the initial bid price and can also set a reserve bid price (the minimum amount accepted for the auction contract to be consummated). The seller may also include a "buy it now" option that allows the initial bidder to purchase the item at a set price before any lower bids are entered and the auction begins. The listing fee eBay charges is a function of this initial bid. The inclusion of a reserve price reduces the probability that the auction will end unsuccessfully (i.e., no sale is made). If the sale, however, is made it assures that, at minimum, the seller's reservation price is met. Some gamesmanship is involved in determining the proper combination of minimum bid and reservation price that attracts sufficient bidders but minimizes auction cost. Research on this issue was published in April 2000 by Katkar and Lucking-Reiley (2001) using 50 "matched pairs" of Pokemon trading cards. The results of their research indicated that the use of secret reserve prices resulted in lower revenues than when the reserve price was revealed to the buyers. The authors state that there are "negative effects on probability of selling a card, the number of serious bidders, and the price received from the winning bid" (Katkar and Lucking-Reiley, 2001).

The seller typically specifies the length of the auction, the shipping options, and shipping prices (usually paid by the buyer). The seller can choose to have the auction last three, five,

seven or ten days. The most frequently used delivery services are the U.S. Mail, Federal Express or UPS. Payment options selected by the seller include certified check, money order, personal check, or credit card. The advantages of using a credit card, generally processed by PayPal or Billpoint, accrue to both the buyer and seller. Because sellers are generally reluctant to ship merchandise prior to certifying that they have received good funds, the buyer using a credit card may receive their purchase in the time it would take for a payment by certified, cashiers, or personal check to be delivered to the seller. In the case of a personal check, the seller usually specifies that shipping will be further delayed until the check has cleared the banking system. While eBay provides all buyers a limited reimbursement up to $200 in the event of fraud, the buyer using a credit card also has additional "insurance" provisions provided by the credit card issuer. These provisions allow the buyer to contest the charges and in effect obtain a refund in cases where the product never arrived or is damaged. The buyer sending a check or certified funds has only eBay's fraud protection since one can not stop payment on a check after the check has cleared the system and the seller has the funds. The seller accepting a credit card or using PayPal, or one of their competitors, has the benefit of faster cash flow and hence a shorter cash conversion cycle since the electronic transfers are available almost instantaneously.

The seller creates the description of the item for sale. For our calculator data set, sellers can specify information regarding product characteristics that may enhance a sale such as the age and shape of the product ("new", "as is", "damaged"– "major" or "minor wear") and whether any warranty accompanies the product. eBay allows two pictures to be posted at no charge. Because buyers want to minimize the risk of the purchase, the seller's reputation is believed to be an important variable. Near the end of the product display, eBay provides a feedback/ratings section. This section lists the number of positive, neutral, and negative experiences reported by auction participants who have had dealings with the seller. In addition, the buyer can review the comments provided by the parties the seller has previously contracted with on eBay as either a buyer, or a seller.

The following sections of this paper discuss the regression analyses used to evaluate the importance of quantitative data available to customers who would consider using the e-commerce means for procurement/distribution operations. Auctions, like those facilitated by eBay, provide information on many aspects of the process. The data set used to evaluate eBay operations contains information on auctions of hand-held calculators. There are more than 25 variables identified and defined that measure eBay options and characteristics. Finding the appropriate settings for the variables is important for businesses that use e-commerce to support their distribution functions.

METHODOLOGY AND DATA

The intent of this study was to identify factors that influence supply chain efficiency and effectiveness. Here, efficiency is defined as the ability of the distribution function (eBay) to maximize the ending auction price. Effectiveness is defined as the ability of the chosen factor levels to attract bidder customers. In other words, the study was looking for factors that significantly impact the ending auction price and the number of bidders participating in the

auction. Since many of those factors are under the control of the seller, identifying them may help sellers improve the outcome of their sales.

Multiple regression analysis was used to determine which factors had significant influence on each of the dependent variables, ending auction price, and number of bidders. Table 1 provides the descriptive statistics from our data set. One regression model investigated the influence of the variables on the ending auction price. The second model regressed the number of bidders against the set of independent variables. Individual t-tests were used to identify significance of the factors.

Between September 2000 and March 2001, we searched eBay daily for new auction listings denominated in U.S. dollars for Hewlett Packard 12-C calculators. New listings were added to one of several "Watch Lists." As these auctions ended the relevant information was entered into the data set. The specific data collected is listed and summarized below.

We excluded several auctions from our data set. If the last bid price was below the seller's "reserve price," then no sale resulted and the auction was eliminated from the data set. Likewise, when an auction received no bids, it was eliminated. When the auction included multiple items it was eliminated. For example, if the auction included the HP12-C and another calculator, it was excluded. We also eliminated any "Dutch Auctions." Dutch Auctions occur when a seller lists multiple calculators for sale to multiple bidders where the selling price for all of the calculators is the lowest winning bid price. Auctions that ended with the recently implemented "Buy it Now" feature were eliminated since the feature was not available the entire period and the auctions did not have the full period of exposure. Our data set included 661 completed auctions meeting our requirements. All references to monetary units are U.S. dollars.

When items are sold on eBay, the seller must select settings for a number of factors/options to be included (or not) on the web page. For this study, we identified variables representing options to the seller that could have some bearing on the selling process. In addition, variables representing seller and buyer experiences were included in the data set. For each auction we collected information on the following variables:

Price -	the auction's ending price - dependent variable for the first regression
Numbids -	The total number of bids the auction received
Bidders -	the number of distinct bidders - dependent variable for the second regression
Hnewinbox -	a dummy variable =1 if the word "new" is in auction's Heading; 0 otherwise
Hmint -	a dummy variable =1 if the word "mint" is in the auction's Heading; 0 otherwise
Hnoreserve -	a dummy variable =1 if the words "no reserve" are in Heading; 0 otherwise
Firstbid -	amount of the first bid
Reservedu -	a dummy = 1 if the seller exercised the option of using a reserve price; 0 otherwise
Month -	the month the auction ended
3Days -	a dummy variable =1 for auctions lasting 3 days; 0 otherwise
5days -	a dummy variable =1 for auctions lasting 5 days; 0 otherwise

10days -	a dummy variable =1 for auctions lasting 10 days; 0 otherwise
Weekend -	a dummy variable = 1 for auctions that ended on Saturday or Sunday; 0 otherwise
Hour -	the hour of the day that the auction ended
Holidaydu -	a dummy variable =1 if the auction ended on a holiday; 0 otherwise
Buyrate -	the buyer's eBay rating
Picture -	a dummy variable =1 if the description included a picture of the item;0 otherwise
Minorwear -	a dummy variable =1 if the description indicated "minor wear"; 0 otherwise
Majorwear -	a dummy variable =1 if the description indicated "major wear" (such as the battery cover missing, cracked display, etc); 0 otherwise
Nocover -	a dummy variable =1 if the description included "no cover" (excluded the vinyl case); 0 otherwise
Withmanual -	a dummy variable =1 if the description included "with manual"; 0 otherwise
Nomanual	a dummy variable =1 if the description included "no manual"; 0 otherwise
Nobatteries -	a dummy variable =1 if the description included "no batteries"; 0 otherwise
Newbatteries -	a dummy variable =1 if the description included "new batteries"; 0 otherwise
Newnbox -	a dummy variable =1 if the description indicated that the calculator was new and included the manual, cover, and paperwork; 0 otherwise
Nonegbuy -	a dummy variable =1 if the description indicated that bids from buyers with negative comments would not be accepted; 0 otherwise
Ccard -	a dummy variable =1 if the seller accepted credit cards; 0 otherwise
Salestax -	a dummy variable =1 if the buyer had to include sales tax; 0 otherwise
Pos -	the number of positive comments received by the seller in the past
Negative -	the number of negative comments received by the seller in the past
Moactive -	the number of months the seller has had that eBay account
Freeshipping -	A dummy variable = 1 if the seller paid the shipping; otherwise 0

Descriptive statistics of the variables are presented in Table 1. As shown, the average final price (the ending auction price of the calculator) for the calculators (Price) was nearly $41.27. For comparison, a "Back to School" ad from Staples during the study period listed this calculator for $69.99. Nearly 8% of these auctions were reserve auctions, where the seller stipulated that a minimum bid was necessary to consummate the sale (reservedu). The fee for using the reserve price option is $.50 if the reserve price is less than $25 and is $1 for reserve prices above $25. The fee is refunded if the ending auction price is below the reserve price. Detailed information on eBay's fees can be found on the eBay web site.

Several auctions used the terms "New," "New In Box," or "NIB," "No Reserve" or "NR," and "Mint" in the heading of the auction. Variations of the term "New" in the heading were found in nearly 29% of the auctions. "No Reserve" and its variations were used in nearly 9% of the auctions, while "Mint" was listed 3% of the time.

Table 1. Descriptive Statistics

Variable	N	Mean	Std Dev	Minimum	Maximum
Hnewinbox	661	0.2874433	0.4529128	0	1.0000
Hmint	661	0.0302572	0.1714239	0	1.0000
Numbids	661	10.7110439	5.3735899	1.0000	52.0000
Bidders	661	6.1255673	2.5597638	1.0000	18.0000
Firstbid	661	13.5974130	10.6871324	0.0100	61.0000
Reservedu	661	0.0786687	0.2694248	0	1.0000
Numdays	661	6.7715582	1.9031494	3.0000	10.0000
3-day	661	0.0922844	0.2896462	0	1.0000
5-day	661	0.1770045	0.3819616	0	1.0000
10-day	661	0.1649017	0.3713728	0	1.0000
Weekend	661	0.3146747	0.4647379	0	1.0000
Holidaydu	661	0.0272315	0.1628805	0	1.0000
Picture	661	0.8124054	0.3906837	0	1.0000
Minorwear	661	0.1558245	0.3629636	0	1.0000
Majorwear	661	0.0166415	0.1280207	0	1.0000
Nocover	661	0.0272315	0.1628805	0	1.0000
Withmanual	661	0.3237519	0.4682610	0	1.0000
Nomanual	661	0.1452345	0.3526039	0	1.0000
Nobatteries	661	0.0468986	0.2115819	0	1.0000
Newbatteries	661	0.0499244	0.2179536	0	1.0000
Newnbox	661	0.3388805	0.4736876	0	1.0000
Nonegbuy	661	0.0257186	0.1584144	0	1.0000
Ccard	661	0.6747352	0.4688285	0	1.0000
Salestax	661	0.1180030	0.3228560	0	1.0000
Pos	661	623.0090772	2174.75	0	27886.00
Negative	661	8.1346445	50.5948107	0	691.0000
Moactive	661	17.2329803	10.9994574	0	56.0000
Freeshipping	661	0.0045386	0.0672668	0	1.0000
Oct	661	0.1376702	0.3448144	0	1.0000
Nov	661	0.1467474	0.3541218	0	1.0000
Dec	661	0.1028744	0.3040249	0	1.0000
Jan	661	0.1573374	0.3643943	0	1.0000
Feb	661	0.1270802	0.3333150	0	1.0000
Mar	661	0.1406959	0.3479709	0	1.0000
Sat	661	0.1361573	0.3432153	0	1.0000
Sun	661	0.1785174	0.3832377	0	1.0000
M	661	0.1558245	0.3629636	0	1.0000
T	661	0.1240545	0.3298933	0	1.0000
W	661	0.1527988	0.3600659	0	1.0000
Thr	661	0.1270802	0.3333150	0	1.0000
F	661	0.1255673	0.3316120	0	1.0000

The typical auction received an average of 10.7 bids from an average of 6.13 distinct bidders. The first bid averaged $13.60. While the seller cannot control the number of distinct bidders, or the number of bids, they do set the initial price (first bid) of the auction. eBay charges the listing fee for these auctions based on the minimum opening bid set by the seller. The listing fees range from $.30 (for initial bids less than $10) to $2.20 (for initial bids greater than $50).

This data covered the months of September through March. The auctions were fairly evenly split over the sample period ranging from 18.8% of the auctions ending in September and 10.2% of the auctions ending in December. The closing day of the auction was investigated for significance in determining the price of the calculators and the number of bidders they attracted. Weekends (Saturday 13.6%, and Sunday 17.9%) accounted for nearly 31% of the auctions. Monday and Wednesday each accounted for over 15% of the auctions while, Tuesday, Thursday, and Friday accounted for approximately 12.5% of the auctions each. We also tested to see if the closing day being a holiday like Labor Day, Thanksgiving, Christmas, New Year's Day, or Presidents Day influenced the winning price. Nearly 3% of the auctions ended on a holiday. We collected the hour of the day the auction was completed as well. The default time was midnight Pacific Time, 00 on the eBay clock. The average hour that the auction ended was 2:00 p.m. Pacific time, the median time of an auction ending was 3:00 p.m. Pacific Time and the most often auction ending time was 8:00 p.m. Pacific Time.

We read the descriptions of the calculators for each auction and searched for several key words or phrases that we felt would enable the buyer to evaluate the calculator. The first set of these we classified as either “minor wear” or “major wear.” The dummy for minor wear was given when the seller indicated in the description that the calculator had small scratches or the HP brand mark was worn, etc. The dummy for “major wear” was used if the calculator was not working, the battery cover was missing or broken, the display was damaged, etc. Calculators with minor wear indicated accounted for nearly 15.6% of the auctions, while major wear added another 1.7%.

Since calculators come from the factory with a soft plastic cover and an instruction manual, we searched the description for auctions that indicated that the calculator came with the manual (withmanual), without the manual (nomanual), or without the cover (nocover). Thirty-two percent of auctions included the manual with the calculator, 14.5% stated that they did not include the manual, (the remaining 53% did not mention the manual), and 2.7% of the auctions indicated that there was no cover included with the calculator being auctioned. Furthermore, the seller included a picture of the calculator in 81% of the auctions in this data set.

Approximately equal sets of sellers auctioned the calculators with no batteries (or dead batteries) or with a set of new batteries. Those with no batteries accounted for 4.7% of the auctions, while those with new batteries made up 5% of the sample. Nearly one third of the calculators were described as “new in the box.” These calculator auctions should include the manual, cover, new batteries, and warranty information.

eBay auctions allow for payments to be made by credit card using the services of either Paypal or Billpoint. These firms collect a percentage of the price from the seller and

electronically transfer funds from the buyer's savings, checking, or credit card accounts to the seller. If the seller does not accept credit cards, then the buyer must either send a check or a money order for payment. Most sellers state that they will delay shipping of the product for 7 to 10 days if a check is sent to allow it to clear. Further, if payment is made through Paypal or Billpoint, most sellers will ship the day after the electronic transfer is made. Sellers accepting credit cards made up 67.5% of the auctions in this sample.

Reputation influences may run in both directions. Roughly 3% of the sellers indicated that they would not transact with buyers with negative comments in their history. The buyer has the opportunity to view comments by participants to the seller's previous transactions. Further, the length of time the seller has been registered with eBay may also serve as a measure of reputation. We noted the number of positive and negative comments each seller had, and the number of months they had been active. The average number of positive comments in this sample was 623, with a standard deviation of 2174.8, a minimum of 0, a maximum of 27886, and a median of 78. The average number of negative comments in this sample was 8.1, with a standard deviation of 50.59, a minimum of 0, a maximum of 691 and a median of 0. The typical seller in this sample has had an account for 17.23 months with a standard deviation of 11 months, a minimum of 0 months, maximum of 56 months and a median of 17 months.

HYPOTHYSES AND RESULTS

The use of the terms "new," "mint," or "no reserve" in the heading and/or the inclusion of a picture were expected to attract the buyer's attention and were hypothesized to positively impact the ending price and the number of bidders. In each case we fail to reject the null hypothesis that these variables have an impact except for the term "New in Box" in the heading. This variable is significant ($t=1.69$, $p<10\%$) at only the 10% level in attracting bidders.

The number of bidders was hypothesized to positively impact the price of the auction. For every additional person that bid in an auction, the final price of the calculator increased by nearly $1. The increase in price was more than just a tautology, though. For an additional buyer to be listed, they must have increased the bid. However, for auctions in this price range, the minimum bid increase was only $0.50.

The seller sets the initial bid when setting up the auction. We hypothesized that the lower the initial bid the more (bargain hunting) bidders would be attracted, but that this should not impact the market clearing price of the auction. Specifically, we hypothesized that there would be no impact of the initial bid on the ending price of the auction, but that there would be a negative relation between initial bid price and the number bidders. Results indicated that there is a statistically significant positive relation between the first bid and the final selling price. Results showed statistically that the first bid was negatively related to the number of bidders, as expected. For every $1 that the initial price was raised, the number of bidders decreased by .12 ($t=-14.5$ $p<.01\%$). The coefficient on "firstbid" was .259. This indicated that for every $1 increase in the first bid, the final price increased by approximately $0.26. This result may have been caused by our exclusion of auctions that did not end in a completed transaction. This result

is actually the increase in the final price given that a sale resulted. Auctions with first bid prices too high would conceivably get no bidders and were excluded from this data set.

The seller may have included a reserve price. We hypothesized that a reserve price would increase the final price of the auction. Results indicated that the presence of the reserve price option did increase the final price of the auction by $2.90. Again, this result may have been affected by the exclusion of auctions where the highest bid was below the reserve price.

We controlled for the month the auction ended in our two regressions. The use of dummy variables in regression required that one of the months be excluded from the regression. That month was September. Except for the month of December (which was not significant), all of the auction prices in the other months were statistically different from the prices in September. The prices were significantly higher (at the 10% level or lower) for the months of October ($1.80), January ($2.27), February ($5.43), and March ($2.71). However, the closing prices were significantly lower in the month of November (-$3.17). The number of bidders was statistically higher in three of the other months by about one additional bidder than in September (January (1.12), February (1.64), and March (1.32)).

Several previous studies have looked at the weekend effect with mixed results. These studies usually hypothesized that there were more buyers and higher closing prices since it is believed that Internet shopping is a leisure activity and more leisure time is available on weekends. Melnik and Alm (2001) found a statistically significant positive coefficient for auctions ending on either Saturday or Sunday. However, Standifird (2001) found a statistically significant negative coefficient for weekend ending auctions. Our study found that the hypothesis claiming higher prices and more bidders on weekends is false. Results demonstrate that the final price on auctions ending on a weekend (Saturday and Sunday) is $2.14 lower than those ending Monday through Friday, a strong result with a t=-3.51. Furthermore, results indicated that auctions ending on a weekend had a statistically significant .45 (t= -2.46) fewer bidders.

We also studied auctions ending on a holiday. As with weekends, more leisure time is believed to be available, allowing for more bidders and higher ending prices. Results indicated that there was no statistical impact of a holiday on either the ending price or the number of bidders.

Lucking-Reiley, Bryan, Prasad, and Reeves, (2000) observed that longer auctions result in higher final bid prices. In this study the default auction period was 7 days. We hypothesized that 10-day auctions would have more bidders and higher prices while 3- and 5-day auctions would have fewer bidders and lower prices. Regarding price, the 3- and 10-day auction results were not statistically different from the 7-day auction, while the 5-day auctions showed a $1.44 higher price (t=1.87, p<7%). Three-day auctions received bids from .51 fewer bidders (t=-1.66, p<10%), though 10-day auctions received bids from an additional .48 bidders (t=2, p<5%). Five-day auctions were not significantly from 7-day auctions in attracting bidders.

Indications of wear (either minor or major) should decrease the price of the auction. We hypothesized further that these wear indications would decrease the number of bidders, also. The

regression results showed that any indication of wear economically and significantly reduced the closing price of the auction. Minor wear reduced the price by $3.18 while calculators with major wear sold for an average $10.63 less than calculators that did not have wear. Results showed that calculators with minor wear do not statistically significantly reduce the number of bidders, while auctions for calculators with major damage were bid on by an average of 1.55 ($p<.03$) fewer bidders.

We hypothesized that the inclusion of a manual would increase the price and the number of bidders. If the auction indicated that no manual was included (nomanual), the regression results indicated that the price was no different than the 53% of the auctions that did not mention the manual, although they were bid on by an average of .48 ($t=-1.61$, $p<11\%$) fewer bidders. However, if the description stated that the manual was included, the ending auction price was $5.31 higher than the auctions that did not mention the manual, and they received bids from an additional .66 bidders. The lack of a cover did not significantly reduce the price or the number of bidders.

We believe that bidders assume that the auction is for a working calculator, which would include working batteries. We hypothesized that auctions of calculators that lack batteries would have both a lower ending price and fewer bidders. The regression results indicated that listing a calculator without batteries significantly reduced the final price of the sale by $3.04, and indicated that 1.12 fewer buyers bid in such an auction. Selling the calculator with new batteries did not significantly change the price or the number of bidders in the auction. In fact, the value of the coefficient for "newbatteries" was negative .34 ($t = -.25$, $p<80\%$). Since this calculator requires three batteries and each battery costs between $1.49 and $1.79, it seems economically advantageous to sell the calculator without batteries and save the trip to Wal-Mart.

If the seller indicated that the calculator was "new" or "new in box" in the description, we hypothesized that it would attract more buyers and result in a higher price. Results indicated that the coefficient for the variable "newnbox" is a statistically and economically significant $9.34 ($t=7.79$)! However, the use of these terms did not increase the number of bidders on the auction.

Shipping expenses are usually borne by the buyer. Only a few sellers indicated that they would pay shipping. We hypothesized that sellers implementing this marketing tool would reap a higher final bid price and an increase in the number of bidders. The regression results in the tables did not reject the null hypotheses that the coefficient is zero, however.

We believe that accepting credit card payments increases the speed of delivery, since the seller does not have to wait for payment to be delivered and checks to clear, and that this increase in speed is valuable to the bidder. Therefore, we hypothesized that sellers who accept credit cards would receive higher ending prices and more bidders at their auctions. The regression results on price indicated that the auctions accepting credit cards ended an average $1.45 higher than auctions that did not. Credit card acceptance did not significantly increase the number of buyers, though.

We tested a number of reputation variables, including the number of months the seller has had an account and the number of positive and negative comments they had acquired. Under the belief that only a "real business" would collect sales tax and that being a "real business" would enhance the reputation of the seller and/or reduce the perceived risk of the buyer, we controlled for sellers who collected sales tax, if the calculator was shipped within the same state as the seller. None of these variables were significant in these regressions, however.

The buyer's reputation was important to nearly 3% of the sellers. They indicated in the auction listing that they would not sell to bidders with negative feedback listed. We hypothesized that including this restriction would reduce the number of potential bidders and the ending price of the auction. However, the variable "nonegbuy" was not significant in either regression.

CONCLUSIONS

This research investigated the auction properties that influence eBay's effectiveness (ability to attract bidders) and efficiency (ability to maximize price or profit) as the distribution link of the supply chain. It extends the literature pioneered by Lucking-Reiley (2000) on eBay auctions. Our research examined an *inexpensive* functional item, the HP12-C financial calculator, rather than functional, but *expensive* items such as the Palm Pilots used in Standifird's (2001) data set or the collectable Pokemon cards in Katkar and Lucking-Reiley's (2001) paper.

We found that the effectiveness of using eBay was influenced by the item description in the auction heading, the initial price, the timing of the auction, and the operating condition of the item. The efficiency of eBay was influenced by the ability to attract bidders, the pricing factors set up by the seller, the product's description, its operating condition, the timing of the auction, and the method of payment options available to the buyer.

Like many other links of the supply chain, the timing of the auction or sale was important. In this study, the sellers saw significantly higher prices and more bidders when the auction ended on weekdays than when the auctions ended on a weekend. The month the auction ended also had significant impacts on price and the number of bidders. This study found that 3-day auctions attracted fewer buyers while 10-day auctions attracted more buyers than 7-day auctions. However, this study also found that the price of 5-day auctions was significantly different from 7-day auctions.

Information on quality characteristics and operating condition was observed on the sale pages describing the calculators for sale. Positive statements on quality (new-in-box, and with manual) significantly increased price and the number of bidders, while negative statements on quality or operating condition (minor wear, major wear, or no batteries) significantly decreased price and bidders. In this study, some of the quality characteristics (no cover, no manual, new batteries) had no significant impact on price or the number of bidders.

The seller's ability to earn higher ending bids was found to be a function of the number of distinct bidders, the first bid, the use of the reserve option, and accepting credit cards. While the seller cannot directly control the number of distinct bidders to their auction, they do set the initial

or first bid and the reserve price. Furthermore, the seller has the option of allowing the buyer to use credit card payments either directly or through Paypal or Billpoint. The convenience of using a credit card not only brought benefit to the seller in increasing the speed of collection, it brought in a significantly higher price.

Finally, it was interesting to note from Table 1 that the range of winning bids showed that Internet auctions might bring higher prices than retail. The use of eBay (or another online auction method) to supplement or provide major pieces of the distribution function of the supply chain can be both effective and efficient.

Although specific results of this study are not generalizable, per se, the structure of the research should be of interest to practitioners. It would be appropriate for any business using Internet auctions to conduct a similar study to identify significant factors to include on the auction page, the best timing for the auctions, and other factors that could improve the effectiveness and efficiency of the distribution function.

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