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The impact of strategic jump bidding in residential English auctions

Aras Khazal, Ole Jakob Sønstebø, Jon Olaf Olaussen and Are Oust

NTNU Business School, Norwegian University of Science and Technology, Trondheim, Norway

ABSTRACT

In the Norwegian real estate market, used dwellings are normally sold through an auction process similar to the standard English (open ascending-bid) auction. Using survey results (N = 1,803), we define jump bids and investigate the motivations behind the use of such strategies. We find that most bidders tend to consider intimidation and signalling as the main motivations for applying a jump-bidding strategy, and intimidation strategies applied by competing bidders appear to be an important reason for bidders withdrawing early from an auction. We also use a sample of 1,142 auction journals and find that, on average, auctions containing jump bids achieve 2.8–9.3 percent higher price premiums compared to strictly straightforward-bidding auctions. The premium is higher when the intimidation strategy fails and competing bidders counter with jump bids. Additionally, this paper provides evidence that jump bids are usually placed at the earliest stage of the auction and have a stronger intimidation effect the earlier they are placed, despite having an overall positive effect on the premium. The results are robust to different valuation approaches and omitted variable bias controls. Our findings have important implications for sellers and buyers in auction settings, and for regulators of auction processes.

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Ascending-bid auctions; English auctions; housing; bid strategies; jump bidding

Introduction

In his seminal paper, Counterspeculation, auctions, and competitive sealed tenders, Vickrey (1961) argues that placing marginal bid increases (straightforward bidding) is the Pareto optimal solution for an open ascending-bid auction (hereafter called an English auction). Consider an English auction with two rational and risk neutral bidders, B_1 and B_2, with privately known values, v_i, randomly drawn from a known distribution $[0, \bar{v}]$, where $\bar{v} \geq v_1 > v_2$. Placing sequential bids, b, where $b = 1, \ldots, v_1$, with marginal bid increases m, B_2 will stop bidding at $b_2 = v_2$, while B_1 will place a marginally higher bid $b_1 = v_2 + m$, where $m \approx 0$. As such, B_1 wins the auction at approximately the second highest valuation. If the design of an English auction allows for jump bidding, i.e. bid increases higher than what is necessary to become the standing high bidder, the last bid increase may not be marginal and the mechanism could become a hybrid of a first- and a second-price auction. According to Vickrey's (1961) revenue equivalence theorem, however, this will not lead to a difference in expected outcomes.

CONTACT Ole Jakob Sønstebø ole.j.sonstebo@ntnu.no

Conversely, there is also literature suggesting that jump bidding may increase buyer revenue: Avery (1998) suggests that a lower price can be achieved in cases where competitors withdraw early from an affiliated-values auction (developed by Milgrom and Weber (1982)), after a jump-bidding strategy is applied. Likewise, Daniel and Hirshleifer (2018) argue that the use of jump-bidding strategies may impede bidder participation in the case of costly sequential bidding, where B_1 signals a high valuation that leads B_2 to stop bidding at a valuation lower than v_2, as a cost-effective strategy. While the theoretical models assume rational players, this may not be the case in practice. However, Isaac et al. (2007) propose that neither irrationality nor intimidation are necessary causes for jump bidding, but rather that time costs may create impatience among bidders that results in the adoption of such a strategy. Allowing for impatience and strategic bidding in their model, they find that auctions are highly efficient and that both seller revenue and expected bidder utility increase.

In a companion paper, Isaac et al. (2005) conduct an experimental study and find that impatience, rather than signalling behaviour, may indeed be the cause of jump bidding, supporting the implications from their theoretical model. Grether et al. (2011) conduct a field experiment analysing 24 online auctions comprising some 15,000 second-hand cars for sale in Texas and New York. The results provide evidence that both impatience and intimidation are important factors behind jump-bidding strategies, when considering time costs.

A number of studies have investigated strategic jump bidding in internet auctions. Haruvy and Leszczyc (2010) find that jump bids are directly responsible for higher prices, and Herrmann et al. (2016) show that jump bidding has a negative effect on the bidder's likelihood of winning the auction, and that the strategy is unsuccessful in deterring bidder participation. However, Easley and Tenorio (2004) find the strategy effective, as early jump bidding discourages later entry and fewer bids are placed overall. They note that the incentives to jump increase with competition, and that jump bids are more likely and have a higher strategic value earlier in the auction. Similarly, Kwasnica and Katok (2007), find that bid increment is a decreasing function of bid number, and an increasing function of time costs. Observations of early jump bids are also found in simultaneous ascending spectrum auctions, where jump bids seem to be the result of impatience, and have little or no effect on final prices (Plott & Salmon, 2004) or on dissuading other bidders (Banks et al., 2003).[1]

In this paper, we take advantage of a distinctive trait that differentiates the Norwegian real estate market from most others – the fact that nearly all second-hand residential dwellings are sold at formal auctions. This provides a unique opportunity to evaluate empirical findings concerning jump bidding in regard to the theory, as the magnitude of the private investments in this market is relatively substantial compared with markets examined in previous auction studies. Some studies have been conducted on the somewhat similar Swedish real estate auction market: In an empirical analysis, Hungria-Gunnelin (2013) find that jump bidding restricts the number of participants. While these results are in line with the theoretical jump-bidding models, Hungria-Gunnelin (2018) provides evidence that jump bidding increases seller revenue, which seems to support the theoretical arguments for straightforward bidding. Although the Swedish real estate auctions are of the English type, there is a vast difference between the highly regulated Norwegian process and the generally unrestricted manner in which auctions are conducted in Sweden. For example, the fact that bids are not formally binding in the Swedish market represents a huge conceptual difference from a true English auction. As such, the market displays a different dynamic, and results from the Swedish market might not be transferable to English auctions in general, especially when considering strategic bidding. In a study from the Norwegian market, Sønstebø et al. (2020) find that auctions starting with a high opening bid are associated with fewer active bidders but achieve higher price premiums. This implies that the price effect of an intimidating bid is stronger than its intimidation effect. The intimidation effect refers to the successful act of deterring competing bidders from continuing and is expected to have a negative impact on prices. The price effect is anticipated to have a positive impact on prices and has two components – the direct price impact of increasing the standing high bid with a higher amount than under straightforward bidding, and the indirect effect of signalling a high valuation. The indirect effect may lead competing bidders to adjust their initial valuation of the object accordingly, and thus end up bidding higher. Results from auction studies also have implications for actors in markets where negotiation is the typical sales mechanism for properties. Han and Strange (2014) document an increase in bidding wars in negotiated sales, especially in a boom market, but also persisting through a bust. Bidding wars are similar to auctions in that bids from several buyers are received shortly after listing, and such transactions are usually associated with a price higher than the asking price.

To identify and quantify the impact of jump-bidding strategies on the sales premium of residential dwellings, we use 1,142 auction journals from Norwegian sales transactions over the period of 2014–2016, in addition to results from a survey carried out during 2016–2017. We find that intimidation and signalling are the main motivations for applying a jump-bid strategy, and that the strategy may explain why bidders drop out early. However, our main result is that auctions containing jump bids achieve a higher price premium with respect to the asking price compared to strictly straightforward-bidding auctions. A failed jump-bid strategy, exemplified by multiple jump bidders in one auction, yields even higher premiums. Further, we find that the first jump bid is usually placed early in the auction and that while the price effect dominates overall, the intimidation effect is stronger the earlier the jump bid is placed. Our findings are robust even after applying repeat sales valuations and after attempting to control for the potential omitted variable bias where bidders with high individual valuations may be more likely to place jump bids.

The paper is further structured as follows: The next section offers a background of Norwegian real estate auctions, followed by the data section with information about the auction journal and survey data, and a methodology section. The results are discussed in the subsequent section, while the last section concludes.

Background

In the Norwegian real estate market, used dwellings are normally sold through an auction process similar to the standard open ascending-bid, or English, auction. The seller usually employs a real estate agent to market the dwelling and manage the auction process as an independent third party. Together with the seller, the agent uses their education, experience and knowledge about the market to assess the value of the dwelling and assign an asking price. Although under-pricing is a potential strategy for agents – i.e., deliberately listing a dwelling below the expected market value in order to attract more buyers (see for example, Han and Strange (2016)) – Norwegian market laws prohibit this practice. Regulators monitor and sanction infringing actors, and agents who under-price will fall into disrepute. Specifically, the Consumer Authority (CA), a public enforcement authority, supervises the purchase, rental and construction of housing and monitors market actors such as real estate agents by regularly conducting controls of marketing practice and the setting of prices. The CA is mandated to enforce the market regulations laid out through the Marketing Act (2009), the Regulation on Real Estate (2007), and the Industry Norm (2014), which control the auction process, real estate agents, and asking prices. Hence, the asking price is regulated to reflect the true market value and cannot be lower than the seller's reservation price. While it could be argued that due to loss aversion, sellers might tend to set higher asking prices in bust periods (see e.g., Genesove and Mayer (2001)), the market has not seen a downturn during the sample period.

Through various marketing channels, such as the real estate agency's website and classified advertisement websites such as Finn.no, the dwelling is advertised with the asking price, details of the property, photographs, dates of open house viewings, comprehensive information about the location, and the surveyor's report. At the open house, potential buyers can sign up to a list of interested viewers to receive bidding information during the auction – i.e., every bid submission and its corresponding acceptance deadline. Since there is no physical location for the auction, bids are usually submitted electronically, in a sequential manner. The auction typically starts after the last viewing or in the following morning, and the vast majority is conducted in the span of a day or two.[2] Even though there are no restrictions on bid size or deadlines, the agent can still choose to refuse relatively short deadlines or try to influence the bidder to expand the deadline. If the seller rejects the bid or the deadline expires, the bid is no longer valid. Conversely, the bid is binding, and the auction is over if the seller accepts the bid within the deadline. Additionally, counteroffers can be submitted to the bidder if the seller is not satisfied with the highest bid, thus initiating negotiations with the highest bidder. In the case of no bidder turnout, an unsuccessful auction or negotiation, the seller and the agent can schedule a new open house and a following auction.

Data

In this paper, we utilise two separate sets of data: We use survey results to define jump bids and to identify and get a better understanding of the motivation behind the use of such strategies. In the main empirical analysis, we use auction journal data from the Norwegian residential housing market. Both sets of data are presented in the following two sections.

Survey data

A survey regarding real estate auctions was conducted between December 2016 and January 2017, with 1,803 respondents from Trondheim, Stavanger and the capital, Oslo – three of the largest cities in Norway. The questions aimed to identify bidders' knowledge, motivation and usage regarding bidding strategies in auctions for second-hand dwellings. Sønstebø (2020) provides a comprehensive description of the survey.

In one section, 1,283 respondents answered that they had previous bidder experience, and they were asked to consider the last auction in which they participated when they answered the following question: 'If you quit bidding during the auction, what was the most important reason for doing so?' Out of the 1,283 respondents, 887 (69 percent) answered that they did not withdraw, indicating that they won the auction.[3] The answers from the remaining respondents, who withdrew from the auction, are presented in Figure 1.

While almost 8 percent found a better match during the auction and about 3 percent quit bidding because of time factors, most of the respondents disengaged because of bidding-related causes. About 69 percent of the respondents withdrew because their personal price limit was surpassed by a competing bidder, whereas 10 percent cited their bank's borrowing limit being surpassed as the most important reason. Although the answers may not be mutually exclusive, the results suggest that the majority of bidders participated in the auction until the price level they were willing to pay was exceeded, regardless of competing bidders' strategies, which is in line with classic auction theory. The final 10 percent answered that high bid increases from competing bidders was the most important reason for withdrawing from the auction. Assuming that these bidders stopped before the price level they were willing to pay was exceeded, the results indicate that intimidation and signalling may indeed make participating bidders quit earlier. However, the proportion of respondents who withdrew because of competitors' strategic bidding is quite small compared with the almost eight times larger percentage who continued up to the price level they were willing to pay. Furthermore, the prevalence of jump bidding in these auctions cannot be ascertained, making it difficult to draw conclusions regarding the strategy's success rate.

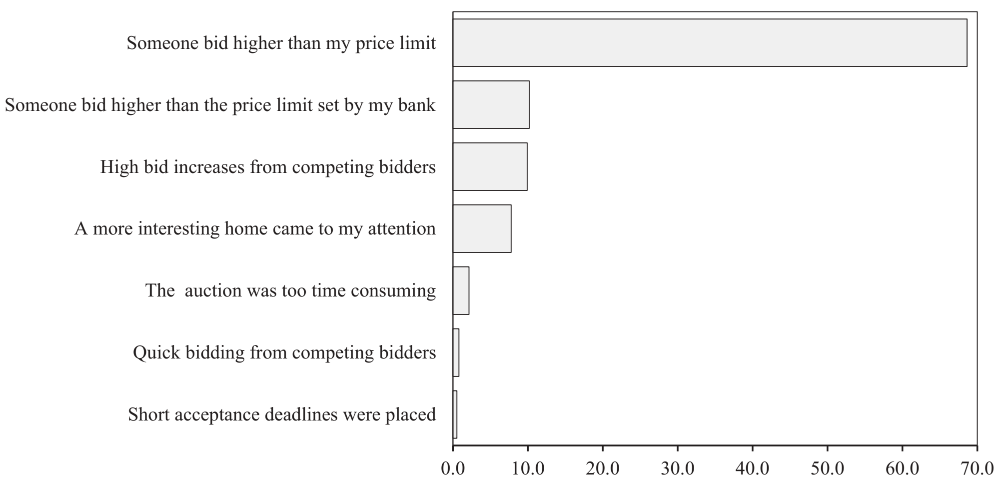

Figure 1. Question: 'If you quit bidding during the auction, what was the most important reason for doing so?'.

In another section, the respondents were faced with a hypothetical auction scenario for a home they wish to buy. Each respondent was randomly given a combination of one of three different asking prices and one of two numbers of potential bidders, equally distributed. To get a better perception of bidder behaviour, two questions regarding preference and motivation were asked: 'Given that the standing high bid is equal to the asking price, would you prefer to place low or high bid increases?' and 'If you were to place a high bid increase, what would be the most important reason?' The answers are presented in Figure 2.

While about 22 and 19 percent prefer to submit low and high bid increases, respectively, the majority (almost 50 percent) answer that the magnitude of their preferred bid increase is conditional on other bidders' actions, as presented in Panel A. This indicates that bidders do not necessarily have a pre-set strategy, but rather develop their strategy during the auction, based on signals obtained from other bidders. This also may be explained by the fact that information about the common value aspect of the auctioned object is acquired through competitors' actions, which may influence the bidding strategy. Among those willing to submit high bid increases, in Panel B, about 59 percent of the respondents answered that the most important motivation for submitting a high bid increase is to intimidate other bidders, while 22 percent intend to signal economic strength. Time costs also seem to be an important factor, as 19 percent of the participants cite impatience as their strongest motivation. Placing high bid increases based on the notion that it is considered impolite or embarrassing to place low bid increases seems to be of trivial importance among the respondents.

In the hypothetical auction scenario, respondents were also asked two questions regarding the size of bid increases, given that the standing high bid is equal to the asking price: 'What do you consider to be a low bid increase?' and 'What do you consider to be a high bid increase?' In order to examine whether the price level of the dwelling and the number of potential bidders are contributing factors in choosing the magnitude of bid increases, we present the answers to these questions among the six different given scenarios. Figure 3 reports the answers to the first question.

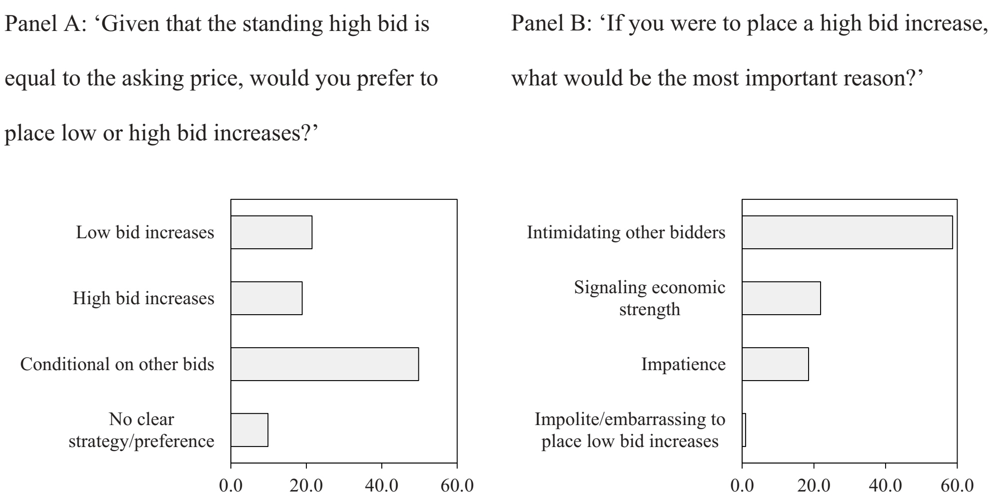

Figure 2. Answers to questions about preference and purpose regarding bid increases (percentages).

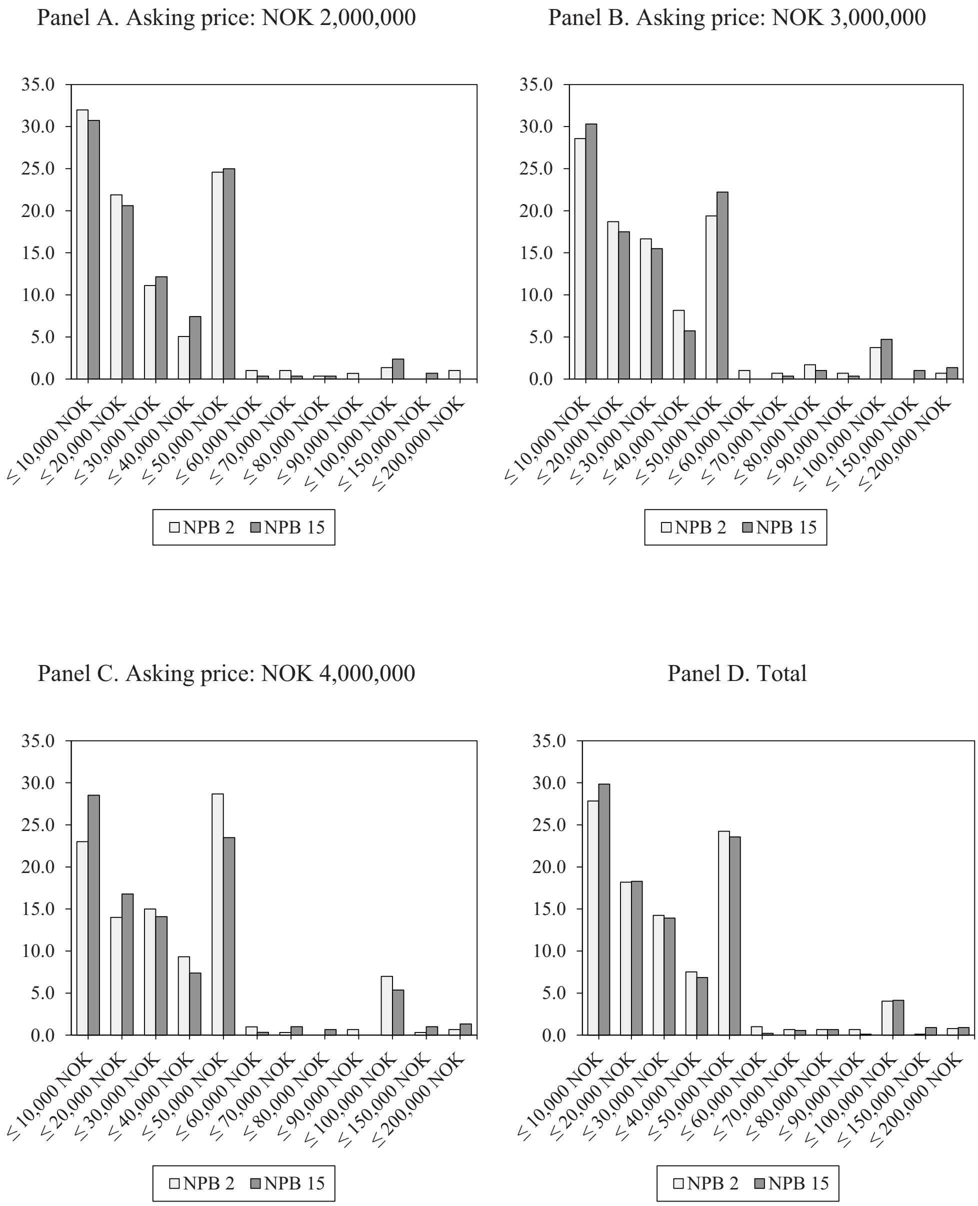

Figure 3. Question: 'Given that the standing high bid is equal to the asking price, what do you consider to be a low bid increase?'.

Figure 3, Panel D shows that, cumulatively, 92 percent of the respondents consider a low bid increase to be equal to or lower than NOK 50,000.[4] While there are some differences regarding the number of potential bidders in each asking-price scenario, no clear pattern seems to exist. Interestingly, the proportions of answers to each option seem highly consistent across the different asking prices. We observe a slight increase in the percentages of answers in the larger threshold values as the asking price increases, but not enough to assume that there is a directly proportional relationship. The average threshold values across the three asking-price scenarios are 30,590, 33,790 and 37,040, respectively. This gives us an increase of 10.5 percent between the 2- and 3-million scenarios, and an increase of 21.1 percent between the 2- and 4-million scenarios, whereas we would expect an increase of 50 and 100 percent, respectively, if the threshold values were directly proportional to the asking price. If we only compare respondents with actual auction experience, the increases are even lower. Since a 100 percent increase in asking price appears to yield only about a 20 percent increase in the mean threshold value, it seems more appropriate to use absolute values than relative values to define straightforward bidding. Additionally, the five lowest threshold values have the highest proportions of answers and the same ranking across all asking-price scenarios. To examine whether this holds regarding high bid increases as well, we report the answers to the second question in Figure 4.

In Figure 4, Panel D, the five most answered alternatives for what is considered a high bid increase have the lower threshold values of 50,000, 100,000, 150,000, 200,000 and 300,000 (NOK). Again, we observe some differences regarding the number of potential bidders, but nothing that indicates any pattern. Similar to the results in Figure 3, we find that the answers appear to be consistent across the asking-price scenarios. The minor increases observed in the answers to the higher threshold values are not of a magnitude that suggests perceptions of high bid increases are directly proportional to the price level. The average threshold values for the 2-, 3-, and 4-million asking-price scenarios are 107,787, 117,285 and 124,848, respectively. This gives us an increase of 8.8 percent between the 2- and 3-million scenarios, and an increase of 15.8 percent between the 2- and 4-million scenarios. If we only consider respondents with auction experience, these increases are only 6.8 and 10.4 percent, respectively. Again, we would expect an increase of 50 and 100 percent, respectively, if the threshold values were directly proportional to the asking price. Moreover, the threshold value alternatives with the roundest numbers are more frequently answered than the rest, suggesting that some heuristics may also be involved in the perception of bid increase magnitude.

Auction journal data

The auction journal dataset is obtained from two of the largest Norwegian real estate agencies, containing 2,551 sales observations with comprehensive information about each auction over the period of 2014–2016, from the counties Møre og Romsdal and Trøndelag, with Trondheim as the largest city. However, the auction data does not contain property characteristics, and is therefore matched with data obtained from Eiendomsverdi.no.[5] Some data cleansing is necessary in order to conduct this analysis: Logically, it requires at least two bids in order to define a bid increase, and since an auction with only one bidder, but more than one bid, can be considered a negotiation, we consider only the 1,259 auctions with at least two bidders. We end up with 1,142 observations after excluding commercial dwellings, garages, farms and plots of land, in addition to observations with missing values for asking price, time on market, size and number of bedrooms.

Periods of bidding frenzy, where several bids are placed almost simultaneously, are observed in some auctions. In these cases, bidders may not yet have received information

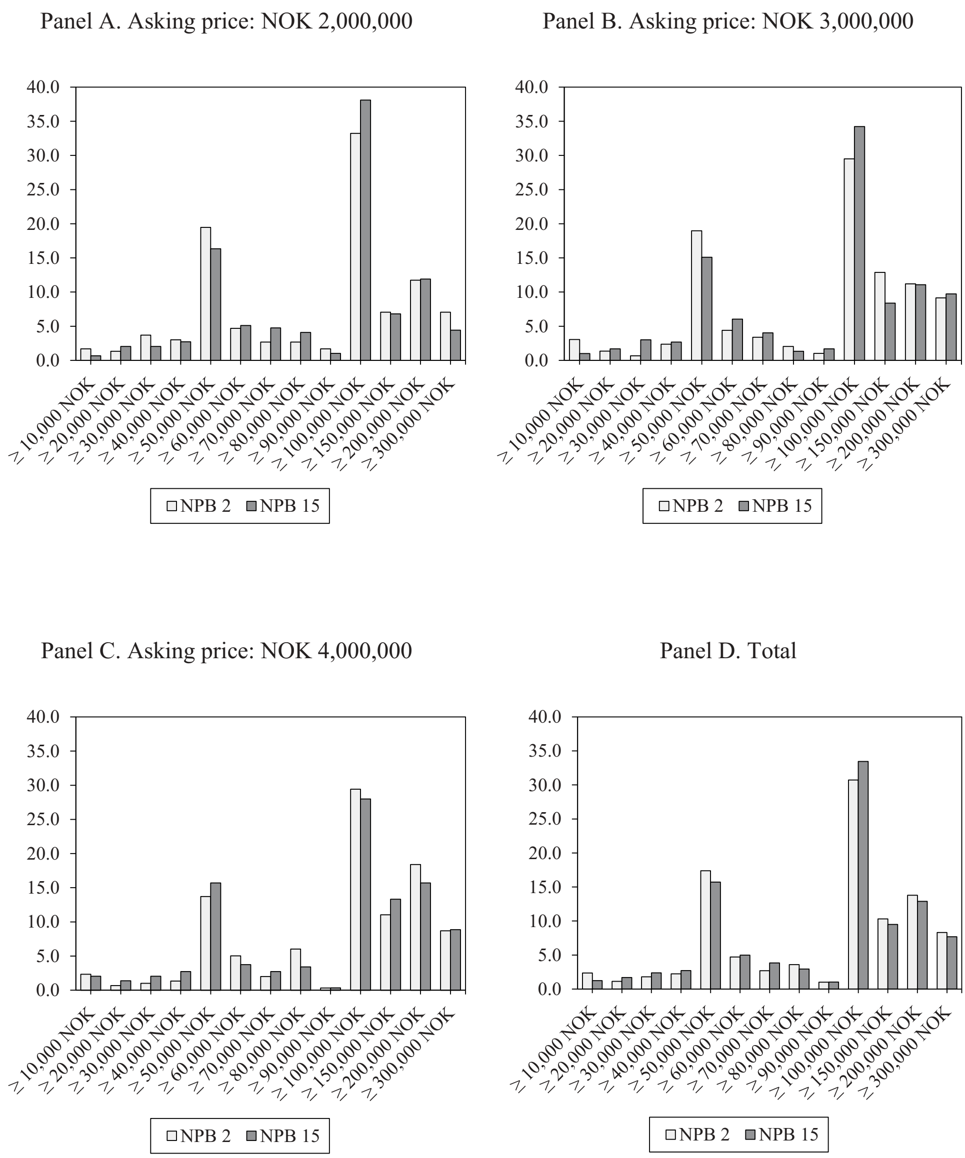

Figure 4. Question: 'Given that the standing high bid is equal to the asking price, what do you consider to be a high bid increase?'.

about the standing high bid before they place their bid, and negative bid increases may occur. For example, if bidder B and C receive a signal that bid a is the standing high bid and both place their respective bids, b and c (where $b > c > a$), almost simultaneously, we have a negative bid increase of $c - b$. To mitigate this problem, we only consider non-negative bid increases – in this case, $b - a$.

Table 1 presents descriptive statistics for the dataset used in this analysis. The total average sales price is about NOK 2.8 million, the total average asking price is about NOK 2.7 million, while the total average opening bid is NOK 2.5 million. Sellers will sometimes

Table 1. Descriptive statistics, auction journal data.

Variables	Mean	SD	Min	Max
Sales price (NOK)	2,819,201	1,301,700	370,000	13,200,000
Asking price (NOK)	2,672,745	1,215,968	300,000	12,000,000
Opening bid (NOK)	2,500,673	1,157,992	265,000	11,000,000
Average bid increase (NOK)	54,965	64,259	0	1,400,000
Number of bidders	2.81	1.18	2	11
Counteroffer (%)	7.10			
Burned objects (%)	8.14			
Time on market (days)	19.75	36.34	0	680
Age (years)	41.98	28.56	0	214
Size (m^2)	96.33	51.24	21	396
Number of bedrooms	2.43	1.27	0	13
Type of dwelling (%):				
Freehold apartment	25.39			
Freehold detached	22.24			
Freehold semi-detached	7.53			
Freehold townhouse	5.60			
Leisure home	1.49			
Cooperative townhouse	3.24			
Cooperative apartment	34.51			
Transaction period (%):				
Quarter 1	39.32			
Quarter 2	16.99			
Quarter 3	8.06			
Quarter 4	35.64			
Year 2014	29.16			
Year 2015	30.04			
Year 2016	40.81			
Location (*N* zip codes)	219			
Real estate agent (*N* offices)	36			
Number of observations	1,142			

Note: NOK 1 ≈ EUR 0.10; NOK 1 ≈ USD 0.12 (per 31.12.2019)

accept bids lower than the asking price, for example, due to low demand, impatience or risk aversion. Hence, it may be rational for bidders to start at a lower level, as observed in the positive difference between average asking price and average opening bid. About 7 percent of the auctions contain counteroffers from the seller, and about 8 percent are considered burned objects. We categorise dwellings as burned based on three criteria: (1) if the dwelling had more than one open house with a different asking price, (2) if the journal contains more than one auction, separated by a duration of 7 days or more, and (3) if the journal's last auction contains a different set of bidders. In cases where two or more of these criteria are satisfied, only the last auction in the journal is considered, and the observation is flagged as a burned object.

Methodology

In order to assess the impact of jump bidding on auction outcomes, we start with a standard hedonic time dummy model. As mentioned in the background section, the asking price gives a signal about the seller's true reservation price and is assumed to reflect the market price. Taking advantage of this, we define the price premium, p, as the difference between sales price, P^{sales}, and asking price, P^{ask}, with respect to the asking price, shown in the following equation[6]:

$$p_i = \alpha + \gamma_1 J_i + \gamma_2 I_i + \delta' A_i + \beta' X + F + \varepsilon_i \quad (1)$$

where J is the jump-bidding variable defined as a dummy taking the value 1 if the auction contains at least one bid increase equal to or higher than a threshold value, and 0 otherwise. Based on the results from the survey data (Figure 4), we apply the following threshold values for five different specifications of J: NOK 50,000, NOK 100,000, NOK 150,000, NOK 200,000 or NOK 300,000.[7] Likewise, we define the reference group as straightforward bidding, with auctions containing bid increases strictly lower than NOK 50,000 (Figure 3). To quantify and isolate the impact of jump bidding, we include dummies for auctions with intermediate bidding, I, where the highest bid increase lies between the reference group and the jump-bid variable – i.e., this dummy takes the value 0 if the auction contains either jump or strictly straightforward bidding and takes the value 1 otherwise.

The vector A represents a number of auction-specific variables, namely burned object, counteroffer, time on market, opening bid ratio and number of bidders. Burned object is a dummy that takes the value 1 when the auction follows a prior unsuccessful auction, and 0 otherwise. Counteroffer takes the value 1 for auctions containing counteroffers from the seller, indicating a shift from auction to negotiation, and 0 otherwise. Measuring the number of days from the registration date to the sales date, time on market controls for time-variant effects during this period. The ratio of opening bid to asking price is included in order to control for the signalling effect of the opening bid, along with the number of active bidders which is generally found to have a positive relationship with prices. The vector X represents dwelling characteristics such as size, number of bedrooms, age and type of dwelling, in addition to yearly and quarterly effects. Real estate agencies may have varying marketing strategies, experience and knowledge about submarkets, and could thus attract more or fewer potential buyers during the marketing and at the open house. We therefore include fixed effects, F, that control for 36 different real estate agent offices, in addition to 219 zip codes controlling for the locational variations.

A potential endogeneity issue in the model is the possibility that both time on market and jump bidding could be functions of the asking price, while jump bidding at the same time could be a function of time on market. However, we find no substantial linear or non-linear relationship between time on market and either asking price or jump bidding, and the relationship between jump bidding and asking price is controlled for by including property characteristics.[8] Excluding time on market from the equation yields no essential changes in the results and we therefore find the potential endogeneity to be a minor concern.

Results

Table A1 in the Appendix shows that about 12 percent of our observations are strictly straightforward-bidding auctions. The share of jump-bidding auctions varies from 88 percent under the lowest threshold value to seven percent under the highest. Except for under the first specification, most auctions contain only one jump bidder and multiple jump bidders are less common the higher the threshold value. As illustrated in Figure 5 as well, the first jump bid is usually placed as early as possible across all five jump-bid specifications.

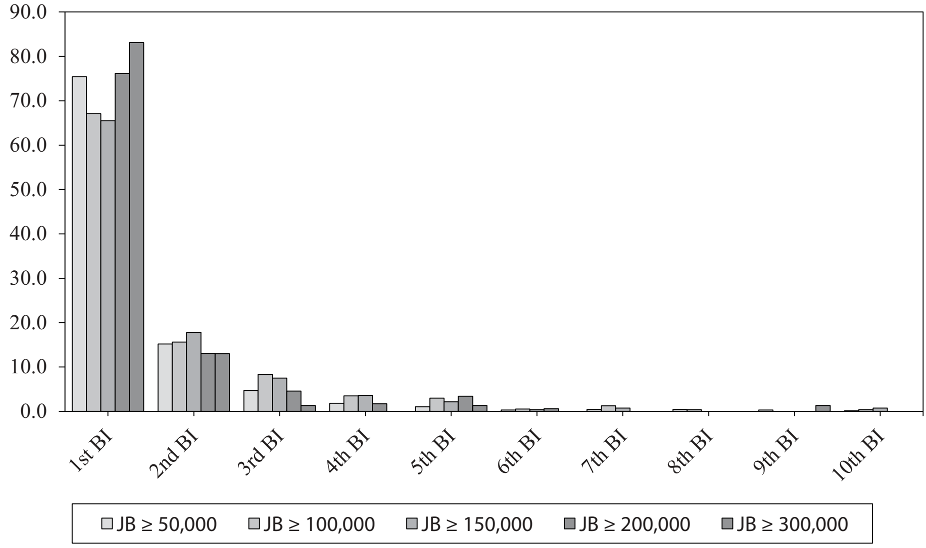

Figure 5. Distribution of the first jump bid's position in the order of bidding.

Two main effects in the relation between participants and intimidation may exist. First, early jump bidding may have more of an entry deterrence effects (see for example, He and Leszczyc (2013) and Sønstebø et al. (2020)) while later jump bidding may have more of a deterrence to continue bidding effect. The latter will not be observed in the number of bidders, as active bidders who withdraw early are already counted. Second, a higher number of bidders may lead to a higher probability of using jump bidding as an intimidation strategy, but also if jump bidding is randomly distributed among bidders (the more bidders, the higher probability that one is a jump bidder). Indeed, we find a positive, but weak, correlation between the number of bidders and jump bidding, indicating that the positive effect from number of bidders on jump bidding is dominating the potential negative effects the opposite direction.[9]

Similarly, the relationship between auction duration (measured as the time between the first and last bid submission) and jump bidding may also have two directions. First, a longer duration could mean a higher probability that a jump bid is placed sometime during the auction. Second, one would expect the duration to be reduced if jump bidding is successful in making competitors withdraw early and/or if it is motivated by impatience. We find a positive, but even weaker correlation between auction duration and jump bidding, suggesting that the positive effect is dominating. Overall, these relationships suggest that jump bidding may not have the intended effect either in terms of intimidation or impatience.

Table 2 reports the estimations of equation 1, with the five different specifications of the jump-bid variable described in the column headers. We interpret the results based on the assumption that the intimidation effect and the price effect have opposing impacts on the price premium. Thus, we expect to see a positive coefficient of the jump-bid variables when the price effect is strongest, a negative coefficient when the intimidation effect is strongest, and a zero coefficient if the two effects balance out.

Table 2. Price premium estimations – equation 1.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
Jump bid (*J*)	0.0282***	0.0441***	0.0586***	0.0664***	0.0926***
	(0.0054)	(0.0065)	(0.0070)	(0.0077)	(0.0103)
Intermediate bidding (*I*)	–	0.0214***	0.0274***	0.0287***	0.0318***
		(0.0053)	(0.0053)	(0.0053)	(0.0053)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Opening bid ratio (ln)	0.2864***	0.3334***	0.3703***	0.3704***	0.3899***
	(0.0321)	(0.0348)	(0.0362)	(0.0347)	(0.0322)
Number of bidders	0.0268***	0.0259***	0.0259***	0.0258***	0.0265***
	(0.0018)	(0.0018)	(0.0018)	(0.0017)	(0.0018)
Counteroffer	−0.0515***	−0.0525***	−0.0529***	−0.0470***	−0.0446***
	(0.0060)	(0.0059)	(0.0058)	(0.0059)	(0.0062)
Burned object	−0.0138**	−0.0091	−0.0114**	−0.0129**	−0.0138**
	(0.0056)	(0.0057)	(0.0054)	(0.0054)	(0.0055)
Time on market	−0.0003***	−0.0003***	−0.0003***	−0.0003***	−0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Constant	0.0219	0.0448	0.0654**	0.0620*	0.0596*
	(0.0322)	(0.0316)	(0.0331)	(0.0328)	(0.0323)
Attributes and FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.529	0.545	0.552	0.554	0.560
Observations	1,142	1,142	1,142	1,142	1,142

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The coefficient of *J* is positive and significant across all specifications, indicating that auctions containing jump bids yield a higher price premium compared with straightforward-bidding auctions. With a coefficient varying from 2.8 to 9.3 percent, the impact on the price premium is increasing with stricter definitions of jump bids, indicating that the price effect dominates any possible intimidation effects. Since the price effect increases with increasing jump-bid levels (a bid increase of NOK 300,000 has a greater impact on the price than a bid increase of NOK 50,000), the intimidation effect is either zero, stable or increases at a slower rate across specifications than does the price effect. Overall, we find no evidence that a jump-bidding strategy may have a negative effect on the price premium, and thus, for a bidder aiming to intimidate, the desired effect is not achieved.

Further, we control for auctions containing intermediate bidding and find positive and significant coefficients that are consistent regardless of jump-bid levels. Burned objects, counteroffers and the dwelling's time on market all have a negative impact on the price premium, and their respective coefficients have the same significance and magnitude across the different specifications. On average, an auction shifting towards a negotiation is associated with a 5 percent decrease in the price premium, while dwellings with a previous unsuccessful auction suffer a decrease in price premium of approximately 1 percent. For a dwelling with an average time on market of 20 days, ceteris paribus, the price premium is 0.6 percent lower than an identical dwelling sold on the first day. Both the opening bid and the number of bidders have positive impacts on the price, which are stable across the five specifications. In the following tables, we only report the variables of interest.[10]

The abovementioned results capture the overall effect of jump bids on the price premium. However, there may be several bidders applying a jump-bidding strategy within the same auction, and this aspect is not accounted for in the *J* variable. In order to obtain a more detailed analysis of the jump-bid strategy, we split the *J* variable in two, J^1 and J^S: The one jump bidder variable, J^1, takes the value 1 in auctions where a single bidder places one or more jump bids, and 0 otherwise. The second jump bidder variable, J^S, takes the value 1 strictly for auctions where multiple bidders place jump bids, and 0 otherwise. By including J^1, J^S and I in the following regression, presented in equation 2, straightforward-bidding auctions serve as the reference group.

$$p_i = \alpha + \gamma_1 J_i^1 + \gamma_2 J_i^S + \gamma_3 I_i + \delta' A_i + \beta' X + F + \varepsilon_i \quad (2)$$

One interpretation of the variable J^S is that it represents an unsuccessful intimidation strategy from the first jump bidder, as other bidders are either not intimidated, retaliate with a jump bid of their own, or do not consider the jump bid as intimidation, but rather as a signal of an adjusted normal bid increase level. The results are reported in Table 3.

The coefficient of J^1 is significant in all specifications and similar in magnitude to the coefficients in Table 2, displaying the same pattern of increasing the stricter the jump-bid specifications are. However, if the intimidation strategy fails and a second jump bidder enters, we observe a higher impact on the price premium, represented by the coefficient of J^S. The coefficient of the second jump bidder is also significant, positive and increasing with a stricter jump-bid specification, where the price premium increase associated with an auction with multiple jump bidders ranges between 4.2 and 14.1 percent across the five specifications.

To examine whether the jump-bidding strategy's impact on the price premium is affected by the opening bid signal, we include interaction terms between the opening bid ratio and the J^1 and J^S variables, respectively. The results are reported in Table 4.

Since the interaction terms are zero when the opening bid ratio is one, the coefficients of J^1 and J^S can be interpreted as the effect on the price premium in cases where the opening bid is equal to the asking price.[11] Except for the nonsignificant J^1 coefficient in the first specification, we find the same sign and significance as in Table 3, but with a slightly lower magnitude. The second jump bidder coefficients remain consistent. Looking at the interaction terms we find that for auctions with an opening bid higher than the asking price, the price effect of a single jump bidder is reduced when the opening bid increases, while in the case of a second jump bidder, this holds true in the first two specifications only. However, the total price effect is still stronger than the intimidation effect, and thus there is no incentive for bidders to place jump bids even if the opening bid is high.

Table 3. Price premium estimations – equation 2.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
One jump bidder (J^1)	0.0166***	0.0399***	0.0567***	0.0641***	0.0889***
	(0.0054)	(0.0065)	(0.0070)	(0.0077)	(0.0102)
Second jump bidder (J^S)	0.0424***	0.0693***	0.0888***	0.1065***	0.1406***
	(0.0058)	(0.0080)	(0.0132)	(0.0161)	(0.0243)
Intermediate bidding (I)	–	0.0229***	0.0282***	0.0293***	0.0321***
		(0.0052)	(0.0053)	(0.0053)	(0.0053)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Constant	0.0464	0.0710**	0.0668**	0.0657**	0.0616*
	(0.0318)	(0.0308)	(0.0328)	(0.0324)	(0.0322)
Attributes and FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.551	0.561	0.556	0.558	0.562
Observations	1,142	1,142	1,142	1,142	1,142

Note: Auction-specific variables are included in all estimations, but not reported.
Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Price premium estimations – equation 2 with opening bid interaction.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
One jump bidder (J^1)	0.0078	0.0323***	0.0459***	0.0452***	0.0490***
	(0.0066)	(0.0073)	(0.0086)	(0.0095)	(0.0144)
Second jump bidder (J^S)	0.0307***	0.0638***	0.0707***	0.1060***	0.1833***
	(0.0067)	(0.0094)	(0.0233)	(0.0348)	(0.0351)
Intermediate bidding (I)	–	0.0268***	0.0314***	0.0324***	0.0341***
		(0.0052)	(0.0052)	(0.0052)	(0.0052)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Opening bid ratio (ln)	0.6891***	0.5028***	0.4692***	0.4512***	0.4352***
	(0.1077)	(0.0575)	(0.0454)	(0.0397)	(0.0340)
J^1 interaction	−0.3670***	−0.2044***	−0.1709***	−0.2026***	−0.2497***
	(0.1165)	(0.0694)	(0.0649)	(0.0624)	(0.0674)
J^S interaction	−0.4069***	−0.1839**	−0.2286	−0.0722	0.2728*
	(0.1132)	(0.0915)	(0.1464)	(0.2152)	(0.1623)
Constant	0.0550*	0.0803***	0.0741**	0.0724**	0.0688**
	(0.0321)	(0.0306)	(0.0322)	(0.0323)	(0.0324)
Attributes and FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.556	0.567	0.561	0.565	0.569
Observations	1,142	1,142	1,142	1,142	1,142

Note: Auction-specific variables are included in all estimations, but not reported.
Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Next, we examine whether the first jump bid's position in the order of bidding has any effect on the price premium. Figure 5 reports the distribution of first jump-bid (FJB) positions, and we observe that an overwhelmingly high amount of FJBs are placed as the second bid of the auction, regardless of jump-bid specification. The proportion of FJBs gradually decreases throughout an auction, which could indicate that impatient bidders are more active at the beginning of an auction, and that bidders employing a strategy of intimidation prefer to signal their valuation early in the game.

For this analysis, we replace the J variable from equation 1 with three dummy variables, as shown in equation 3:

$$p_i = \alpha + \gamma_1 FJB1_i + \gamma_2 FJB2_i + \gamma_3 FJB3_i + \gamma_4 I_i + \delta' A_i + \beta' X + F + \varepsilon_i \tag{3}$$

Here, $FJB1$ takes the value 1 if the FJB is placed at the first bid increment, and 0 otherwise, $FJB2$ takes the value 1 if the FJB is placed at the second bid increment, and 0 otherwise, and $FJB3$ takes the value 1 if the FJB is placed at the third or a later bid increment, and 0 otherwise.[12] Additionally, we interact the FJB variables with the opening bid ratio. The results are presented in Table 5.

The results show that, for most specifications, the later the first jump bid is placed, the stronger effect it has on the price premium. Whereas auctions with the first jump bid at the first bid increase ($FJB1$) achieve a price premium of 1.8–5.6 percent, auctions with the first jump bid at the third or a later bid increase ($FJB3$) achieve a premium of up to 14.1 percent. There appears to be no significant difference between $FJB2$ and $FJB3$ in the two lowest jump-bid specifications, but the difference increases with the threshold value. We find that as the opening bid increases, an early jump bid may help reduce the price effect, while a jump bid placed at a later stage has no significant dampening effect on the price premium. Although the results indicate that an early jump bid may have a stronger intimidation effect compared with jump bids placed later in the auction, the overall price effect is still positive compared to the baseline straightforward-bidding auctions.

Table 5. Price premium estimations – equation 3.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
FJB1	0.0184***	0.0301***	0.0356***	0.0379***	0.0557***
	(0.0065)	(0.0071)	(0.0095)	(0.0110)	(0.0203)
FJB2	0.0206**	0.0535***	0.0705***	0.0682***	0.0933***
	(0.0088)	(0.0108)	(0.0120)	(0.0194)	(0.0314)
FJB3	0.0165*	0.0565***	0.0629***	0.0863***	0.1411***
	(0.0085)	(0.0107)	(0.0138)	(0.0128)	(0.0247)
Intermediate bidding (I)	–	0.0257***	0.0307***	0.0318***	0.0334***
		(0.0052)	(0.0052)	(0.0052)	(0.0052)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Opening bid ratio (ln)	0.6893***	0.4967***	0.4714***	0.4481***	0.4345***
	(0.1078)	(0.0588)	(0.0455)	(0.0397)	(0.0342)
FJB1 interaction	−0.4269***	−0.2660***	−0.2484***	−0.2442***	−0.2424***
	(0.1119)	(0.0700)	(0.0675)	(0.0663)	(0.0843)
FJB2 interaction	−0.2965*	−0.0252	0.0440	−0.0275	0.2143
	(0.1685)	(0.1323)	(0.1305)	(0.1855)	(0.2705)
FJB3 interaction	−0.2600**	0.0708	−0.0739	0.0699	0.4648***
	(0.1264)	(0.1224)	(0.1290)	(0.2425)	(0.1297)
Constant	0.0322	0.0557*	0.0748**	0.0671**	0.0599**
	(0.0311)	(0.0295)	(0.0320)	(0.0320)	(0.0305)
Fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.537	0.560	0.561	0.563	0.567
Observations	1,142	1,142	1,142	1,142	1,142

Note: Auction-specific variables are included in all estimations, but not reported.
Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6. Price premium estimations – equation 4.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
Jump-bidder winner (J^W)	0.0315***	0.0479***	0.0578***	0.0668***	0.1001***
	(0.0055)	(0.0067)	(0.0074)	(0.0084)	(0.0104)
Jump-bidder loser (J^L)	0.0174***	0.0388***	0.0598***	0.0658***	0.0841***
	(0.0065)	(0.0072)	(0.0083)	(0.0099)	(0.0148)
Intermediate bidding (I)	–	0.0216***	0.0274***	0.0287***	0.0317***
		(0.0053)	(0.0053)	(0.0053)	(0.0052)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Constant	0.0220	0.0462	0.0658**	0.0619*	0.0588*
	(0.0320)	(0.0315)	(0.0331)	(0.0327)	(0.0320)
Attributes and FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.533	0.547	0.551	0.554	0.560
Observations	1,142	1,142	1,142	1,142	1,142

Note: Auction-specific variables are included in all estimations, but not reported.
Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Robustness checks

We conducted several robustness checks to corroborate our findings. Since bidders' true valuations are unobserved in our data, there is a possibility of potential omitted variable bias in the models. Specifically, if jump bidding is motivated in part by (abnormal) high individual valuations (assuming high-value bidders also tend to win the auctions in which they participate), the estimated impact of jump bidding on price premiums could merely be capturing this unobserved valuation as opposed to the strategic effect. In an attempt to rule out this possibility, we therefore divide the variable J from equation 1 into two groups, as shown in equation 4,

$$p_i = \alpha + \gamma_1 J_i^W + \gamma_2 J_i^L + \gamma_3 I_i + \delta' A_i + \beta' X + F + \varepsilon_i \quad (4)$$

where J^W denotes auctions where the winner places at least one jump bid during the game and J^L represents auctions containing jump bids, but where the winner is not a jump bidder. If premiums are driven by high-value bidders who tend to jump bid, we would expect to see significantly higher coefficients for J^W than for J^L. The results are presented in Table 6.

Comparing the coefficients of auctions with a jump-bidding winner to those with a jump-bidding loser, or losers, we find that the jump-bid coefficients are very similar throughout and not significantly different from each other. The same results are found when considering winners and losers among one jump bidder and second jump bidder cases separately (not reported). Alternatively, we use individual bidders' highest bids as proxies to calculate each auction's standard deviation of valuations. Although the high bids are not perfect representations of individual valuations, the survey results in Figure 1 indicate that most bidders bid up to their valuation. A higher standard deviation indicates a higher probability that one or more bidders have overvalued the object (for example, due to uncertainty, see Bazerman and Samuelson (1983)). By adding the standard deviation as an explanatory variable in equation 1, we can control for some of the potential bias stemming from unobserved valuations. As shown in Table A3 in the Appendix, we do find that a broader distribution of valuations has a positive price premium impact, yet the jump-bid coefficients remain consistent. Although we cannot completely reject the possibility of omitted variable bias in terms of unobserved valuation, these results suggest that the potential issue is a minor concern.

For the main estimation, equation 1, we have used two supplementary mass-valuation methods in place of the asking price – a hedonic valuation and a repeat sales valuation. Although the hedonic valuation may be subject to issues of unobserved quality, it will remain robust to the possibility of any pricing strategy related to the asking price. We also expand this valuation sample to include nearly 27,000 transactions from the same period and location as the auction journal sample in order to achieve more accurate price estimates. The repeat sales valuation, created by Bailey et al. (1963), is similar to a fixed-effects model, where we are able to control for micro-location using previous sales of the same dwelling as the explanatory variable, effectively controlling for unobserved dwelling characteristics. We use a subsample of dwellings that have been sold at least one previous time, and apply the weighted repeat sales method introduced by Case and Shiller (1987) to account for differences in quality upgrading between sales. The results are reported in Tables A4 and A5 in the Appendix, and largely support the findings presented in Table 2. While we observe jump-bid coefficients of a higher magnitude, possibly because of the different valuation methods for the price premium, the results support the notion that auctions containing jump bids achieve a premium compared with straightforward-bidding auctions.

Although the survey data examined in the data section indicates that absolute values are most appropriate to use regarding bidders' perceptions of jump bids, we also consider relative values. In Table A6 in the Appendix, we again estimate equation 1, but the jump-bid variable, J, now indicates whether the auction contains at least one bid increase equal to or higher than a threshold percentage relative to the opening bid. In five different specifications, the threshold values are 2.5, 5.0, 7.5, 10.0 and 15.0 percent, where each specification uses auctions containing bid increases lower than 2.5 percent relative to the opening bid (straightforward bidding) as the reference group and control for intermediate bidding. We find the jump-bid coefficients to be of similar sign, significance and magnitude as the results in Table 2.

Impatience may be a stronger motivation for placing jump bids early in the auction, especially after a low opening bid signal. Time concerns related to the likely longer interval before the expected price is achieved and the upwards correction of a low opening bid signal can both be dealt with by placing a high bid increase, without intimidation being the original intention. To control for this, we rerun the equation 1 regressions twice, with stricter definitions of jump bids, whereby we only consider bid increases after a standing high bid of at least 80 percent or 100 percent of the asking price, respectively. Overall, the results remain robust to these constraints.[13]

While most of the removed single-bidder auctions show clear signs of being de facto negotiations, we identify 100 auctions with pre-emptive bidding that may have prevented potential buyers from participating. By including these observations in equation 1 and controlling for the possibility of unobserved deterred participants, we find that at least two potential bidders must have been discouraged from participating for pre-emptive jump bidding to be profitable. However, given the minor impact found in Sønstebø et al. (2020), this seems unlikely.

Lastly, although the majority of sales observations lie within the NOK 2–4 million market segment, which was used in the survey, we also want to control for the possibility of more heterogeneity in objects at the tail ends of the market. This is to make sure that the premiums are not driven by any potential systematic bias in the pricing of these dwellings. We run all regressions with controls for high-end (asking price higher than NOK 4,000,000) and low-end (asking price lower than NOK 2,000,000) segments and find that the results are largely consistent and robust across all regressions.[14]

Conclusion

In this paper, we examined how jump-bidding strategies in English auctions impact price premiums, combining survey results with unique auction journal data from the Norwegian real estate market. Analysing respondents' answers to a questionnaire concerning real estate auctions and bidding strategies, we find that most bidders consider intimidation and signalling to be the main motivations for applying a jump-bidding strategy, together with impatience as a central factor. While some bidders prefer to place either low or high bid increases, the majority appear to have no predetermined strategy in mind, adjusting their actions according to the signals given by the competition. As proposed by Avery (1998), Daniel and Hirshleifer (2018) and others, intimidation strategies applied by the competition seem to be an important reason for bidders withdrawing from an auction. Nevertheless, our results indicate that the majority bid up to the level they are willing to pay before withdrawing, adhering to the standard ratchet solution put forth by Vickrey (1961). Furthermore, our findings suggest that for the price levels relevant in this study, both straightforward and jump bids are more aptly perceived as fixed than directly proportional to the price level.

Using this information as a basis for further analysis, we use a sample of 1,142 auction journals and find that, in our base model, auctions containing jump bids achieve 2.8–9.3 percent higher price premiums compared to strictly straightforward-bidding auctions. These results hold true in a number of robustness checks. Closer inspection reveals that when the intimidation strategy fails and competing bidders counter with jump bids, the premium is even higher, even when controlling for opening bid interaction effects. We also find that the first jump bids are usually placed at the earliest stage of the auction and have a stronger intimidation effect the earlier they are placed, despite having an overall positive effect on the premium. Our findings are robust even after applying hedonic and repeat sales mass valuations and after attempting to control for the potential omitted variable bias where bidders with high individual valuations may be more likely to place jump bids.

The results are not surprising when considering that the Norwegian auction process is more in line with the universe of Vickrey (1961) where there are no bidding costs – in contrast to the assumptions of Daniel and Hirshleifer (2018) – and therefore little incentive to withdraw early rather than bidding up to one's valuation. Although the price premium we find is in accordance with the increased seller revenue that impatient bidders might be willing to forego in exchange for a more efficient auction, proposed by Isaac et al. (2005, 2007), we find no evidence that auction duration decreases as a result of jump bidding.

We contribute to the existing auction literature by studying jump bidding in a firmly regulated sales process where private actors invest in high-value objects. Bidding strategies are important for both sellers and buyers in formal auctions and in various auction-like settings, such as real estate sales in high-demand areas. Sellers and auction regulators need to be aware of the price effect generated by different buyer strategies when choosing the optimal sales format, and policy makers must consider the market effects of allowing buyers to bid aggressively, which could be a bubble-contributing factor.

Notes

1. For a comprehensive overview of auction theory and developments in the auction literature, see e.g., Stark and Rothkopf (1979), Engelbrecht-Wiggans (1980), McAfee and McMillan (1987), and Klemperer (2018).
2. More than 80 percent of our sample auctions were completed within one day of the first bid being submitted, and a further 10 percent completed within two days.
3. While this means that the survey sample is skewed towards recent winners, no substantial differences are found when controlling for this throughout the survey data section.
4. NOK 1 ≈ EUR 0.10; NOK 1 ≈ USD 0.12 (per 31.12.2019).
5. Eiendomsverdi.no is an online provider of the Norwegian property register.
6. We define the price premium as $p = \ln P^{sales} - \ln P^{ask} \approx \left(\left(P^{sales} - P^{ask}\right)/P^{ask}\right)$.
7. See Table A1 for more details about these and other specifications and distribution of the jump-bid variables.
8. See also the robustness checks where jump bids are considered in relative terms and where asking price is replaced by repeat sales and hedonic valuation.
9. See Table A2 in the Appendix for correlations.
10. Complete results are available from the authors upon request.
11. An opening bid equal to the asking price gives ln(opening bid ratio) = ln(1) = 0, making the interaction terms zero.
12. See Table A1 for more details about these and other specifications and distributions of the jump-bid variables.
13. Results available from the authors upon request.
14. Results available from the authors upon request.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Aras Khazal is a PhD research scholar at NTNU Business School, Norwegian University of Science and Technology. His primary area of research focuses on real estate economics and behavioural economics. A former board member of NTNU Business School, Khazal is currently a member of the Center for Real Estate and Environmental Economics, board deputy member of NTNU Faculty of Economics and Management and safety deputy at NTNU Business School. Khazal has functioned as a referee for the Energy Journal.

Ole Jakob Sønstebø is a PhD research scholar at NTNU Business School, Norwegian University of Science and Technology, and a member of NTNU Center for Real Estate and Environmental Economics. His research interests include real estate finance and economics, auctions and behavioural economics.

Jon Olaf Olaussen is professor of economics at NTNU Business School, Norwegian University of Science and Technology. He is vice dean at the Faculty of Economics and Management and head of NTNU Center for Real Estate and Environmental Economics. Olaussen holds a PhD in Economics from Norwegian University of Science and Technology (NTNU). His research interests include natural resource economics, environmental economics, and real estate economics.

Are Oust is associate professor of financial economics at NTNU Business School, Norwegian University of Science and Technology and adjunct associate professor at Norwegian School of Economics. He is the deputy head of NTNU Center for Real estate and Environmental Economics. Oust holds a PhD in Economics from Norwegian University of Science and Technology (NTNU). His primary area of research focuses on real estate finance and economics and empirical finance. Oust has published in journals such as *Journal of Real Estate Finance and Economics, International Journal of Housing Policy* and *International Journal of Housing Markets and Analysis*.

ORCID

Ole Jakob Sønstebø http://orcid.org/0000-0002-7726-0148

References

Avery, C. (1998). Strategic jump bidding in English auctions. *The Review of Economic Studies*, *65*(2), 185–210. https://doi.org/10.1111/1467-937X.00041

Bailey, M. J., Muth, R. F., & Nourse, H. O. (1963). A regression method for real estate price index construction. *Journal of the American Statistical Association*, *58*(304), 933–942. https://doi.org/10.1080/01621459.1963.10480679

Banks, J., Olson, M., Porter, D., Rassenti, S., & Smith, V. (2003). Theory, experiment and the federal communications commission spectrum auctions. *Journal of Economic Behavior & Organization*, *51*(3), 303–350. https://doi.org/10.1016/S0167-2681(02)00149-X

Bazerman, M. H., & Samuelson, W. F. (1983). I won the auction but don't want the prize. *Journal of Conflict Resolution*, *27*(4), 618–634. https://doi.org/10.1177/0022002783027004003

Case, K. E., & Shiller, R. J. (1987). *Prices of single family homes since 1970: New indexes for four cities*. National Bureau of Economic Research.

Daniel, K. D., & Hirshleifer, D. (2018). A theory of costly sequential bidding. *Review of Finance*, *22*(5), 1631–1665. https://doi.org/10.1093/rof/rfy009

Easley, R. F., & Tenorio, R. (2004). Jump bidding strategies in internet auctions. *Management Science*, *50*(10), 1407–1419. https://doi.org/10.1287/mnsc.1040.0286

Engelbrecht-Wiggans, R. (1980). State of the art—auctions and bidding models: A survey. *Management Science*, *26*(2), 119–142. https://doi.org/10.1287/mnsc.26.2.119

Genesove, D., & Mayer, C. (2001). Loss aversion and seller behavior: Evidence from the housing market. *The Quarterly Journal of Economics*, *116*(4), 1233–1260. https://doi.org/10.1162/003355301753265561

Grether, D., Porter, D., & Shum, M. (2011). *Intimidation or impatience? Jump bidding in on-line ascending automobile auctions*. ESI Working Paper 11-07. Retrieved from http://digitalcommons.chapman.edu/esi_working_papers/101

Han, L., & Strange, W. C. (2014). Bidding wars for houses. *Real Estate Economics*, *42*(1), 1–32. https://doi.org/10.1111/reec.12015

Han, L., & Strange, W. C. (2016). What is the role of the asking price for a house? *Journal of Urban Economics*, *93*, 115–130. https://doi.org/10.1016/j.jue.2016.03.008

Haruvy, E., & Leszczyc, P. T. P. (2010). The impact of online auction duration. *Decision Analysis*, *7*(1), 99–106. https://doi.org/10.1287/deca.1090.0149

He, Y., & Leszczyc, P. T. P. (2013). The impact of jump bidding in online auctions. *Marketing Letters*, *24*(4), 387–397. https://doi.org/10.1007/s11002-013-9228-3

Herrmann, P., Kundisch, D., & Rahman, M. S. (2016). *To bid or not to bid aggressively?: An empirical study*. Universitätsbibliothek.

Hungria-Gunnelin, R. (2013). Impact of number of bidders on sale price of auctioned condominium apartments in Stockholm. *International Real Estate Review*, *16*(3), 274–295. https://www.um.edu.mo/fba/irer/papers/current/vol16n3_pdf/03.pdf

Hungria-Gunnelin, R. (2018). An analysis of auction strategies in apartment sales. *Journal of European Real Estate Research*, *11*(2), 202–223. https://doi.org/10.1108/JERER-12-2017-0043

Industry Norm. (2014). *Bransjenorm for markedsføring av bolig*. Retrieved from https://www.forbrukerradet.no/wp-content/uploads/2015/10/Bransjenorm-oppdatert-versjon-2014.pdf.

Isaac, R. M., Salmon, T. C., & Zillante, A. (2005). An experimental test of alternative models of bidding in ascending auctions. *International Journal of Game Theory*, *33*(2), 287–313. https://doi.org/10.1007/s00182-005-0203-y

Isaac, R. M., Salmon, T. C., & Zillante, A. (2007). A theory of jump bidding in ascending auctions. *Journal of Economic Behavior & Organization*, *62*(1), 144–164. https://doi.org/10.1016/j.jebo.2004.04.009

Klemperer, P. (2018). *Auctions: Theory and practice*. Princeton University Press.

Kwasnica, A. M., & Katok, E. (2007). The effect of timing on jump bidding in ascending auctions. *Production and Operations Management*, *16*(4), 483–494. https://doi.org/10.1111/j.1937-5956.2007.tb00274.x

Marketing Act (2009). Lov om Kontroll med Markedsføring og Avtalevilkår mv. (markedsføringsloven). Available online: https://lovdata.no/NLE/lov/2009-01-09-2 (accessed on 18 May 2020).

McAfee, R. P., & McMillan, J. (1987). Auctions and bidding. *Journal of Economic Literature*, *25*(2), 699–738. https://www.jstor.org/stable/2726107

Milgrom, P. R., & Weber, R. J. (1982). A theory of auctions and competitive bidding. *Econometrica: Journal of the Econometric Society*, *50*(5), 1089–1122. https://doi.org/10.2307/1911865

Plott, C. R., & Salmon, T. C. (2004). The simultaneous, ascending auction: Dynamics of price adjustment in experiments and in the UK3G spectrum auction. *Journal of Economic Behavior & Organization*, *53*(3), 353–383. https://doi.org/10.1016/j.jebo.2003.01.003

Regulation on Real Estate (2007). Forskrift Om Eiendomsmegling. Available online: https://lovdata.no/forskrift/2007-11-23-1318 (accessed on 18 May 2020).

Stark, R. M., & Rothkopf, M. H. (1979). Competitive bidding: A comprehensive bibliography. *Operations Research*, *27*(2), 364–390. https://doi.org/10.1287/opre.27.2.364

Sønstebø, O. J. (2017). *Bidding Round Survey Report. Working Paper* NTNU.

Sønstebø, O. J., Olaussen, J. O., & Oust, A (2020). Opening bid strategies in English auctions. *[Forthcoming in] Journal of Real Estate Research*

Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *The Journal of Finance*, *16*(1), 8–37. https://doi.org/10.1111/j.1540-6261.1961.tb02789.x

Appendix

Table A1. Bid variable specifications and distributions.

Variables and threshold values (NOK)	N	% of total	% of *J*
Straightforward bidding:			
–Lower than 50,000	141	12.3	
Jump bid (J):			
50,000 or higher	1,001	87.7	100.0
100,000 or higher	577	50.5	100.0
150,000 or higher	281	24.6	100.0
200,000 or higher	176	15.4	100.0
300,000 or higher	77	6.7	100.0
One jump bidder (J^1):			
50,000 or higher	362	31.7	36.2
100,000 or higher	399	34.9	69.2
150,000 or higher	249	21.8	88.6
200,000 or higher	159	13.9	90.3
300,000 or higher	72	6.3	93.5
Second jump bidder (J^S):			
50,000 or higher	639	56.0	63.8
100,000 or higher	178	15.6	30.8
150,000 or higher	32	2.8	11.4
200,000 or higher	17	1.5	9.7
300,000 or higher	5	0.4	6.5
*FJB*1:			
50,000 or higher	755	66.1	75.4
100,000 or higher	387	33.9	67.1
150,000 or higher	184	16.1	65.5
200,000 or higher	134	11.7	76.1
300,000 or higher	64	5.6	83.1
*FJB*2:			
50,000 or higher	152	13.3	15.2
100,000 or higher	90	7.9	15.6
150,000 or higher	50	4.4	17.8
200,000 or higher	23	2.0	13.1
300,000 or higher	10	0.9	13.0
*FJB*3:			
50,000 or higher	94	8.2	9.4
100,000 or higher	100	8.8	17.3
150,000 or higher	47	4.1	16.7
200,000 or higher	19	1.7	10.8
300,000 or higher	3	0.3	3.9

Note: The straightforward-bidding variable takes the value 1 if all bid increases are lower than the threshold value, and 0 otherwise. All J, J^1 and J^S specifications take the value 1 if the auction contains at least one bid increase in accordance with the given threshold value, and 0 otherwise. *FJB*1: First jump bid placed at the first bid increase. *FJB*2: First jump bid placed at the second bid increase. *FBJ*3: First jump bid placed at the third or later bid increase. Total N = 1,142.

Table A2. Jump bid correlations with number of bidders and duration.

	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
Number of bidders	0.1341***	0.1523***	0.1394***	0.1503***	0.0666**
Duration (log)	0.0260	0.0689**	0.0876***	0.0880***	0.0748**

Note: The table shows Pearson correlations with significance levels.
N = 1,141. ** $p < 0.05$, *** $p < 0.01$.

Table A3. Price premium estimations with valuation control – equation 1.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
Jump bid (J)	0.0239***	0.0396***	0.0537***	0.0613***	0.0867***
	(0.0055)	(0.0067)	(0.0071)	(0.0078)	(0.0105)
Intermediate bidding (I)	–	0.0184***	0.0240***	0.0252***	0.0283***
		(0.0054)	(0.0054)	(0.0054)	(0.0054)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Valuation SD	0.0056***	0.0045***	0.0045***	0.0045***	0.0044***
	(0.0016)	(0.0015)	(0.0014)	(0.0014)	(0.0014)
Constant	–0.0119	0.0159	0.0356	0.0327	0.0313
	(0.0343)	(0.0337)	(0.0350)	(0.0345)	(0.0342)
Attributes and FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.536	0.549	0.556	0.558	0.564
Observations	1,142	1,142	1,142	1,142	1,142

Note: Auction-specific variables not reported. Valuation SD is the auction-wise (log) standard deviation of individual high bids. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A4. Price premium estimations based on hedonic valuation – equation 1.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
Jump bid (J)	0.0605***	0.0970***	0.1030***	0.1285***	0.1672***
	(0.0199)	(0.0214)	(0.0229)	(0.0245)	(0.0317)
Intermediate bidding (I)	–	0.0369*	0.0549***	0.0569***	0.0630***
		(0.0202)	(0.0200)	(0.0200)	(0.0199)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Constant	–0.0180	–0.0122	–0.0113	–0.0092	–0.0140
	(0.0217)	(0.0214)	(0.0218)	(0.0217)	(0.0218)
Fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.186	0.205	0.195	0.201	0.201
Observations	1,142	1,142	1,142	1,142	1,142

Note: Estimated equation: $p_i = \alpha + \gamma_1 J_i + \gamma_2 I_i + \delta' A + \beta' X + F + \varepsilon_i$, where $p_i = \ln(salesprice/hedonicpriceestimate)$, and the hedonic price estimate is based on a regression of 26,868 observations in the same geographical area and time period as the auction journal sample. Auction-specific variables not reported. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5. Price premium estimations based on repeat sales valuation – equation 1.

Variables	Jump bid ≥ 50,000	Jump bid ≥ 100,000	Jump bid ≥ 150,000	Jump bid ≥ 200,000	Jump bid ≥ 300,000
Jump bid (J)	0.0639***	0.0928***	0.1304***	0.1447***	0.1365**
	(0.0230)	(0.0269)	(0.0345)	(0.0414)	(0.0677)
Intermediate bidding (I)	–	0.0460*	0.0572**	0.0628***	0.0658***
		(0.0241)	(0.0227)	(0.0229)	(0.0231)
Straightforward bidding	Ref.	Ref.	Ref.	Ref.	Ref.
Constant	–0.0469	–0.0445	–0.0322	–0.0338	–0.0402
	(0.0304)	(0.0304)	(0.0295)	(0.0294)	(0.0292)
Fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.217	0.224	0.229	0.229	0.220
Observations	731	731	731	731	731

Note: Estimated equation: $p_i = \alpha + \gamma_1 J_i + \gamma_2 I_i + \delta' A + \beta' X + F + \varepsilon_i$, where $p_i = \ln(salesprice/repeatsalespriceestimat)$, and the repeat sales price estimate is based on a weighted repeat sales regression of 2,134 pairs of sales observations from dwellings with more than one sale in the auction journal sample. Auction-specific variables not reported. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6. Price premium estimations with jump bids as relative values – equation 1.

Variables	Jump bid ≥ 2.5%	Jump bid ≥ 5.0%	Jump bid ≥ 7.5%	Jump bid ≥ 10.0%	Jump bid ≥ 15.0%
Jump bid (J)	0.0263***	0.0502***	0.0798***	0.0946***	0.1014***
	(0.0037)	(0.0056)	(0.0077)	(0.0094)	(0.0117)
Intermediate bidding (I)	–	0.0181***	0.0238***	0.0257***	0.0276***
		(0.0036)	(0.0035)	(0.0035)	(0.0035)
Straightforward bidding (<2.5%)	Ref.	Ref.	Ref.	Ref.	Ref.
Constant	−0.0074	−0.0013	0.0061	0.0071	0.0129
	(0.0320)	(0.0313)	(0.0294)	(0.0294)	(0.0309)
Fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.538	0.564	0.591	0.593	0.571
Observations	1,142	1,142	1,142	1,142	1,142

Note: Estimated equation: $p_i = \alpha + \gamma_1 J_i + \gamma_2 I_i + \delta' A + \beta' X + F + \varepsilon_i$,, where J_i is a dummy taking the value 1 if the auction contains at least one bid increase relative to the opening bid that is equal to or higher than 2.5%, 5%, 7.5%, 10% or 15%, respectively, for each specification, and 0 otherwise. Auction-specific variables not reported. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$