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GENERAL RESEARCH

Market structure and quality uncertainty: a theoretical framework for online auction research

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Abstract Given large numbers of buyers and sellers, with access to a wide variety of information, economic theory suggests that online auction markets should provide an efficient mechanism for establishing equilibrium prices. Previous research on online auction prices, however, is far from conclusive, having produced mixed findings. The seemingly inconsistent and sometimes contradictory results make it very difficult to integrate empirical findings into a coherent body of knowledge. The purpose of this paper is to present a framework that can reconcile previous findings and provide direction for future research. Accordingly, we propose a simple theoretical framework with two dimensions—market structure (thick vs. thin) and quality uncertainty (high vs. low). By examining the literature in the context of market structure and quality uncertainty we find that previous studies are not necessarily at odds, but that there is actually a fairly consistent pattern of results.

Keywords Online auctions · Auction price · Quality uncertainty · Market structure · Thick market · Thin market

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Introduction

The past decade has witnessed a tremendous growth in online auctions. According to Jupiter Research (www.jupiterresearch.com), online consumer auction sales increased from $8.4 billion in 2001 to $30 billion in 2007, representing a 24% annual growth rate. By 2010, online consumer auction sales will reach $42 billion, accounting for 1.5% of total retail sales. Today, there are numerous auction sites providing a forum in which sellers and buyers can come together. For example, eBay, the largest online auction site, had 667 million new item listings during the second quarter of 2008, and approximately 84.5 million eBay users bid, bought, or listed an item during that quarter (www.ebay.com). In response to the tremendous growth of online auctions a large body of academic research has emerged.

Online auctions are beneficial for both sellers and buyers. For sellers, online auctions provide access to a large number of potential buyers, and the low transaction costs allow sellers to list items that otherwise might feasibly be sold only in a local market (e.g., a yard sale or a flea market), discarded, or stored away. For buyers, online auctions provide access to a wide variety of items—some common and ordinary, some rare and unique—without investing considerable time, effort, and expense. Due to the tremendous volume of transactions continually taking place online auctions also help to establish the underlying market price of various types of items.

Given large numbers of buyers and sellers, with access to a wide variety of information, economic theory suggests that online auction markets should provide an efficient mechanism for establishing equilibrium prices (Wilson 1980). However,

many studies have found that is not always the case. Instead, research has found that auction prices oftentimes are heavily influenced by participants' buying and selling strategies; i.e., that certain selling strategies (such as the use of a starting bid or reserve price) can lead to higher selling prices (Lucking-Reiley et al. 2007; Suter and Hardesty 2005), and that some buying strategies (such as late bidding) can lead to lower prices (Roth and Ockenfels 2002). Similarly, some studies have found that differences in seller and buyer characteristics (such as experience or reputation) oftentimes result in similar items selling at vastly different prices (Ba and Pavlou 2002; Dewan and Hsu 2004; Kauffman and Wood 2006; McDonald and Slawson 2002).

Previous research on online auction prices, however, is far from conclusive, having produced mixed findings. For example, some studies have found a positive relationship between the use of a starting bid and the auction price (Kamins et al. 2004; Lucking-Reiley et al. 2007; Suter and Hardesty 2005), whereas others have found a negative correlation (Ku et al. 2005, 2006). Some researchers have reported a positive relationship between the presence of a reserve price and the final selling price (Bajari and Hortacsu 2003; Lucking-Reiley et al. 2007), whereas others have not found any relationship (Brint 2003; Katkar and Reiley 2006; Standifird 2001). Though a number of studies have found that seller reputation drives up the auction price (Ba and Pavlou 2002; Dewally and Ederington 2006; Dewan and Hsu 2001; Houser and Wooders 2006; Livingston 2005; Melnik and Alm 2002, 2005), others have not found such effect (Ariely and Simonson 2003; Brint 2003; Eaton 2005; Resnick and Zeckhauser 2002). Similarly, several researchers have reported that experienced bidders are more likely to pay a lower price than less experienced bidders (Dewan and Hsu 2004); however, others studies do not support those findings (Gilkeson and Reynolds 2003; Huston and Spencer 2002). Unfortunately, given conflicting findings it is almost impossible to arrive at any valid generalizations regarding the effects of these factors on auction prices.

Hampering our understanding of online auctions is the lack of a theoretical framework. Although economists have long studied traditional auctions (Riley and Samuelson 1981, Milgrom and Weber 1982) building upon solid theoretical foundations, studies of online auctions have largely been empirically driven, oftentimes lacking in theory. As a result, it is difficult to reconcile the seemingly inconsistent and sometimes contradictory results of previous studies into a coherent and meaningful body of knowledge. Although the empirical nature of these studies is undoubtedly a strength of online auction research (especially vis-à-vis traditional auction studies, which have relied on lab experiments and mathematical modeling), what is missing is a strong and robust theoretical framework that can guide research and place findings in their proper context. The rapid growth of online auctions, coupled with easy access to real world data on selling and bidding behavior, certainly has been conducive to conducting empirical studies. However, empirical research is at its best when it is theory-driven, and when deduction is emphasized over induction.

The purpose of this paper is to present a framework that can reconcile and integrate previous findings and provide direction for future research. Accordingly, we propose a simple theoretical framework with two dimensions—market structure (thick vs. thin) and quality uncertainty (high vs. low)—that moderate the effects of seller and bidder characteristics and strategies. By examining the literature in the context of market structure and quality uncertainty we find that previous studies are not necessarily at odds, but that there is actually a fairly consistent pattern of results. Throughout this paper we demonstrate that there are certain conditions in which auction markets are highly efficient and hence buyer and seller characteristics and strategies have little influence, but there are other situations in which these factors can significantly affect auction prices. The framework not only helps to clarify previous research, it also provides direction for future studies of online auctions.

The influence of market structure and quality uncertainty on auction prices

A basic tenet of economic theory is that price is determined by supply and demand (Landsburg 2001). Markets in which supply and demand are equal, and in which buyers and sellers have access to complete and accurate information, embody perfect competition. However, full and symmetric information rarely exists, and supply and demand oftentimes are not equal. In reality, imbalances of supply and demand, combined with varying levels of asymmetric information and quality uncertainty, result in prices that are greater, or less than, those found in perfectly competitive markets. It is in these conditions that individuals are more likely to be able to influence auction prices via various selling tactics or buying strategies, and in which characteristics such as buyer or seller experience are more apt to serve as cues that subtly affect auction prices.

The underlying structure of online auctions can be characterized along a continuum, from "thick" to "thin." A thick market is one in which relatively homogeneous items are auctioned on a regular basis, and in which there are multiple sellers and bidders. A prototypical item would be laptop computers. In a thick market it is relatively easy for buyers to identify a fair market price because of the availability of information about what others have recently paid for similar or identical items. A thin market, in contrast, is one in which a particular type of item appears

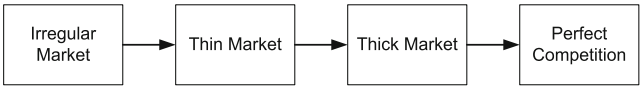

Fig. 1 A typology of market structure

for auction less frequently, and in which there are fewer sellers and buyers. A thin market involves items that are more heterogeneous across key attributes and are of varying quality levels; some examples are used furniture and rare antiques. In a thin market it is more difficult to identify a fair market price because less information is available, and because seemingly similar items can vary considerably in terms of their underlying attributes and quality. Whereas prices of similar items in a thick market are likely to converge, prices of similar items in a thin market tend to exhibit greater variation. Figure 1 depicts the different types of market structure, from the least competitive to the most competitive market. The extreme case of a thick market is perfect competition, whereas the extreme case of a thin market is an "irregular" market. Irregular markets are those in which a particular type of item appears so infrequently that bidders do not know when such an tem will be put up for auction.

Online auctions differ not only in terms of market structure but also in regards to quality uncertainty. Given the nature of online auctions there typically is no opportunity for bidders to physically inspect the item being offered, hence, it can be somewhat challenging to assess product quality. Although in some product categories quality is relatively easy to ascertain, in others it is inherently more difficult to determine. Pre-owned cars, for example, tend to present a higher level of quality uncertainty as compared to coins (whose values can more readily be assessed via pictures) and digital cameras (which are relatively standard items). Furthermore, even within the same product category some items present greater quality uncertainty than others (e.g., new vs. used computers, and certified vs. uncertified coins). Quality uncertainty can be influenced by a number of factors. The availability of pricing guides, book values, and third-party certifications, for example, can reduce quality uncertainty. When such information is not available buyer and seller characteristics and strategies oftentimes exert considerable influence on auction prices. Indeed, Brint (2003) found that in the absence of price guides and third-party certifications marketing mix variables can have a significant effect on auction prices.

As previously mentioned, in online auctions sellers and bidders rarely are equally and perfectly informed as to product quality. When information regarding quality is full and symmetric prices tend to conform to an underlying true value. However, when quality information is incomplete and asymmetric prices are more apt to deviate from the true value of a particular item. Consequently, auction markets that are characterized by higher levels of quality uncertainty result in greater price variation as compared to auction markets in which quality is more certain. Furthermore, because some sellers do a better job of informing bidders about the features and characteristics of a particular item, and some bidders do a better job of ascertaining quality and placing their bids throughout the auction process, selling prices can vary considerably across seemingly identical items.

It is important to note that in online auctions a single type of market structure can encompass different levels of quality uncertainty. For example, furniture and rare antiques both exemplify a thin market, but the quality of furniture tends to be more difficult to assess as compared to that of rare antiques; i.e., given the availability of price guides for antiques. Similarly, although the market for certified and uncertified coins is thick, the quality of certified coins is more apparent. Figure 2 depicts a classification of online auctions based on two dimensions—market structure (thick vs. thin) and quality uncertainty (high vs. low). This framework results in four types of online auction markets, a thick market with high quality uncertainty, a thick market with low quality uncertainty, a thin market with high quality uncertainty, and a thin market with low quality uncertainty.

Although a classification of online auctions within a market structure and quality uncertainty framework is new and unique, the relationships among market structures, quality uncertainty, and pricing have previously been explored in the fields of economics and finance. For example, studies have found that market prices increase with the level of quality uncertainty under monopolistic competition and monopoly (Bagwell and Riordan 1991; Dranove and Satterthwaite 1992), that different types of market structures often influence how price changes (Axarloglou 2007; Carlton 1986; Domberger and Fiebig 1993), and that price formation in securities markets can be

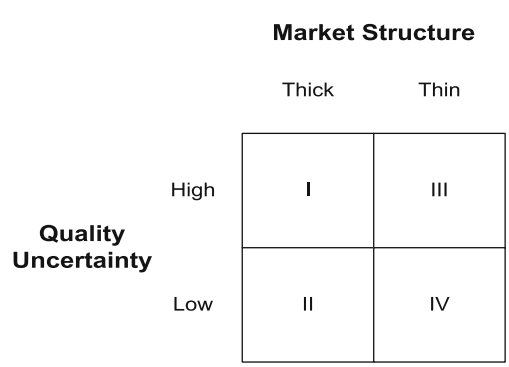

Fig. 2 A classification of online auctions based on a market structure and quality uncertainty framework

affected by market structures and uncertainty, or risk (Biais 1993; Easley et al. 1996; Easley and O'Hara 1987; Fung et al. 2004). It should be noted, however, that online auctions are substantially different from traditional auctions; which typically attract a small number of participants who often need to be physically present, involve high transaction costs, and offer a limited scope of items that typically are non-standardized. As such, traditional auctions are less characterized by thick vs. thin market structure, as competing auctions selling similar or identical items rarely occur. In effect, thick markets rarely exist in traditional auctions. Moreover, the issue of quality uncertainty is magnified in online auctions, due to the physical separation between sellers and buyers. Indeed, previous research has shown that online bidders are more reluctant to pay high prices when quality variation is substantial (Kazumori and McMillan 2005). Therefore, though there is a long history of study of traditional auctions and a rich body of auction theories (Klemperer 1999; McAfee and McMillan 1987), the framework in this study adds value to both the online and offline auction literature.

In the following sections we describe how the effects of various seller and bidder characteristics and strategies vary across the four quadrants. We explain, for example, that seller and bidder expertise play a more important role in thin markets due to the heterogeneity of auction items, but that the effects of expertise are weak under conditions of low quality uncertainty. Consequently, the effects of seller and bidder expertise tend to be strongest in Quadrant III, weakest in Quadrant II, and moderate in Quadrants I and IV. In the remainder of the paper we will review existing research and interpret the findings in the context of market structure and quality uncertainty.

Reconciling previous studies within the proposed framework

In the context of online auctions in which the participants are individual sellers and buyers, the key variables under their control are the starting bid, the reserve price, the product information, the return policy, seller reputation and expertise, bidder expertise, bidders' late bidding behavior, etc. Indeed, each of these has been the focus of numerous studies.

Figure 3 organizes the topics and relationships implied by the existing literature. On the supply side there are different types of sellers; some are experienced and others are inexperienced. Different sellers adopt different selling strategies (e.g., in terms of the starting bid, the reserve price, product pictures, return policies, etc.), which in turn affect the final auction price. On the demand side, bidders also differ in terms of their product knowledge and auction expertise, which in turn may influence how much they bid, when they bid, and how often they bid. Unfortunately, our understanding of these factors is constrained by the fact that previous studies oftentimes report contradictory results. In order to demonstrate the inconsistent and seemingly contradictory nature of these findings Table 1 groups previous studies according to their

Fig. 3 An integrated framework

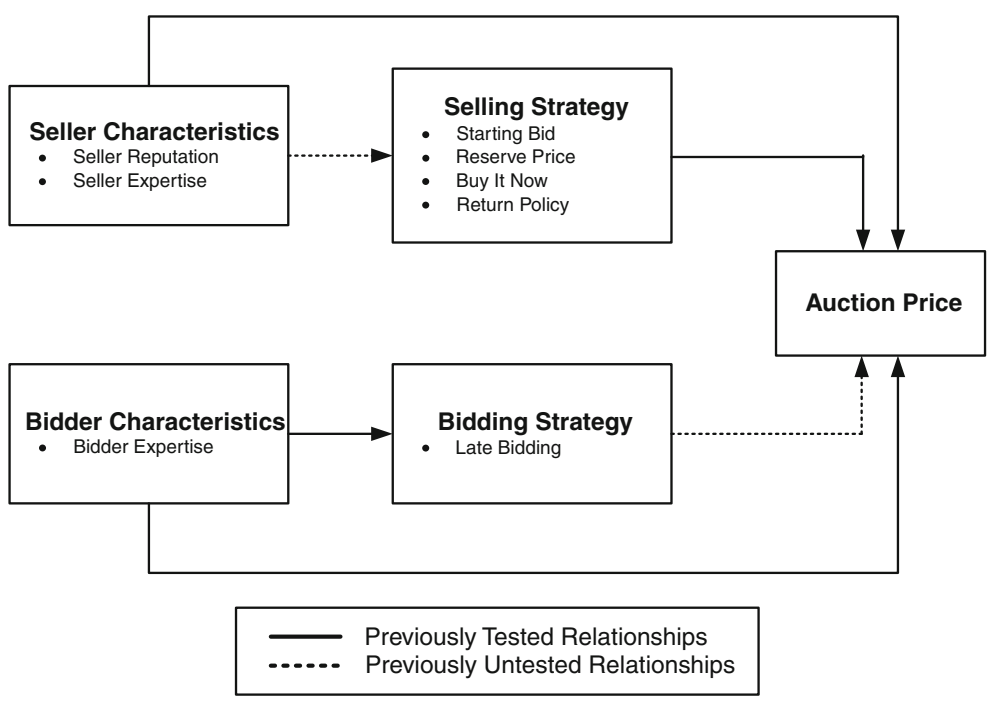

Table 1 Review of literature on factors affecting the auction price

Factors	Major Findings	Relevant Literature	Quadrant
Seller characteristics			
Reputation	Positive effect on price	Ba and Pavlou 2002; Dewally and Ederington 2006; Dewan and Hsu 2001; Houser and Wooders 2006; Livingston 2005; Lucking-Reiley et al. 2007; McDonald and Slawson 2002; Melnik and Alm 2002, 2005	**I**
	No effect on price	Ariely and Simonson 2003; Brint 2003; Eaton 2005; Resnick and Zeckhauser 2002	**II**
Seller expertise	Positive effect on price	Kauffman and Wood 2006; McDonald and Slawson 2002	**I**
	No effect on price	Huston and Spencer 2002	**II**
Selling strategy			
Starting bid	Positive effect on price	Bajari and Hortacsu 2003; Häubl and Popkowski Leszczyc 2003; Kamins et al. 2004; Lucking-Reiley et al. 2007; Suter and Hardesty 2005	**I & III**
	Negative effect on price	Ku et al. 2005, 2006; Malhotra and Murnighan 2000	**II & IV**
Reserve price	Positive effect on price	Bajari and Hortacsu 2003; Li et al. 2004; Lucking-Reiley et al. 2007	**I**
	No effect on price	Brint 2003; Standifird 2001	**II**
	Negative effect on price	Katkar and Reiley 2006	**II**
Buy it now	The Buy-It-Now option positively affects price	Anderson et al. 2008; Budish and Takeyama 2001; Dodonova and Khoroshilov 2004; Li et al. 2004; Reynolds and Wooders 2003	**I & III**
	No effect on price	Standifird et al. 2005	**II**
Return policy	Positive effect on price	Li et al. 2004	**I**
	No effect on price	Dewally and Ederington 2006	**II**
Bidder characteristics			
Bidder expertise	Negative effect on price	Dewan and Hsu 2004	**III**
	No effect on price	Gilkeson and Reynolds 2003; Huston and Spencer 2002	**I &II**
Bidding strategy			
Late bidding	The extent of late bidding, not the effect of late bidding on price	Bajari and Hortacsu 2003; Borle et al. 2006; Roth and Ockenfels 2002; Wilcox 2000	**II, III, &IV**

empirical results. In the sections that follow we attempt to reconcile these findings within the context of market structure and market uncertainty.

Although previous studies (see Table 1) cannot always be definitely classified as belonging to one of the four quadrants shown in Fig. 2, the various studies and product categories studied previously can be compared in a relative sense. In stock markets, for example, frequently traded stocks can represent a thick market, whereas infrequently traded stocks can represent a thin market. In other words, even it is difficult to draw a line between frequency and infrequency, we can always reasonably state that one market is thicker or thinner than another. Just as the frequency of trading in stock markets can be used as a measure of market structure, several indicators in online auctions (e.g., the number of available auctions and the number of bidders per auction) can serve as a proxy for measuring whether a market is relatively thicker or thinner than others. As a result, product categories involving more sellers (auctions) and buyers (bidders per auction) are thicker than those involving fewer sellers and buyers. The same can be done for quality uncertainty, e.g., antique coins have a higher level of quality uncertainty than football tickets. One important caveat here, however, is that systematic research is needed to provide a strong test of the framework.

Seller characteristics

Seller expertise

Two studies have reported a positive relationship between seller expertise and auction price (Kauffman and Wood 2006; McDonald and Slawson 2002); however, Huston and Spencer (2002) found just the opposite. Although each of these studies investigated a thick market the two that found a positive relationship examined a market with a high level of quality uncertainty (i.e., uncertified coins of different types and denominations), whereas the lone study that found a negative relationship investigated a market characterized by a lower lever of quality uncertainty (i.e., 1921 Morgan Dollar certified and uncertified coins). It thus

appears that in markets characterized by high quality uncertainty (Quadrant I) seller expertise is used by bidders as a proxy for trustworthiness and reputation. However, when bidders are more readily able to discern product quality (Quadrant II) they do not need to depend on ancillary cues to determine the worth of an item.

Although no studies have examined seller expertise in the context of a thin market, one might expect its impact to be greater vis-à-vis thick market conditions. Because a thin market is characterized by fewer sellers and a greater heterogeneity of items bidders are apt to be more cautious. In this type of situation seller expertise can serve as an indicator of non-opportunism and trustworthiness. Accordingly, it is expected that higher levels of seller expertise will reduce risk in thin markets, and that seller expertise will have a greater impact on price in a thin market than in a thick market. Overall, the effects of seller expertise should be strongest in a thin market with high quality uncertainty (Quadrant III), weakest in a thick market with a low quality uncertainty (Quadrant II), and moderate in both thick and thin markets with high quality uncertainty (Quadrants I and IV).

Seller reputation

Online auction sites typically allow buyers to provide feedback about sellers, which other bidders oftentimes use as a measure of seller reputation. A number of studies have examined the role of seller reputation in online auctions; however, the results are mixed. Although Melnik and Alm (2005)—in their study of eBay collectible coin auctions—reported that when the number of feedback ratings increased from zero to 1889 the winning bid increased by approximately 25%, most studies have found seller reputation to have a relatively small effect on price (Ba and Pavlou 2002; Dewan and Hsu 2001; Houser and Wooders 2006; Livingston 2005; Lucking-Reiley et al. 2007; McDonald and Slawson 2002; Melnik and Alm 2002), or no effect at all (Ariely and Simonson 2003; Brint 2003; Eaton 2005; Resnick and Zeckhauser 2002). Interestingly, Melnik and Alm (2005) also found that a doubling of sellers' positive ratings from 1889 to 3778 led to an increase in the winning bid of only 2.3%, thus indicating that reputation has a positive impact on auction prices only within an intermediate range. In other words, it could be that reputation affects auction price only when the number of seller ratings exceeds a minimum "threshold"; however, as the number of ratings exceed a certain "ceiling" the influence of reputation reaches a steady state. Finally, although Resnick and Zeckhauser (2002) found that seller feedback does not influence the auction price, they found that higher levels do increase the probability of a sale.

In order to explain these conflicting results some researchers posit that quality uncertainty and financial risk moderate the effect of seller reputation on price (Dewally and Ederington 2006; Bajari and Hortacsu 2004). Indeed, all of those studies that did not find a significant effect of seller reputation on price were conducted in thick markets with relatively low levels of quality uncertainty or financial risk (Quadrant II). Ariely and Simonson (2003), for example, found that seller reputation had no effect on the price of tickets to the 2000 Rose Bowl; while Kauffman and Wood (2006) found reputation to have no effect on prices of relatively inexpensive, U.S. two-cent coins. On the other hand, the one study that was conducted in a market characterized by higher levels of quality uncertainty (Quadrant I; Melnik and Alm 2005) found that seller reputation had a positive effect on price. Apparently, as quality uncertainty and financial risk increase seller reputation takes on greater significance.

Unfortunately, none of these studies were conducted in thin markets (Quadrants III and IV). Nonetheless, as with seller expertise, it is expected that seller reputation will have a stronger effect on price in a thin market—for two reasons. First, a thin market typically involves unstandardized and rare items (i.e., heterogeneous goods such as antiques), of which product quality is more difficult to assess. Second, a thin market implies fewer sellers, which in turn leads to higher prices and a greater likelihood of opportunistic seller behavior. Thus, potential buyers often face a higher risk in a thin market. To reduce their risk, buyers are more apt to take seller reputation into consideration, and thus should be more willing to bid higher prices as they become more confident of quality assurance.

Selling strategy

Starting bid

A starting bid is a required feature for sellers. With traditional auctions one way to prevent an item from being sold for less than its market value is to set a starting bid equal to one's valuation of the item (oftentimes referred to as a "public" reserve price). In most online auctions, however, the starting bid is not set at a seller's valuation of the item. Generally, sellers tend to set a considerably lower starting bid than the auction item's "book" value. For example, Bajari and Hortacsu (2003) found that the starting bid in their sample of eBay's coin auctions averaged 63% of the book value.

Studies examining the effect of starting bid on final selling price have produced mixed results. Some researchers have found a positive relationship between the starting bid price and final selling price (Bajari and Hortacsu 2003; Häubl and Popkowski Leszczyc 2003; Lucking-Reiley et al. 2007; Suter and Hardesty 2005), whereas others have found a negative correlation (Ku et al. 2005, 2006; Malhotra and Murnighan

2000). Although at first glance it appears that these findings are contradictory the pattern of results can be explained within the market structure and quality uncertainty framework. More specifically, the positive relationship between starting bid and auction price holds primarily under conditions of high quality uncertainty, and in situations in which comparable items are not readily available and hence market value is difficult to determine (Quadrants I and III). Under these conditions the starting bid serves as a "value construction" mechanism (Häubl and Popkowski Leszczyc 2003; Kamins et al. 2004; Suter and Hardesty 2005); that is, it serves as an indicator of quality, which in turn has a positive effect on bidders' valuation of an item (Li et al. 2004). A negative relationship, on the other hand, is more likely to occur under conditions of low quality uncertainty. Malhotra and Murnighan (2000), for example, found a negative effect within Quadrant IV—a thin market with low quality uncertainty (life-sized fiberglass cows). Similarly, Ku et al. (2006) found partial support for a negative effect within Quadrant II—a thick market with low to moderate quality uncertainty (Tommy Bahama Silk Shirts). In these latter situations the negative effect of starting bid on selling price has been attributed to "auction fever" (Heyman et al. 2004; Malhotra and Murnighan 2000). Specifically, Ku et al. (2005, 2006) indicated that a low starting bid price attracts more bidders, who then get "caught up" in a bidding war, thus driving up the selling price. Conversely, a relatively high starting bid results in fewer bidders, who then are less inclined to get into a bidding war, thus resulting in lower prices. Heyman et al. (2004) further argued that auction fever may occur in online auctions due to the effect of quasi-endowment where the competitive bidding environment builds up a feeling of possession, and bidders who have been actively participating in the auction tend to overbid in order to avoid losing the auction item (i.e., loss aversion).

Reserve price

Sellers have an option to set a reserve price for an item. Although bidders are informed as to whether an auction has a reserve price, and if it has been met, the amount remains confidential. The rationale for implementing a reserve price is to prevent the item from being sold at an amount lower than the seller's valuation of the object. The potential downside to a reserve price, though, is that bidders will not enter an auction if the reserve price appears to be greater than their own valuations of the item. Previous research on traditional auctions indicates that the use of a reserve price can increase a seller's revenue (Milgrom and Weber 1982).

Several studies of online auctions have found reserve price to have a positive effect on the winning bid (Bajari & Hortacsu 2003; Li et al. 2004; Lucking-Reiley et al. 2007); however, others have found either no relationship (Brint 2003; Standifird 2001) or a negative effect (Katkar and Reiley 2006). Further inspection, though, reveals that studies that have found a positive relationship between reserve price and winning bid price have been conducted in thick markets with high levels of quality uncertainty (Quadrant I), whereas those that have found no relationship or a negative effect have been conducted in thick markets with low levels of quality uncertainty (Quadrant II). Lucking-Reiley et al. (2007), for example, found that the presence of a reserve price increased the winning bid by about 15% in an eBay coin auction (a thick market with a high level of quality uncertainty); whereas Standifird (2001) found no relationship in eBay auctions of brand new, in-box 3Com Palm Pilots (a thick markets with a low level of quality uncertainty). Katkar and Reiley (2006) found that the use of a reserve price had a negative effect in an auction of Pokemon cards (a thick market characterized by a low level of financial risk, which in turn lessens buyers' concerns regarding quality uncertainty). It appears, then, that in conditions of high quality uncertainty some buyers use reserve price as a cue for quality.

Buy it now

Most online auction sites allow sellers to set an optional, fixed price for an item; namely, a "Buy-It-Now" (BIN) price. A BIN price provides buyers with the option to forego the bidding process and purchase an item immediately. When not invoked, a BIN price can serve as a reference point or a quality indicator that influences a bidder's valuation of the item (Kamins et al. 2004; Li et al. 2004).

Although several studies have found that the BIN option has a positive effect on auction price (Anderson et al. 2008; Budish and Takeyama 2001; Dodonova and Khoroshilov 2004; Reynolds and Wooders 2003), others have found otherwise (Standifird et al. 2005). Studies that have found a positive effect typically have been conducted in markets with high quality uncertainty, whereas those that have found no effect have been conducted in markets with low quality uncertainty. Indeed, in studies based on high-end jewelry items (Quadrant III—a thin market with a high quality uncertainty), Dodonova and Khoroshilov (2004) found that auctions with higher BIN prices resulted in higher selling prices as compared to identical auctions with lower BIN prices. They concluded that bidders, when having difficulty assessing quality, tend to use the BIN price as a proxy, which influences their valuations of the item. Standifird et al. (2005), however, found that BIN had no effect on price in auctions of inexpensive collectible coins (Quadrant II—a thick market with a low quality uncertainty). With this type of item equilibrium prices are fairly well-established, and thus BIN did not affect bidders' evaluations.

Return policy

Return policies reduce financial risk for buyers. Sellers oftentimes adopt return policies when their target market is highly risk averse and the retail price is relatively high (Che 1996). A return policy, in effect, is a type of "warranty" and can serve as a quality indicator and thus lead to favorable product valuations (Boulding and Kirmani 1993; Shimp and Bearden 1982; Soberman 2003; Wiener 1985).

Two studies have investigated the effect of return policies on auction price, but once again the results are mixed. Li et al. (2004) found that in eBay's painting and silver plate auctions (thick markets), in which there is a high level of quality uncertainty (Quadrant I), money-back guarantees attract more bidders and drive up their price threshold. Dewally and Ederington (2006), however, did not find a significant effect of money-back guarantees on price in eBay's comic book auctions; a thick market with a relatively low quality uncertainty (Quadrant II). Rather than being in conflict, these two sets of findings are exactly what one would expect when taking quality uncertainty into account. Liberal return policies are most valuable in situations in which a combination of price and quality uncertainty creates higher levels of financial risk.

Bidder characteristics

Bidder expertise

Bidder expertise has been a focus of research in traditional auctions, particularly within the experimental economics literature. In general, research has found that inexperienced bidders are more likely to overbid, as compared to experienced bidders. Experienced bidders, on the other hand, are more likely to make adjustments or exit when prices rise above the item's market value (Kagel and Levin 1986, Cox et al. 2001).

Several studies on online auctions have examined whether bidder expertise influences the amount that winning bidders pay. Dewan and Hsu (2004) investigated a thin market with a high level of quality uncertainty (i.e., rare stamps—Quadrant III), and found that experienced bidders end up paying lower prices (i.e., for similar items), as compared to less experienced bidders. Other researchers, however, have found bidder expertise to have no effect on price. Gilkeson and Reynolds 2003, and Huston and Spencer 2002 examined thick markets with different levels of quality uncertainty (Quadrants I and II) and found no difference in the prices paid by experienced vs. inexperienced bidders. These results indicate that bidder expertise is more relevant in thin markets (in which equilibrium prices are less established) than in thick markets (in which equilibrium prices are more apparent).

Bidding strategy

Late bidding

Many bidders engage in a strategy termed as "late bidding," or "sniping," which refers to submitting one's bid as late as possible (Bajari and Hortacsu 2003; Roth and Ockenfels 2002; Wilcox 2000). The underlying motivation for late bidding is twofold: 1) to improve a bidder's chance of winning, while 2) minimizing the winning bid price. Because late bidding results in fewer and less frequent bids this tactic reduces the potential for a bidding war (Roth and Ockenfels 2002), which in turn results in lower auction prices (Brint 2003). By observing others' bids right up to the end of the auction period late bidding also allows individuals to better assess the value of an item.

Some researchers have found that late bidding is more prevalent in thin markets with high levels of quality uncertainty (Wilcox 2000). Roth and Ockenfels (2002), for example, found that eBay users are more likely to engage in late bidding for antiques (a relatively thin market with high quality uncertainty—Quadrant III) as compared to computers (a thick market with relatively low quality uncertainty—Quadrant II). Borle et al. (2006) further investigated the extent of late bidding across 15 different product categories, and found late bidding to be more prevalent in auctions for hair dryer, handheld calculators, and luggage bags (thin markets with low quality uncertainty—Quadrant IV), and less prevalent in auctions for sunglasses, electric drills, and premium wristwatches such as Rolex (thick markets with low quality uncertainty—Quadrant II).

Unfortunately, each of the aforementioned studies examined only the extent of late bidding, but did not examine the effect of late bidding on price. Consequently, it is not known whether late bidding actually leads to lower winning bids. Hopefully, future research can resolve this issue, and can determine under which conditions late bidding is most effective.

Summary and conclusions

Research in online auctions in the past decade has generated a large body of empirical results, particularly on pricing issues. The present study develops a theoretic framework that is able to reconcile seemingly mixed findings in the literature. In essence, online auction markets differ in terms of market structures (thick vs. thin) and levels of quality uncertainty (high vs. low). Under different combinations of market structures and quality uncertainty, seller and bidder characteristics as well as selling and bidding strategies have different effects on auction prices. Their effects tend to be strongest in thin markets with high

Table 2 A summary of propositions

Factors	Propositions
Seller characteristics	
Reputation	Seller reputation has the strongest positive effect on price in thin markets with high levels of quality uncertainty (Quadrant III), the weakest effect in thick markets with low levels of quality uncertainty (Quadrant II), and moderate effect in thick markets with high levels of quality uncertainty (Quadrant I) and thin markets with low quality uncertainty (Quadrant IV).
Seller expertise	Seller expertise has the strongest positive effect on price in Quadrant III, the weakest effect in Quadrant II, and moderate effect in Quadrants I and IV.
Selling strategy	
Starting bid	Starting bid has a positive effect on price when there is a high level of quality uncertainty (Quadrants I and III). Such positive effect tends to be stronger in Quadrant III than in Quadrant I. Starting bid has a negative effect on price when there is a low level of quality uncertainty (Quadrants II and IV). Such negative effect tends to be stronger in Quadrant II than in Quadrant IV.
Reserve price	The presence of a reserve price has the strongest positive effect on price in Quadrant III, the weakest effect in Quadrant II, and moderate effect in Quadrants I and IV.
Buy it now	The presence of Buy-It-Now has the strongest positive effect on price in Quadrant III, the weakest effect in Quadrant II, and moderate effect in Quadrants I and IV.
Return policy	A money-back guarantee has the strongest positive effect on price in Quadrant III, the weakest effect in Quadrant II, and moderate effect in Quadrants I and IV.
Bidder characteristics	
Bidder Expertise	Bidder expertise has the strongest negative effect on price in Quadrant III, the weakest effect in Quadrant II, and moderate effect in Quadrants I and IV.
Bidding strategy	
Late bidding	Late bidding is most likely to occur in Quadrant III, least likely to occur in Quadrant II, and moderately likely to occur in Quadrants I and IV. Late bidding has the strongest negative effect on price in Quadrant III, the weakest effect in Quadrant II, and moderate effect in Quadrants I and IV.

levels of quality uncertainty, and tend to be weaker in thick markets with low levels of quality uncertainty.

Table 2 summarizes the findings as a set of research propositions. Systematic research, across each of the four quadrants, is needed to provide a strong test of the framework. In order to develop a coherent body of literature, future researchers should specify the type of market structure, as well as the level of quality uncertainty, that best characterizes the context of their studies. Doing so will increase our knowledge and understanding of online auctions, and will lead to more accurate and meaningful generalizations.

Implications for sellers

The results from this study have important implications for auction design. For example, considering that the effect of starting bid on the auction price differs across varying levels of quality uncertainty, sellers, in order to increase their revenues, should set a high starting bid when selling items of uncertain quality, and a low starting bid when selling items whose quality can be discerned with greater certainty. Overall, online sellers can optimize their auction design by understanding how different strategies influence the final price across thick and thin market structures and varying levels of quality uncertainty.

Future research

When reviewing the literature it is clear that the vast majority of empirical studies have been conducted in thick markets. The reason for this trend is simply that data are more readily available for thick markets (i.e., due to the large number of ongoing auctions). Nonetheless, future research should focus to a greater extent on thin markets. Although research in thin markets is more challenging because fewer data points exist, this problem can be overcome by extending the time frame of one's study, and by implementing lab experiments. These types of studies not only expand the boundary of our research, but also increase internal validity. Table 1 shows how existing studies fit into different quadrants of the framework. Of the 37 unique studies cited, 18 fall into Quadrant I, 13 in Quadrant II, 4 in Quadrant III, and 2 in Quadrant IV. Clearly, Quadrants III (thin markets with high quality uncertainty) and IV (thin markets with low quality uncertainty) are underrepresented in the literature. Much can be learned by investigating online auctions within these contexts.

With the four quadrants of the framework in mind, along with the buyer and seller variables reviewed in this paper, a variety of issues are relevant. For example, do sellers with different levels of expertise adopt different strategies, depending on thick vs. thin, or various levels of quality uncertainty? There is also a dearth of information regarding

the effect of seller reputation in a thin market. Though one might expect that seller reputation would be more important in a thin market vis-à-vis a thick market empirical evidence would be valuable. Another issue is whether seller reputation and product information are substitutes or complements. Anand and Shachar (2004a, b) found that reputation and product information are substitutes in offline consumer choice making, whereas Yin (2005) showed that reputation and product information are complements in online auctions, and both drive up price. Again, the market structure and quality uncertainty framework might help to better understand this issue.

A variety of other issues are also relevant. For example, when is it more advantageous for sellers to use a secret reserve price, as compared to an observable starting bid? Likewise, should a seller set a low starting bid with a reserve price or a high starting bid without a reserve price? Although Bajari and Hortacsu (2003) concluded that a secret reserve price can yield noticeably higher revenues than using a high starting bid, more research needs to be conducted in this area in order to establish boundary conditions.

As previously mentioned, future studies should also examine the effect of late bidding on auction prices. Furthermore, studies should determine whether late bidding is more likely to lead to lower prices in thick vs. thin markets, and under conditions of high vs. low quality uncertainty. Other bidding strategies, such as jump bidding where bidders submit a high bid in order to scare off their competitors, sequential bidding where bidders participate in one auction at a time, and simultaneous bidding where bidders participate in several auctions at the same time, may be also of interest, especially within the market structure and quality uncertainty framework.

Finally, considering that online bidding involves multiple decision-making processes (Ariely and Simonson 2003; Cheema et al. 2005); such as how much to bid and how to bid (sequentially or simultaneously), and where and when to enter an auction; additional research is needed to integrate various behavioral constructs into online auction studies (e.g., irrational bidding, heuristics, and framing effects). In many instances online bidders are often uncertain about their own valuation of the item, and thus research is needed to better understand how online bidders construct their choices and value assessment (Bettman et al. 1998; Fischhoff 1991). In thick markets with a high level of quality uncertainty bidders often have difficulty screening alternatives, and are more likely to enter auctions with existing bids while ignoring comparable or more attractive auctions without any bids. Additional research is needed to better understand the heuristics that lead to this "herding" bias (Simonsohn and Ariely 2008; Dholakia and Soltysinski 2001; Dholakia et al. 2002). Further research is also needed to better understand how and when anchoring biases (Tversky and Kahneman 1974) influence online bidding; e.g., how a starting bid and a buy-it-now price can serve as a reference point for potential bidders (Dodonova and Khoroshilov 2004; Kamins et al. 2004). Future research should investigate these behavioral issues within the market structure and quality uncertainty framework.

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