Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Economics and Management
NTNU Business School

Henrik Tangen Karlsen & Simen Ramsøy Dalland

An examination of time factors in Norwegian real estate auctions

A quantitative study to examine the effects of the acceptance deadline and the response time utilized in Norwegian real estate auctions on the dwelling's price premium and sales price

Master's thesis in Business Administration & Management
Supervisor: Are Oust
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Preface

This master thesis is our final work for our Master's degree in Business Administration & Management with a major in finance, at the Norwegian School of Science and Technology (NTNU) in Trondheim. The thesis account for 30 credits and was written during the spring of 2020.

The purpose of this study has been to study specific bidding factors, the acceptance deadline and the response time, in order to help buyers navigate through the process of getting the lowest sales price in an auction. During this process, we have acquired experience utilizing different research tools and a great deal of knowledge surrounding the Norwegian real estate auction.

We would like to thank our supervisor Are Oust for the great guidance during this term. We would also like to thank Ole Jacob Sønstebø and Randi Hammervold for valuable feedback and help with this paper.

Abstract

Buying a dwelling has been and still is a large investment for most Norwegians. Getting the lowest sales price is therefore important for buyers, and a strategy they may apply for achieving this is being aggressive in auctions. The purpose of this paper is to examine the effect of this strategy on the dwelling's price premium and sales price, and it defines aggressive behavior as shortening the acceptance deadline and the response time as part of an aggressive strategy. These effects are measured by applying regression models and SEM-models. We also control for the bid increase and the opening bid ratio, that are two other variables which measure aggressive behavior. In addition, we control for the number of bidders. The input are data from a set of auction journals recorded in the period 2014-2016 and a survey regarding real estate auction conducted between 2016 and 2017. To our knowledge, this is the first study to include these factors in a structural equation modeling-model (SEM). We find that a use of this aggressive strategy is associated with higher price premiums and sales prices. For potential buyers, this implies that using a non-aggressive strategy is a better approach for obtaining the dwelling at the lowest possible sales price in an English auction.

Sammendrag

Kjøp av bolig har vært og er fremdeles en stor investering for de fleste nordmenn. En lavest mulig pris er dermed viktig for kjøperne og en mulig strategi som kan brukes for å oppnå dette er å være aggressiv i auksjonen. Hensikten med denne artikkelen er å undersøke effekten av denne strategien på boligens gevinst og salgspris, og den definerer aggressiv atferd som å sette en kortere akseptfrist og å respondere raskere som del av en aggressiv strategi. Effektene er målt ved å anvende både regresjonsmodeller og SEM-modeller. Vi kontrollerer også for budøkning og åpningsbud, som er to andre variabler som måler aggressiv atferd. I tillegg kontrollerer vi for antall budgivere. Innmaten er data fra en samling av auksjonsjournaler fra perioden 2014 til 2016 og en spørreundersøkelse som omhandler boligauksjoner gjennomført mellom 2016 og 2017. Til vår kjennskap er dette den første studien som inkluderer disse faktorene i en SEM-modell. Vi finner ut at å anvende en aggressiv strategi assosieres med høyere gevinster og salgspriser. For potensielle kjøpere vil dette innebære å bruke en ikke-aggressiv strategi for å oppnå lavest mulig pris på boligen.

Table of Contents

List of tables

Appendix

List of figures

1 Introduction

Buying a dwelling has been and still is a large investment for most Norwegians. 77 percent of them own their own dwelling (SSB, 2017). Because of this fact, it is important for buyers to acquire knowledge about the process of buying a dwelling. Transactions in the Norwegian real estate market are based on an English auction model, where the market dictates the price of dwellings. The Norwegian market experienced a strong growth in prices since the financial crisis of 2009 (Eiendom Norge AS, personal communication, 16. March 2020), and it is likely to assume that most auctions have ended up with a high price premium during this period. From this perspective, it may be reasonable for buyers to assume that real estate is a safe long-term investment. This type of mindset could be a contributor for buyers to use an aggressive behavior in order to maximize their chances at winning a real estate auction. However, to win an auction by blatantly using an aggressive behavior is not necessarily the optimal investment strategy. Buyers should acquire a deeper understanding in the use of this type of strategy, and this knowledge could be helpful in obtaining the dwelling at the lowest possible price. This paper defines aggressive behavior as shortening the acceptance deadline and the response time as part of an aggressive strategy. *The aim of this paper is to examine the effects of the acceptance deadline and the response time utilized in Norwegian real estate auctions on the dwelling's price premium and sales price*.

There are several studies that have explored different factors as measurements for aggressive behavior in auctions (Sønstebø, Olaussen and Oust, 2020; Khazal, Sønstebø, Olaussen and Oust, 2020; Hungria-Gunnelin, 2013; Hungria-Gunnelin, 2018). Most of these studies focuses on the size of the bid as the only strategy tool, where the use of opening bid and jump bidding in auctions are analyzed in relation to the sales price. This type of research has for the most part excluded the time factors. Sønstebø, Olaussen and Oust (2020) analyze the effect of opening bid strategies in English auctions, while Khazal, Sønstebø, Olaussen and Oust (2020) study the effect of jump bidding strategies in English auctions. Hungria-Gunnelin (2013) studies whether the number of bidders have an impact on the sales price in the Swedish housing market. In Hungria-Gunnelin (2018), she expands her research by adding several new factors that could have an impact on the sales price.

We apply two datasets to study strategies based on the time factors in this paper. The first dataset is a survey (Sønstebø, 2017) regarding real estate auctions. The majority of the 1,803 respondents believe that both a short response time and a short acceptance deadline, can be used as strategy tools to obtain a house at the lowest possible price. Based on these answers, we will in this paper discuss the role of the response time and the acceptance deadline in auctions. The next dataset we use in this paper, is a dataset including 2,257 auction journals from property sales in two Norwegian counties, Trøndelag and Møre og Romsdal. This gives us the opportunity to uncover the effects of the time factors as part of an aggressive strategy. To uncover these effects on the price premium and sales price, we estimate several regression models and structural equations modeling-models (SEM). We also control for the bid increase and the opening bid ratio, that are two other variables which measure aggressive behavior. In addition, we control for the number of bidders. To our knowledge, we are the first to study the time factors in English auctions by applying SEM-models.

In most of the regressions we compare the sales price with the asking price set by the real estate agency, and this ratio is used as the dependent variable. In addition, we estimate a few hedonic regression models where the sales price is used as the dependent variable. These hedonic regressions include some external features with the purpose of explaining the value of the dwelling. We estimate some SEM-models with the purpose of revealing the direct and the indirect effects that may occur in an auction.

We find through our estimations that an aggressive strategy has a positive impact on the price premium and the sales price. We observe that a shorter response time has a positive effect on the price premium and the sales price. We also observe that a shorter acceptance deadline has a positive effect on the price premium and the sales price.

The paper is further presented in the following sections. Section 2 is divided into two parts and provides a literature review and an overview of the Norwegian housing market and the Norwegian real estate auction process. Section 3 gives a description of the data, and the methodology is presented in Section 4. The results are presented in Section 5, followed by a discussion section in Section 6.

2 Literature review and background

2.1 Literature review

Hungria-Gunnelin (2013) studies the impact that the number of bidders has on the sales price of apartments in Stockholm. By applying hedonic equations using a dataset of 512 auctions, the study finds that an increase in the number of bidders increases the sales price of an apartment. Hungria-Gunnelin (2018) bases her research on what previous literature calls “auction fever”. This phenomenon appears in real estate auctions when time pressure makes the bidders act irrational, and this irrational behavior can result in bids that exceed an individual's budget limit. By estimating regression models using data from 629 auctions, Hungria-Gunnelin finds a positive correlation between the speed of the auction and the number of bidders in the Swedish housing market. She also finds a positive correlation between the speed of the auction and the sales price. Furthermore, the study finds a relationship between the average bid increment and the sales price. It illustrates that a higher average bid increment yields a higher sales price.

Sønstebø, Olaussen and Oust (2020) focuses on using opening bid as a factor for aggressive behavior in English auctions. Through an empirical analysis of 2,257 auction journals, they find that the direct price effect is stronger than the intimidation effect in their price premium estimations. The results show that an aggressive opening bid strategy lead to a higher sales price. Another interesting finding in the study, is that an increase in the opening bid has a quite small impact on the number of bidders. A one percent increase in the opening bid lead to a decrease of 0.8 percent in the number of bidders.

Another study, Khazal, Sønstebø, Olaussen and Oust (2020), concentrates on using jump bidding as a factor for aggressive behavior in English auctions. By using survey results, they find that most bidders have signaling, intimidation and impatience as motivation for applying a jump bidding strategy. As in the previous study we presented, they conclude from an empirical analysis of 1,142 auction journals that the direct price effect is stronger than the intimidation effect. Despite of this overall positive effect on the price premium, the study also illustrates that the intimidation effect becomes stronger the earlier the jump bids are placed in the auction.

Other theoretical papers, like Avery (1998), claim opposite results, concluding that jump bidding can be used as signaling or communicating among other bidders to create an advantage. By using jump bidding as a strategy, the buyer can achieve a lower sales price for the dwelling being auctioned off. Daniel and Hirshleifer (2018) is another theoretical paper that support this claim. They conclude that applying an aggressive strategy in form of placing jump bids to intimidate and reduce the number of bidders, can result in a lower price premium. Hungria-Gunnelin (2013, 2018) as we mentioned earlier, describe the possibility of achieving a reduction in the number of bidders by signaling a high valuation in an early stage of the auction. Despite this, there is no evidence that a strategy including intimidation contributes to a reduced sales price. Hörner and Sahuguet (2007) tries to analyze an auction where bidders use jump bidding as signaling to other bidders. The goal for this type of bidding strategy can cause different types of effects, like deterrence effect where other bidders quit the auction, or an escalation where the other bidders stay in the auction. This paper concludes that signaling can be effective, but there are also cases where it can be a disadvantage.

A common problem in the housing market has been the deceiving use of the asking price. This means that the asking price is used as a strategic tool for selling, rather than showing the dwelling's correct market value. Several studies done by the Consumer Authority support this. The Consumer Authority conducts regular inspections of real estate firms to prevent cases of underpricing, which seem to work as intended (Forbrukertilsynet, 2016). Han and Strange (2016) study the role of the asking price in the housing market. Through a search model, they find that a lower asking price increases the number of bidders in the auction, but only to a certain point.

Levin and Pryce (2007) illustrates that a change in the number of bids from 1 to 4 increases the probability of a higher maximum bid. But in the same illustration, they find that a similar change in the number of bids decreases the probability of a higher average bid. There is also previous literature that investigates the impact that time restrictions have on a housing market. Rosenthal (2009) use a Poisson test to establish if there is an imbalance between the seller and the real estate agent's incentive when a deadline is introduced. This paper conclude that the presence of a deadline shall not influence the real estate agent to pressure the seller to accept a lower asking price.

2.2 The process of a Norwegian real estate auction

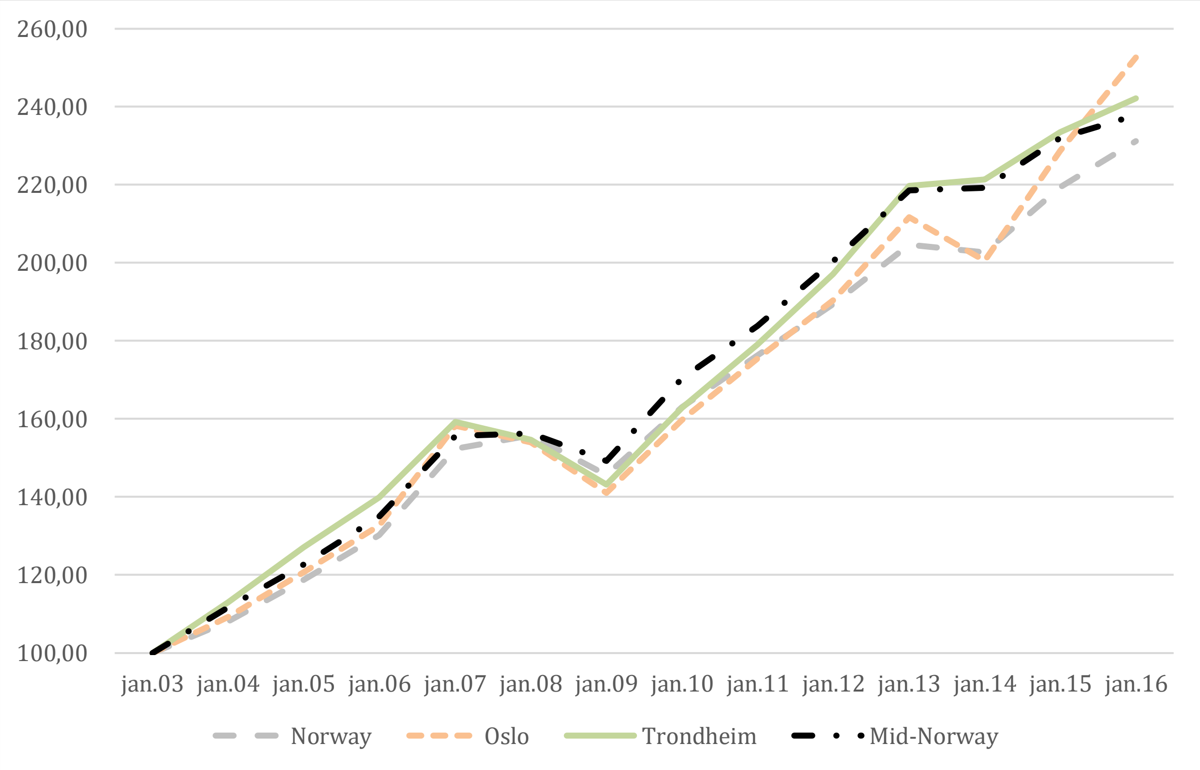
In Norway, there are several standard rules regarding to how the auction should be conducted. The seller of the dwelling employs a real estate agent, and this agent will provide the seller with information about relevant bids on the dwelling. All bids from the bidders are sent to the agent in written form, and the agent informs the seller about the bids. Before the agent informs the seller, he needs to obtain valid identification and signature from the bidder. The requirement of identification and signature can be met by using different types of e-signature, such as BankID or MinID. A bid should include the address of the property, size of the bid, bidder’s contact information, acceptance deadline, plan for financing, and a closing date (Norges Eiendomsmeglerforbund, 2014).

The real estate agent is responsible for facilitating a proper settlement of the auction. The agent shall not relay bids with an acceptance deadline set earlier than 12:00 pm the first business day after the last advertised viewing. After the first deadline, the bidders should set an acceptance deadline that gives the agent enough time to inform the seller and the other bidders. Bids that discriminate or exclude other bidders from the auction, or bids set with an acceptance deadline that is obviously too short for the agent to conduct the auction in a proper manner, will be dissuaded by the agent. As far as necessary, the agent shall keep the bidders informed of new and higher bids. He/she shall also confirm to the bidders in writing as soon as possible after their bid has been received (Forskrift om eiendomsmegling, 2007, § 6-3).

When the trade has come to an end, or if the auction ends without a completed transaction, the bidders who have participated can request a copy of the auction journal in anonymized form. The buyer and seller shall also receive a copy of the auction journal after the trade has been completed (Norges Eiendomsmeglerforbund, 2014).

2.3 The Norwegian housing market

Figure 1. House price index.



Notes: House price index from 2005-2016 in Norway, Oslo, Trondheim and Mid-Norway. The figure shows the house price index for all types of dwellings. The house price index has a base value of 100 in January 2003. Data source: Eiendom Norge AS (Eiendom Norge AS, personal communication, 16. March 2020).

Since all our auction journals originate from Trondheim and Mid-Norway, it would be interesting to observe the development of the house price index in these regions. The dwellings in this paper were all sold in 2014, 2015 or 2016, and we concentrate on these years only. The house price indexes for Trondheim and Mid-Norway of January 2014 were 221.33 and 219.30, respectively. At that time, the house price indexes were close to 200 for Oslo and Norway. We can extract from the figure that Oslo and Norway had a stronger growth than Trondheim and Mid-Norway in the house price indexes from January 2014 to January 2016. The house price indexes for Trondheim and Mid-Norway show an almost equal development during this time. The value for Trondheim was 242.17 in January 2016, while it was 237.85 for Mid-Norway. These house price indexes were somewhat higher than the house price index for Norway at that time. Oslo had in the meanwhile the highest house price index of them all. This data is provided by Eiendom Norge AS.

3 Data

In this paper, we perform our analyzes by utilizing two different datasets. The first dataset is a survey carried out in Trondheim, Stavanger and Oslo, which are three of the largest cities in Norway. The second dataset is a collection of auction journals obtained from two of the largest real estate agencies in the region. The collection contains data from two counties, Trøndelag and Møre og Romsdal.

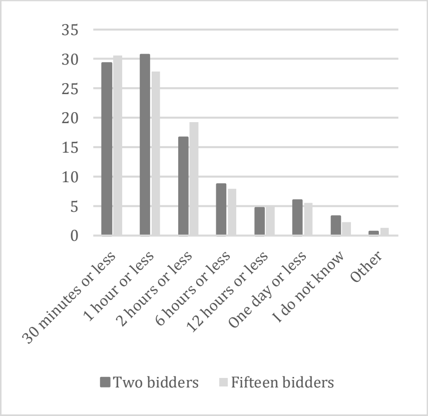
3.1 Survey regarding real estate auctions

A survey, Sønstebø (2017), was conducted between December 2016 and January 2017. The respondents (N=1803) were asked to answer questions regarding strategic bidding behavior in auctions. The purpose of the survey was to map bidders’ knowledge and attitude regarding auction participation.

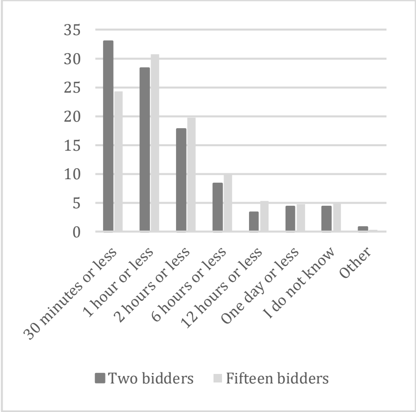
The respondents had to first decide what acceptance deadline they considered to be a short one, and then what they considered to be a long one. The alternatives to choose from were “30 minutes or less”, “1 hour or less”, “2 hours or less”, “6 hours or less”, “12 hours or less”, “One day or less”, “I don't know” or “Other”. Each respondent was presented one of three different scenarios regarding the dwelling’s asking price, and with an associated number of bidders. The asking price in question was either “NOK 2 000 000”, “NOK 3 000 000” or “NOK 4 000 000”, and the number of bidders was either two or fifteen. The number of respondents in each scenario was either 300 or 301. Figures 2 and 3 present the results of these questions.

Figure 2. Question: “What do you consider to be a short acceptance deadline?”.

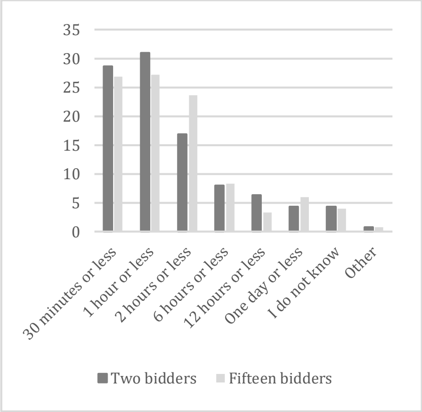
(a) Asking price
NOK 2 000 000



(b) Asking price
NOK 3 000 000



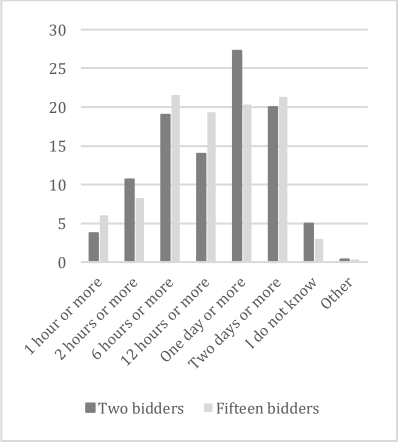
(c) Asking price
NOK 4 000 000



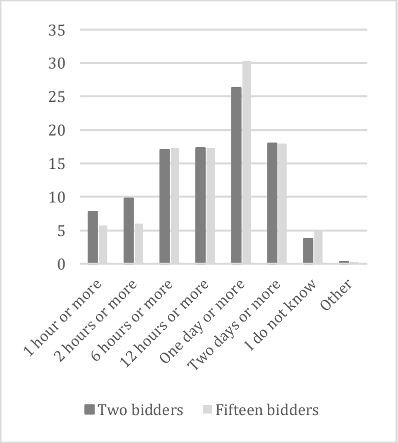
Notes: Responses to the three different scenarios.
The answers in the figure are in percentages.

Figure 3. Question: “What do you consider to be a long acceptance deadline?”.

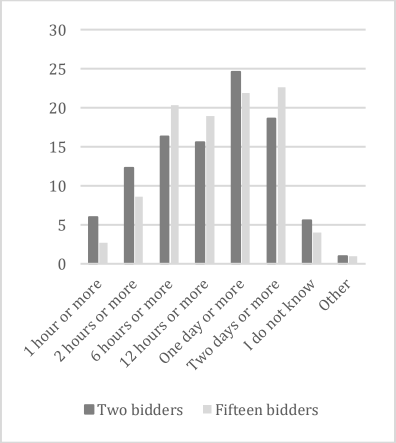
(a) Asking price
NOK 2 000 000



(b) Asking price
NOK 3 000 000



(c) Asking price
NOK 4 000 000



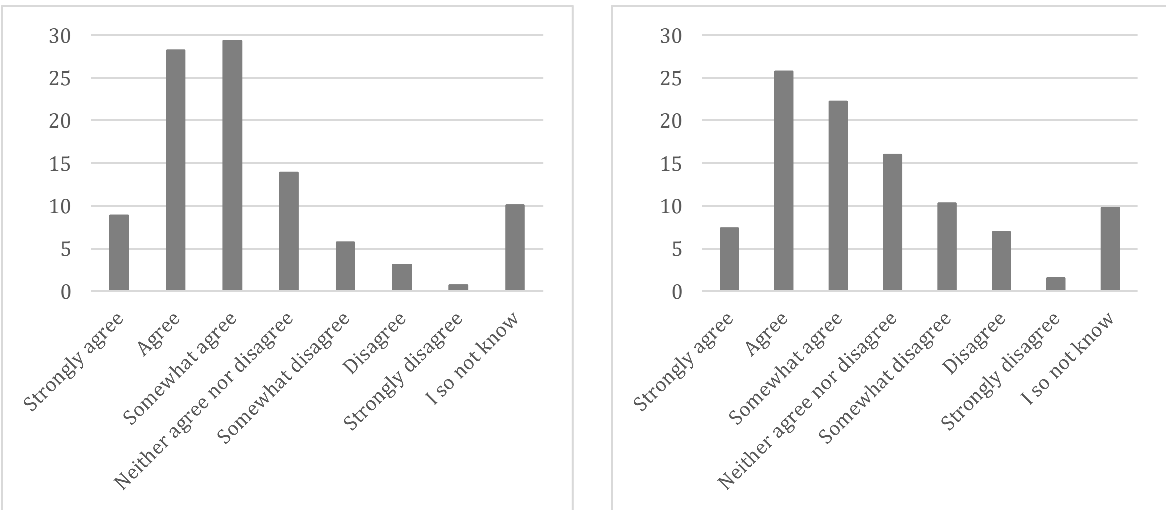
Notes: Responses to the three different scenarios.
The answers in the figure are in percentages.

Regarding what the respondents consider to be a short acceptance deadline, the dominant response is “30 minutes or less” or “1 hour or less”. This result applies to all the scenarios. The answers to what the respondents consider as a long acceptance deadline appear to be more normally distributed in all scenarios. The most popular answer in the cases with two bidders is “One day or more”, but the asking price appears to play a bigger role in the cases with fifteen bidders.

Another section of the survey were several statements the respondents were asked to agree or disagree to, and the answers had to be on a scale from one to seven. Statement 5 is a relevant statement for this thesis, and it goes as follows: “In order to obtain a home at the lowest possible price, it is generally advisable to place bids with short acceptance deadline.”. Another relevant statement for this thesis is statement 6, which goes as follows: “In order to obtain a home at the lowest possible price, it is generally advisable to respond quickly to others’ bid.”. Figure 4 shows the results from these statements.

Figure 4. Statements**.**

(a) Statement 5 (b) Statement 6



Notes: All 1803 responses to both statement 5 and statement 6. (n=601) in Stavanger, (n=600) in Trondheim and (n=602) in Oslo. Figure 4 shows the total results in percentages.

Statement 5 claims that it is advisable to place a bid with a short acceptance deadline, while statement 6 claims that it is advisable to respond quickly to others bid. In other words, an aggressive approach lowers the sales price. The majority of the respondents answer agree or somewhat agree to the statements, respectively 28.2 % and 29.3 % on statement 5, and 25.7 % and 22.2 % on statement 6. The options with the lowest rate on the statements were disagree and strongly disagree. Combining these time factors as a strategy to obtain the lowest possible price seems like a very popular strategy among the respondents in this survey.

3.2 Auction journal data

The data we are analyzing to answer our thesis question is a collection of 2,257 auction journals from two counties in Norway, Trøndelag and Møre og Romsdal. This collection originates from two of the largest real estate agencies in Norway, and the auctions were performed in the period 2014-2016. Each auction journal contains information about the address of the property for sale, the asking price of the property and the sales price of the property. The journals also contain unique information of each bid in the auction, such as timestamp, deadline and ID number for each bidder. In addition, there is also acquired information from *eiendomsverdi.no*. This adds to the information acquired from the auction journals and gives a better insight of the property that is being auctioned off. This information includes type of dwelling, size of the property, number of bedrooms and the age of the building.

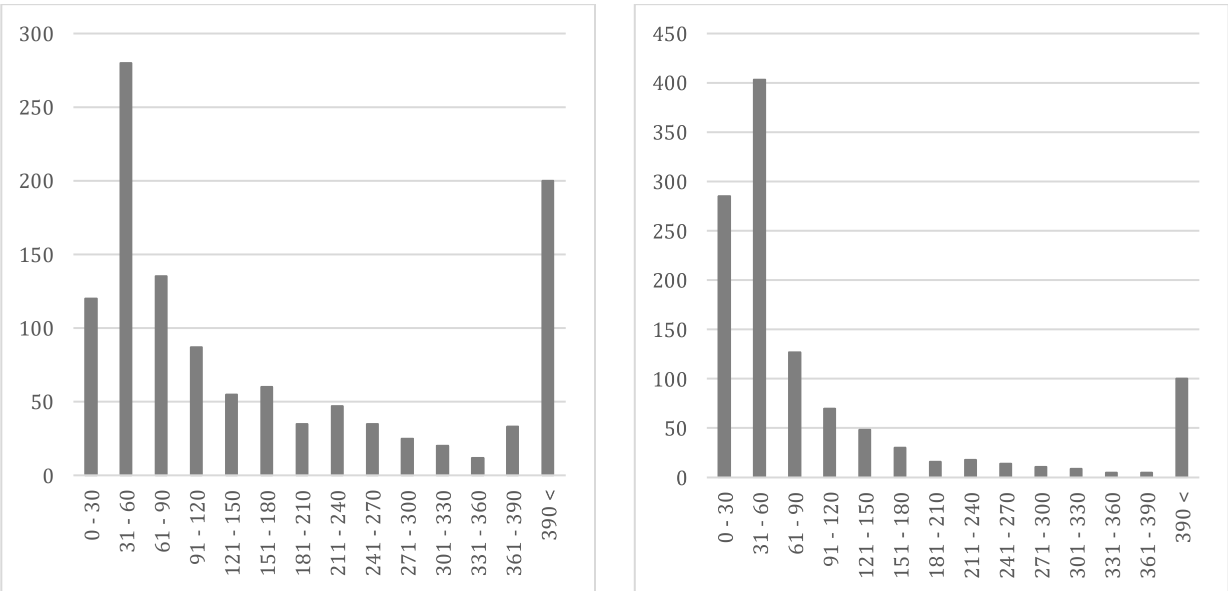
The aim of this paper is to observe the time factors as part of an aggressive bidding strategy and is the reason to exclude the observations that do not give a statistical answer to our topic. Single-bid auctions do not give an opportunity to observe the effect of an aggressive strategy and is therefore not viable as an indicator in this analysis. The same goes for the observations not containing its registered time. After taking this into account, we ended up with 1,152 observations for our set of data.

Furthermore, we present several figures showing the distribution of the average acceptance deadline, the average response time, the average bid increase and the opening bid. Figure 5 presents the distribution of the average acceptance deadline, where (a) represent the average acceptance deadline where we include the deadline for all bids and (b) represent the average acceptance deadline where we exclude the deadline for the first bid. In our data, the first bid often has a longer acceptance deadline than the other bids in the auction. This may be caused by the rule that prevent acceptance deadlines set earlier than 12:00 pm the first business day after the last advertised viewing (Forskrift om eiendomsmegling, 2007, § 6-3). Thus, we decide to exclude the deadline for the first bid. The interval “31-60 minutes” has the highest proportion of observations in (a) and (b). Figure 6 presents the distribution of the average response time, and the interval with the highest proportion of observations is “0-30 minutes”. Given the distribution of the opening bid to asking price ratio (Appendix, Figure A1), we observe that there are very few observations with a ratio lower than 0.80 and higher than 1.00. Given the distribution of the average bid increase (Appendix, Figure A2), we observe that most of these bid increases are equal to or below NOK 100 000.

Figure 5. Distribution of the average acceptance deadline in minutes.

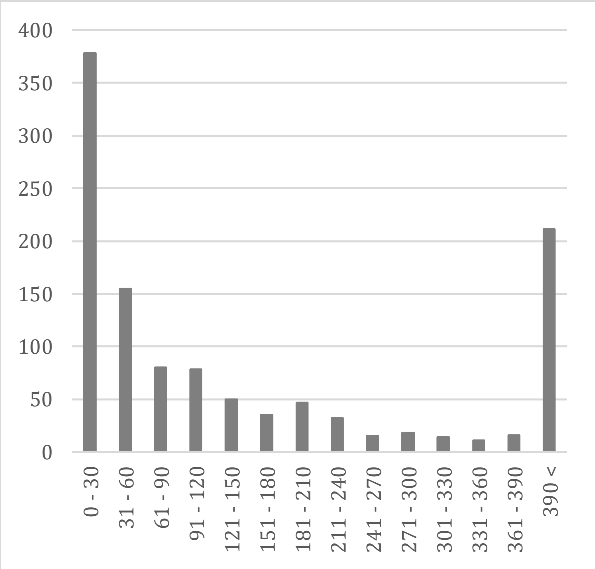
(a) Average acceptance deadline in minutes (including all deadlines)

(b) Average acceptance deadline in minutes (excluding the first deadline)



Notes: Number of observations = 1152.
Figure 5 shows the results of the intervals.

Figure 6. Distribution of the average response time in minutes.



Notes: Number of observations = 1151.
Figure 6 shows the results of the intervals.

The descriptive statistics are divided into two parts, one part related to the bidding process which is given in Table 1 and one part related to the building specifications (Appendix, Table A1). From the descriptive statistics of the bidding process, we observe that the average acceptance deadline including all deadlines has a mean of 320.43 minutes. Furthermore, the mean of the average acceptance deadline excluding the first deadline is 198.42 minutes and the mean of the average response time is 384 minutes. The mean of the number of bidders is nearly 3. Given the descriptive statistics of the building specification, we notice that the mean of the time on market is about 20 days and the mean of the building year is 1970.

Table 1. Descriptive statistics - bidding process.

Variable	Observations	Mean	Standard deviation	Min	Max
Sales price	1,152	NOK 2 711 529	1 266 672	NOK 171 000	NOK 11 000 000
Asking price	1,086	NOK 2 624 070	1 158 720	NOK 300 000	NOK 9 900 000
Opening bid	1,144	NOK 2 377 131	1 121 055	NOK 170 000	NOK 8 000 000
Sales price / Asking price (%)	1,086	105.60	8.54	46.22	166.67
Opening bid / Asking price (%)	1,078	92.53	8.60	20.20	108.79
Average bid increase	1,152	NOK 55 462.99	78 735.9	NOK 0	NOK 1 400 000
Average acceptance deadline (including all deadlines)	1,152	320.43 minutes	697.4594	15 minutes	7 965 minutes
Average acceptance deadline (excluding the first deadline)	1,152	198.42 minutes	677.8436	10 minutes	9 029 minutes
Average response time	1,152	384 minutes	1216.712	0 minutes	22 116 minutes
Number of bids	1,152	8.43	5.276094	2	39
Number of bidders	1,152	2.77	1.142847	2	11

Notes: 2014: € 1 = NOK 8,3548, 2015: € 1 = NOK 8,9410, 2016: € 1 = 9,2928 NOK (Norges Bank, 2020).

4 Methodology

In order to study the effect of an aggressive bidding strategy, we compare the sales price with the estimated value of the dwelling. One method is to use the asking price set by the real estate agent as the estimated value. Another method is to use a hedonic approach where we include some external features as a replacement for the asking price set by the real estate agent. To answer our research questions, we estimate several regression models and SEM-models in the statistical software, STATA. The regression models are based on the ordinary least squares (OLS). In the first part of this section we describe the regression models, and then we build the SEM-models to fit our purposes.

4.1 Regression models

4.1.1 Price premium estimations

As the dependent variable in the regression models, we use the natural logarithm of the ratio of sales price to asking price. We define this as the price premium:

$$P_i = ln\ (Sales\ price_i\ /\ Asking\ price_i)$$

All standard errors in the models are robust to heteroskedasticity problems. The first regression models estimate the effects that the average acceptance deadline and the average response time have on the price premium. First, we define the average acceptance deadline in minutes as the sum of all acceptance deadlines divided by the number of bids in the auction. Secondly, we define it by excluding the first deadline from the calculation. The reason for doing this is to declare if there are any differences by including or excluding the deadline of the first bid. This gives us our main equation:

$$P_i = \alpha + \beta A_i + \omega B_i + \gamma C_i + \delta D_i + \lambda E_i + \mu F_i + \rho G_i + \varepsilon_i, \qquad \text{(Equation 1 - 10)}$$

where P_i is the natural logarithm of the price premium for dwelling i, A_i is the natural logarithm of the average acceptance deadline, and B_i is the natural logarithm of the average response time. Furthermore, C_i is the natural logarithm of the opening bid ratio, which is defined as the first bid with respect to the asking price of the dwelling. The value of this constructed continuous variable becomes negative when the opening bid is lower than the asking price, and it becomes positive when the opening bid is higher than the asking price. D_i is the natural logarithm of the average bid increase, which is defined by calculating the average of all bid increments in the auction. E_i is the natural logarithm of the time on market, which shows how long the dwelling sits on the market before it is sold. F_i is the natural logarithm of the number of bidders in the auction. G_i represents a set of dummy variables, including location, type of dwelling, sales year and sales quarter.

Equation 1 - 4: We use our main equation to estimate ten different regression models. First, we estimate two regressions where we exclude the average response time (B_i) from the equation. The first one includes the average acceptance deadline including all deadlines (A_i), and the second one includes the average acceptance deadline excluding the first deadline (A_i). Second, we estimate the same regressions one more time, but this time we exclude the number of bidders (F_i) from the equation.

Equation 5 - 6: The next regressions we estimate are almost like the previous, but this time we include the average response time (B_i) instead of the average acceptance deadline (A_i). We define the average response time in minutes as the sum of the registered time between each bid divided by the number of bids in the auction. In the first regression, we exclude the average acceptance deadline from the equation. In the second regression, we exclude both the average acceptance deadline and the number of bidders (F_i) from the equation.

Equation 7 - 10: The last regressions with the price premium (P_i) as a dependent variable, are four models where we include both the average acceptance deadline (A_i) and the average response time (B_i) as independent variables in the equation. First, we estimate two regressions which include all the variables given in our main equation. The first one includes the average acceptance deadline including all deadlines, and the second one includes the average acceptance deadline excluding the first deadline. Second, we estimate the same regressions one more time, but this time we exclude the number of bidders (F_i) from the equation.

4.1.2 Sales price estimations

In the next regressions, we use the sales price of the dwelling as the dependent variable. These models have a hedonic approach and include some external features with the purpose of explaining the value of the dwelling. With this approach we get a result that is independent from the asking price set by the real estate agent and is based on the attributes of the dwelling which should essentially affect the sales price. The hedonic model also removes systematic and unsystematic errors related to the asking price, such as underpricing and mispricing. All standard errors in the models are robust to heteroskedasticity problems. We estimate three regressions based on the following equation:

$$P_{s_i} = \alpha + \beta A_i + \omega B_i + \gamma C_i + \delta D_i + \lambda E_i + \mu F_i + \rho G_i + \varepsilon_i, \qquad \text{(Equation 11 - 13)}$$

where P_{s_i} is the natural logarithm of the sales price, A_i is the natural logarithm of the average acceptance deadline, B_i is the natural logarithm of the average response time, C_i is the natural logarithm of the age of the dwelling, D_i is the natural logarithm of the size of the dwelling, E_i is the natural logarithm of the time on market and F_i is the natural logarithm of the number of bidders. G_i represents a set of dummy variables, including location, type of dwelling, sales year and sales quarter.

Equation 11 - 13: First, we estimate two regressions where we exclude the average response time (B_i) from the equation. The first one includes the average acceptance deadline including all deadlines, and the second one includes the average acceptance deadline excluding the first deadline. In the last regression we include the average response time (B_i) instead of the average acceptance deadline (A_i).

4.2 Structural Equation Modeling (SEM)

In this second part of the section, we will describe and build the SEM-models. SEM is a combination of regression equations and factor analysis, which is used to analyze structural relationships between observed variables and latent variables. The regression models test strength and direction of relationships between the dependent and the independent variables, and how these fit with the hypotheses set for the paper. The limitations of using SEM involves making a correct model that fits the analyzed data, and it may be hard to define correct latent variables that fit the model (Bowen & Guo, 2012, p. 6).

When interpreting the results from the SEM-model, there are several tests for goodness of fit. The perfect value for the chi squared test will be 0.00 with an associated p-value of 1.00, and a good adjusted model has a chi squared value as close as possible to 0.00 and a p-value close to 1.00. Another test is the root mean square error of approximation (RMSEA). This test defines a good adjusted model when the value is below 0.05, and an acceptable value for this test will be between 0.05 and 0.08. Other tests are the close fit test that should show a p-value above 0.10, the comparative fit index (CFI) that should show a value above 0.97 and the standardized mean square residual (SRMR) that should show a value below 0.05 (Hammervold, 2020, p. 235). In a case where the chi squared test is indicating a nonsignificant and a poor fitted model, the already mentioned tests can still support the claim of a good fit (Bowen & Guo, 2012, p. 49).

For this study, we decide to use pathway analysis only using observed variables. During this type of analysis, the relationship between a dependent variable and an independent variable can be both a direct relationship and an indirect relationship with one or more mediating variables. The mediating effect can also be categorized into partial mediation and full mediation, based on whether the indirect effect is significant. The total effects are the combined effects from all pathways (Suhr, 2008, p. 1).

4.2.1 Main model

In our main research model, we include the natural logarithm of the average acceptance deadline and the natural logarithm of the average response time as strategy variables. Figure

7 show an illustration of the main model. We estimate the model twice, once with the average acceptance deadline including all deadlines and once more with the average acceptance deadline excluding the first deadline. We have connected some observed variables with the purpose of searching for significant relationships. This model is a recursive pathway model, where all paths eventually end up at the price premium dependent variable. The price premium is defined as the natural logarithm of the ratio of sales price to asking price. The number of bidders and the average response time act as both dependent and independent variables in this model. First, we present the hypotheses which are based on the previous literature, the survey data and logical reasoning. These hypotheses apply for both estimations. Secondly, we present the equations for the estimations.

Hypotheses:

Sønstebø, Olaussen and Oust (2020) describes that the opening bid has a negative effect on the number of bidders and the price premium. Based on this paper we construct the hypotheses:

H1 : *Opening bid ratio (ln) has a negative effect on number of bidders (ln)*

H9 : *Opening bid ratio (ln) has a positive effect on price premium*

Based on Avery (1998) and Daniel and Hirshleifer (2018) where they suggest that jump bidding can be applied to decrease the number of bidders in an auction, we construct the hypothesis:

H2 : *Average bid increase (ln) has a negative effect on number of bidders (ln)*

Based on the reasoning that a short acceptance deadline will force the counterbids to have a short response time, it is logical that the average acceptance deadline and the average response time are highly correlated. From this perspective we include the following hypotheses:

H3 : *Average acceptance deadline (Including all deadlines) (ln) has a positive effect on average response time (ln)*

H4 : *Average acceptance deadline (Excluding the first deadline) (ln) has a positive effect on average response time (ln)*

In an auction with a high average bid increase, there is a likely reason for an increase in the average response time. Bidders must consider several restraints that can limit their ability to place a bid. These restraints can include a limited budget and bank negotiations, and in this case we choose to include the hypothesis:

H5 : *Average bid increase (ln) has a positive effect on average response time (ln)*

The survey report (Sønstebø, 2017) illustrate that most bidders believe that applying a strategy involving shortening the acceptance deadline and the response time will yield a lower sales price. Considering this suggestion, we construct the hypotheses:

H7 : *Average acceptance deadline (Including all deadlines) (ln) has a positive effect on price premium*

H8 : *Average acceptance deadline (Excluding the first deadline) (ln) has a positive effect on price premium*

H11 : *Average response time (ln) has a positive effect on price premium*

Khazal, Sønstebø, Olaussen and Oust (2020) suggest that applying a jump bidding strategy yields a higher price premium and Hungria-Gunnelin (2018) finds a positive correlation between the average bid increase and the sales price. The following hypothesis is based on these claims:

H10 : *Average bid increase (ln) has a positive effect on price premium*

Hungria-Gunnelin (2013) finds that an increase in the number of bidders leads to an increase in the sales price of an apartment, and we construct a hypothesis based on this suggestion:

H12 : *Number of bidders (ln) has a positive effect on price premium*

Hungria-Gunnelin (2013) is expanded upon in Hungria-Gunnelin (2018) and finds a positive correlation between the number of bidders and the speed of the auction. From this perspective, we decide to include the hypothesis:

H6 : *Number of bidders (ln) has a negative effect on average response time (ln)*

Equations (14-16):

(14): *Number of bidders (ln)* $= \gamma_{12}$*Opening bid ratio (ln)*$+ \gamma_{13}$*Average bid increase (ln)*$+ \zeta_1$

(15): *Average response time (ln)* $= \gamma_{21}$*Average acceptance deadline (Including all deadlines) (ln)* $+\gamma_{23}$*Average bid increase (ln)*$+\beta_{21}$*Number of bidders (ln)*$+ \zeta_2$

(16): *Price premium* $= \gamma_{21}$*Average acceptance deadline (Including all deadlines) (ln)* $+\gamma_{32}$*Opening bid ratio (ln)*$+ \gamma_{33}$*Average bid increase (ln)* $+\beta_{31}$*Number of bidders (ln)* $+\beta_{32}$*Average response time (ln)*$+ \zeta_3$

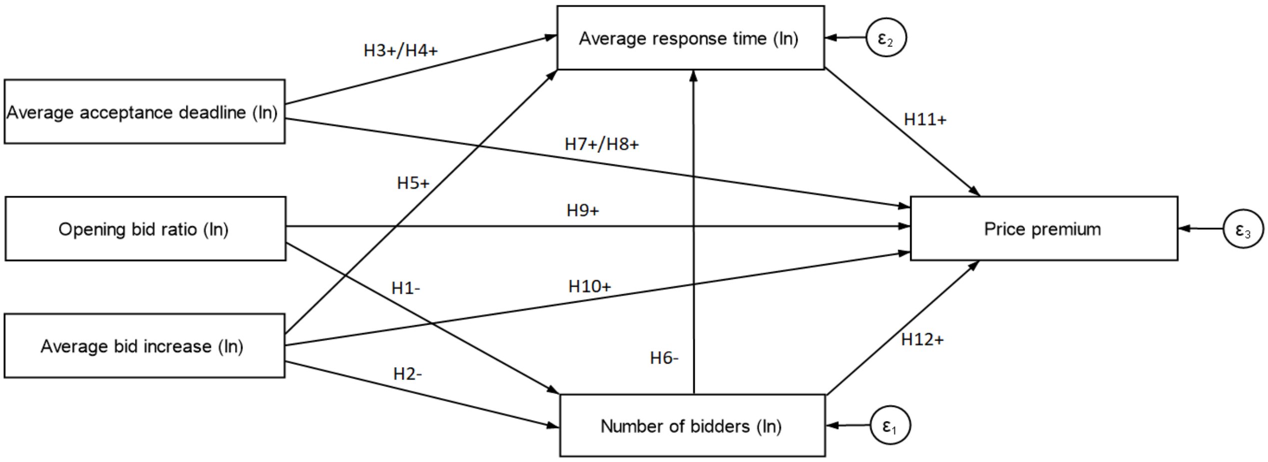
Equations (17-19):

(17): *Number of bidders (ln)* $= \gamma_{12}$*Opening bid ratio (ln)*$+ \gamma_{13}$*Average bid increase (ln)*$+ \zeta_1$

(18): *Average response time (ln)* $= \gamma_{21}$*Average acceptance deadline (Excluding the first deadline) (ln)* $+\gamma_{23}$*Average bid increase (ln)*$+ \beta_{21}$*Number of bidders (ln)*$+ \zeta_2$

(19): *Price premium* $= \gamma_{21}$*Average acceptance deadline (Excluding the first deadline) (ln)* $+\gamma_{32}$*Opening bid ratio (ln)*$+ \gamma_{33}$*Average bid increase (ln)* $+\beta_{31}$*Number of bidders (ln)* $+\beta_{32}$*Average response time (ln)*$+ \zeta_3$

Figure 7. Main model with the average acceptance deadline and the average response time as the strategy variables, and the price premium as the dependent variable.



Notes: Estimation 1= Average acceptance deadline (Including all deadlines) (ln), Estimation 2 = Average acceptance deadline (Excluding the first deadline) (ln).

4.2.2 Alternative model 1

The next research model we analyze with SEM, is an alternative model. This model is almost like the main model, but this time we exclude the average response time. Figure 8 shows an illustration of the alternative model. We estimate the model twice, once with the average acceptance deadline including all deadlines and once more with the average acceptance deadline excluding the first deadline. This model is a recursive pathway model, where all paths eventually end up at the price premium dependent variable. The number of bidders act as both dependent and independent variable in this model. First, we present the hypotheses which are based on the previous literature, the survey data and logical reasoning. These hypotheses apply for both estimations. Secondly, we present the equations for the estimations.

Hypotheses:

H1	:	*Opening bid ratio (ln) has a negative effect on number of bidders (ln)*
H2	:	*Average bid increase (ln) has a negative effect on number of bidders (ln)*
H7	:	*Average acceptance deadline (Including all deadlines) (ln) has a positive effect on price premium*
H8	:	*Average acceptance deadline (Excluding the first deadline) (ln) has a positive effect on price premium*
H9	:	*Opening bid ratio (ln) has a positive effect on price premium*
H10	:	*Average bid increase (ln) has a positive effect on price premium*
H12	:	*Number of bidders (ln) has a positive effect on price premium*

Equations (20-21):

(20): *Number of bidders (ln)* = γ_{12}*Opening bid ratio (ln)*+ γ_{13}*Average bid increase (ln)* + ζ_1

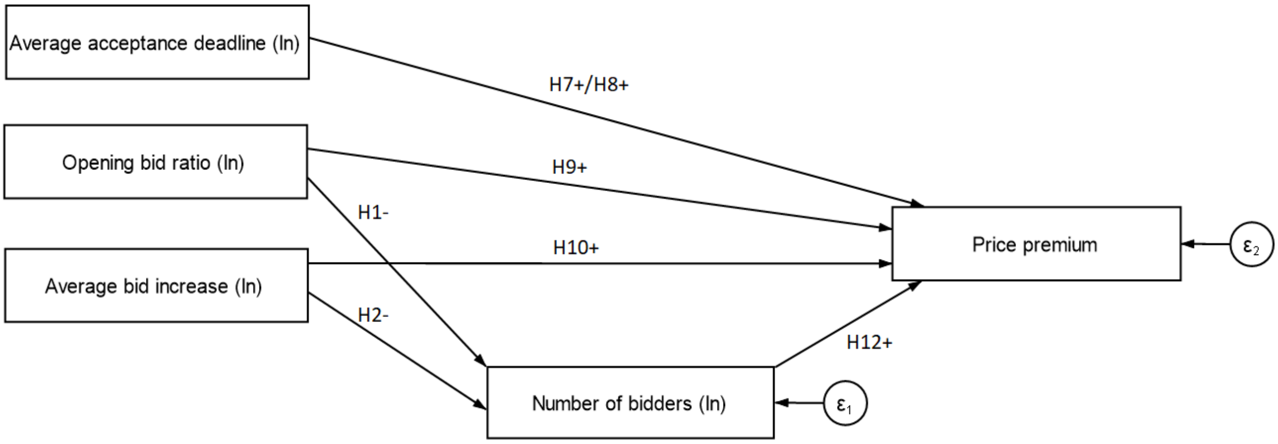
(21): *Price premium* = γ_{21}*Average acceptance deadline (Including the first deadline) (ln)* +γ_{22}*Opening bid ratio (ln)*+ γ_{23}*Average bid increase (ln)* +β_{21}*Number of bidders (ln)*+ ζ_2

Equations (22-23):

(22): *Number of bidders (ln)* = γ_{12}*Opening bid ratio (ln)*+ γ_{13}*Average bid increase (ln)* + ζ_1

(23): *Price premium* = γ_{21}*Average acceptance deadline (Excluding the first deadline) (ln)* +γ_{22}*Opening bid ratio (ln)*+ γ_{23}*Average bid increase (ln)* +β_{21}*Number of bidders (ln)*+ ζ_2

Figure 8. Alternative model 1 with the average acceptance deadline (ln) as the strategy variable, and price premium as the dependent variable.



Notes: Estimation 1 = Average acceptance deadline (Including all deadlines) (ln), Estimation 2 = Average acceptance deadline (Excluding the first deadline) (ln).

4.2.3 Alternative model 2

The last research model we analyze with SEM, is also an alternative model. The model is almost like the main model, but this time we exclude the average acceptance deadline from the equation. Figure 9 shows an illustration of the model. This model is a recursive pathway model, where all paths eventually end up at the price premium dependent variable. The number of bidders and the average response time act as both dependent and independent variables in this model. First, we present the hypotheses which are based on the previous literature, the survey data and logical reasoning. Secondly, we present the equations.

Hypotheses:

H1 : *Opening bid ratio (ln) has a negative effect on number of bidders (ln)*

H2 : *Average bid increase (ln) has a negative effect on number of bidders (ln)*

H5 : *Average bid increase (ln) has a positive effect on average response time (ln)*

H6 : *Number of bidders (ln) has a negative effect on average response time (ln)*

H9 : *Opening bid ratio (ln) has a positive effect on price premium*

H10 : *Average bid increase (ln) has a positive effect on price premium*

H11 : *Average response time (ln) has a positive effect on price premium*

H12 : *Number of bidders (ln) has a positive effect on price premium*

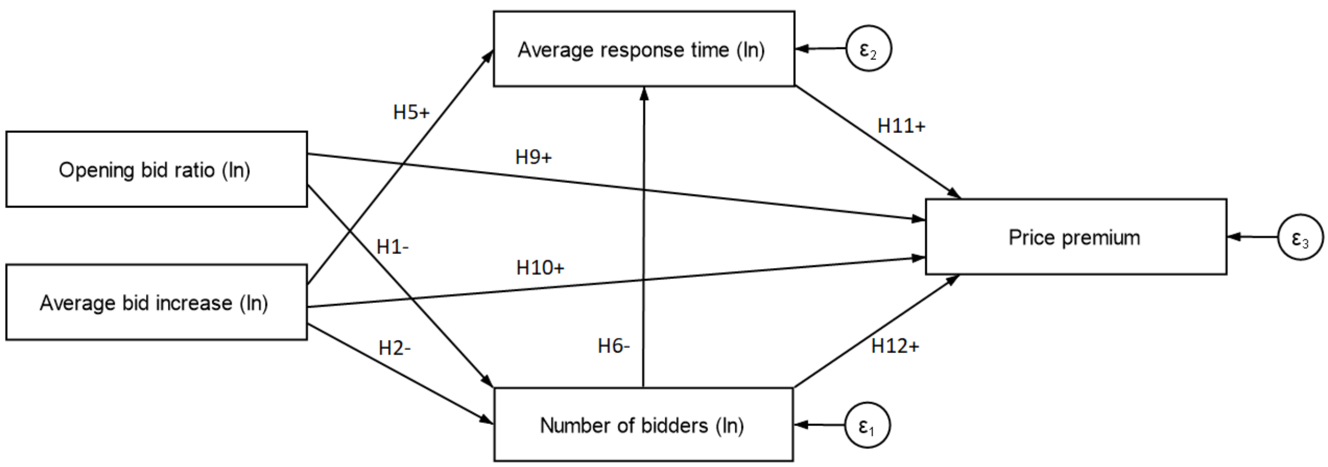
Equations (24-26):

(24): *Number of bidders (ln)* = γ_{11}*Opening bid ratio (ln)*+ γ_{12}*Average bid increase (ln)*+ ζ_1

(25): *Average response time (ln)* = γ_{22}*Average bid increase (ln)* +β_{21}*Number of bidders (ln)*+ ζ_2

(26): *Price premium* = γ_{31}*Opening bid ratio (ln)*+ γ_{32}*Average bid increase (ln)* +β_{31}*Number of bidders (ln)*+ β_{32}*Average response time (ln)*+ ζ_3

Figure 9. Alternative model 2 with the average response time (ln) as the strategy variable, and price premium as the dependent variable.



5 Results

5.1 Regression models

We present the results from the regression models in the same order as in the methodology section. First, the regressions utilizing the asking price valuation followed by the regressions utilizing the hedonic valuation.

5.1.1 Price premium estimations

Table 2. Price premium estimations with the average acceptance deadline.

Variables	Equation (1) Price premium	Equation (2) Price premium	Equation (3) Price premium	Equation (4) Price premium
Average acceptance deadline (Including all deadlines) (ln)	-0.0037* (0.0020)		-0.0009 (0.0022)	
Average acceptance deadline (Excluding the first deadline) (ln)		-0.0048** (0.0023)		-0.0012 (0.0026)
Opening bid ratio (ln)	0.2411*** (0.0592)	0.2400*** (0.0588)	0.2217*** (0.0587)	0.2214*** (0.0584)
Average bid increase (ln)	0.0269*** (0.0078)	0.0264*** (0.0076)	0.0171** (0.0086)	0.0170** (0.0084)
Time on market (ln)	-0.0164*** (0.0027)	-0.0160*** (0.0027)	-0.0292*** (0.0031)	-0.0291*** (0.0031)
Number of bidders (ln)	0.1102*** (0.0072)	0.1106*** (0.0072)		
Dummies	Yes	Yes	Yes	Yes
Constant	-0.2867*** (0.0804)	-0.2796*** (0.0778)	-0.0430 (0.0842)	-0.0410 (0.0818)
Adjusted R^2	0.4141	0.4151	0.2224	0.2225
Observations	1,060	1,060	1,060	1,060

Notes: Dummies include year, quarter, type of dwelling, and location.
Dependent variable: Price premium = ln (sales price / asking price).
*Standard errors in parantheses. *p < 0.10, **p < 0.05, ***p < 0.01.*
All equations are multiple bid auctions.

The estimations of equations (1 - 4) are presented in Table 2. The average acceptance deadline coefficient in equation (1) is negative and significant at the ten-percent level, which indicates that a longer acceptance deadline yields a lower price premium. A one percent increase in the average acceptance deadline leads to a decrease of 0.0037 percent in the price premium. By excluding the deadline for the first bid in the auction, we can observe from equation (2) that a one percent increase in the average acceptance deadline leads to a decrease of 0.0048 percent in the price premium. This coefficient is significant at five-percent level.

An increase in the opening bid ratio by one percent is associated with an increase of about 0.24 percent in the price premium of the dwelling, in equations (1) and (2). These coefficients are significant at the one-percent level. From the explanatory variables, the average bid increase and the time on market, we observe that the coefficients are significant at the one-percent level in equations (1) and (2). A higher average bid increase seems to yield a higher price premium, while an increase in the time on market seems to yield a lower price premium. The average acceptance deadline coefficients in equations (3) and (4) does not show any significant impact on the price premium when we exclude the number of bidders from the regressions.

Table 3. Price premium estimations with the average response time.

Variables	Equation (5) Price premium	Equation (6) Price premium
Average response time (ln)	-0.0076*** (0.0015)	-0.0090*** (0.0017)
Opening bid ratio (ln)	0.2416*** (0.0577)	0.2221*** (0.0564)
Average bid increase (ln)	0.0299*** (0.0077)	0.0219** (0.0084)
Time on market (ln)	-0.0131*** (0.0027)	-0.0241*** (0.0030)
Number of bidders (ln)	0.1069*** (0.0068)	
Dummies	Yes	Yes
Constant	-0.3086*** (0.0799)	-0.0733 (0.0833)
Adjusted R^2	0.4306	0.2492
Observations	1,060	1,060

Notes: Dummies include year, quarter, type of dwelling, and location.
Dependent variable: Price premium = ln (sales price / asking price).
*Standard errors in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01.*
All equations are multiple bid auctions.

Table 3 presents the estimations from equations (5) and (6), using the average response time as the strategy variable. The coefficient to the average response time in equation (5) is negative and significant at the one-percent level, and we find that a one percent increase is associated with a decrease of about 0.008 percent in the price premium. The coefficients to the explanatory variables, the opening bid ratio, the average bid increase and the number of bidders, are all positive and significant at the one-percent level. An increase in these variables yields a higher price premium. Furthermore, we observe from equation (6) that the coefficient to the average response time is still negative and significant at the one-percent level when we exclude the number of bidders from the equation. A one percent increase leads to a decrease of 0.009 percent in the price premium.

Table 4. Price premium estimations with the average acceptance deadline and the average response time.

Variables	Equation (7) Price premium	Equation (8) Price premium	Equation (9) Price premium	Equation (10) Price premium
Average acceptance deadline (Including all deadlines) (ln)	0.0101*** (0.0025)		0.0197*** (0.0031)	
Average acceptance deadline (Excluding the first deadline) (ln)		0.0014 (0.0022)		0.0077*** (0.0026)
Average response time (ln)	-0.0139*** (0.0018)	-0.0082*** (0.0014)	-0.0211*** (0.0024)	-0.0119*** (0.0017)
Opening bid ratio (ln)	0.2434*** (0.0575)	0.2421*** (0.0576)	0.2273*** (0.0562)	0.2255*** (0.0568)
Average bid increase (ln)	0.0303*** (0.0077)	0.0301*** (0.0077)	0.0235*** (0.0083)	0.0229*** (0.0084)
Time on market (ln)	-0.0125*** (0.0027)	-0.0133*** (0.0026)	-0.0219*** (0.0030)	-0.0245*** (0.0030)
Number of bidders (ln)	0.1019*** (0.0070)	0.1063*** (0.0067)		
Dummies	Yes	Yes	Yes	Yes
Constant	-0.3299*** (0.0799)	-0.3127*** (0.0779)	-0.1364 (0.0838)	-0.1027 (0.0821)
Adjusted R^2	0.4388	0.4309	0.2818	0.2563
Observations	1,060	1,060	1,060	1,060

Notes: Dummies include year, quarter, type of dwelling, and location.
Dependent variable: Price premium = ln (sales price / asking price).
*Standard errors in parantheses. *p < 0.10, **p < 0.05, ***p < 0.01.*
All equations are multiple bid auctions.

Table 4 presents the estimations of equations (7 - 10), where the average acceptance deadline and the average response time are used as the strategy variables. The coefficients to the average response time in equations (7), (8), (9) and (10) are all negative and significant at the one-percent level. In these equations, a one percent increase in the average response time leads to a range between 0.0082 and 0.0211 percent decrease in the price premium. The coefficients to the average acceptance deadline including all deadlines in equations (7) and (9) are both positive and significant at the one-percent level. The coefficients to the average acceptance deadline excluding the first deadline in equations (8) and (10) are both positive, but it is only significant at the one-percent level in equation (10). An increase of one percent in the average acceptance deadline excluding the first deadline leads to an increase of about 0.008 percent in the price premium.

5.1.2 Sales price estimations

Table 5. Sales price estimations with the average acceptance deadline and the average response time.

Variables	Equation (11) Sales price (ln)	Equation (12) Sales price (ln)	Equation (13) Sales price (ln)
Average acceptance deadline (Including all deadlines) (ln)	-0.0263*** (0.0075)		
Average acceptance deadline (Excluding the first deadline) (ln)		-0.0409*** (0.0099)	
Average response time (ln)			-0.0155*** (0.0056)
Time on market (ln)	-0.0507*** (0.0145)	-0.0457*** (0.0138)	-0.0483*** (0.0146)
Size (ln)	0.6493*** (0.0277)	0.6451*** (0.0271)	0.6546*** (0.0278)
Age (ln)	-0.0768*** (0.0101)	-0.0752*** (0.0101)	-0.0783*** (0.0103)
Dummies	Yes	Yes	Yes
Constant	12.7355*** (0.1243)	12.7841*** (0.1222)	12.6547*** (0.1223)
Adjusted R^2	0.6858	0.6899	0.6839
Observations	1,060	1,060	1,060

Notes: Dummies include year, quarter, type of dwelling, and location.
Dependent variable: ln (sales price). Standard errors in parentheses.
**p < 0.10, **p < 0.05, ***p < 0.01. All equations are multiple bid auctions.*

The results presented in Table 5 are the sales price estimations from equations (11 - 13). First, we zero in on the equations including the average acceptance deadline as the strategy variable. The coefficients to the strategy variable in equations (11) and (12) are negative and significant at the one-percent level. An interesting point is to observe the differences of excluding the deadline for the first bid in the auction. While an increase of one percent in the strategy variable in equation (11) is associated with a decrease of about 0.026 percent in the sales price, a one percent increase in the strategy variable in equation (12) leads to a decrease of about 0.041 percent in the sales price of the dwelling. This is comparable to the asking price valuation, where we also observe the same trends. Next we proceed with equation (13), where we apply the average response time as the strategy variable. The coefficient to the strategy variable is negative and significant, and a one percent increase leads to a decrease of about 0.016 percent in the sales price of the dwelling.

5.2 Structural Equation Modelling (SEM)

In this part we present the estimations of the SEM-models in the same order as in the methodology section. First we present the estimations of the main model, followed by the estimations of the first alternative model and then the estimation of the second alternative model. The results consist of pathway models presented by direct, indirect and total effects from the independent variables to the dependent variables. The values of the direct and indirect coefficients indicate which direction the effect flows, and the sum of these effects is described by the total effect. In addition, there are performed several of goodness of fit tests to examine if the models are well fitted.

At the very end of this section we present the hypotheses in a table, where they are either confirmed or denied by our estimations. A correlation matrix of the variables from our SEM-models is given in Table A2 (Appendix, Table A2). As expected, there is a strong positive correlation (0.7913) between the average response time and the average acceptance deadline including all deadlines. By excluding the first deadline, we observe a decrease in the correlation (0.5687) between the average response time and the average acceptance deadline. Before running the estimations of the SEM-models we need to check for multivariate normal distribution. There are different methods that could be used to estimate a SEM-model, and these methods have different normality assumptions. The maximum likelihood (ML) method assumes that our variables are multivariate normally distributed, while the robust maximum likelihood (RML) method has no normality assumptions (Hammervold, 2020, p. 198). When testing for multivariate normal distribution in our variables, we find that there are nonnormality in our data. Therefore, we tested to estimate the SEM-models with both ML and RML. The results from RML were close to identical as the results from ML, which means that the nonnormality bear no significance. As a result of this, we decided to apply ML to estimate our SEM-models.

5.2.1 Main model

First, we present the estimation of the SEM-model using the average response time and the average acceptance deadline including all deadlines as the strategy variables. Table 6a present the direct, indirect and total effects, and Table 6b present the goodness of fit tests. Secondly, we present the estimation of the SEM-model using the average response time and the average acceptance deadline excluding the first deadline as the strategy variables. Table 7a present the direct, indirect and total effects, and Table 7b present the goodness of fit tests.

Table 6a. Main model using the average response time and the average acceptance deadline (including all deadlines) as strategy variables.

	Equation (14)			Equation (15)			Equation (16)		
Variables	**Number of bidders (ln)**			**Average response time (ln)**			**Price premium**		
	Direct	***Indirect***	***Total***	***Direct***	***Indirect***	***Total***	***Direct***	***Indirect***	***Total***
Number of bidders (ln)				-0.7215*** (0.0838)	0 (no path)	-0.7215*** (0.0838)	0.1034*** (0.0058)	0.0118*** (0.0020)	0.1152*** (0.0058)
Average response time (ln)							-0.0163*** (0.0020)	0 (no path)	-0.0163*** (0.0020)
Average bid increase (ln)	-0.0506*** (0.0157)	0 (no path)	-0.0506*** (0.0157)	0.2005*** (0.0414)	0.0365*** (0.0121)	0.2370*** (0.0427)	0.0283*** (0.0029)	-0.0091*** (0.0019)	0.0192*** (0.0035)
Opening bid ratio (ln)	-0.0085 (0.0934)	0 (no path)	-0.0085 (0.0934)	0 (no path)	0.0061 (0.0674)	0.0061 (0.0674)	0.2302*** (0.0173)	-0.0010 (0.0108)	0.2292*** (0.0204)
Average acceptance deadline (Including all deadlines) (ln)				1.0010*** (0.0231)	0 (no path)	1.0010*** (0.02312)	0.0128*** (0.0026)	-0.0163*** (0.0021)	-0.0035** (0.0016)
Adjusted R^2	0.0105			0.6577			0.3856		
Overall adjusted R^2	0.7118								
Observations	1,078								

Notes: Price premium = ln (sales price / asking price). Standard errors in parentheses.
**p < 0.10, **p < 0.05, ***p < 0.01.*

Table 6b. Goodness of fit tests.

Chi^2, = 0	RMSEA, < 0.05	p-value, = 1	CFI, > 0.97	SRMR, < 0.05	Close fit test, > 0.05	df
1.01	0.000	0.6033	1.000	0.009	0.952	2

Based on the results in Table 6b, we can confirm that the main model has a good fit. The chi squared and the p-value of the model are 1.01 and 0.6033, respectively. SRMR and the Close fit test are also showing results indicating a good adjusted model. Briefly summarized, we can conclude that this main model does not necessarily need any re-specification.

Direct effect

The effect that the average acceptance deadline has on the average response time is close to 1.00, which means that an increase of one minute in the average acceptance deadline leads to an almost equal increase in the average response time. This confirms that the hypothesis H3 is correct. The direct effect that the average response time has on the price premium is significant at the one-percent level, and an increase of one percent leads to a decrease of about 0.016 percent in the price premium. This is not confirming the hypothesis H11. The same is true for the average acceptance deadline, but with an increase of about 0.013 percent in the price premium. This is confirming the hypothesis H7. The legitimacy of these results can be backed up by the results from equations (7) and (9) in the regression section. The number of bidders, the average bid increase and the opening bid ratio all have a positive and significant effect at the one-percent level on the price premium. These results are confirming the hypotheses H12, H10 and H9, respectively.

Indirect effect

The average acceptance deadline has a significant effect at the one-percent level on the price premium. A one percent increase in the average acceptance deadline leads to a decrease of about 0.016 percent in the price premium. This indirect effect is flowing through the average response time and is impacting the total effect. Given the total effect results, the total effect of the average acceptance deadline on the price premium is negative at the five-percent level.

Table 7a. Main model using the average response time and the average acceptance deadline (excluding the first deadline) as strategy variables.

Variables	Equation (17) Number of bidders (ln)			Equation (18) Average response time (ln)			Equation (19) Price premium		
	Direct	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*	*Direct*	*Indirect*	*Total*
Number of bidders (ln)				-0.8019*** (0.1132)	0 (no path)	-0.8019*** (0.1132)	0.1081*** (0.0058)	0.0073*** (0.0016)	0.1154*** (0.0058)
Average response time (ln)							-0.0091*** (0.0015)	0 (no path)	-0.0091*** (0.0015)
Average bid increase (ln)	-0.0506*** (0.0157)	0 (no path)	-0.0506*** (0.0157)	0.3422*** (0.0556)	0.0406*** (0.0138)	0.3828*** (0.0567)	0.0277*** (0.0030)	-0.0090*** (0.0020)	0.0188*** (0.0035)
Opening bid ratio (ln)	-0.0085 (0.0934)	0 (no path)	-0.0085 (0.0934)	0 (no path)	0.0068 (0.0749)	0.0068 (0.0749)	0.2281*** (0.0175)	-0.0010 (0.0108)	0.2272*** (0.0206)
Average acceptance deadline (Excluding the first deadline) (ln)				0.8033*** (0.0345)	0 (no path)	0.8033*** (0.0345)	0.0022 (0.0021)	-0.0073*** (0.0013)	-0.0051*** (0.0018)
Adjusted R^2	0.0105			0.3789			0.3725		
Overall adjusted R^2	0.4625								
Observations	1,078								

Notes: Price premium = ln (sales price / asking price). Standard errors in parentheses.
**p < 0.10, **p < 0.05, ***p < 0.01.*

Table 7b. Goodness of fit tests.

Chi^2, = 0	RMSEA, < 0.05	p-value, = 1	CFI, > 0.97	SRMR, < 0.05	Close fit test, > 0.05	df
0.44	0.000	0.8027	1.000	0.004	0.982	2

Based on the results in Table 7b, we can confirm that the main model has a good fit. The chi squared and the p-value of the model are 0.44 and 0.8027, respectively. SRMR and the Close fit test are also showing results indicating a good adjusted model. Briefly summarized, we can conclude that this main model does not necessarily need any re-specification.

Direct effect

The average response time has a significant effect at the one-percent level on the price premium. An increase of one percent in the average response time leads to a decrease of about 0.009 percent in the price premium and is not confirming the hypothesis H11. We can observe from Table 7a that the average acceptance deadline has a significant effect at the one-percent level on the average response time, but no significant effect on the price premium. An increase of one percent in the average acceptance deadline leads to an increase of about 0.8 percent in the average response time and is confirming the hypothesis H4. The number of bidders, the average bid increase and the opening bid ratio all have a positive and significant effect at the one-percent level on the price premium. These results are confirming the hypotheses H12, H10 and H9, respectively.

Indirect effect

The average acceptance deadline has a significant effect at the one-percent level on the price premium. A one percent increase in the average acceptance deadline leads to a decrease of about 0.007 percent in the price premium. This indirect effect is flowing through the average response time and is impacting the total effect. Given the total effect results, the total effect of the average acceptance deadline on the price premium is negative at the one-percent level.

5.2.2 Alternative model 1

First, we present the estimations of the SEM-model using the average acceptance deadline including all deadlines as the strategy variable. Table 8a present the direct, indirect and total effects, Table 8b present the goodness of fit tests. Secondly, we present the estimations of the SEM-model using the average acceptance deadline excluding the first deadline as the strategy variable. Table 9a present the direct, indirect and total effects, Table 9b present the goodness of fit tests.

Table 8a. Alternative model 1 using the average acceptance deadline (including all deadlines) as strategy variable.

	Equation (20)			**Equation (21)**		
Variables	**Number of bidders (ln)**			**Price premium**		
	Direct	***Indirect***	***Total***	***Direct***	***Indirect***	***Total***
Number of bidders (ln)				0.1152*** (0.0058)	0 (no path)	0.1152*** (0.0058)
Average bid increase (ln)	-0.0506*** (0.0157)	0 (no path)	-0.0506*** (0.0157)	0.0251*** (0.0030)	-0.0058*** (0.0018)	0.0193*** (0.0035)
Opening bid ratio (ln)	-0.0085 (0.0934)	0 (no path)	-0.0085 (0.0934)	0.2320*** (0.0179)	-0.0010 (0.0108)	0.2310*** (0.0208)
Average acceptance deadline (Including all deadlines) (ln)				-0.0035** (0.0016)	0 (no path)	-0.0035** (0.0016)
Adjusted R^2	0.0105			0.3503		
Overall adjusted R^2	0.1640					
Observations	1,078					

Notes: Price premium = ln (sales price / asking price). Standard errors in parentheses.
**p < 0.10, **p < 0.05, ***p < 0.01.*

Table 8b. Goodness of fit tests.

Chi^2, = 0	**RMSEA, < 0.05**	**p-value, = 1**	**CFI, > 0.97**	**SRMR, < 0.05**	**Close fit test, > 0.05**	**df**
0.82	0.000	0.3654	1.000	0.008	0.775	1

Based on the results in Table 8b, we can confirm that the main model has a good fit. The chi squared and the p-value of the model are 0.82 and 0.3654, respectively. SRMR and the Close fit test are also showing results indicating a good adjusted model. Briefly summarized, we can conclude that this main model does not necessarily need any re-specification.

Direct effect

In this alternative model, the average acceptance deadline has a significant direct effect at the five-percent level on the price premium. An increase of one percent in the average acceptance deadline leads to a decrease of about 0.004 percent in the price premium, which is not corresponding with the main model. This result makes the hypothesis H7 incorrect. The number of bidders, the average bid increase and the opening bid ratio all have a positive and significant effect at the one-percent level on the price premium. These results are confirming the hypotheses H12, H10 and H9, respectively.

Indirect effect

The only significant indirect effect in this model flows from the average bid increase to the price premium, with the number of bidders as the mediating factor. This effect is negative and significant at the one-percent level. The average acceptance deadline does not have any indirect pathway in this model, and the total effect is in this case only the sum of the direct effect.

Table 9a. Alternative model 1 using the average acceptance deadline (excluding the first deadline) as strategy variable.

	Equation (22)			**Equation (23)**		
Variables	**Number of bidders (ln)**			**Price premium**		
	Direct	***Indirect***	***Total***	***Direct***	***Indirect***	***Total***
Number of bidders (ln)				0.1154*** (0.0058)	0 (no path)	0.1154*** (0.0058)
Average bid increase (ln)	-0.0506*** (0.0157)	0 (no path)	-0.0506*** (0.0157)	0.0247*** (0.0030)	-0.0059*** (0.0018)	0.0190*** (0.0035)
Opening bid ratio (ln)	-0.0085 (0.0934)	0 (no path)	-0.0085 (0.0934)	0.2301*** (0.0178)	-0.0010 (0.0108)	0.2291*** (0.0208)
Average acceptance deadline (Excluding the first deadline) (ln)				-0.0051*** (0.0018)	0 (no path)	-0.0051*** (0.0018)
Adjusted R^2	0.0105			0.3530		
Overall adjusted R^2	0.1668					
Observations	1,078					

Notes: Price premium = ln (sales price / asking price). Standard errors in parentheses.
**p < 0.10, **p < 0.05, ***p < 0.01.*

Table 9b. Goodness of fit tests.

Chi^2, = 0	RMSEA, < 0.05	p-value, = 1	CFI, > 0.97	SRMR, < 0.05	Close fit test, > 0.05	df
0.06	0.000	0.8098	1.000	0.002	0.949	1

Based on the results in Table 9b, we can confirm that the main model has a good fit. The chi squared and the p-value of the model are 0.06 and 0.8098, respectively. SRMR and the Close fit test are also showing results indicating a good adjusted model. Briefly summarized, we can conclude that this main model does not necessarily need any re-specification.

Direct effect

The average acceptance deadline has a significant direct effect at the one-percent level on the price premium. An increase of one percent in the average acceptance deadline is associated with a decrease of about 0.005 percent in the price premium. This result makes the hypothesis H8 incorrect. Furthermore, the coefficients to the number of bidders, the average bid increase and the opening bid ratio are all significant at one-percent level, and they all yield a higher price premium. These results are confirming the hypotheses H12, H10 and H9, respectively.

Indirect effect

The average acceptance deadline has no mediating factors in this model, and the total effect is therefore only consisting of the direct effect. The only variable with an indirect effect is the average bid increase, and a one percent increase in this variable leads to a decrease of about 0.006 percent in the price premium.

5.2.3 Alternative model 2

In this part we present the estimations of the SEM-model using the average response time. Table 10a present the direct, indirect and total effects, Table 10b present the goodness of fit tests.

Table 10a. Alternative model 2 using the average response time as strategy variable.

	Equation (23)			Equation (24)			Equation (25)		
Variables	**Number of bidders (ln)**			**Average response time (ln)**			**Price premium**		
	Direct	***Indirect***	***Total***	***Direct***	***Indirect***	***Total***	***Direct***	***Indirect***	***Total***
Number of bidders (ln)				-0.8204*** (0.1387)	0 (no path)	-0.8204*** (0.1387)	0.1088*** (0.0058)	0.0067*** (0.0015)	0.1155*** (0.0058)
Average bid increase (ln)	-0.0506*** (0.0157)	0 (no path)	-0.0506*** (0.0157)	0.4097*** (0.0680)	0.0415*** (0.0147)	0.4512*** (0.0689)	0.0274*** (0.0030)	-0.0092*** (0.0020)	0.0182*** (0.0035)
Opening bid ratio (ln)	-0.0085 (0.0934)	0 (no path)	-0.0085 (0.0934)		0.0070 (0.0767)	0.0070 (0.0767)	0.2269*** (0.0175)	-0.0010 (0.0108)	0.2260*** (0.0205)
Average response time (ln)							-0.0082*** (0.0013)	0 (no path)	-0.0082*** (0.0013)
Adjusted R^2	0.0105			0.0686			0.3688		
Overall adjusted R^2	0.1916								
Observations	1,078								

Notes: Price premium = ln (sales price / asking price). Standard errors in parentheses.
**p < 0.10, **p < 0.05, ***p < 0.01.*

Table 10b. Goodness of fit tests.

Chi^2, = 0	RMSEA, < 0.05	p-value, = 1	CFI, > 0.97	SRMR, < 0.05	Close fit test, > 0.05	df
5.46	0.064	0.0194	0.992	0.018	0.243	1

Based on the results in Table 10b, the model is not supported by the chi squared test and the associated p-value. However, it is possible to claim a good fit due to the result of the other goodness of fit tests.

Direct effect

The average response time has a significant direct effect at the one-percent level on the price premium. An increase of one percent in the average response time leads to a decrease of about 0.008 percent in the price premium. This result does not support the hypothesis H11. The number of bidders, the average bid increase and the opening bid ratio all have a significant and positive effect on the price premium. These results are confirming the hypothesis H12, H10 and H9, respectively. Furthermore, the average bid increase has a significant and negative effect on the number of bidders and a significant and positive effect on the average response time. An increase of one percent in the average bid increase is associated with an increase of about 0.41 percent in the average response time.

Indirect effect

The average bid increase has a significant indirect effect at the one-percent level on the price premium, where a one percent increase leads to a decrease of 0.0092 percent. The number of bidders has the opposite effect, where an increase of one percent leads to an increase of 0.0067 percent in the price premium. Furthermore, the opening bid ratio has a nonsignificant indirect effect at the price premium. The average response time has no mediating factors in this model, and the total effect is only consisting of the direct effect.

Hypotheses

Table 11 presents a summarize of all the hypotheses for the different SEM-models. The hypotheses are marked with “Yes” if they are confirmed by the model and marked with “No” if they are denied by the model. Most of the results appear to be stable, with the exception of hypotheses H7 and H8. The hypothesis H7 is confirmed by the estimations of the main model, while the hypothesis H8 is denied by the estimations of the alternative model 1.

Table 11. Answers to the hypotheses.

	Table 6a. Main model	**Table 7a.** Main model	**Table 8a.** Alternative model 1	**Table 9a.** Alternative model 1	**Table 10a.** Alternative model 2
H1: *Opening bid ratio (ln) has a negative effect on number of bidders (ln)*	Yes	Yes	Yes	Yes	Yes
H2: *Average bid increase (ln) has a negative effect on number of bidders (ln)*	Yes***	Yes***	Yes***	Yes***	Yes***
H3: *Average acceptance deadline (Including all deadlines) (ln) has a positive effect on average response time (ln)*	Yes***				
H4: *Average acceptance deadline (Excluding the first deadline) has a positive effect on average response time (ln)*		Yes***			
H5: *Average bid increase (ln) has a positive effect on average response time (ln)*	Yes***	Yes***			Yes***
H6: *Number of bidders (ln) has a negative effect on average response time (ln)*	Yes***	Yes***			Yes***
H7: *Average acceptance deadline (Including all deadlines) (ln) has a positive effect on price premium*	Yes***		No**		
H8: *Average acceptance deadline (Excluding the first deadline) (ln) has a positive effect on price premium*		Yes		No***	
H9: *Opening bid ratio (ln) has a positive effect on price premium*	Yes***	Yes***	Yes***	Yes***	Yes***
H10: *Average bid increase (ln) has a positive effect on price premium*	Yes***	Yes***	Yes***	Yes***	Yes***
H11: *Average response time (ln) has a positive effect on price premium*	No***	No***			No***
H12: *Number of bidders (ln) has a positive effect on price premium*	Yes***	Yes***	Yes***	Yes***	Yes***

*Notes: *p < 0.10, **p < 0.05, ***p < 0.01.*
"Yes" if the hypothesis is true and "No" if the hypothesis is false.

6 Discussion and conclusion

The purpose of this paper is to get a deeper understanding of the aspect of time in an aggressive bidding strategy. By using a sample containing 1,152 auction journals, we study the effect of the time factors on the price premium and the sales price. The time factors we consider in this paper are the average acceptance deadline and the average response time. Because of the regulatory limitations of the first deadline in an auction (Forskrift om eiendomsmegling, 2007, § 6-3), we decide to utilize two different average acceptance deadlines. The first average acceptance deadline includes deadlines for all bids. In the second average acceptance deadline, we exclude the first bid's deadline. By analyzing the respondents answers in a survey (Sønstebø, 2017), we find that most bidders believe that placing bids with short acceptance deadlines and by responding quickly to other bids is the optimal strategy to achieve the dwelling at the lowest possible price.

There are several papers written on the topic of aggressive behavior in an English auction. Most of these concentrate on different factors connected to bid size as a definition for aggressive behavior. In the case of time factors there are considerably less papers written on the topic, and this research is to our knowledge solely based on regression models. Using SEM in addition to regression models, we set out a goal to get a deeper understanding of this phenomenon. Estimating SEM-models enables us to map the direct and indirect effects that time factors have on the price premium.

All the regressions with price premium estimations show a significant and negative relationship between the average response time and the price premium. The hedonic regression shows a significant and negative relationship between the average response time and the sales price. From our SEM-models we find results suggesting that the average response time has a significant and negative direct effect on the price premium. Based on these results, it is possible to suggest that a shorter average response time yields a higher price premium and a higher sales price of the dwelling. These results directly coincide with Sønstebø, Olaussen and Oust (2020) and Khazal, Sønstebø, Olaussen and Oust (2020), where they suggest that an aggressive behavior yields a higher sales price. The results also appear to be consistent with Hungria-Gunnelin's (2018) findings. Her study suggests that an increase in the speed of the auction increases the sales price of the apartment. This suggestion is contrary to what the majority of the respondents in the survey (Sønstebø, 2017) consider as an outcome for responding quickly to others bid.

Regarding the average acceptance deadline, it is interesting to note the differences occurred by including or excluding the deadline for the first bid. Most of the regressions including price premium estimations show a significant relationship between the average acceptance deadline including all deadlines and the price premium. One of them shows a negative relationship, while the rest of them show a positive relationship. The hedonic regression shows a significant and negative relationship between the average acceptance deadline including all deadlines and the sales price. From our main SEM-model containing the average acceptance deadline including all deadlines, the results suggest that the average acceptance deadline has a significant and positive direct effect and a significant and negative indirect effect on the price premium. The indirect effect dominates in this case, which indicates a total negative effect on the price premium. Our first alternative model suggests that the average acceptance deadline including all deadlines has a significant and negative direct effect on the price premium. Just as for the average response time, most of these results suggest that aggressive behavior leads to higher price premiums and sales prices. These suggestions coincide with Sønstebø, Olaussen and Oust (2020) and Khazal, Sønstebø, Olaussen and Oust, (2020), even though their studies are based on other factors related to aggressive behavior. Avery (1998) and Daniel and Hirshleifer (2018) suggest that an aggressive strategy can result in a lower sales price, which is contrary to our findings.

Two of the regressions including price premium estimations show a significant relationship between the average acceptance deadline excluding the first deadline and the price premium. One of them shows a negative relationship, while the other one shows a positive relationship. The hedonic regression shows a significant and negative relationship between the average acceptance deadline excluding the first deadline and the sales price. From our main SEM-model containing the average acceptance deadline excluding the first deadline, the results suggest that the average acceptance deadline has a significant and negative indirect effect on the price premium. Our first alternative model suggests that the average acceptance deadline excluding the first deadline has a significant and negative direct effect on the price premium. Most of these suggestions are contrary to what the majority of the respondents in the survey (Sønstebø, 2017) consider as an outcome for placing a bid with a short acceptance deadline.

The aim of this paper is to examine the effects of the acceptance deadline and the response time utilized in Norwegian real estate auctions on the dwelling's price premium and sales price. When testing for these effects, we find a strong indication that a shorter response time has a positive effect on the dwelling's price premium and sales price. We also find an indication that a shorter acceptance deadline has a positive effect on the dwelling's price premium and sales price, but we do not observe this positive effect as frequent as we do for the response time. We do not find any noticeable differences by including or excluding the first deadline from the average acceptance deadline. Based on these results, we can briefly summarize that an aggressive strategy is non-effective for achieving a lower sales price and it can in worst case scenario increase the price premium. For potential buyers, this will imply that using a non-aggressive strategy is the more beneficial approach to obtain the dwelling at the lowest possible sales price.

7 References

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8 Appendix

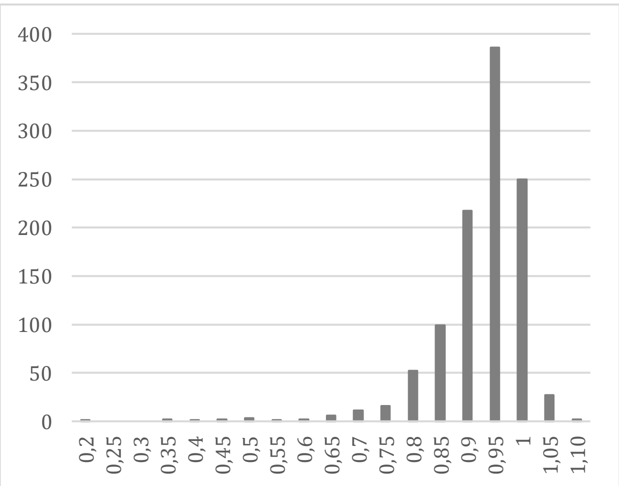
Table A1. Descriptive statistics - building specifications.

Variable	Observations	Mean	Standard deviation	Min	Max
Size	1,075	97.12 m^2	50.95186	21 m^2	396 m^2
Year built	1,080	1973.13	28.74148	1800	2017
Time on market	1,079	20.07 days	37.08597	0 days	680 days
Type of dwelling:					
Freehold apartment,	1,084	274	.4347994	0	1
Freehold detached,	1,084	257	.4254911	0	1
Freehold semi-detached,	1,084	80	.261567	0	1
Freehold townhouse,	1,084	61	.2305546	0	1
Leisure home,	1,084	17	.1243019	0	1
Cooperative townhouse	1,084	32	.1693378	0	1
Cooperative apartment.	1,084	363	.4721631	0	1
Location:					
Trondheim center	1,094	213	.3961494	0	1
Trondheim East	1,094	179	.3700993	0	1
Lerkendal	1,094	205	.3903993	0	1
Heimdal	1,094	115	.3068467	0	1
Outside Trondheim	1,094	122	.3149157	0	1
Outside Rural.	1,094	260	.4258444	0	1
Year of sale:					
2014	1,152	385	.4719154	0	1
2015	1,152	263	.4199184	0	1
2016	1,152	504	.4962938	0	1
Sales quarter:					
1. Quarter	1,152	454	.4888681	0	1
2. Quarter	1,152	168	.3530923	0	1
3. Quarter	1,152	90	.2684847	0	1
4. Quarter	1,152	440	.486074	0	1

Table A2. Correlation matrix of the variables included in the SEM-models.

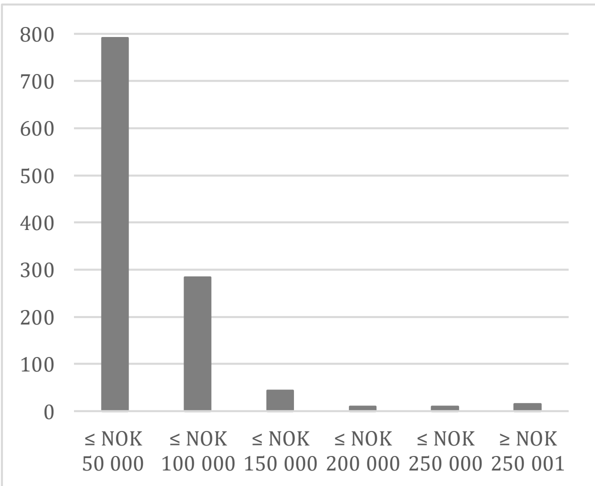
Variables	Standard deviations	Price premium	Number of bidders (ln)	Average response time (ln)	Average acceptance deadline (Including all bids) (ln)	Average acceptance deadline (Excluding the first bid) (ln)	Opening bid ratio (ln)	Average bid increase (ln)
Price premium	0.0793	1.0000						
Number of bidders (ln)	0.3383	0.4816	1.0000					
Average response time (ln)	1.5880	-0.2491	-0.1930	1.0000				
Average acceptance deadline (Including all bids)	1.2293	-0.0853	-0.0392	0.7913	1.0000			
Average acceptance deadline (Excluding the first bid) (ln)	1.1043	-0.1023	-0.0124	0.5687	0.8094	1.0000		
Opening bid ratio (ln)	0.1158	0.2898	0.0302	-0.1274	-0.1128	-0.1084	1.0000	
Average bid increase (ln)	0.6900	0.0529	-0.1023	0.1959	0.1201	0.0532	-0.3208	1.0000

Figure A1. Distribution of the opening bid to asking price ratio.



Notes: Number of observations = 1078.

Figure A2. Distribution of the average bid increase.



Notes: Number of observations = 1152.

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