BIDDING BEHAVIOURS IN ONLINE AUCTIONS:
EVIDENCE FROM A USED CAR MARKET

DEFNE SANDIKCIOĞLU

BOĞAZİÇİ UNIVERSITY

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BIDDING BEHAVIOURS IN ONLINE AUCTIONS: EVIDENCE FROM A USED CAR MARKET

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DECLARATION OF ORIGINALITY

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ABSTRACT

Bidding Behaviours in Online Auctions:

Evidence from a Used Car Market

This thesis investigates the impact of sellers' different strategies and the bidders' behaviors on the auction outcome among different auction formats. We aim to complement and extend the existing literature by providing evidence on how different levels of the secret reserve price affect the winning bid and the probability of sale in an emerging market by using high-frequency bid data of an online auction website for second-hand cars, ikinciyeni.com. Furthermore, we discuss how the bidders' entry decisions and bidding strategies change according to their experience and perception of the different auction formats. Using the data on 42,621 auctions with 2,228,960 bids recorded in 2020, we find a significant and positive impact of the secret reserve price level on the sales price controlling for the auction and car characteristics. Also, we conclude that the presence of a secret reserve with a positive opening price decreases the sellers' revenue compared to a zero secret reserve-positive opening price auction. Lastly, it is found that setting a higher secret reserve price significantly reduces the likelihood of a sale.

ÖZET

Çevrimiçi İhalelerde Teklif Veren Davranışları: İkinci El Araç Pazarı Analizi

Bu tez, farklı ihale formatları karşılaştırıldığında, satıcıların farklı stratejilerinin ve teklif verenlerin davranışlarının ihalenin sonucu nasıl etkilediğini araştırmaktadır. İkinci el otomobiller için bir çevrimiçi açık artırma internet sitesi olan ikinciyeni.com'un teklif ve ihale verilerini kullanarak, gelişen bir ülkede farklı gizli rezerv fiyatlarının kazanan teklifi ve satış olasılığını nasıl etkilediğine dair kanıtlar sağlayarak mevcut literatürü tamamlamayı ve genişletmeyi amaçlıyoruz. Ayrıca, teklif sahiplerinin ihaleye katılma kararlarının ve teklif stratejilerinin, deneyim seviyelerine ve farklı açık artırma formatlarını algılama biçimlerine bağlı olarak nasıl değiştiğini inceliyoruz. 2020 yılında kaydedilen 2.228.960 teklif ile 42.621 ihaleye ilişkin verileri kullanarak, gizli rezerv fiyat seviyesinin satış fiyatı üzerinde önemli ve olumlu bir etkisi olduğunu bulduk. Ek olarak, gizli rezerv fiyatı ile pozitif açılış fiyatına aynı anda sahip bir ihalenin, gizli rezerv olmayan pozitif açılış fiyatlı bir ihaleye kıyasla satıcıların gelirini azaltacağını bulduk. Son olarak, daha yüksek seviyeli gizli rezerv fiyatlarının, satış olasılığını önemli ölçüde azaltacağına ulaştık.

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CHAPTER 1

INTRODUCTION

Over the last two decades, the popularity of internet auctions of used cars, especially the use of eBay Motors, has increased significantly. Particularly after the Covid-19 pandemic, a shortage of new cars and people's hesitancy against public transportation created a frenzy in the used-car market throughout the world (Rosenbaum, 2020). The proliferation of online auctions and the increasing demand in the used-car market enable researchers to analyze the bidders' and sellers' behaviors using the auction data. There exists numerous work using the data from eBay Motors; however, the literature is quite narrow in Turkey. Both the pandemic and the unaffordability of brand-new cars due to decreasing purchasing power result in the growth in used-car sales in Turkey in 2020 (Bloomberg HT, 2021). Therefore, using 2020 data from a Turkish online auction website for second-hand cars, ikinciyeni.com, this thesis aims to contribute to the existing literature by providing an analysis of the bidders' behaviors and sellers' strategies in different auction formats in an emerging market.

In online auctions, a seller has to decide on the auction format before her listing becomes available on the auction web page. The most critical decision for a seller is whether to use a reserve price which is the minimum price that the seller is willing to sell the automobile and, if used, at which level and how it should be set: public or secret? In ikinciyeni.com, there can be three options: using both types of reserve prices (secret reserve auctions), using only the public reserve[1] (open reserve auctions), or setting both reserve price levels to zero (absolute auctions).[2] There are different conclusions in the literature about whether setting a positive secret reserve price increases the sellers' revenue and how its existence affects the probability of sale, which is discussed widely in chapter 2. Therefore, understanding the reason for using a hidden price level has always been an intriguing subject in auction theory. According to Katkar and Reiley (2007), the most popular argument about why sellers

[1] Public reserve price, opening price, starting price, and minimum bid are used interchangeably.

[2] The company we obtained the data from does not allow to use secret reserves without a public reserve price. This rule may change between different online action platforms.

use secret reserves is because a high public reserve price, i.e., an opening price which is the publicly announced minimum price level a seller is willing to sell his object, intimidates the potential buyers; hence, keeping it secret and setting a low public reserve price may increase the probability of a sale with a desired final price since it boosts bidding momentum with the higher number of bidders.

Online auctions provide information on whether a secret reserve is used or not in the auction until a bidder hits the secret reserve price. When a bidder submits a bid equal to the secret reserve price level, the platform announces that the secret reserve price is met, and the reserve price level henceforth becomes publicly available information. Therefore, despite the popularity of reserve prices in the existing literature, due to the design of the online auctions and the limitations on accessing the proprietary data, researchers are not able to observe the secret reserve price levels in all auctions when they collect the data by scraping the information from the auction web page. For this reason, in most empirical papers using data from online auction platforms, a dummy variable indicating the presence of a secret reserve in an auction is used rather than a price level variable. The data we used in this thesis is obtained directly from the company's database;[3] hence, it allows us to observe the different dimensions of the auction data such that we are able to observe the secret reserve price levels for all listings, even if they are not revealed on the auction page.

We complement and extend the literature by providing evidence on the relationship between the secret reserve price levels and the auction outcome in an emerging market by using unique, high-frequency bid data. Compared to the auction data used in the existing empirical work, the importance of our data comes from its uniqueness and its size, which is explained in detail in chapter 3. Not only do we have the data on the secret reserve price levels for all auctions regardless of the highest bid level, but also ikinciyeni.com provides us all the background information on the bidding processes, which would be otherwise impossible to be observed by a researcher. The data is exceptionally detailed such that it even provides us

[3]The information on the bidders' identities is masked; only the numeric user IDs are shared with us to ensure the confidentiality.

information on which channel a bidder uses to submit her bids in an auction: website, mobile, or automatic bidding. In terms of the size of the data, the only paper using a larger sample of car auctions compared to our sample is Choi, Nesheim, and Rasul (2016) with 258,068 auctions. The number of listings in our data is approximately four-fold of the second largest sample size among the papers focusing on the secret reserves in a used-car market mentioned in chapter 2, which is 10,893 in Chen et al. (2020).

Our data has information on auction and car characteristics, bid levels, bidder numbers, and bidding channels. By using the information on 42,621 listings with 2,228,960 bid records in 2020, we mainly question the relationship between the secret reserve price and the sales price, and the impact of the secret reserve price on failure to sell. Furthermore, this thesis provides an analysis of bidders' behaviors across different auction formats. We discuss how the bidders' entry decisions and bidding strategies are shaped, based on the findings of Jehiel and Lamy (2015).

In our empirical analysis, first we analyze the relationship between the secret reserve price level and the sales price. We regress the sales price on the secret reserve price level, auction duration, bidder numbers, car characteristics such as car brand, car model, car body type, car's age, kilometer, fuel type, transmission type, and time of the year. We find a significant and positive impact of the secret reserve price level on the sales price controlling for the auction and car characteristics. To see whether the impact is similar for the listings that do not end up with a sale, we incorporate the unsold listings into the sample and estimate another model in which the highest bid is the dependent variable, following the work of Roberts (2013). The results are consistent with the first model; the highest bid is highly and positively correlated with the secret reserve price level.

Furthermore, we analyze the impact of the existence of a secret reserve price on the final price rather than its level, to compare the results with the current work using only the presence of the secret reserve price. We use a dummy variable for the presence of a secret reserve and control the opening price level to compare two

auction formats in terms of sellers' revenue. We find that the presence of a secret reserve with a positive opening price decreases the sellers' revenue compared to a zero secret reserve-positive opening price auction.

Lastly, we estimate a logit model to understand the impact of secret reserve price levels on the probability of sale. We regress a binary variable indicating whether a car is sold or not on the secret reserve price level, auction duration, bidder numbers, and aforementioned car characteristics variables. It is found that setting a secret reserve price significantly reduces the likelihood of a sale.

The remainder of this thesis is organized as follows. Chapter 2 overviews the auction literature both in terms of empirical and theoretical aspects. In chapter 3, the institutional features of ikinciyeni.com, and descriptive statistics of our data are discussed. Chapter 4 presents our OLS and logit models used in estimation. The results are discussed in chapter 5 and chapter 6 concludes. In Appendix A, summary statistics of different auction formats are presented, in Appendix B, cross correlations are given, and lastly, Appendices C, D, and E provide additional estimation results.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews empirical and theoretical studies in the auction literature. First, the theoretical background for using reserve prices, bidder behaviors, and auction format selection is discussed; then, an overview for empirical studies on the effects of reserve prices, public or secret, in online auction markets is provided.

2.1 Theoretical background

Riley and Samuelson (1981) provide that in the second bid auctions, using either optimal secret or public reserve price yields the same expected revenue since the bidders' optimal strategy is to bid one's reservation value. Similarly, there is again no additional benefit of keeping the reserve price secret in the first bid auctions. Also, they conclude that sellers' expected revenue is maximized if the seller announces an optimally set minimum or secret reserve price, which are independent of the number of the bidders in the independent private values model. The theory in their work implies that an increase in the reserve price leads to a decrease in the number of bidders and the probability of sale, but an increase in the selling price conditional on the object being sold.

Contrary to Riley and Samuelson (1981), Levin and Smith (1994) suggest that a revenue-maximizing mechanism for the seller does not include reserve prices in the independent value paradigm with endogenous entry. Also, they conclude that the optimal reserve price declines with the number of bidders.

Milgrom and Weber (1982) theoretically show that given any reserve price for the first-price auction, second-price auction, or English auction, providing as much information to the bidders increases the expected revenues, which is also called the "linkage principle". In other words, as Bajari and Hortaçsu (2003) state, the sellers will be punished with lower prices as a result of hiding information. They state that setting a positive reserve price will change the set of bidders who are willing to enter

and bid at least the reserve price level. The sellers can achieve to attract the same set of buyers by setting the reserve price "in a manner depending on the particular realization of his information variable" (Milgrom & Weber, 1982).

Related to the work of Milgrom and Weber (1982), Vincent (1995) provides that in a common value auction, keeping the reserve price secret may provide more information to the bidders; therefore, it increases the sellers' revenues. Although this result seems to contradict the previous findings, it is supported by them. This result follows from the fact that disclosure of the reserve price keeps some bidders from participating in the auction, even though the provided information may imply a successful sale. Hence, the secret reserve price encourages entry, and with a higher number of bidders, more information will be aggregated. The more information is provided, the more a seller can increase his revenues.

In a private-value environment, Myerson (1981) concludes that a seller increases his expected revenue by setting a reserve price above his valuation of the item when the bidders are symmetric. In the independent-values paradigm, Elyakime, Laffont, Loisel, and Vuong (1994) shows that the optimal strategy for a seller is to set the reserve price at his private valuation. They use data from first-price sealed bid auctions and show that moving from the secret reserve auctions to the open reserve auctions will increase the sellers' revenue.

Analysis of the bidder behaviors across auction formats in chapter 3 relies on the work of Jehiel and Lamy (2015). They investigate the relationship between reserve prices and entry decisions between the different auction formats, and try to provide an explanation for the use of absolute auctions and reserve prices set at the sellers' valuation. They argue that the most attractive reserve price for the bidders is the lowest reserve price; hence, the seller choose to disclose it. Similarly, the seller choose to keep the high reserve prices secret not to discourage the entry. However, if the bidders are rational, they should expect this rationale of the sellers. Hence, Jehiel and Lamy (2015) state that an auction with a secret reserve price can only be attractive to the inexperienced bidders.

They describe to what extent the bidders are heterogeneous in their understanding of how entry decisions relate to the auction formats and how reserve prices are distributed when they are hidden. They suggest that this heterogeneity is derived from the lack of experience. As a result, three cognitive types of buyers occur: fully rational (FR), fully coarse (FC), and partially coarse (PC). FC bidders miss the relationship between the participation rate and the auction format; therefore, they do not understand that the entry decisions may decrease with the reserve price. PC buyers see the impact of the auction format on auction participation but miss that the secret and public reserve prices are not distributed in the same way. In other words, they observe all reserve prices used before and analyze this information as if the reserve price, when secret, was drawn from the same distribution. Assume that the secret reserve price is not disclosed in an auction since a bidder does not hit it. Then, from PC's perspective, the auctions with lower secret reserve prices will be overrepresented compared to the auctions with high secret reserves.

At competitive equilibrium, according to the fault interpretations of mistaken bidders mentioned above, FC bidders only opt for absolute auctions since they can not internalize the link between the participation rate and auction format. Hence, if there are only FC buyers, we only see absolute auctions at equilibrium. FR bidders should select the auction formats with a positive public reserve price which are set truthfully since they have correct expectations. Lastly, PC bidders should choose either listing with secret reserve prices or strictly positive public reserve prices since they expect that both reserve prices are drawn from the same distribution.

Another question related to our work discussed in Jehiel and Lamy (2015) is how do realized and expected payoffs differ across different cognitive types. Jehiel and Lamy (2015) state that absolute auction participants, i.e., FC buyers, are less likely to win the auction and pay more on average as a result of bidding frenzy or auction fever (start low, pay above your valuation as a buyer). The more experienced bidders are more likely to participate in the higher open reserve auctions.

2.2 Empirical studies

2.2.1 Reserve prices

The studies discussed below empirically investigate the impacts of reserve price levels on bidders' entry decisions, probability of sale, and final price. It is important to note that there are various findings regarding the impacts of using reserve prices on the auction outcomes.

Simonsohn and Ariely (2008) investigate the non-rational herding mechanism by estimating the effect of opening prices and the number of existing bids on bidders' entry decisions. They find that while a low starting price leads to a higher ending price and more total bids on average, it decreases the probability of winning an auction for the bidders. Also, they conclude that more experienced bidders are less likely to participate in low starting price auctions, which is consistent with Jehiel and Lamy (2015). Ku, Galinsky, and Murnighan (2006) analyze how lower starting prices result in higher sales prices, and they conclude that lower starting prices decrease barriers to entry, seduce bidders to spend more time, and the bidding traffic brings more traffic since bidders become able to infer the value of the item.

Bajari and Hortaçsu (2003) find that sellers tend to use higher secret reserve prices for higher quality objects with higher book value. The sellers who decide to use higher secret reserve price levels prefer setting lower opening prices to encourage entry, and there is a positive effect of quality on participation in secret reserve auctions (Bajari & Hortaçsu, 2003). Furthermore, Bajari and Hortaçsu (2003) conclude that the expected revenue from a secret reserve price with a low opening price is higher than the expected revenue from an auction with an opening price that is set equal to the secret reserve price level, because of the winner's curse.[4] Lucking-Reiley, Bryan, Prasad, and Reeves (2007) find the presence of a hidden reserve price significantly increases the final price. The effect of the minimum bid level has a negative but insignificant relationship with the final price, while it has a

[4] In a common value auction in which all bidders have approximately the same valuation of the object, the winner of the auction is the most optimistic bidder and overpays since she overestimates the value of the auctioned item.

positive and significant impact on the entry decision of the bidders. Han, Qiu, and Popkowski Leszczyc (2018) estimate the effect of auction competition on a seller's reserve price strategies. They found that the more the number of auctions for identical items, the more likely the item will be sold at a lower price. Also, they conclude that the mean opening prices of the auctions do not effect the auction outcome.

There are also considerable number of work in experimental settings. Katkar and Reiley (2007) find that the secret reserve price decreases the probability of sales and strictly discourages entry because the bidders expect that the secret reserve level is set higher than their valuation. Also, when a zero starting price is combined with a secret reserve price, sellers' revenue decreases. Based on the theoretical model that is suggested by Riley and Samuelson (1981), Reiley (2006) investigates the impact of the opening prices in first-price sealed-bid auctions. The paper concludes that a higher opening prices decrease the number of bidders, the number of bids, and the probability of an item being sold. On the other hand, setting a minimum bid increases the sellers' revenue conditional on sale. Walley and Fortin (2005) conclude that lower reserve prices attract a larger range of potential bidders. They also find disclosure increases the final price. The optimal strategy for the sellers is to set a lower public reserve price, particularly absolute auctions may maximize the sellers' revenue (Walley & Fortin, 2005). In another experimental work by Barrymore and Raviv (2009), they also find that the seller profits are maximized if the seller does not set any price floor. The price floors has a negative impact on the number of bids and bidders. Kim (2007) finds there is a positive relationship between increasing the opening price and the sales price.

2.2.2 Used-car market

Several different topics are widely discussed using the data from second-hand car auctions. Some of the papers cover the impact of car characteristics and their disclosure on the auction outcome, the relationship between the existence of a secret

reserve price on the final price, and the effect of the number of competitors on the sales price.

Lewis (2011) analyzes how the buyers respond to the disclosure on eBay Motors. Theory predicts that bidder behavior is affected by the disclosed information on the auction web page. Accordingly, it is found that the number of photos is related to the quality of the car, and through disclosure, adverse selection problems in internet auctions can be mitigated. The results of Andrews and Benzing (2007) indicate that a clear title of the car and the ending time of an auction have significant effects on bid premium, which is defined as the difference between the book value and the sales price. Adams, Hosken, and Newberry (2011) test the presence of asymmetric information problems in eBay Motors auctions. They find little evidence of asymmetric information problems for a specific type of car.

Chen et al. (2020) question the impact of the shill bidding on the auction outcome by using data from eBay Motors. They find that while the probability of sale decreases with the opening price and the existence of a secret reserve price, the final price increases in both. Choi et al. (2016) use data from second-hand car auctions and find that an increase in public reserve price leads to a decrease in the number of bidders and the probability of a sale but increases the revenue conditional on sale.

Roberts (2013) argues that not all characteristics of the auctioned item are observable to the econometrician but to the seller and the bidder. He shows how one of the choice variables of the seller, the reserve price, can be used to obtain information about the unobserved part of the auctioned item. It is found that there is a strong, positive correlation between the reserve price and the final price within the sample of sold cars. This result also holds when he incorporates the listings that are not sold because the reserve price is not met. Therefore, the results suggest that using the reserve price is a good approach in controlling for unobserved variation in an object's quality. Using this information, he structurally estimates the distributions of the bidders' valuations and examines to what extent the sellers benefit from the

auction platform. He concludes that using the reserve prices as a bargaining power is not as beneficial as an extra bidder.

Newberry (2015) analyzes the effect of competition among Chevrolet Corvettes auctions on the final price. He defines three types of competitive auctions: the ones that end on the same day, end within three days, and the ones that overlap. For the first two definitions, he finds that as the number of competitors increases, the final price declines due to the thinning of the market. He finds an insignificant effect of the number of competitors on the final price for the overlapping auctions.

In most of the work mentioned above controls for warranty situation of the vehicles, photo quality, the title of the item, and the seller's reputation. Unlike the literature discussed above, since ikinciyeni.com acts as an intermediator between the sellers and the bidders, they do not have a feedback mechanism as in eBay. Furthermore, the picture qualities are standardized, and the same type of warranty is applied to all the vehicles.

CHAPTER 3

DATA

The data is provided by ikinciyeni.com and covers all auctions taken place in 2020. This chapter introduces ikinciyeni.com in detail to give an idea of how the platform works; then, it provides descriptive statistics of the variables used in the analysis.

3.1 Institutional features

Ikinciyeni.com, a sub-company of Çelik Motor, provides a platform for dealers and individuals to sell their cars through first-price hard-end[5] online auctions. A dealer or an individual can be both buyer or seller with the same user ID, participate in more than one auction simultaneously, reenter the ongoing auctions, and resell a car that she buys from ikinciyeni.com. Besides dealers and individuals, Çelik Motor also can be a seller in an auction. In the remainder of this subsection, the conditions and rules that apply prior to the commencement of the auction, during the auction, and after the sale are discussed.

Before deciding to participate in an auction, a buyer can observe the current bid in an auction on the web page. To participate in an auction, buyers must pay the provision fee of 2,000 Turkish Lira (TRY).[6] The provision will be refunded to the buyer if she buys the car or her offer is canceled by the seller after the auction is closed. If the buyer wins an auction and decides not to buy the vehicle, the provision will not be refunded. After activating the provision, buyers can manually increase the current bid by 200, 500, and 1000 TRY. Also, suppose a buyer knows the maximum price she wants to pay for a vehicle. In that case, she can use an automatic bidding mechanism and enter the maximum amount she is willing to bid. Then, the system increases the bid on behalf of the buyer up to the upper limit she has entered. The platform will automatically increase her bids by 200 TRY each time she is outbid until the upper limit is met. If the last offer tendered by another bidder is lower than

[5] The platform does not allow for a time extension at the end of the auction.

[6] The information on provision fee, notary fee, service fees, and minimum bid increment rules are reported according to 2020 levels.

your automatic bid amount, you can win the auction at a lower price than you expected. There are three crucial points about the automatic bidding mechanism:

i. In the auctions with secret reserve prices, if the automatic bid amount is higher than the secret reserve price of the car, then the current bid in the auction directly reaches the secret reserve price, and the secret price level becomes publicly available. Assume that the seller sets the secret reserve price to 80,000 TRY, and the current highest bid equals 50,000 TRY. According to the rules, a bidder can increase the current bid by 200, 500, or 1000 TRY. However, suppose another bidder decides to use the automatic bid mechanism and sets the upper limit to 100,000 TRY. In that case, the highest bid automatically reaches 80,000 TRY since the bidder hits the secret reserve with her upper limit. In short, she declares that she is willing to buy the car for a higher price than the secret reserve.

ii. When a bidder enters an automatic bid level higher than the level which has already been entered by another bidder, the current bid in the auction reaches the lowest upper limit. Assume that the current highest bid is 50,000 TRY, and there is a bidder who has already participated in the auction and has set her upper limit to 80,000 TRY. When another bidder enters the auction with an upper limit of 100,000 TRY, then the current highest bid automatically reaches 80,000 TRY since it is guaranteed that the second bidder will outbid the former bidder.

iii. When a bidder wants to enter an automatic bid amount that another bidder has already entered, the current bid reaches the level the former bidder has entered. The first bidder becomes the current highest bidder. Suppose that the current highest bid equals 50,000 TRY and a bidder has an upper limit of 80,000 TRY. If a new bidder enters the auction and also sets her upper limit to 80,000 TRY, then the current highest bid reaches 80,000 TRY as if the former bidder outbids the new bidder.

If the car is sold, the bidder must pay the notary fee of 400 TRY. Also, the service fee depending on the sales price must be paid by the buyer. The service fee, i.e., the commission rate ranges from 1,250 TRY to 4,000 TRY, depending on the sales price of the vehicle. Every detail about the payments is available on the auction page for each car; hence, the bidder knows the exact amount she has to pay if she gets the car.

Before the auction begins, a seller must decide on two price levels in the auctions: opening and secret reserve prices. Opening price (public reserve price) is the minimum price that the seller accepts in an auction, and it is known to all bidders. In ikinciyeni.com, a seller can request a consultation while deciding on the opening price level or decide on her own. A secret reserve price is the minimum price level that the seller wants to sell her car, which is not visible to anyone but the seller; bidders only know if there is a secret reserve price. When a bidder hits the secret reserve price, it becomes public information that the secret reserve price is met. If the secret reserve price level is not hit by a bidder, then the seller has the option of selling the car to the highest current bid; the company does not prevent her from selling the object even though the secret reserve price is not revealed. Unlike eBay Motors, sellers do not have to pay a reserve price fee to set a secret price.

The company has three auction formats: absolute auction, secret reserve auction, and open reserve auction. In the absolute auctions (AA), use of the opening and secret reserve prices are not allowed. In ikinciyeni.com, the opening price can be a minimum of 1,000 TRY, and the secret reserve can be set to equal to zero. In the secret reserve auctions (SRA), sellers set a hidden reserve price together with an opening price. The company does not allow sellers to set secret reserve prices without an opening price. There is no relationship between the levels of secret reserve and opening price; prices depend on the seller's valuation or the company's expertise. The expertise service is free of charge for every seller, and as a result of this expertise, the book values of the cars are calculated. The platform does not allow bidders to submit bids less than the public opening price, but it does accept bids less

than the secret reserve price. A seller has the right to revise the secret reserve price downwards three times during the auction, before a bidder hits it. Lastly, the third auction format is open reserve auctions (ORA), in which secret reserve prices are not used, and sellers set a publicly available opening price that must be higher than 1,000 TRY. Besides these auction formats, sellers can sell their cars through the buy-now option. There is a fixed price for each car in the buy-now option, all buyers know the amount they have to pay for the object, and trade occurs immediately.

Unlike eBay Motors, as aforementioned in the previous chapter, ikinciyeni.com acts as an intermediator; hence, the number and quality of photos are standardized, there is no variation in the description of the cars that must be controlled. Another different feature of our company compared to eBay Motors is the feedback mechanism. On the auction page, the seller appears as the company itself; the seller's identity is not revealed, and only the location of the branch where the vehicle will be delivered is declared. Therefore, bidders' decisions are not affected by the sellers' feedback.

3.2 Variables and descriptive statistics

We have data for all auctions in 2020, and for each listing, we have:

i. Car characteristics: brand, model, year, transmission type -automatic or manual, horsepower, fuel type, kilometer, car body type, car owner -Çelik Motor or not;

ii. Auction characteristics: start and end dates, duration (derived from the start and end date information), number of bidders (derived from user ID), number of bids submitted per bidder (derived from user ID), process type of the bids -automatic, web or mobile, notary approval of the sales;

iii. Price information: bid amounts and increments, secret reserve price (for each update), opening price, sales price, commission rate, provision price, plate price.

The plate price can be equal to 350 TRY or 400 TRY. As aforementioned, the commission rate changes according to the sales price, and the provision price is the same for all bidders. Because the company provides the same type of warranty for all cars, we do not have additional information on the warranty situation. Also, we have information on the number of painted pieces, half painted pieces, changed pieces, and the book value of the cars, but not for each vehicle since the company, Çelik Motor, does not keep the record for the book values of its own cars. We are informed that they do not use the expertise service for their cars. The detailed explanations of the variables that are analyzed in the subsequent statistics can be found in Table 1.

Besides the characteristics mentioned, we can observe whether a car is deleted or updated, resulting in an early ending and whether it is a buy-now listing. Before proceeding to the estimation, we first eliminate 1,136 buy-now listings since they are not auctions. Since the sellers can change the secret reserve price level before it is met, we also omit the previous listings of the updated cars to prevent duplication in the data and include the latest secret reserve levels of those auctions in the sample. At that point, we have 45,644 listings with 2,600,663 bid records.

In the light of the company's guidance, we delete eight listings: five listings with 1,051 bid records are deleted because the sellers were able to set secret reserve prices without an opening price, even though the company does not allow this format. Similarly, three listings with erroneous information (e.g., arbitrarily high opening prices) are eliminated. Furthermore, 2,069 listings with missing information on car characteristics are excluded. We are left with 43,567 listings with 2,352,980 bid records, 13,376 unique bidders and 23,965 cars.

The sales price variable in our data has a right-skewed distribution as in Figure 1. To have a more accurate analysis, as a last step, we extract the possible outliers of sales price according to the interquartile range (IQR) criterion. Hence, all listings outside the interval given by

$$I = [q_{0.25} - 1.5 \times IQR; q_{0.75} + 1.5 \times IQR],$$

where IQR is the difference between the third and first quartile ($q_{0.75}$ and $q_{0.25}$, respectively) are considered as potential outliers. As a result, 946 listings between 277,400 TRY-1,550,000 TRY with 378,963 TRY mean value are extracted. The distribution of the sales price after the elimination of the outliers can be seen in Figure 2.

Table 1. Explanations of the Variables

Variable	Explanation
Bid frequency	The number of bids of a bidder per auction
Bid amount	Bid level of a bidder
Bid increment	The difference between bids placed by a bidder and the previous bids in each listing
Bidder entry	Number of unique bidders per auction
Sold	Dummy variable indicating whether a car is sold or not
Number of competitors	The number of competitors which are in the same car brand group and have the same age with a car within auction duration
Age	Calculated by subtracting the model year from 2020
Car brand groups	
Premium	Mercedes, BMW, Audi, Aston Martin, Porsche, Volvo, Jaguar, Infiniti, Maserati, Land Rover, Chrysler, DS, Alfa Romeo, Jeep
Other EU	Peugeot, Opel, Citroen, Mini, Smart, Seat, Skoda, Dacia, Lancia, Lada, Fiat
Asia	Honda, Mazda, Mitsubishi, Nissan, Subaru, Suzuki, Toyota, Kia, Isuzu, Daewoo, Hyundai, Ssangyong, Chery, Daihatsu
United States	Chevrolet, Dodge

We include all auctions receiving at least one bid regardless of whether the reserve price is met or not. In our estimation sample, we have 42,621 auctions, 2,228,960 bid records, 13,216 unique bidders and 15,770 successful sale (see Panel A in Table 2). In Panel B of Table 2, the number of auctions in SRA format overrides

the number of auctions in AA and ORA. Unlike eBay Motors, since using a secret reserve price (SRP) is not costly, the sellers might opt to use SRA. The mean number of bidder entries in Panel C of Table 2 indicates that approximately seven bidders participated in each auction, and each bidder placed more than seven bids. The mean opening price is 131,060 TRY for all sample, the average SRP equals 146,296 TRY, and the cars were sold for 133,780 TRY on average.

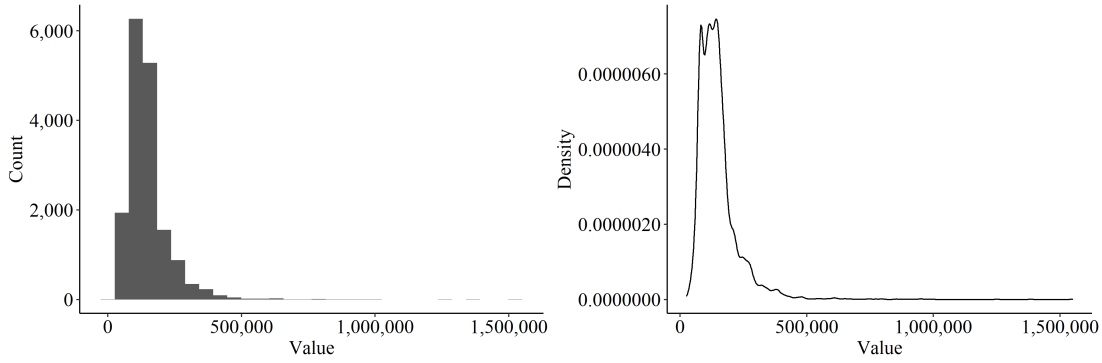

Figure 1. Sales price distribution before trimming the data

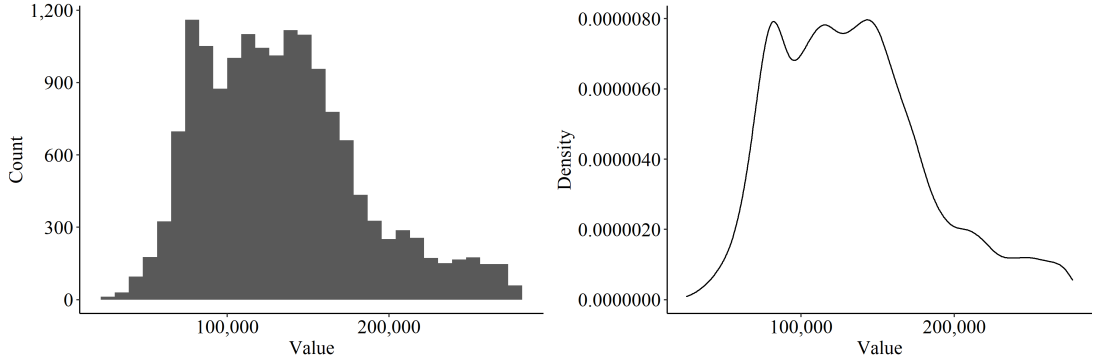

Figure 2. Sales price distribution after trimming the data

We do not have book values for all cars. There are 6,307 cars in the sample with missing book values. For the cars having book value information, the mean book value equals 156,067 TRY. In the sub-sample of the sold cars, it equals 131,612, which is 99% of the average sales price. Also, among the cars with a book value and listed with an opening price, the mean opening price equals 138,233 TRY while the

mean book value is 156,062 TRY. Hence, the opening prices are set around 11% lower than the book value, which is in the revenue maximizing interval suggested by the simulation results in Bajari and Hortaçsu (2003). They find that setting the minimum bid at 10-20% less than the book value maximizes the sellers' revenue.

Table 2. Observation and Mean Numbers in 2020

Panel A: Observation Numbers				All Sample
Number of auctions				42,621
Number of bids				2,228,960
Number of proxy bids				800,004
Number of bidders				13,216
Panel B: Observation Numbers by Auction Format		**AA**	**SRA**	**ORA**
Number of auctions		632	38,948	3,041
Number of bids		140,037	1,813,616	275,307
Number of proxy bids		64,106	622,864	113,034
Number of bidders		3,477	12,344	5,362
Panel C: Mean Numbers (All)	**Mean**	**SD**	**Min**	**Max**
Bid Frequency	7.59	8	1	277
Bid Amount	154,824	99,894	1,200	1,801,700
Bid Increment	374	1,724	0	304,900
Bidder Entry	7.09	5.12	1	47
Sales Price	133,780	49,434	25,200	277,300
Opening Price	131,060	83,750	1,000	1,750,000
Reserve Price	146,296	104,279	0	2,000,000
Book Value	156,067	98,788	8,400	3,200,000

In Table 3, the mean numbers of the variables are given for each auction format. Absolute auctions, as suggested by Jehiel and Lamy (2015), Simonsohn and Ariely (2008) and Ku et al. (2006) for the lower opening prices, receive the highest bid frequency per user per auction on average. Observe that the highest share of the automatic bids in all bids occurs in AA, followed by ORA and SRA in Table 2. They are equal to 0.46, 0.41, and 0.34, respectively. One might think that the higher level of bid frequency in AA might be driven by the higher share of the automatic bids. However, when we filter non-automatic bids in the sample, the order remains the

same. The bidders in AA might be caught up in auction fever, resulting in the bidding frenzy.

Even though the number of listings is too low in AA, the higher values of bid numbers and sales prices compared to ORA indicate that FC bidders (Jehiel & Lamy, 2015) opt for AA. Also, consistent with the theory suggested in Jehiel and Lamy (2015), participation rates are higher in AA and ORA than in SRA. Furthermore, the sales price in AA is higher than SRA and ORA, supporting the findings of Jehiel and Lamy (2015) that inexperienced bidders or FC bidders are more likely to select this type. It is important to mention that the mean secret reserve price level also includes the listings that are not sold. Therefore, the secret reserve price level appears lower than the sales price on average in Table 3. However, within the sample of the sold cars conditional on the secret reserve price being met, the mean secret reserve price level equals 126,558 TRY. The mean book values of SRA listings in Table 3 are calculated for all sample regardless of a successful trade. The mean book value of sold cars in SRA equals 131,715 TRY. Observe that in SRA and ORA, opening prices are set significantly lower than the book value, as stated in Lewis (2011).

The average number of listings per month equals 3,552 and 117 per day. Figure 3 illustrates the number of auctions per month and the sales number. There is a significant decline in the number of auctions and sales during April and May, probably due to the outbreak of Covid-19 in Turkey, resulting in lockdowns. The horizontal blue and green dashed lines indicate the mean of auctions and sales numbers, respectively.

Table 4 and Table 5 give the summary statistics in 2020 for all sample and for each auction type, respectively. In Table 4, it can be seen that in 2020, 15,770 vehicles (37% of the listings with positive number of bids) sold. A listing is online for approximately two days on average. The number of competitor variable indicates the number of competitive listings available within the duration of an auction with the same car group and age, similar to the definition of overlapping competitive auctions in Newberry (2015). In our setting, the listing which are defined as the competitors

do not have to start and end at the same time. If a bidder is able to choose between the auctions with the same car groups before submitting her bids, then these listings are competitors. There exist 32.27 competitors on average within groups with a maximum value of 235.

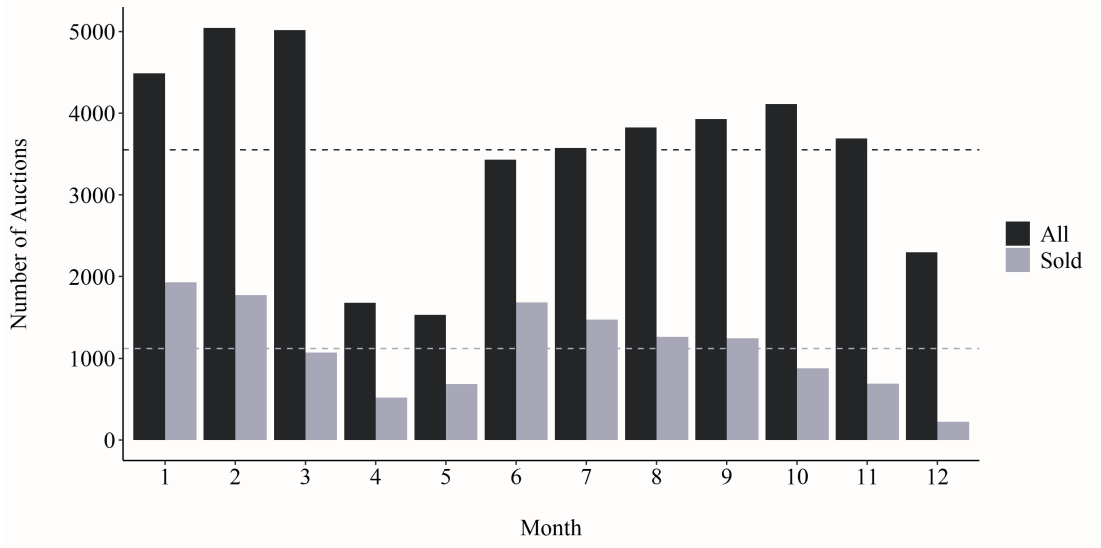

Figure 3. Auction numbers per month

As aforementioned in the institutional features, all the information regarding car characteristics is available on the auction page. Summary statistics for age, kilometer, car brands, car body types, fuel types, horsepower, and transmission types are also given in Table 4. The summary statistics for categorical variables are not presented. The production years vary between 2005 and 2020, and while the 2005 model cars have the minimum share, the highest rate belongs to 2017 model vehicles. The listed cars are approximately four years old on average, with a mean of 89,122 kilometers. Following the method of Lewis (2011), we classify 43 car brands. While the most popular group is “Other EU”, Renault has the highest share.

Table 5 compares the summary statistics between different auction formats (summary for car characteristics by auction format is given in Appendix A). It is important to observe that since we include all auctions with at least one bid, it is inevitable to have a 100% sales rate in AA and ORA formats as they do not have a

Table 3. Mean Numbers in 2020 by Auction Format

	AA				SRA				ORA			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Bid Frequency	12.94	9.08	2.2	139.67	7.59	8.18	1	277	6.39	3.96	1	49
Bid Amount	109,422	66,397	1,200	276,600	162,095	106,697	14,500	1,801,700	130,019	39,259	40,200	276,900
Bid Increment	734	5,175	0	221,800	341	1,135	0	304,900	402	1,375	0	61,700
Bidder Entry	18.22	6.30	5	41	6.37	4.30	1	34	13.98	6.56	1	47
Sales Price	155,466	55,246	67,400	276,600	131,753	50,379	25,200	277,300	137,339	42,627	40,200	276,900
Opening Price	1,000	0	1,000	1,000	135,396	85,035	14,300	1,750,000	102,554	33,553	40,000	275,000
Reserve Price	0	0	0	0	160,093	98,442	20,000	2,000,000	0	0	0	0
Book Value	164,914	53,018	80,100	251,000	156,325	99,085	8,400	3,200,000	125,876	50,933	36,000	290,700

Notes: The company allows a minimum opening price of 1,000 TRY in absolute auctions. In AA and ORA, the sellers are not allowed to set secret reserve prices. For the listings with one bid, the bid increment equals zero; however, for the listings with multiple bids, the minimum bid increment must be 200 TRY when the automatic bidding rules mentioned in Section 3.1 do not apply.

secret lower limit to sell the item. Among the listings with at least one bid summarized in Table 5, the sales rate equals 0.31 for SRA. It is important to note that this rate includes the cars that are sold even though the secret reserve is not met, but the seller decided the sell the item to the highest bidder nevertheless. After excluding these listings, the sales rate becomes 0.14.

We are informed by the company that they use the AA format to sell their own vehicles. In AA, 603 out of 632 listings are auctioned by Çelik Motor, and in ORA, it is 2,697 listings out of 3,041. Among SRA, 2,157 listings are auctioned by Çelik Motor, which is significantly lower than the other auction formats. Since we can observe Çelik Motor as an experienced seller, we can infer that they may have learned that the bidders might be intimidated by the existence of an SRP. Therefore, they prefer using AA and ORA to guarantee the sale. The fact that the highest average sales price has occurred in AA supports the findings of Jehiel and Lamy (2015), FR bidders learn that they should stay away from AA.

In Figure 4, the relationship between the sales price and the book values for sold listings with book value information is presented. The positive relationship between these variables is obvious visually. The ratio of the sales price to book value in this sample equals 1.005, meaning the cars are sold almost equal to their book values. Therefore, since the sellers know the book value before the auction commencement, it is reasonable to set the reserve prices according to the book value, as suggested in Bajari and Hortaçsu (2003). When we look at the correlations and the ratio between the variables, the results confirm this behavior of the sellers.

According to the company rules, the opening price, and the reserve price can be set freely, not related to the book value. However, in Appendix B, it is shown that the correlations between the variables mentioned above and also the sales price are significantly high. The correlation of opening price and reserve price with the sales price is 0.95 and 0.99, respectively, which prevents us from controlling both variables in the estimation due to high collinearity. The positive correlation between the secret reserve and opening prices are contrary to the findings in Bajari and Hortaçsu (2003),

Table 4. Summary Statistics (All Sample)

Variable	N	Mean	SD	Min	Max
Sold	42621	0.37	0.48	0	1
Sales Price	15770	133,780	49,434	25,200	277,300
Duration	42621	2.03	0.91	0.46	6.64
Duration ($d \leq 1$)	84	0.65	0.09	0.46	0.78
Duration ($1 < d \leq 3$)	34625	1.62	0.16	1.44	2.70
Duration ($d > 3$)	7912	3.82	0.60	3.50	6.64
Number of competitor	42621	32.27	38.31	0	235
Age	23526	3.64	2.07	0	15
Mileage (km)	23527	89,122	54,688	0	1,285,106
Car Brand Groups					
Premium	2281 (9.7%)				
Other EU	8519 (36.21%)				
Asia	3541 (15.05%)				
United States	70 (0.3%)				
Renault	5291 (22.49%)				
Ford	1100 (4.68%)				
Volkswagen	2724 (11.58%)				
Car Body					
Sedan	11048 (46.96%)				
Hatchback	8613 (36.61%)				
Off-road	1874 (7.97%)				
Mini MVP	624 (2.65%)				
Combi	526 (2.24%)				
Wagon	450 (1.91%)				
Fuel Type					
Electric	2 (0.01%)				
Hybrid	44 (0.19%)				
LPG	99 (0.42%)				
Gasoline	3859 (16.4%)				
Diesel	19522 (82.98%)				
Horsepower	23526	111.85	27.43	0	517
Transmission Type					
Manual	7871 (33.5%)				
Automatic	15655 (66.5%)				

Notes: The number of observations of "Sold" dummy equals the number of all listings since the dummy can take the value of either one or zero.

Table 5. Summary Statistics (Auction Format)

Variable	N	Mean	SD	Min	Max
Panel A: Absolute Auctions					
Sold	632	1	0	1	1
Sales Price	632	155,466	55,246	67,400	276,600
Duration	632	1.94	0.89	1.44	6.56
Duration ($d \leq 1$)	0				
Duration ($1 < d \leq 3$)	530	1.58	0.19	1.44	2.59
Duration ($d > 3$)	102	3.85	0.59	3.54	6.56
Number of competitor	632	37.31	32.50	0	199
Panel B: Secret Reserve Auctions					
Sold	38948	0.311	0.46	0	1
Sales Price	12097	131,753	50,379	25,200	277,300
Duration	38948	2.03	0.90	0.46	6.64
Duration ($d \leq 1$)	81	0.65	0.09	0.46	0.78
Duration ($1 < d \leq 3$)	31684	1.63	0.15	1.44	2.70
Duration ($d > 3$)	7183	3.82	0.60	3.50	6.64
Number of competitor	38948	29.04	34.82	0	235
Panel C: Open Reserve Auctions					
Sold	3041	1	0	1	1
Sales Price	3041	137,339	42,627	40,200	276,900
Duration	3041	2.07	0.97	0.64	6.62
Duration ($d \leq 1$)	3	0.68	0.05	0.64	0.73
Duration ($1 > d \leq 3$)	2411	1.60	0.18	1.44	2.65
Duration ($d > 3$)	627	3.85	0.64	3.54	6.62
Number of competitor	3041	72.62	55.28	0	235

who find that the sellers combine high secret reserves with the low opening prices to attract bidders. Furthermore, as expected, the car's mileage and age negatively correlate with the price levels. There is no significant correlation between the SRP level and the bidder number in an auction. The entry decision of a bidder is not significantly correlated with the secret reserve price but with the opening price.

Lastly, in Figure 5, sales rate by different secret reserve price levels is presented. The data is cut in eleven groups with 25,000 TRY intervals. The highest sales rate occurs between 113,000 TRY and 137,500 TRY, and gradually declines afterwards.

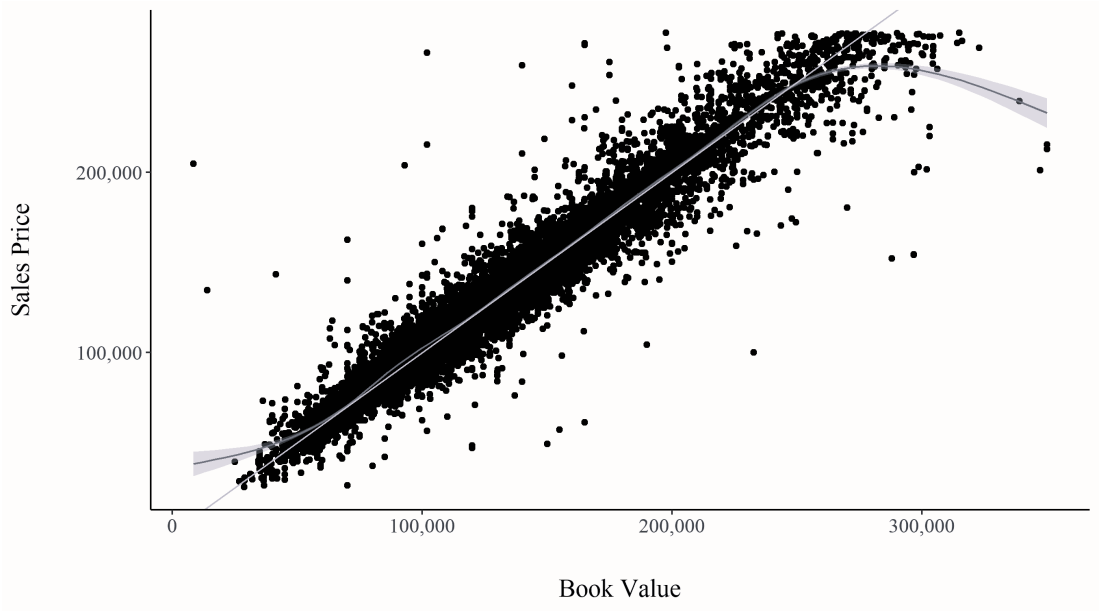

Figure 4. Sales price by book value

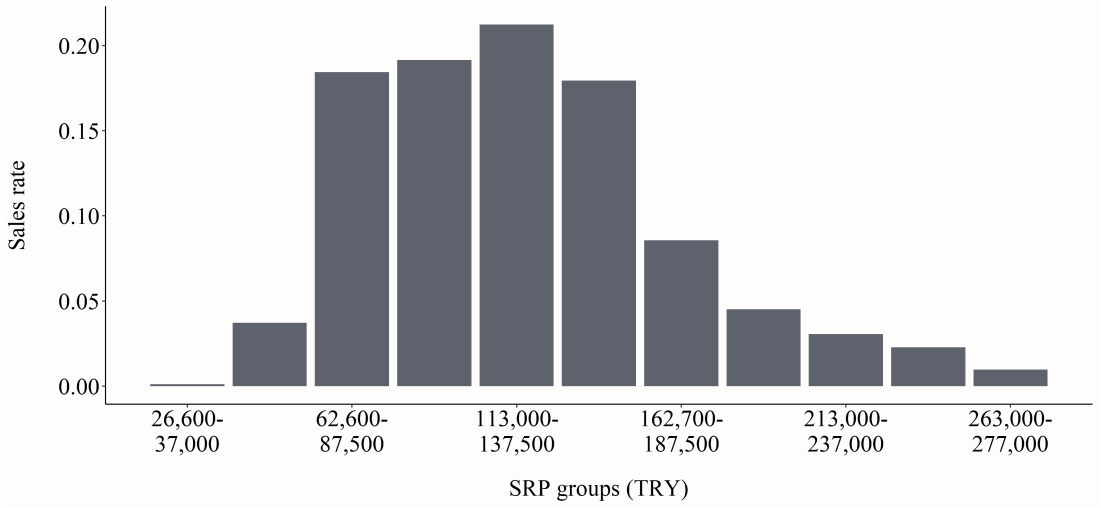

Figure 5. Sales rate by different SRP levels

CHAPTER 4

EMPIRICAL MODEL

In this chapter we present our empirical models. We have three models; firstly, we analyze the relationship between the secret reserve price level and the sales price, or alternatively, the highest bid. Our second model aims to capture the impact of the existence of a secret reserve price, instead of its level, on the sellers' revenue. This model helps us compare the SRA and the ORA from the sellers' perspective. Lastly, we estimate a logit model to understand how an increase in the secret reserve price level impacts the probability of sale.

In the first model, following the model in Roberts (2013), we estimate three different specifications where the dependent variable is the log of the sales price in each auction. Our goal is to analyze the relationship between the final price and the secret reserve price level. In these specifications, the sample consists of all SRA listings with a sale conditional on the secret reserve price being met.[7] Specification one controls car's age, brand, model, mileage, body type, fuel type, transmission type, dummy variables for each month in the sample, bidder number, and auction duration in days. The details of the variables can be found in Table 6. In specification two, we add the log of the secret reserve price level to the first model to see how controlling the secret reserve price (SRP) improves the overall fit of the model. Lastly, in the third specification, we regress the log of the sales price on the log of the secret reserve price to analyze the comovement between the SRP and sales price.

The sample used in the specifications mentioned above includes the sold listings conditional on SRP being hit; however, as Roberts (2013) suggested, it is important to check whether the impact of the SRP is similar for the auctions where the highest bid does not hit the SRP; hence, the car is not sold. To incorporate the listings with no transaction to the sample, we use the log of the highest bid, rather than the sales price, as the dependent variable as in Roberts (2013). In Roberts

[7] As aforementioned in chapter 3, a seller can prefer to sell the car to the highest bidder even though the SRP is not met. There are 7,682 SRA listings that are sold without meeting the SRP level, which are not included in the estimation sample.

(2013), the listings which are end up with a sale without hitting the SRP are not existent in the sample either. By incorporating the auctions where the SRP is not met, the sample size increases to 31,266 auctions from 4,415. We estimate three specifications on the highest bid using the same independent variables as above. As mentioned in chapter 3, a seller has the right to sell the car to the highest bidder even though that bidder does not hit the secret reserve price. Hence, it is important to note that we do not include the listings that end up with a sale even though the highest bid does not hit the SRP, but the seller decides to sell the item. Since they do not represent an SRP listing, they would have been misleading and distorted the results if we had included them.

In SRA, the level of opening price is also essential since the bidders might be intimidated by the high opening prices, hence prefer not to enter; or, more experienced bidders might opt for higher opening prices as suggested in Jehiel and Lamy (2015). However, we cannot control both price levels due to the high correlation between the secret reserve price and the opening price. Hence, instead of controlling for the opening price of an auction, we control for the log of the mean opening prices of the competitors and the number of competitors, which are defined in Table 1. Therefore, we estimate the same models with an additional control variable for the number of competitors and their mean opening prices of the competitors to see whether the auction outcome is affected by the simultaneously held similar auctions. The number of competitors is defined as the number of active listings in the same car group within the auction duration. They are not supposed to start and end at the same time.

The second model estimates how the sellers' revenue differs if she moves from ORA to SRA for the same level of the opening price. We use a dummy variable for the existence of an SRP instead of its level. Unlike the previous model, the sample includes both ORA and SRA listings in this estimation. Hence, the dummy variable equals one if it is an SRA listing, zero if ORA. This model allows us to control the log of the opening price together with the existence of a secret reserve

price. The analysis is again applied to both the sales price and the highest bid. We control all car characteristics, month-of-the-year dummies, number of bidders, auction duration.

Lastly, in the third model, we estimate a logit model with two specifications to analyze the relationship between the SRP and the probability of sale. The dependent variable, "Sold", equals one if a car is sold, zero otherwise. Two types of listings are included in the sample: First, auctions with sale conditional on secret reserve price being met; second, auctions that fail to sell since the secret reserve price is not hit by the highest bid. We control log of the SRP, auction duration in days, car's age, mileage, transmission type, horse power, fuel type, model, car body, bidder number and month dummies in both specifications. In specification two, we additionally control the number of competitors and the log of the mean opening prices of the competitors.

Table 6. Descriptions of the Variables

Variable	Description
Dependent variables	
Specifications one, two, and three:	Log of the sales price, log(Price)
Specifications four, five, and six:	Log of the highest bid, log(Highest)
Logit specifications	Sold = 1 if the car is sold
Independent variables	
Log(SRP)	Log of the secret reserve price level
Bidder number	Number of bidders in the auction
Age	Model year of car subtracted from 2020
Duration	Duration of the auction (days)
Kilometer	Kilometer of a car
Manual transmission	Dummy = 1 if manual transmission
Horsepower	Horsepower of a car
Brand	Dummies for each car brand
Model	Dummies for each car model
Car body	Dummies for each car body type
Fuel type	Dummies for fuel types
Comp	Number of competitors
Log(Mean_OP)	Mean opening prices of the competitors
Log(OP)	Log of the opening price level
SRP_dummy	Dummy = 1 if SRP exists

CHAPTER 5

RESULTS

5.1 Sales price determinants

In this section, we present the results for the two models in which we analyze the determinants of the sales price. We first discuss the impact of the secret reserve price level and then the existence of a secret reserve price on the sellers' revenue.

5.1.1 The impact of secret reserve price level on sales price

We report the results for the relationship between the sales price, i.e. the highest bid, and the secret reserve price level in Table 7. The coefficients on log(SRP) are almost identical with the coefficients in Roberts (2013). The secret reserve price has a huge and highly significant positive impact on the final price. Controlling the secret reserve price levels increases the overall fit of the model and has a statistically significant positive effect on sales price in specification two. Also, in specification one, observe that the number of bidders has an insignificant impact on the auction outcome whereas it is statistically significant when we control the SRP. For the same level of secret reserve price, an extra bidder in an auction increases the sellers' revenue. In specification three, the high correlation between the sales price and secret reserve price can be observed, which is in line with the findings of Roberts (2013), suggesting that comovement between the SRP and the final price can be used to control for the unobserved item heterogeneity.

When we switch to the sample which incorporates the listings that are not sold since the SRP is not met, the results are similar to the previous findings. The coefficient on log(SRP) in specification five is slightly lower then the coefficient in specification two, still statistically significant and positive. In other words, keeping the car characteristics, auction duration, and the number of bidders constant, an increase in the secret reserve price level have a slightly higher impact on the sales price than the highest bid. The impact of bidder number on the final price change in

the second sample; comparing the specifications one and four, it can be seen that the relationship between the highest bid and bidder number is significant but very small.

The negative impacts of car's age, kilometer and manual transmission, and the positive impact of horsepower on final price are expected and found in all specifications. Duration of the auction has no impact neither on the sales price or the highest bid when we control the secret reserve price level, contrary to the findings of Lucking-Reiley et al. (2007).

Table 7. Sales Price and Highest Bid Determinants

	(1) log(Price)	(2) log(Price)	(3) log(Price)	(4) log(Highest)	(5) log(Highest)	(6) log(Highest)
log(SRP)		0.803***	0.985***		0.794***	0.992***
		(25.58)	(379.41)		(26.78)	(579.80)
Bidder number	-0.0000925	0.00171***		-0.000368*	0.00305***	
	(-0.25)	(11.23)		(-2.18)	(18.10)	
Age	-0.0666***	-0.0125***		-0.0648***	-0.0152***	
	(-17.55)	(-5.11)		(-56.56)	(-8.15)	
Duration	0.00312*	0.000764		0.000610	0.000209	
	(2.18)	(0.87)		(0.86)	(0.54)	
Kilometer	-0.00903***	-0.00165***		-0.0146***	-0.00354***	
	(-4.56)	(-3.36)		(-24.96)	(-7.77)	
Manual transmission	-0.161***	-0.0306***		-0.159***	-0.0388***	
	(-22.88)	(-4.66)		(-59.21)	(-8.58)	
Horsepower	0.00263***	0.000412***		0.00214***	0.000301***	
	(9.84)	(3.34)		(13.75)	(3.73)	
Constant	11.66***	2.316***	0.198***	11.80***	2.412***	0.0329
	(286.29)	(6.25)	(6.43)	(224.89)	(6.85)	(1.63)
Brand Dummies	Yes	Yes		Yes	Yes	
Fuel Type Dummies	Yes	Yes		Yes	Yes	
Car Body Dummies	Yes	Yes		Yes	Yes	
Model Dummies	Yes	Yes		Yes	Yes	
Monthly Dummies	Yes	Yes		Yes	Yes	
N	4415	4415	4415	31266	31266	31266
R^2	0.951	0.989	0.984	0.953	0.984	0.978

Notes: t statistics in parentheses. Kilometer is divided by 10,000. Specifications 1, 2 and 3 include all sold SRA cars conditional on the secret reserve price being met. Specifications 4, 5 and 6 incorporate the listings that are not sold since the secret reserve price level is not hit by the highest bid. *p $<$ 0.05, **p $<$ 0.01, ***p $<$ 0.001. Standard errors are robust.

We repeat the same estimations with an additional variable for automatic bids. We prefer controlling for the percentage of the automatic bids in all bids rather than the total number of bids per auction since the total number of bids might be inflated

by the number of the automatic bids; hence, it might be a mechanical increase. Also, since the number of bids increases with an extra bidder, adding both the number of bids and the bidders might result in collinearity.[8] In our sample of 4,415 listings, 1,716 of them end up with an automatic bid. We can not see, however, whether the final bid is also the upper limit of the bidder's automatic bid order.

The impact of SRP on sales price is nearly identical when we control the percentage of automatic bids in all bids. The existence of automatic bids is statistically significant only when we control for SRP. Results are presented in Appendix C. Furthermore, to compare the results with Newberry (2015) and Han et al. (2018), we control the number of competitors and the log of the mean opening prices of the competitors in Appendix C. The impact of number of competitors on sales price is insignificant; hence, the magnitude and the sign of the secret reserve do not change significantly. While these results are contrary to the findings of Han et al. (2018), they are consistent with Newberry (2015) who concludes that the impact of number of competitors on sales price is insignificant for the overlapping auctions. However, the insignificant effect of the mean opening prices of the competitors on selling price is in line with the findings of Han et al. (2018).

As argued in Roberts (2013), one might stress that having a positive relationship between the secret reserve price and the sales price is an inevitable result of the auction format since the final price is formed after the SRP is hit. In the words of Roberts (2013), this strong relationship "may have been a mechanical result if the winning bidder tended to be the only bidder bidding above the reserve price." If there exists only one bid above the secret reserve, then it is unavoidable to have the SRP and the final price "move in lockstep" (Roberts, 2013). In our data, for the sample of the first three specifications, the mean number of bids submitted above the secret reserve price equals 14.4, and the mean bidder entry after the SRP being hit equals 4.29. Also, only 15% of the listings do not receive additional bids after the SRP is hit. Hence, once a bidder hits the SRP, the competition to get the car does not cease.

[8]The correlation of the bidder number, the sales price, and the secret reserve price with the percentage of the automatic bids in all bids equals -0.17, 0.16, and 0.15, respectively.

These statistics conclude that the relationship between the SRP and the final price is not mechanical for our sample either.

5.1.2 The impact of existence of a secret reserve on sales price

In Table 8, we present the results for the second model in which we expand the sample to the opening price and secret reserve auctions. In this model, as mentioned in the previous chapter, rather than the SRP level, we include a dummy variable for the existence of the SRP. Controlling both the SRP dummy and the opening price in this model enables us to compare two auction formats since the company does not allow to set a secret reserve price without an opening price. We again use two samples in the estimation: the first sample includes all sold ORA and SRA listings conditional on SRP being met. The second sample again incorporates all SRA listings that are not sold since SRP is not hit; hence, we use the log of the highest bid as a dependent variable.

According to the results presented in Table 8, in both specifications, the opening price alone has a positive and statistically significant effect on the final bid, consistent with Simonsohn and Ariely (2008). However, keeping the opening price constant, observe that using an SRP decreases the final price or the highest bid, meaning that an auction ends with a higher sales price in an ORA than in an SRA, as found in Table 3. This result is consistent with the findings of Bajari and Hortaçsu (2003) and Katkar and Reiley (2007), who state that a secret reserve discourages bidders to continuing to bid. Elyakime et al. (1994) also show that using an opening price is a more profitable strategy for a seller than using a secret reserve price.

Furthermore, both specifications show that an increase in the number of bidders results in an increase in the highest bid -or sales price, but in a small magnitude. As expected and found in Table 7, as the car gets older, is used more, and has a manual transmission, the sellers' revenue decreases.

We repeat the same estimation by adding the number of competitors as a control variable. We find that it has an insignificant effect, hence, the results do not

Table 8. The Impact of Existence of a Secret Reserve on Price

	(1) log(Price)	(2) log(Highest)
SRP_dummy = 1	-0.0138***	-0.0312***
	(-7.33)	(-18.37)
log(OP)	0.376***	0.536***
	(23.43)	(41.08)
Bidder number	0.00362***	0.00737***
	(13.47)	(40.50)
Age	-0.0361***	-0.0290***
	(-18.91)	(-30.10)
Duration	0.00191*	-0.000163
	(2.41)	(-0.35)
Kilometer	-0.00724***	-0.00640***
	(-6.24)	(-18.94)
Manual transmission	-0.0996***	-0.0712***
	(-17.48)	(-27.43)
Horsepower	0.00163***	0.00104***
	(8.73)	(11.88)
Constant	7.354***	5.480***
	(38.69)	(35.28)
Brand Dummies	Yes	Yes
Fuel Type Dummies	Yes	Yes
Car Body Dummies	Yes	Yes
Model Dummies	Yes	Yes
Monthly Dummies	Yes	Yes
N	7456	34307
R^2	0.971	0.976

Notes: t statistics in parantheses. ORA and SRA listings are included. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard errors are robust.

change in the specification one. For the specification two, the coefficient of number of competitors is statistically significant and positive but very small. Contrary to the findings in Han et al. (2018), the mean opening prices of the competitors has a statistically significant and positive impact in the both specifications. As the mean opening prices of the competitors increases, the sales price, i.e., the highest bid also increases. This might be followed from the fact that for the higher opening prices, the bidders might opt for participating in the similar auctions with lower opening prices, even the bidders with high valuations. As Han et al. (2018) hypothesize, some bidders avoid from participating in the listings with a high opening price and move to less discouraging auctions, leading to higher selling price, given in Appendix C.

5.2 Failure to sell determinants

Table 9 presents the marginal effects of the secret reserve price, auction duration, car characteristics, and bidder number on the probability of sale after controlling the dummies for each month, brand, model and fuel type. As aforementioned before, AA and ORA listings have 100% sales rate by nature. Hence, we can not examine the impact of the existence of a secret reserve price on failure to sell since there is no variation. Also, it is not possible to control SRP and opening price (OP) levels simultaneously since they are highly correlated. Therefore, we investigate the impact of SRP level and opening prices of competitors on the probability of sale.

In specification one, observe that the impact of the log of the secret reserve price is highly significant and highly negative, as in the work of Katkar and Reiley (2007), and Bajari and Hortaçsu (2003), who find that the secret reserve prices discourage entry and result in failure to sell. As an additional bid does not hit the secret reserve price level, the bidders might choose not to place another bid or not participate in the auction if they have not already, resulting in unsold cars. Observe that the auction duration has no significant impact on the sales probability. Therefore, keeping the secret reserve price constant, an additional day does not contribute to the realization of a deal and does not call for additional bidders with valuations higher than SRP. In both specifications, an extra bidder contributes positively to the successful sale. Age, kilometer, and manual transmission negatively affect the transaction probability, whereas the higher the horsepower, the more likely it is to have a successful sale.

When the number of competitors and their mean opening prices are added to the model as in specification two, the negative impact of the secret reserve price level on the probability of sale slightly decreases from -0.796 to -0.788 and is still highly significant. The mean opening prices of the competitors have an insignificant impact on the probability of an item being sold. Keeping the secret reserve price and mean opening prices of the competitors constant, an increase in the number of competitors have a tiny but positive impact on the probability of sale.

Table 9. Successful Sale Determinants

	(1) Sold	(2) Sold
log(SRP)	-0.796***	-0.788***
	(-35.95)	(-33.82)
Duration	-0.000356	-0.00179
	(-0.18)	(-0.89)
Age	-0.0506***	-0.0481***
	(-23.58)	(-21.18)
Kilometer	-0.0114***	-0.0118***
	(-14.15)	(-14.40)
Manual transmission	-0.126***	-0.125***
	(-18.10)	(-17.62)
Horsepower	0.000960***	0.000967***
	(4.20)	(4.22)
Bidder number	0.0132***	0.0128***
	(35.06)	(32.30)
Comp		0.000508***
		(7.93)
log(Mean_OP)		0.00148
		(1.16)
Fuel Type Dummies	Yes	Yes
Car Body Dummies	Yes	Yes
Model Dummies	Yes	Yes
Monthly Dummies	Yes	Yes
N	29931	29931
Pseudo R^2	0.2861	0.2886

Notes: t statistics in parentheses. Kilometer values are divided by 10,000. Two types of listings are included in the sample: First, auctions with successful sales conditional on the secret reserve price being met; second, auctions that fail to sell since the secret reserve price is not hit by the highest bid. "Comp" variable is the number of competitors where the competitor is defined as the active auctions within the same car group during the auction period. We do not restrict the start and end timings of the competitive auctions to make them entirely overlap. "Log(Mean_OP)" variable is the mean opening prices of the competitors. Standard errors are robust. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

When we repeat the logit estimation with an additional variable for automatic bids, the results are almost identical, given in Appendix D. Lastly, as aforementioned in the data section, since there was a huge decline in April and May due to the Covid-19 lockdowns, we estimate the three models after excluding April and May. The results are presented in Appendix E. The coefficients of interest are nor impacted when we eliminate those months. As a robustness check, when we estimate the model before eliminating the outliers, we obtain the similar results.

CHAPTER 6

CONCLUSION

This thesis investigates bidding strategies and bidders' format selection according to their cognitive types by using data for a year from a Turkish used-car online auction platform, ikinciyeni.com. Also, we analyze how the highest bid in an auction, or the sales price, is affected by the secret reserve price level and in which direction its existence impacts the final price. Our data contains all listings started on January 1, 2020 and ended on December 31, 2020. After a meticulous data cleaning process, we are left with 42,621 listings differing in their formats, 2,228,960 bids, and 13,216 unique bidders.

The bidding patterns and the participation rates presented in chapter 3 support the findings of Jehiel and Lamy (2015). The highest mean sales price and bidder entry in absolute auctions indicate that the fully coarse bidders are attracted by the absence of a barrier to entry; hence, they choose to participate in absolute auctions. Also, the fact that the lowest bid frequency occurs in open reserve auctions and the highest in absolute auctions implies two things: first, the existence of a bidding frenzy in absolute auctions by fully coarse bidders; second, fully rational bidders participate in open reserve auctions.

We find that there is a highly significant and positive correlation between the secret reserve price level and the highest bid, suggesting that even if the car is not sold, the relationship between the secret reserve price level and the highest bid submitted is very strong. Controlling the number of competitors and the fraction of the automatic bids in all bids do not change the results significantly.

Furthermore, when we add open reserve auctions to the estimation sample and control the existence of a secret reserve price in an auction rather than its level, we conclude that keeping the opening price constant, moving from an open reserve auction to a secret reserve auction decreases the sellers' revenue, as shown in Table 3. This conclusion also holds for the highest bid. For the same opening price levels, if

the bidders know a secret reserve exists in an auction, they choose not to continue to bid.

Lastly, our logit results show that it becomes less likely to sell the item as the seller sets the secret reserve price to higher levels. The number of competitors has a significant but minor impact on failure to sell, whereas the auction duration is insignificant. Since we can not control the secret reserve price level and the opening price level in the same model, we control the mean opening prices of the competitors. We find that the higher the opening prices of the competitors, the more it is likely to have a sale.

APPENDIX A

CAR CHARACTERISTICS BY AUCTION FORMAT

Variable	N	Mean	SD	Min	Max
Panel A: Absolute Auctions					
Age	616	2.82	0.63	1	6
Mileage (km)	616	53,344	24,541	3,207	254,462
Car Brand Groups					
Premium	42 (6.82%)				
Other EU	178 (28.9%)				
Asia	163 (26.46%)				
United States					
Renault	136 (22.08%)				
Ford	19 (3.08%)				
Volkswagen	78 (12.66%)				
Changed Piece	616				
Car Body					
Combi	1 (0.16%)				
Wagon	20 (3.25%)				
Hatchback	235 (38.15%)				
Mini MVP	7 (1.14%)				
Off-road	71 (11.53%)				
Sedan	280 (45.45%)				
Fuel Type					
Gasoline	46 (7.47%)				
Diesel	570 (92.53%)				
Electric					
Hybrid					
LPG					
Horsepower	616	110.97	20.88	75	190
Transmission Type					
Automatic	461 (74.8%)				
Manual	155 (25.2%)				
Panel B: Secret Reserve Auctions					
Age	20259	3.75	2.19	0	15
Mileage (km)	20260	89,542	56,073	0	1,285,106
Car Brand Groups					
Premium	2175 (10.74%)				
Other EU	6866 (33.89%)				

Asia	2979 (14.7%)				
United States	69 (0.34%)				
Renault	4599 (22.7%)				
Ford	1057 (5.22%)				
Volkswagen	2514 (12.41%)				
Changed Piece	20259				
Car Body					
Combi	523 (2.58%)				
Wagon	382 (1.89%)				
Hatchback	6549 (32.33%)				
Mini MVP	596 (2.94%)				
Off-road	1718 (8.48%)				
Sedan	10104 (49.87%)				
Fuel Type					
Gasoline	3747 (18.5%)				
Diesel	16367 (80.79%)				
Electric	2 (0.01%)				
Hybrid	44 (0.22%)				
LPG	99 (0.49%)				
Horsepower	20259	112.29	28.48	51	517
Transmission Type					
Automatic	13199 (65.2%)				
Manual	7060 (34.8%)				
Panel C: Open Reserve Auctions					
Age	2905	3.02	0.90	0	13
Mileage (km)	2905	93,963	46,053	15	311,708
Car Brand Groups					
Premium	81 (2.79%)				
Other EU	1575 (54.22%)				
Asia	435 (14.97%)				
United States	1 (0.03%)				
Renault	618 (21.27%)				
Ford	32 (1.1%)				
Volkswagen	163 (5.61%)				
Changed Piece	2905				
Car Body					
Combi	10 (0.34%)				
Wagon	53 (1.82%)				
Hatchback	1923 (66.2%)				
Mini MVP	29 (1%)				
Off-road	95 (3.27%)				
Sedan	792 (27.26%)				

Fuel Type					
Gasoline	109 (3.75%)				
Diesel	2794 (96.18%)				
Electric					
Hybrid					
LPG	2 (0.07%)				
Horsepower	2905	108.42	19.12	0	286
Transmission Type					
Automatic	2147 (73.9%)				
Manual	758 (26.1%)				

APPENDIX B

CROSS CORRELATIONS

Variables	Sales Price	OPLevel	SRPLevel	Book Value	Horsepower	Kilometer	Age	Duration	Bidder Number	Bid Number	Auto-bid (%)	Comp	log(Mean_OP)
Sales Price	1.00												
OPLevel	0.95	1.00											
	(0.00)												
SRPLevel	0.99	0.96	1.00										
	(0.00)	(0.00)											
Book Value	0.94	0.91	0.93	1.00									
	(0.00)	(0.00)	(0.00)										
Horsepower	0.61	0.59	0.61	0.56	1.00								
	(0.00)	(0.00)	(0.00)	(0.00)									
Kilometer	-0.18	-0.19	-0.18	-0.25	0.02	1.00							
	(0.00)	(0.00)	(0.00)	(0.00)	(0.28)								
Age	-0.24	-0.22	-0.24	-0.26	0.07	0.43	1.00						
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)							
Duration	0.03	0.05	0.04	0.04	0.00	-0.01	-0.03	1.00					
	(0.02)	(0.00)	(0.02)	(0.06)	(0.89)	(0.56)	(0.02)						
Bidder Number	0.05	-0.09	0.02	-0.04	0.00	-0.02	-0.13	-0.01	1.00				
	(0.00)	(0.00)	(0.24)	(0.05)	(0.99)	(0.13)	(0.00)	(0.57)					
Bid Number	0.39	0.19	0.35	0.33	0.21	-0.07	-0.12	0.00	0.55	1.00			
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.77)	(0.00)				
Auto-bid (%)	0.16	0.11	0.15	0.12	0.10	0.02	-0.05	0.00	-0.17	0.09	1.00		
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.12)	(0.00)	(0.77)	(0.00)	(0.00)			
Comp	0.00	-0.10	-0.01	-0.14	-0.01	0.22	-0.17	0.07	0.22	0.13	0.09	1.00	
	(0.87)	(0.00)	(0.42)	(0.00)	(0.57)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		
log(Mean_OP)	0.20	0.19	0.20	0.19	0.05	-0.12	-0.39	0.01	0.08	0.10	0.02	0.12	1.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.39)	(0.00)	(0.00)	(0.12)	(0.00)	

APPENDIX C

OLS RESULTS WITH AUTO-BIDS AND COMPETITORS

	Model 1 with Auto-bid		Model 1 with Competitors		Model 2 with Auto-bid		Model 2 with Competitors	
	log(SP)	log(HB)	log(SP)	log(HB)	log(SP)	log(HB)	log(SP)	log(HB)
log(SRP)	0.803***	0.795***	0.802***	0.795***				
	(25.70)	(26.75)	(25.33)	(26.68)				
Bidder number	0.00187***	0.00300***	0.00170***	0.00298***	0.00408***	0.00729***	0.00359***	0.00733***
	(12.18)	(18.04)	(11.14)	(18.03)	(15.04)	(40.58)	(13.21)	(40.60)
Age	-0.0124***	-0.0151***	-0.0123***	-0.0148***	-0.0339***	-0.0276***	-0.0350***	-0.0284***
	(-5.07)	(-8.06)	(-5.02)	(-7.91)	(-18.12)	(-27.91)	(-17.65)	(-29.13)
Duration	0.000739	0.000191	0.000764	0.0000309	0.00166*	-0.000294	0.00193*	-0.000305
	(0.84)	(0.49)	(0.84)	(0.08)	(2.14)	(-0.64)	(2.37)	(-0.65)
Kilometer	-0.00164***	-0.00354***	-0.00167***	-0.00360***	-0.00700***	-0.00624***	-0.00729***	-0.00646***
	(-3.36)	(-7.77)	(-3.38)	(-7.92)	(-6.20)	(-18.52)	(-6.22)	(-19.06)
Manual_T	-0.0303***	-0.0388***	-0.0305***	-0.0385***	-0.0958***	-0.0692***	-0.0994***	-0.0709***
	(-4.64)	(-8.57)	(-4.65)	(-8.47)	(-16.99)	(-26.34)	(-17.46)	(-27.20)
Horsepower	0.000409***	0.000301***	0.000417***	0.000305***	0.00157***	0.00102***	0.00164***	0.00105***
	(3.33)	(3.72)	(3.40)	(3.77)	(8.87)	(11.87)	(8.80)	(11.94)
Auto-bid (%)	0.000231***	0.0000868***			0.000828***	0.000562***		
	(6.78)	(4.80)			(13.80)	(25.52)		
Comp			0.000000739	0.0000767***			-0.00000228	0.0000418**
			(0.03)	(5.67)			(-0.08)	(2.59)
log(mean_OP)			0.000594	0.000501*			0.00264**	0.00101***
			(1.20)	(2.06)			(2.71)	(3.35)
SRP_dummy=1					-0.0128***	-0.0301***	-0.0140***	-0.0308***
					(-7.01)	(-18.19)	(-7.37)	(-18.44)
log(Opening Price)					0.398***	0.549***	0.375***	0.536***
					(24.02)	(41.01)	(23.05)	(40.84)
Constant	2.299***	2.407***	2.313***	2.397***	7.069***	5.312***	7.330***	5.464***
	(6.24)	(6.82)	(6.21)	(6.79)	(35.91)	(33.42)	(38.44)	(35.11)
Brand Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel Type Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Car Body Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Monthly Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4415	31266	4415	31266	7456	34307	7456	34307
R^2	0.989	0.984	0.989	0.984	0.972	0.976	0.971	0.976

Notes: t statistics in parentheses. SP is “Sales price” and HB is “Highest bid”. Kilometer values are divided by 10000. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

APPENDIX D

LOGIT RESULTS WITH AUTO-BIDS

	(1) (Sold)	(2) (Sold)
log(SRP)	-0.784***	-0.776***
	(-34.30)	(-34.92)
Auto-bid (%)	0.00185***	0.00182***
	(19.27)	(19.21)
Age	-0.0482***	-0.0460***
	(-22.31)	(-20.83)
Duration	-0.000432	-0.00173
	(-0.22)	(-0.88)
Kilometer	-0.0114***	-0.0118***
	(-14.24)	(-14.60)
Manual transmission	-0.123***	-0.122***
	(-17.80)	(-17.80)
Horsepower	0.000917***	0.000920***
	(3.92)	(3.93)
Bidder number	0.0133***	0.0129***
	(34.12)	(33.99)
Comp		0.000462***
		(7.28)
log(Mean_OP)		0.00119
		(0.94)
Fuel Type Dummies	Yes	Yes
Car Body Dummies	Yes	Yes
Model Dummies	Yes	Yes
Monthly Dummies	Yes	Yes
N	29931	29931
Pseudo-R^2	0.3003	0.3024

Notes: t statistics in parentheses. Kilometer values are divided by 10,000.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX E

RESULTS WITHOUT COVID-19 LOCKDOWNS

	Model 1		Model 2		Model 3	
	log(Sales Price)	log(Highest Bid)	log(Sales Price)	log(Highest Bid)	Sold	Sold
log(SRP)	0.797***	0.804***			-0.756***	-0.748***
	(22.76)	(26.94)			(-32.15)	(-32.44)
Bidder number	0.00164***	0.00307***	0.00362***	0.00756***	0.0127***	0.0123***
	(10.79)	(18.62)	(12.45)	(38.94)	(31.85)	(31.28)
Age	-0.0131***	-0.0146***	-0.0376***	-0.0291***	-0.0476***	-0.0450***
	(-4.93)	(-7.78)	(-19.11)	(-28.97)	(-21.58)	(-19.76)
Duration	0.00149	0.000423	0.00196*	-0.000292	0.00202	0.000218
	(1.48)	(0.97)	(2.12)	(-0.55)	(0.91)	(0.10)
Kilometer	-0.00157***	-0.00343***	-0.00716***	-0.00647***	-0.0109***	-0.0113***
	(-3.09)	(-7.44)	(-5.83)	(-18.07)	(-12.91)	(-13.34)
Manual transmission	-0.0299***	-0.0371***	-0.101***	-0.0714***	-0.118***	-0.117***
	(-4.09)	(-8.29)	(-16.47)	(-26.42)	(-16.39)	(-16.25)
Horsepower	0.000475***	0.000277***	0.00168***	0.00106***	0.000930***	0.000928***
	(3.55)	(3.33)	(8.30)	(11.29)	(4.05)	(4.04)
SRP_dummy = 1			-0.0144***	-0.0325***		
			(-7.03)	(-17.90)		
log(OP)			0.358***	0.532***		
			(21.54)	(39.16)		
Comp						0.000535***
						(8.45)
log(mean_OP)						0.00151
						(1.07)
Constant	2.386***	2.287***	7.592***	5.510***		
	(5.67)	(6.45)	(38.89)	(34.21)		
Brand Dummies	Yes	Yes	Yes	Yes		
Fuel Type Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Car Body Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Model Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Monthly Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	3918	29037	6669	31788	27717	27717
R^2 (Psuedo R^2)	0.989	0.985	0.971	0.976	(0.2895)	(0.2927)

Notes: t statistics in parentheses. Kilometer values are divided by 10,000. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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