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Seniority Purchase Option in the Norwegian Housing Market, and its Effect on Auction Dynamics

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Content

Summary

In our thesis, we study the effects of the presence of "forkjøpsrett", or seniority purchase option (SPO), on the market for cooperative apartments. Norwegian housing is transacted via English auctions, and we hypothesize that the presence of SPO gives incentives for bidders to alter their behavior. The SPO gives members of a cooperative (co-op) the right to buy for-sale apartments at the price determined by the public auction without having to participate in the auction themselves. We argue that this creates an incentive for buyers with SPO to not participate in the auction, and rather exercise their SPO after the fact at a lower price than if they were to participate. Consequentially, this creates an incentive for the remaining bidders to bid more aggressively in order to deter (potential) buyers with seniority from exercising their SPO. To study this, we collect transaction level data from 2015 and 2016, containing hedonics and full bidding logs, as well as information on ownership structure. This enables us to separate between co-ops with and without SPO. As a proxy for aggressive bidding behavior, we study the occurrence of *overbids*. This we define as one unique bidder placing two consecutive bids, without it being as a response to bids placed by other bidders, implying that he effectively overbids himself. We also study the likelihood of an apartment being transacted via bargaining (one bidder) as opposed to an auction (more than one bidder). Results from analyzing these auction characteristics serve as evidence for our hypothesis. We show that overbidding is positively correlated with a higher sales price, controlling for observables, and that it occurs more often when SPO is present. However, SPO co-ops are more often transacted via bargaining, which has a negative effect on price, controlling for observables. Therefore, when testing the overall price effect of the SPO, we find no significant effect. The two countervailing price effects of the SPO turn out to cancel each other out. Given our result, we argue that SPO presence creates additional uncertainty for agents participating in the auction, resulting in a potentially less efficient auction format.

1. Introduction

In this thesis, we study the price effect of the presence of "forkjøpsrett", or seniority purchase option (SPO) as we call it, in the market for cooperative apartments (co-ops). The SPO gives members of a cooperative the right to buy for-sale apartments within the cooperative at the price determined by the public auction[1] (the winning bid) without having to participate in the auction themselves. All co-ops come with some level of SPO (internal SPO). However, when the cooperative is part of the larger, region wide network, like OBOS and USBL, the SPO becomes much more extensive[2] (external SPO).

We hypothesize that SPO presence creates incentives that alter the auction dynamics, which ultimately might influence prices. We point to two auction mechanisms with countervailing effects on price. One the one hand, SPO presence gives buyers with seniority an incentive to *not* participate in the auction and rather exercise their SPO after the fact. Standard auction theory states that the price is increasing in the number of bidders (Bulow and Klemperer, 1996). Thus, when a buyer with seniority removes himself from the auction, he gets a chance to buy the house at a price that is in expectation lower than it would have been had he participated. On the other hand, this gives incentives for the remaining bidders to try and deter potential outside buyers by bidding more aggressively, and thus making it less beneficial for such buyers to exercise their SPO after the auction. Such bidding behavior should have a positive effect on price.

There is, to our knowledge, no existing literature on price effects caused by the presence of SPO. This, we believe, has to do with the fact that (extensive) SPO on housing is close to non-existent in housing markets outside of Norway.

To address our hypothesis, we collect transaction data from 2015 and 2016. The data includes both housing characteristics (hedonics) as well as bidding logs for each observation. All data is collected from one single realtor, based in central Oslo.

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[1] Used housing in Norway is generally sold at English auction.
[2] By extensive, we mean that an object for sale is available for large number of members that can exercise their SPO. For both OBOS and USBL, their annual reports state that the external SPO is exercised in one third of all transactions (we find similar figures in our data). Internal SPO is far less likely to be exercised. In our data set it is never exercised.

Consequently, the geographical distribution of our data set is centered around central Oslo.

Our data also includes information on ownership structure for each transacted property. This is key to our study, as it allows us to identify cooperatives from other ownership structures (e.g. stock cooperatives and privately owned housing). Moreover, we have information on when the cooperative is part of a larger underlying network, namely OBOS and USBL. Since the SPO becomes much more extensive once the cooperative is part of such a network (external SPO), we regard the independent co-ops (with only internal SPO) as having no SPO at all. This separation enables us to compare two arguably similar groups, co-ops with and without SPO. This forms the basis for our analysis, where we compare auction dynamics and prices on OBOS/USBL cooperatives (with SPO) to independent cooperatives (no SPO).

To ensure that our sample consists solely of transactions that has gone through the process of a public auction, we remove observations transacted via so called "kupping", or *coups* as we call them. A coup occurs when buyers bypasses the realtor and places a high "take it or leave it" offer directly to the seller to avoid a public auction.

We empirically study the two mechanisms described previously, reduction in number of bidders and more aggressive bidding. For the latter, we use a proxy we call *overbid*. This we define as one unique bidder placing two consecutive bids, without it being as a response to bids placed by other bidders, implying that he effectively overbids himself. We argue that this reflects deterring behavior on the side of that bidder, i.e. to deter outside buyers holding SPO. We use a dummy variable that indicates when an overbid has occurred in an auction. When studying number of bidders, we construct a dummy that indicates whether the apartment was transacted via auction (more than one bidder) or bargaining (only one bidder). We do a regression analysis to determine the effect of the two auction characteristics on price and how they are affected by the presence SPO.

First, we estimate two hedonic regressions including the two indicator variables described above. By doing so, we estimate effect that each of our auction

characteristics has on the hedonic price. Our estimations suggest that the price of an apartment transacted in an auction rather than via bargaining is around 6% higher, controlling for observables. We also find that the price is almost 4% higher on transactions where overbidding occurs, controlling for observables.

Next, we use a linear probability model to determine how SPO presence affects the likelihood of an overbid occurring or the transaction going to an auction. Our results indicate that SPO presence decreases the likelihood of a transaction going to auction by 8% and that it increases the probability of an overbid occurring by 10.5%.

Thus, we provide evidence that supports our hypotheses that SPO presence indeed alters the auction dynamics. On the one hand, we find that the number of bidders in the auction is affected negatively by SPO presence, which correlates with a lower price. Our evidence shows that co-ops with SPO are more likely to be transacted via bargaining compared to other co-ops. On the other hand, we find that overbidding occurs more often when SPO is present. We also show that this affect the price positively. These results serve as evidence to our hypothesis that bidders are trying to deter potential outside buyers with seniority by increasing the price.

This argument is backed by our additional analysis, where we try an alternative proxy for aggressive bidding behavior, namely jump bidding. A jump bid is a bid with a large increment that can have tactical motives different from ordinary bids (Avery, 1998). We find that jump bidding occurs more often when SPO is present. Moreover, we find that jump bidding is positively correlated with number of bidders, as opposed to overbids, indicating that SPO presence is correlated with aggressive bidding behavior both in bargaining as well as in auctions.

Finally, we study the overall price effect of SPO presence. By doing so, we essentially analyze if one of our two auction mechanisms dominate. However, our estimation shows no significant effect of the SPO on the hedonic price. This might indicate that the two effects effectively cancel each other out. This is supported by a back-of-the-envelope calculation, where we add the two characteristics probabilities of occurring multiplied with their individual price effect. The sum found in this calculation is close to zero, which supports the argument that the two countervailing effects cancel each other out.

2. Literature review

There is no existing research that directly addresses our research question. This, we believe, comes from the fact that no other markets have the extensive SPO found in many Norwegian cooperatives. Moreover, there are only a handful of markets that primarily sell real estate through English auctions, namely the Scandinavian countries, Singapore, Scotland and Australia. However, there are still studies that partly relates to our topic.

Bulow and Klemperer (1996) theoretically compare auctions to negotiations. They show that a simple competitive auction with n +1 bidders will yield the seller a higher expected revenue than he would expect to earn by exploiting his monopoly selling position against n bidders. They focus on company transactions. However, this is a general result, and it shows that a seller is in most circumstances better off if he can attract one more buyer to the auction. They continue this research in Bulow and Klemperer (2009) where they conclude that English auctions are preferable to a sequential mechanism as long as entry into the auction is not costly. Levin and Smith (1994) do a theoretical paper with similar conclusion, that the cost of entry for the buyers will determine the number of bidders in an auction.

Avery (1998) discuss the effectiveness of jump bidding in an English auction. He argues that previous papers, like Milgrom and Weber (1982), do not allow for this mechanic in their theoretical framework. He argues that English auction cannot be viewed as identical to a second price sealed bid auction due to jump bidding being a viable tactic. He states that jump bidding can be compared to bluffing in poker to indicate "strength" to deter other bidders from competing.

Chow et al. (2015) investigate the real estate market in Singapore, and compare revenues from apartments sold at auctions to negotiated sales. Their result show that the revenue is higher when the apartment is sold through auctions rather than when the price is negotiated (similar results are found by among others Ashenfelter and Genesove, 1992). More specifically they find that auctions generate higher sales premia when the properties are more homogenous and when the market is in an upwards trend. Han and Strange (2011) find similar results in their study of the American housing market. They use survey data collected between 1987 and 2010 from individual house owners. In their study, they find that bidding wars are more

common in housing booms. Therefore, auctions yield higher revenues when markets are in an upwards trend. However, they also study other contributing factor, among others buyer irrationality and the asking price.

McAfee and McMillan (1986) study how the sellers revenue is affected by the bidders knowing the number of opponents (other bidders) in the auction. They question the result provided by Milgrom and Weber (1982), which show that it is in many circumstances in the best interest of the seller to release information about the number of bidders in an auction to the other bidders. McAfee and McMillan show that if the bidders are risk averse, the seller's expected revenue in a first-price sealed-bid auction is higher if the bidders do not know how many bidders there are. They state that concealing the number of bidders dominates revealing it. However, if the bidders are risk-neutral it does not matter if the number of bidders is revealed, especially in English auctions and second-price sealed-bid auctions. The bidders will bid their full valuation regardless, and end up with a price equal to the second highest valuation.

Hungria-Gunnelin (2010) empirically test the effect of the number of bidders on the sale price of apartments in Stockholm. The empirical analysis is based on 512 transactions in the inner-city Stockholm in 2010. The dataset include price, property attributes, condominium fee, geographical location, realtor agency, and the actual number of bidders that participated in the auction. She uses hedonic regression to show a positive significant relationship between number of bidders and sale price. She also reviews a number of other research papers in the area, but there are few countries that use the English auction system for housing, so her paper contributes new links between auction theory and dwelling prices.

Genesove and Hansen (2014) find some interesting results from the Australian housing market that suggest that English auction sales prices are more informative with regards to forecasting housing prices as opposed to bargaining. Auctions reflect the common trends in the market to a greater extent, while one on one bargaining is more susceptible to shocks that change the relative strength of the bargaining positions of buyers and sellers as well as shifts in the dispersion of valuations.

3. Conceptual Framework

3.1. Ownership structure and the Seniority Purchase Option

Housing in Norway, especially apartments, generally come in three types of ownership: Privately owned, stock cooperative (stock) and cooperative (co-ops)[3]. With privately owned housing, the buyer has exclusive ownership of the unit and holds all tenure rights. Any buyer can own a private house, both private and commercial entities. Stock housing resembles the cooperative structure, but share some features with private housing. For instance, commercial entities can (in general) own stock apartments, similar to privately owned housing. Also, the tenure rights can be more lenient compared to cooperatives[4]. With cooperative housing, the owner holds a share in a larger joint ownership, typically consisting of a few apartment buildings. Co-ops come with more restrictive legal rights than privately owned housing (Lov om Burettslag). Only private entities can buy in on a co-op and there are typically more restrictive tenure rights. However, there is no document duty on co-op transactions (similar as with stock housing), whilst there is a 2.5% duty on privately owned units (Lov om Dokumentavgift §6-7).

A key feature of housing cooperatives is that some are part of a larger, region wide, network. For instance, in Oslo we have OBOS and USBL which act as parent organizations to many cooperatives, providing management support, counseling etc. Around 90 000 houses/apartments are organized under OBOS and around 72 000 under USBL. Owners of USBL/OBOS-housing are automatically registered as members in the organization. However, outsiders can also decide to become a OBOS or USBL member, to obtain membership benefits. Also, seniority can be inherited/transferred within a family. In total, there are around 416 000 OBOS members (OBOS, 2016) and 94 000 UBSL members nationwide (USBL, 2016).

Owning a share in any cooperative, regardless of underlying co-op network, give certain benefits. One such benefit is the "forkjøpsrett", or Seniority Purchase Option (SPO) as we call it. The SPO gives existing members of the cooperative the right to buy a used apartment that is put up for sale at the price determined by the public

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[3] In Norwegian, these terms are "selveier", "aksjelag" and "borettslag" respectively.
[4] The legal framework is ambiguous on tenure rights for stock apartments.

auction (the winning bid). This without having to participate in the auction themselves. Who gets the first right to exercise their SPO, is determined by member seniority in the cooperative. We distinguish between internal and external SPO. Internal SPO is only an option available for others who currently live in the same cooperative. External SPO only applies when the cooperative is part of a larger network, such as OBOS or USBL. Then, the SPO is available for all members of that network (provided that the internal SPO has not been exercised). So, when a co-op is part of a larger network, the SPO automatically becomes much more extensive, in the sense that there are far more buyers who can bypass the auction to exercise their SPO. For both OBOS and USBL, the external SPO is exercised in one third of all transactions (OBOS, 2016 and USBL, 2016). In contrast, internal SPO is very rarely exercised.

3.2. Housing auctions and the SPO

Used housing in Norway is generally transacted via English auction where the seller has a private reserve price. Shortly after the public viewing(s) the realtor arranges an auction, open for anyone to enter. The seller is free to accept any bid from the auction. Though, he is not allowed to announce an asking price that he is not willing to accept (Forbrukerombudet.no).

Our hypothesis is that the presence of SPO alters the auction dynamics, which ultimately might impact the final price. We focus on two main auction characteristics that we argue are affected by the presence of SPO, where the two have countervailing effects on price. On the one hand, SPO presence can reduce the number of bidders in the auction, as it gives buyers with seniority an incentive to sit out the auction to exercise the SPO after the fact. One can analyze this incentive theoretically using auction theory (Pepall et al. 2013). If the outside buyer has a valuation higher than the winning bid, the SPO allows him to buy the house without outbidding the auction winner, implying a lower price than if he were to participate in the auction. This is also in line with results from standard auction theory (Bulow and Klemperer, 1996), that the price is increasing in the number of bidders participating in the auction. Consequently, this suggests that SPO presence should lower the final sales price.

On the other hand, we argue that SPO presence might also affect the price positively, as it creates an incentive for a bidder (with no or low seniority) to bid more aggressively in order to deter potential buyers with seniority from exercising their SPO. According to auction theory, the winning bid in an English auction is marginally higher than the second highest valuation (Krishna, 2002). In the presence of the SPO however, the threat of potential outside buyers holding SPO gives the bidder an incentive to bid more aggressively since he is not only aiming to (marginally) outbid the other bidders, but also bid higher than the valuation of potential outside buyers with SPO. Note however that the bidder does not know how many outside buyers with seniority (if any) that are actually interested in the apartment[5]. This relates McAfee and McMillan (1986), who show that with risk averse bidders, the price becomes higher when the bidders do not know how many other bidders they are up against.

We can illustrate this dynamic by imagining a continuation game following the public auction. Suppose there is an auction winner with a standing bid marginally higher than the highest valuation of the other bidders. His payoff from the auction is the difference between his own valuation and the standing bid. Now, he faces the threat that there might exist outside buyers with longer seniority, and that their valuation is higher than his standing bid. He must decide on whether to increase his bid (spend parts of his payoff) as a response to this threat, or not. Auction theory suggests that he should increase his bid depending on his beliefs of the threat. Similarly to first price sealed bid auction, he should shade his bid (from his maximum valuation) in response to how many buyers with longer seniority he expects there to be. If he believes that there are many, he should shade his bid less, and vice versa (Pepall et al, 2013).

In our thesis, we analyze the price effect of SPO by studying empirically the two mechanisms described above, reduction in number of bidders and more aggressive bidding. We hypothesize that SPO presence, on the one hand, gives buyers with seniority an incentive to not participate in the auction, and rather exercise their SPO after the auction. On the other hand, this creates an incentive for the remaining

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[5] This is when there is no requirement to pre-auction registration of interested buyers holding SPO ("forhåndsavklaring"). When this is used, the uncertainty of the outside threat is reduced, but not eliminated.

bidders to bid more aggressively, closer to their valuation, to deter the buyers with seniority from exercising their option. We expect these two mechanisms to have countervailing effects on price. We summarize these two mechanisms in Figure 1.
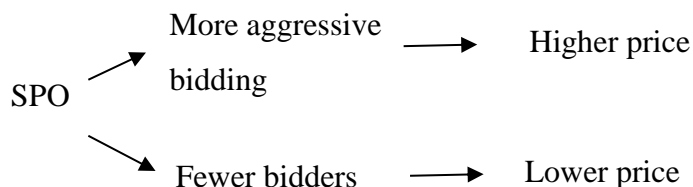

Figure 1.

4. The data

Our research question requires data on both housing hedonics and bidding information for each transaction. To this end, we construct such a data set using bidding information from one realtor that operates in Oslo, Aktiv Eiendom Grønland (Aktiv). The initial data contains all sales conducted by Aktiv during 2015 and 2016. It has approximately 700 observations, containing both hedonics and anonymized bidding logs for each transaction. We remove some extreme outliers that are likely due to errors in the data entry. In addition, we remove all transactions that are not apartments (houses, cabins, parking spaces etc.) and also all observations outside the city of Oslo. The remaining observations are checked against the database Eiendomsverdi.no. This cleaning procedure leaves us with 663 apartment transactions in Oslo, sold during 2015 and 2016.

4.1.Data characteristics

The data collected from Aktiv contains information on location (address and zip code), date of sale, asking price, shared debt, ownership structure (privately owner, stock or cooperative), size, number of rooms (living spaces – bedrooms, living rooms etc), floor, age of apartment building[6] and a balcony-dummy that indicates whether the apartment has access to a private outside area or not. Table 1 contains summery statistics for all these variables.

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[6] Data on apartment building age was quickly removed from our sample as we found the variable to not properly control for apartment age. We argue that any potential age premium on apartments depends on more complex matters than only building age, especially interior standard and potential renovations done to the building, which is unobserved in our sample.

In the raw data, asking price and sales price are reported separate from shared debt. To make observations comparable, we need to take shared debt into account. We simply add shared debt to the sales price and the asking price, assuming buyers evaluate shared debt equal to private debt/wealth. Next, we define premium as the relative difference between the final sales price and the asking price.

$$Premium = \frac{FinalPrice - AskingPrice}{AskingPrice}$$

The distribution of premia in our sample (Figure 2) indicate that the market was in a boom during our sample period (2015-2016). Only 17 of our 663 sales happened below asking price, while 43 were sold at asking price.
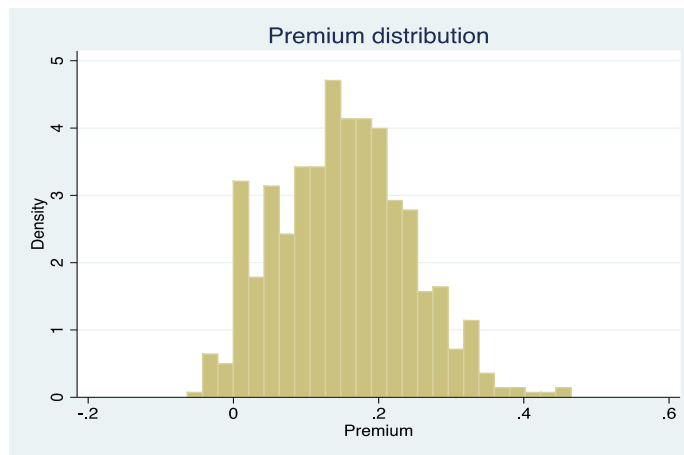
Figure 2: Premium distribution entire sample

Table 1: Descriptive statistics entire sample

	Mean	Std.	Min	Max
Size	55.63801	19.2437	15	154
NbrRooms	2.4736	0.7977	1	5
Floor	3.08446	1.8367	1	13
Premium	0.1509	0.09198	-0.06359	0.46514
Price/ M^2	65576.74	14729.41	29518.52	141858
SharedDebt/ M^2	5007.466	8825.463	0	52396.46
N	663	663	663	663

4.2. Cooperatives with and without SPO

Our data set also contains information on the underlying cooperative network, OBOS, USBL or none (independent), for all cooperative apartments. This information is key for our analysis, as we discuss in chapter 4.4. In addition, we have data on whether or not the SPO has been exercised (dummy variable *SPOX*) for each observation. This applies to both internal SPO within the cooperative and external SPO within the cooperative network (OBOS/USBL). For the latter, our sample does not differ significantly from the national averages reported by OBOS and UBSL (annual reports from OBOS and USBL). In our data, the external SPO is exercised on around one third of OBOS/USBL transactions. In contrast, we find *no* instances of internal SPO being exercised. We argue that the observed difference between internal and external SPO relates to the difference in extensiveness (see chapter 3.1). This essentially lead us to regard co-ops with only internal SPO as having *no* SPO at all. In our analysis, we combine OBOS and USBL housing as one group, cooperatives with SPO, and compare them to the non-SPO co-ops (only internal SPO). Table 2 provides summery stats between the groups.

Table 2: Descriptive stats by ownership structure

	SPO co-ops	Co-ops	
	Mean	Mean	Difference
Size	57.1127	52.9704	4.1422**
NbrRooms	2.4507	2.4729	-0.0222
Floor	2.9577	2.9507	0.0070
Premium	0.1468	0.16189	-0.015
$M^2 SharedDebt$	7201.548	9541.319	-2339.771*
SPOX	0.3239	0	0.3239***
N	142	203	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As the table show, the two groups are fairly similar in characteristics. However, there is a significant difference with regards to apartment size which again contributes to the observed difference in average shared debt per m^2. This we control for in section 4.4 [7]. There are also small geographical differences that are not displayed in the table. Since our data comes from one single realtor, based in

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[7] When excluding the top and bottom 2.5 percentiles from our sample, differences in both size and shared debt per m^2 becomes insignificant.

Gamle Oslo, this borough is heavily favored in our sample. This applies also for the two groups specified above. However, the non-SPO cooperatives have a slightly wider geographical distribution. For non-SPO cooperatives the share of apartments located in Gamle Oslo is 67%, whilst it is 76% for cooperatives with SPO.

4.3. Bidding logs and auction characteristics

One unique feature of our data set is the detailed bidding information for each observation. The bidding logs include information on size and timing (time of bid registration and acceptance deadline) of each submitted bid, as well as a unique ID for each bidder and the seller (for counterbids). The log also contains some additional information which we essentially disregard[8]. In the following sections we describe how we manipulate data from bidding logs to construct our variables of interest.

Similarly as with asking/final prices, we add shared debt to the bids, to ensure comparability across observations. Furthermore, rather than ordering the bids based on the timing of the bid, we order them by size. The reason for this is high frequency of errors in the data[9]. This implies that we assume that bids are placed in ascending order, where bidders have perfect information on the sequence of the auction.

Next, we look at bid increments, that is the relative difference between a bid and the prior standing bid.

$$Bid\ increment(\text{n}) = \frac{Bid(n) - Bid(n-1)}{Bid(n-1)}$$

Since our bidding log is sorted in an ascending order, $Bid\ increment(\text{n}) \geq 0$ for all bids n. Figure 3 shows the distribution of all the bid increments in our sample.

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[8] Reservations on the bid and desired transaction date. We do not use this information in our analysis since, in our data, the winning bid is always the highest bid regardless of reservations and desired transaction date.

[9] Even though the realtors are legally obligated to register all submitted bids, they often fail to do so in real time. Managing an auction is stressful for the realtors, and logging the bids during the auction is done in between juggling phone calls and emails with bidders. As a consequence, the bidding log can seem somewhat chaotic with regards to timing and sequence of the bids.
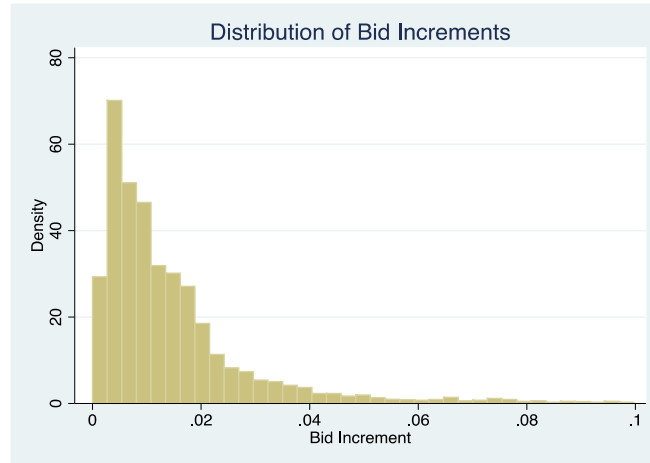
Figure 3: Distribution of bid increments

Based on the information in the bidding logs, we define two variables of interest for our analysis. First, when studying the number of bidders in an auction, we use a dummy variable that indicates whether an auction has a number of unique bidders that exceeds a set threshold (*NbrBidders>X*). For our analysis, we simply set this threshold *X* to *one* bidder *(NbrBidders>1)*. In essence, what this variable indicates is whether the apartment was sold at auction or through a bargaining process. In line with our conceptual framework, we expect this variable to be negatively affected by SPO presence, as buyers with seniority have an incentive to not participate in the auction.

Our second variable of interest, *Overbid*, is constructed as a proxy for aggressive bidding. We define a transaction as having an overbid if the same bidder posts two consecutive bids with increment different from zero. When a bidder, who has the current highest bid, places an even higher bid, an overbid has occurred. This is illustrated by Figure 4. Our variable *Overbid* serves as a proxy for aggressive bidding behavior in the auction. We argue that overbidding oneself serves no rational purpose other than to drive the price upwards with a potential deterring effect. In line with our hypothesis, such bidding behavior should be affected by SPO presence. When defining our variable, we also disregard overbids that occurs below asking price, as these are more likely to come as result of the seller intervening in the auction without placing formal counterbids.
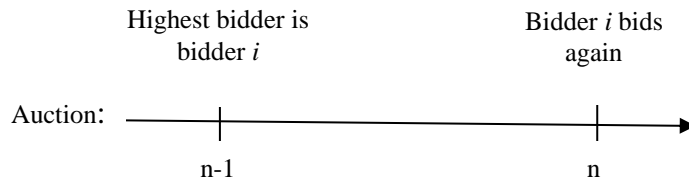
Figure 4

With all our auction characteristics defined, we provide a table of summery stats from the bidding logs. We present statistics both for the entire sample (Table 3) and for the two groups of cooperative housing, with and without SPO (Table 4).

Table3: Summary stats bidding log, entire sample.

	Mean	Std.	Min	Max
NbrBidders	4.3635	3.1275	1	21
Overbid	0.09804	0.2975	0	1
TotalBids	11.3182	8.3763	1	50
SellerCounterbid	0.0332	0.1792	0	1
N	663			

Table 4: Summary stats (means) bidding log, by ownership structure.

	SPO co-ops	*Co-ops*	
	Mean	Mean	Difference
NbrBidders	3.9789	4.3399	0.3610
NbrBidders>1	0.7957	0.8226	0.0269
NbrBiddersGmlOsl	4.2043	5.0169	0.8127[*]
Overbid	0.1761	0.0591	0.1169[***]
TotalBids	9.3732	11.6256	2.2524[**]
SellerCounterbid	0.03521	0.02463	0.0106
N	142	203	

[*] $p < 0.1$, [**] $p < 0.05$, [***] $p < 0.01$

From Table 4, we see that there are significant differences between co-ops with and without SPO, both with regards to the occurrence of overbids as well as the average number of bids in the auction. Looking at the number of bidders (*NbrBidders* and *NbrBidders>1*), we see no significant difference in the sample. However, if we reduce the sample to only include the main borough, Gamle Oslo, we see that there are significant differences between the groups (*NbrBiddersGmlOsl*). This suggests that, with regards to number of bidders, there are differences to be revealed once we control for observables.

4.4. Sample selection

As indicated previously, we restrict the sample to only include cooperative housing. This is done to ensure comparable observations and implies that we exclude both privately owned and stock apartments. We argue that these differ too much from cooperatives with regards to legal rights, which might affect prices and thus bias our results. Moreover, both stock and private apartments differ from co-ops with regards to certain characteristics, especially shared debt. If there exist a difference in valuation of shared vs private debt, as theory suggests (Hjalmarsson Hjalmarsson, 2009), removing stock and private apartments reduces the chance of any bias in our results caused by such a difference (as we assume equal valuation).

From the descriptive statistics presented in Table 2, there are two statistically significant differences between co-ops with and without SPO, size and level of shared debt per square meters. By restricting the sample to properties between $25m^2$ and $110m^2$ (this constitutes the top and bottom 2.5 percentile of our sample) both differences become insignificant. Also, with this size restriction, the small difference in geographical distribution between the two groups becomes even less.

Finally, we also control for what we call coups ("kupping"). A coup is when a buyer bypasses the realtor and places a high "take it or leave it" offer directly to the seller to avoid a public auction. Thus, when there is a coup, there obviously is no auction. Therefore, we need to exclude these transactions, as we want to study auction dynamics. The bidding log does not identify whether an apartment was sold by a coup, or if there simply was only one bidder participating. Therefore, we decide on three assumptions as to what constitutes a coup. First, there must be only one bidder participating in the auction. Secondly, the number of bids must also be limited to only one[10]. Thirdly, we assume that the coup price is strictly higher than the asking price.

Our final sample consists of 286 observations: 118 co-ops with SPO and 168 without.

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[10] This is based on insight given to us by realtors at Aktiv. When a coup occurs, the realtor does not oversee the process and logs no other information than the accepted offer. So, when the bidding log only show one registered bid, there is a good chance that a coup has occurred.

5. Regression analysis

We perform a hedonic regression analysis to study our hypotheses. We want to find out how the characteristics of interest, overbids and number of bidders, affect prices and how they are affected by the presence of SPO. Finally, we study the overall price effect of SPO.

5.1. Price effect of auction characteristics

We analyze the price effect of number of bidders and overbids by estimating the following equations with a log-log specification, using ordinary least squares:

(1) $\log P_i = \alpha + x'_i \gamma + \beta (NbrBidders > 1)_i + \varepsilon_i$

(2) $\log P_i = \alpha + x'_i \gamma + \rho \mathrm{Overbid}_i + \varepsilon_i$

Where P_i is the final price of the apartment, α is an intercept, x_i is a vector of hedonics (listed below) and γ is the vector of coefficients. ρ and β are our coefficients of interest, indicating the price effect of our two auction characteristics. ε_i is the noise term, which we assume to be uncorrelated with the regressor and to have a zero mean.

We estimate equation 1 and 2 both with and without control variables (hedonics and time trends). In the latter case we include apartment size as the only control, since explaining price as a function of the auction characteristics alone makes little economic sense. Our variable of interest in equation 1, (*NbrBidders>1*), is a dummy variable that indicates if an transaction has more than one bidder in the auction. According to theory (Bulow and Klemperer, 2009), we expect β >0. Our variable of interest in equation 2, *Overbid,* is a dummy variable that indicate if an overbid occurs in that auction. We expect *ρ* >0 as well.

Our default set of hedonic controls includes two size controls, *logSize* (log of living area in m^2) and *NbrRooms* (number of rooms). The latter serves as a proxy for how efficiently the living area is organized. Moreover, we control for the negative price effect of lower floor housing by including the dummy variable *FirstFloor.* We also control for the advantage of having access to a private outside area by including the indicator variable *Balcony.* We control for location by using borough indicators for

each property based on the zip codes in the raw data (in total six main boroughs in our sample, plus a seventh: "others"). Finally, we control for time specific effects (overall time trend in the market and "seasonal" effects) by including 24 separate dummy variables that indicates each month in the sample.

5.2. SPO and auction characteristics.

Next, we use a linear probability model to test the effect of the presence of SPO on the two auction characteristics. We estimate the following equation:

$$(3)\ Y_i = \alpha + x'_i \gamma + \phi SPO_i + \varepsilon_i$$

$$Y_i = \begin{cases} (NbrBidders > 1)_i \\ Overbid_i \end{cases}$$

Where Y_i represents the two indicator variables *Overbid* and (*NbrBidders>1*), α is an intercept and ϕ is our coefficient of interest, indicating how SPO presence affect the likelihood of the specific characteristic occurring in the auction. x_i is a vector of hedonics, described previously, and γ is the vector of coefficients. ε_i is the noise term, which we assume to be uncorrelated with the regressor and to have a zero mean.

5.3. Overall price effect of SPO

As a final step, we study the overall price effect of SPO, to determine if one of the previously studied characteristics dominates with regards to price. We do so by estimating equation 4 using OLS.

$$(4)\ \log P_i = \alpha + x'_i \gamma + \phi SPO_i + \varepsilon_i$$

Where P_i is the final price of the apartment, α is an intercept, x_i is the vector of hedonic controls and γ is the vector of coefficients. ϕ is our coefficient of interest, indicating the price effect of the SPO. ε_i is the noise term, which we assume to be uncorrelated with the regressor and to have a zero mean.

6. Results

In this chapter we present our main empirical results, that form the basis for our discussion in chapter 7.

6.1. Price effect of auction Characteristics

First, we study the price effect of the two auction characteristics by estimating equation 1 and 2, both with and without hedonic controls and time trends. The results are presented in Table 5.

From column 2 we see that overbid has a positive price effect, significant at the 10% level. The coefficient indicates an approximately 3% increase to the hedonic price when there is an overbid in the auction. Furthermore, the results in column 3 and 4 show that number of bidders have a positive and statistically significant effect on price. When hedonics are included (column 4), the coefficient indicates that apartments transacted via auctions (more than one bidder) have a price approximately 6% higher than apartments sold in bargaining (only one bidder). From column 6 we also see that when including both indicators to the estimation, both coefficients increase in power. This indicates a correlation between the two, and that there is an omitted variable which the estimates in column 1-4 do not capture. We confirm a negative correlation between number of bidders and overbids, by comparing sample means of these two variables. When an apartment is transacted via auction, there is a 11.69% (SE: 0.0198) likelihood of an overbid occurring. The corresponding figure for bargaining is 33.33% (SE: 0.1054). A simple T-test reveals that the difference between the two is statistically significant at the 1% level.

Table 5.

	(1) logPrice	(2) logPrice	(3) logPrice	(4) logPrice	(5) logPrice	(6) logPrice
Overbid	-0.0192 (0.0277)	0.0317[*] (0.0188)			0.0035 (0.0286)	0.0406[**] (0.0164)
NbrBidders>1			0.0562[*] (0.0343)	0.0561[**] (0.0268)	0.0569 (0.0355)	0.0623[**] (0.0256)
N	286	286	286	286	286	286
R^2	0.4813	0.8313	0.4986	0.8652	0.4866	0.8683
Hedonics	NO	YES	NO	YES	NO	YES

Standard errors in parentheses
[*] $p < 0.1$, [**] $p < 0.05$, [***] $p < 0.01$

6.2. Effect of SPO on auction characteristics

Next, we look at the effect of SPO presence on the two auction characteristics, overbids and number of bidders. We do so by estimating equation 3 with *Overbid* and *NbrBidders>1* as dependent variables. Results are presented in Table 6.

From column 1 and 2 we see that the presence of SPO is positively correlated with occurrence of overbids. The coefficients are statistically significant at the 1% and 5% level. When control variables are included, we find that there is approximately 10.5% higher likelihood that an overbid occurs when the cooperative has SPO. In column 3 and 4 we present our results on how SPO presence affect the number of bidders in the auction. From column 4 we see that when including hedonic controls, we find a negative effect significant at the 5% level. The coefficient indicates that apartments with SPO are approximately 8% less likely to be transacted via auction.

Table 6.

	(1)	(2)	(3)	(4)
	Overbid	*Overbid*	*NbrBidders>1*	*NbrBidders>1*
SPO	0.1157***	0.1032**	-0.0458	-0.0809**
	(0.0418)	(0.0464)	(0.0319)	(0.0387)
N	286	286	286	286
R^2	0.0313	0.1508	0.0104	0.1636
Hedonics	NO	YES	NO	YES

Standard errors in parentheses
$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

6.3. Overall price effect of SPO

Finally, we study the overall price effect of SPO presence. We do so by estimating equation 4, with and without hedonic controls and time trends. Results, presented in Table 7, show no significant price effect of SPO presence, implying that there is no overall effect of SPO presence on the hedonic price.

Table 7.

	(1)	(2)
	logPrice	*logPrice*
SPO	-0.0338	-0.0029
	(0.0275)	(0.0146)
N	286	286
R^2	0.0055	0.8421
Hedonics	NO	YES

Standard errors in parentheses
$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

7. Discussion

In this chapter, we discuss our main results and their consistency with our conceptual framework.

First, we provide evidence that both our auction characteristics of interest, overbid and number of bidders, have a significant effect on the hedonic price. We find that the number of bidders in an auction is positively correlated with price. Specifically, we show that auctions with more than one bidder yield a higher price than bargaining, which is in line with theory (Bulow and Klemperer, 2009). Our results indicate that apartments transacted via bargaining rather than auctions have an around 6% lower price. On the matter of overbids, we find that it is positively correlated with price. Our estimation suggests that occurrence of overbids in an auction increase the hedonic price by approximately 4%. When we consider that prices in our data average around 3.5 million NOK, these numbers are economically significant.

Next, we provide empirical evidence of how our two auction characteristics are affected by the presence of SPO. We find a positive relationship between SPO and overbids, that SPO presence increases the likelihood of an overbid occurring by approximately 10.5%. We also find a negative relationship between SPO presence and number of bidders. The presence of SPO decreases the likelihood of an apartment being transacted via auction by approximately 8%. These results are consistent with our conceptual framework, that buyers do in fact change their behavior in response to the incentives created by the SPO. On the one hand, we prove that SPO presence is associated with fewer bidders, which we argue stems from the incentive for buyers with seniority to remove themselves from the auction. On the other hand, through our proxy variable, we provide evidence to support that the presence of SPO increases the likelihood of aggressive bidding behavior. This we argue follows from the incentive for bidders in the auction to deter outside buyers with seniority[11].

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[11] Interestingly, we also find that in 2/3 of transactions where overbidding (our proxy for aggressiveness) occurs, it is the last registered bid in the log, implying that it is the winning bid. This, we argue, fits well with the narrative described in section 3.2, that there is a continuation game following the public auction.

We also show that there is a negative correlation between number of bidders and overbids. More specifically, we show that overbidding occurs more often in bargaining. This gives further evidence to support our hypothesis that there are two countervailing forces affecting the price. Apartments with SPO are more likely to transact via bargaining, and it is more likely that an overbid occurs in a bargaining sale.

In our additional analysis (chapter 8) we try an alternative proxy for aggressive bidding behavior, namely jump bidding. A jump bid is a bid with a large increment that can have tactical motives different from ordinary bids (Avery, 1998). We argue that jump bidding, similar to overbidding, indicates aggressive bidding behavior that might have a deterring motive. According to our hypothesis, such bidding behavior might be affected by the presence of SPO. We provide results indicating that jump bidding is positively correlated with price, and that it occurs approximately 16% more often when SPO is present. As oppose to overbids, we find that jump bidding is positively correlated with the number of bidders in the auction. This is interesting, as it provides further evidence to support our hypothesis of more aggressive bidding behavior in the presence of SPO, both in auctions as well as in bargaining.

Finally, when analyzing the overall price effect of SPO presence, we find that is has no significant effect on the hedonic price. However, considering that the two auction characteristics have countervailing effects on price, this result is not in conflict with our conceptual framework. We show that the occurrence of overbids increases the price by around 4% and that the likelihood of an overbid occurring is approximately 10.5% higher when SPO is present. In contrast, we show that there is a negative price effect of approximately 6% when apartments are transacted via bargaining and that there is around 8% higher probability that this is the case when SPO is present. A back-of-the-envelope calculation using these results, reveal that the overall price effect caused by these two characteristics sum to approximately zero. A positive effect from overbid of 0.42% (10.5% $\times$ 4%) and a negative effect from number of bidders of 0.48% (6% $\times$ 8%)

8. Additional Analysis

8.1. Jump bids and SPO

We also test an additional proxy for aggressive bidding behavior, namely jump bidding, and how it is affected by the presence of SPO. A jump bid is a bid with a large increment that can have tactical motives different from ordinary bids (Avery, 1998). We argue that jump bidding, similar to overbidding, indicates aggressive bidding behavior that might have a deterring motive. According to our hypothesis, such bidding behavior should be affected by the presence of SPO.

For our analysis, we define a jump bid threshold of 0,04 (or 4%), for which any bid increment above this threshold is characterized as a jump bid. This is approximately the top 7.5 percentile of our restricted sample[12]. Moreover, we restrict our definition of jump bids to bids that are higher than the asking price. Similarly as with overbids we construct a dummy variable *(JumpBid)* that indicates when one or more jump bids occur in that transaction. We use the same analytical approach as in our main analysis, using the same sample. First, we estimate equation 7 using OLS, both with and without hedonic controls and time trends, to study the price effect of jump bidding (coefficient of interest: λ). Next, we use a linear probability model and estimate equation 8 to study how SPO presence affects the likelihood that jump bids occur (coefficient of interest: ϕ).

$$(7) \quad \log P_i = \alpha + x'_i \gamma + \lambda Jumpbid_i + \varepsilon_i$$

$$(8) \quad JumpBid_i = \alpha + x'_i \gamma + \phi SPO_i + \varepsilon_i$$

P_i is the final price of the apartment, α is an intercept, x_i is the vector of hedonic controls and γ is the vector of coefficients. ε_i is the noise term, which we assume to be uncorrelated with the regressor and to have a zero mean. Our coefficients of interest are λ and ϕ.

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[12] Setting the threshold to approximately 0.05 or 0.035 would constitute the top 5% and 10% percentile respectively. Using either of these instead, does not alter our results with regards to sign and significance of the coefficients.

Results from estimating these equations are presented in Table 9. As seen in column 2, when control variables are included, we find that the presence of jump bids is positively correlated with the final price, significant at the 1% level. The coefficient suggests that auctions where jump bids occur result in a price approximately 4% higher than the hedonic price. Moreover, as seen in column 3 and 4, we find that SPO presence has a positive and statistical significant effect on the occurrence of jump bids. The coefficients indicate that the presence of SPO increase the likelihood of jump bidding by approximately 16-17%.

Table 9.

	(1) logPrice	(2) logPrice	(3) JumpBid	(4) JumpBid
JumpBid	0.0227	0.037***		
	(0.0193)	(0.0128)		
SPO			0.1744***	0.1606**
			(0.0593)	(0.0708)
N	286	286	286	286
R^2	0.4849	0.8352	0.034	0.158
Hedonics	NO	YES	NO	YES

Standard errors in parentheses
$^*\, p < 0.1$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$

As a final note, we study the relationship between jump bids and the number of bidders in the auction. We use a similar approach as in section 6.1, and do a simple comparison of means. This reveals that occurrence of jump bidding, as oppose to overbidding, is increasing in the number of bidders. Meaning there is a higher likelihood that jump bidding occurs when there is an auction (more than one bidder). In the case of bargaining, jump bids occur in only 14.3% of the transactions (SE: 0.0782). In contrast, when there is an auction, jump bids occur in 48.7% of the transactions (SE: 0.0308). This difference is statistically significant the 1% level.

It is noteworthy that we find jump bidding to occur more often in auctions and that overbidding occurs more often in bargaining (from main results), and that both are positively correlated with SPO presence. We argue that this supports our hypothesis that the presence of SPO incentivizes aggressive bidding behavior, in bargaining as well as auctions. Also, this suggest that overbidding and jump bidding are separate deterring tactics (dependent on the number of bidders participating in the auction).

8.2. Coups and SPO

We also study how occurrence of coups are affected by SPO presence. A coup occurs when a buyer places a high "take it or leave it" offer directly to the seller to bypass a public auction. An important fact is that when there is a coup, cooperative members still have the right to exercise their SPO at the "coup-price". Following the logic of our conceptual framework, we argue that the SPO should create an incentive for the buyer to increase his "take it or leave it" offer, to deter buyers with seniority from exercising their option.

We study this by going through the same analytical steps as before, using the same control variables. The sample is restricted similarly as before, except we drop the "non coup"-restriction. This increases our sample to 325 observations. Our variable of interest, *Coup*, is defined as described in chapter 4.4, and is a dummy variable that indicates when a coup has occurred. We estimate equation 8, with and without hedonic controls, to study how coups affect the hedonic price (coefficient of interest: θ). Next, we estimate equation 9 to study how SPO presence affects the likelihood of a coup occurring (coefficient of interest: λ). We also estimate equation 11 to study how SPO presence affect the *CoupPrice*. That is, the (log) price when a coup occurs.

$$(9) \quad \log P_i = \alpha + x'_i \gamma + \theta Coups_i + \varepsilon_i$$
$$(10) \quad Coup_i = \alpha + x'_i \gamma + \phi SPO_i + \varepsilon_i$$
$$(11) \quad \log CoupP_i = \alpha + x'_i \gamma + \phi SPO_i + \varepsilon_i$$

P_i is the final price of the apartment, $CoupP_i$ is the price in the case of a coup, α is an intercept, x_i is the vector of hedonic controls and γ is the vector of coefficients. ε_i is the noise term, which we assume to be uncorrelated with the regressor and to have a zero mean. Our coefficients of interest are θ and ϕ.

Results from estimating these equations are presented in Table 10. We find no significant results to back our hypothesis on this matter. We find that SPO has no significant effect on the occurrence of coups (column 3 and 4). Also, from column 5 and 6 we see that when a coup occurs (39 instances in our sample) SPO presence

does not affect the "coup price". In fact, results from column 1 and 2 show that coups have no significant effect on price at all. This we find interesting, so we study it closer in appendix (table A2), although it is not directly related to our thesis. There we look at the premium (relative deviation from asking price) for both coups and regular auction transactions. We use the entire unrestricted sample, 663 observations in total. The table show that there is in fact *no* significant difference between the sample means of *Premium* (coups excluded) and *CoupPremium* (premium in the case of a coup). This implies that the seller is, on average, not better off by accepting a "take it or leave it" offer than to go through with a public auction.

Table 10.

	(1) *logPrice*	(2) *logPrice*	(3) *Coup*	(4) *Coup*	(5) *log CoupPrice*	(6) *log CoupPrice*
Coup	0.0131 (0.0269)	-0.0037 (0.0138)				
SPO			-0.0252 (0.0365)	-0.0259 (0.0479)	0.0337 (0.0866)	0.0142 (0.0545)
N	325	325	325	325	39	39
R^2	0.4849	0.8352	0.0022	0.0851	0.0042	0.9827
Hedonics	NO	YES	NO	YES	NO	YES

Standard errors in parentheses
[*] $p < 0.1$, [**] $p < 0.05$, [***] $p < 0.01$

8.3. When is SPO exercised?

Our data set also contains information on when the SPO is exercised (the variable *SPOX*). This we use to study if our proxies for aggressive bidding behavior matter for whether the SPO is exercised or not. We use a linear probability model, where we set *SPOX* as the dependent variable and the auction characteristics as independent variables. For further details on methodology, see the appendix.

Essentially what we test is whether the deterrence work to prevent SPO from being exercised. However, our results (Table A3 in appendix) indicate that none of our auction characteristics have a significant effect, which could indicate that deterrence does not work against the SPO being exercised. We argue that this might be explained by the fact that apartments with SPO have fewer bidders participating in the auction (from main results). As the number of participating bidders is reduced, so is also the distribution of valuations. Thus, as the SPO becomes more extensive, increasing the number of potential buyers outside the auction, the

likelihood that one of them has the higher valuation increases. Then, deterrence is less likely to work. However, our results in this analysis might very well stem from the fact that the power of this analysis is fairly limited. We only have 132 observations where the SPO has been exercised. A larger sample would perhaps yield a different result.

9. Robustness and limitations

In this chapter, we discuss the robustness of our results and the limitations of our data.

The fact that our data only comes from one single realtor agency, make our study vulnerable to heterogeneity between different realtors. In particular they might differ in how actively they use information asymmetries created by the SPO to influence bidder behavior. Moreover, using only one agency make our data set not as geographically diverse as we should ideally like it.

For comparability reasons, we restrict our sample to only include a little under 300 out of 650 observations. Although reasonable, our sample size will not give the same level of accuracy as a larger sample would have provided. We also want to mention that our data covers a time period of two years where the housing market in Oslo was in a boom. Practically none of our observations transact below asking price. This might change how buyers behave in an auction (Han and Strange, 2012), and therefore how SPO presence affects the auction dynamics.

Moreover, many of our variable definitions rely on assumptions that are open for critique. In particular, we recognize that we rely heavily on the asking price being the lowest price the seller is willing to accept. This might be an overly simplistic assumption, and is arguably only possible since the market was in a boom during our sample period. Only 6 months after our sample period, this assumption would not hold.

When controlling for shared debt, we assume that buyers evaluate shared and private debt equally. In contrast, research suggests that shared debt is valued lower (Almenberg & Karapetyan (2014) and Hjalmarsson & Hjalmarsson (2009)). A simple analysis presented in the appendix (Table A1) suggest that this is also the

case in our sample. One could argue that we should take this into account when adding shared debt to the price/bids. However, our sample restrictions (chapter 4.4) ensure that observations are comparable with regards to shared debt. In addition, when we try to perform our analysis under the assumption that shared debt is valuated lower than private (using the coefficient from Table A1), our coefficients of interest do not change in terms of sign and significance.

When analyzing the effect of SPO presence on our two auction characteristics (Table 6), we notice that OBOS is the driving force in the significance of our SPO indicator. In the appendix (Table A4) we present the results from splitting the SPO category into USBL and OBOS. This shows that the USBL coefficient is non-significant, whilst the OBOS coefficient is statistically significant and also larger in absolute value than the SPO coefficient. This might indicate some unobserved heterogeneity between OBOS and USBL or it can simply come as a result of the OBOS SPO being far more extensive than USBL[13].

In our analysis of how SPO presence affects the number of bidders, we only compare bargaining (one bidder) against auctions (more than one bidder). If we were to extend this analysis, using (*NbrBidders>2)* and (*NbrBidders>3)*, we do not find a significant effect of SPO presence, even when separating OBOS and USBL. However, when regressing SPO directly on *NbrBidders* (a discrete variable counting the number of bidders in the auction), the results indicate that there is some negative correlation between SPO presence and the number of bidders (Table 8).

Table 8:

	(1) *NbrBidders*	(1) *NbrBidders*
SPO	-0.5614	-0.668[*]
	(0.3737)	(0.399)
N	286	286
R^2	0.0072	0.1646
Hedonics	NO	YES

Standard errors in parentheses
[*] $p < 0.1$, [**] $p < 0.05$, [***] $p < 0.01$

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[13] OBOS have 416 000 members and 90 000 apartments, whilst USBL has 94 000 members and 72 000 apartments.

In general, we cannot say if the SPO represent some other unobserved heterogeneity that affect USBL and OBOS housing in the same way. There are also specific omitted variable issues to be addressed. For instance, our data does not contain information on independent appraisals. For this reason, we have to assume that the asking price is not discounted for strategic reasons ("lokkepris"). Moreover, our data does not say anything about the number of buyers with seniority standing outside of the auction. It does also not include information on whether or not the bidders know of potential buyers outside of the auction. Though, we argue (section 3.2) that this should not matter, that the threat of outside buyers alone should create incentives to bid more aggressively.

10. Concluding remarks

We provide evidence that SPO presence reduces the number of bidders participating in the auction and that aggressive bidding behavior occurs more often when SPO is present. We argue that these results serve as evidence for our hypothesis, that buyers indeed alter their behavior in response to the incentives created by SPO presence. Buyers with seniority have an incentive to not participate in the auction, and rather exercise their SPO after the fact at a price that is in expectation lower than if they were to participate. This again, creates an incentive for the remaining bidders in the auction to bid more aggressively and closer to their valuation. However, in our data these two countervailing effect seem to balance each other out, resulting in no overall effect of the SPO on price.

The topic of our study has, to our knowledge, not been analyzed properly before. Even though there is no overall price effect in our data, we argue that the presence of SPO creates an unnecessary uncertainty for the bidders. We believe that a more transparent arrangement would give bidders better information, which could contribute to a potentially more efficient auction format. Moreover, we believe SPO presence can also give realtors room to manipulate buyers by playing on this uncertainty.

Since a large fraction of the Norwegian housing market, especially Oslo, consist of cooperatives with SPO, any potential inefficiency caused by the presence of SPO is undesirable. Because of the limited existing studies on this topic, we recommend further research to be made to determine if SPO is a practice that should continue.

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Appendix

I: Evaluation of shared debt.

We do a simple analysis of the evaluation of shared debt, by estimating the following equation:

$$P/M^2{}_i = \alpha + x'_i\gamma + \beta(Debt/M^2)_i + \varepsilon_i$$

P/M^2 and $Debt/M^2$ are sales price (not including shared debt) and shared debt per square meters respectively. x_i is a vector of hedonic controls (floor, balcony, location and time of sales) and γ is the vector of coefficients. We restrict the sample as in our main analysis, but include coups. β is our coefficient of interest. If buyers evaluate shared debt equal as private debt/wealth, β should be equal to minus one. Results are presented in Table A1.

Table A1.

	(1) P/M^2	(2) P/M^2
Debt/M²	-0.6654***	-0.767***
	(0.0678)	(0.0562)
N	325	325
R²	0.2332	0.615
Hedonics	NO	YES

Standard errors in parentheses

$^{*}\,p < 0.1,\,^{**}\,p < 0.05,\,^{***}\,p < 0.01$

Results from this simple analysis indicate that buyers have a discounted valuation of shared debt. This is in line with findings from Almenberg & Karapetyan (2014) and Hjalmarsson & Hjalmarsson (2009).

II: Additional analysis on "coup premium"

The following table is referred to in our additional analysis, chapter 8.2.

Table A2.

	Premium	Coup Premium	Difference	T-statistics
Mean	0.1497	0.1605	-0.0108	-0.9308
	(0.0038)	(0.0102)		
N	593	70		

Standard errors in parentheses
[*] $p < 0.1$, [**] $p < 0.05$, [***] $p < 0.01$

III: When is SPO exercised?

In chapter 8.3 we use the variable SPOX (a dummy variable indicating when the SPO is exercised) to do an additional study to determine if aggressive bidding behavior matter for whether the SPO is exercised or not. We use a linear probability model displayed by the equation below, which we estimate using OLS. x_i is a vector of hedonics and γ is the vector of coefficients. Hedonic controls and time trend are included in all regressions. All results are displayed in table A3.

$$SPOX_i = \alpha + x'_i \gamma + \rho z_i + \varepsilon_i$$

$$z = \begin{cases} Overbid \\ JumpBid \\ Premium \end{cases}$$

First, we estimate the model looking at *Overbid* and *JumpBid* separately. Essentially what we test is whether the deterrence work to prevent SPO from being exercised. However, our results indicate that they do not. This is also the case when both variables are included to the model. Moreover, we find no evidence that a higher premium is associated with lower probability of the SPO being exercised. This we study by estimating our model using an indicator variable, *HighPremium,* which indicate whether the premium exceeds the top 10th percentile in our sample (results are robust to setting the threshold both higher or lower).

Table A3

	(1) SPOX	(2) SPOX	(3) SPOX	(4) SPOX
Overbid	0.1004		0.0975	
	(0.1136)		(0.1156)	
JumpBid		0.0246	0.0031	
		(0.0893)	(0.0954)	
HighPremium				0.1472
				(0.1621)
N	132	132	132	132
R^2	0.0582	0.0523	0.0597	0.0588
Hedonics	YES	YES	YES	YES

Standard errors in parentheses
$^*\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

IV: Robustness: separating OBOS from USBL

When analyzing SPO effect on the auction dynamics, we see that OBOS is the driving force behind our SPO indicator. In Table A4, we present the results from our linear probability model (chapter 5.2, equation 3) when splitting the SPO category into USBL and OBOS. Results show that in fact OBOS is the driving factor in our main analysis.

Table A4.

	(1) Overbid	(2) Overbid	(3) NbrBidders>1	(4) NbrBidders>1
OBOS	0.1553***	0.146**	-0.0751**	-0.107**
	(0.0524)	(0.0625)	(0.0417)	(0.0647)
USBL	0.0394	0.0281	0.0106	-0.0354
	(0.0562)	(0.0594)	(0.0368)	(0.0504)
N	286	286	286	286
R^2	0.0426	0.1677	0.0204	0.1693
Hedonics	NO	YES	NO	YES

Standard errors in parentheses
$^*\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

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Table of content

Abstract

In out master thesis we wish to study the price effect caused by the presence of "forkjøpsrett" on Norwegian housing market. By "forkjøpsrett", we mean the privilege for members of a housing cooperative to purchase housing by bypassing the public auction and rather exercise their "forkjøpsrett" instead. We define this as the term Seniority Purchase Option, or SPO. Theory suggest that the presence of the SPO could act as a dampener on the price level, since one or more buyers stand outside of the auction, but also inflate prices by creating incentives for jump-bids. We believe there are several methods in which we could study this effect. Our preferred method is to study bidding logs to see whether the auction dynamics differ in the presence of SPO. Alternatively we wish to study price level data to see if there is a statistically significant difference in prices with and without the presence of SPO. We are currently in the process of gathering data. We are in contact with several Oslo based realtors, as well as OBOS, NBBL, USBL and Eiendomsverdi Norge with hopes that they will help us collect an appropriate sample for our studies.

1.1 Introduction

The Norwegian housing market continues to climb to ever record setting levels. Especially Oslo and surrounding areas have experienced extreme price increase the last few years. SSB report a 17.9% increase in prices from 3rd quarter in 2015 to the same quarter 2016, in Oslo and Bærum.

In our Master thesis, we wish to study a concept that we think has gone somewhat under the radar in the very hot debate surrounding the Norwegian housing market, namely the so called "forkjøpsrett". That is the privilege for members of a housing cooperative to purchase housing by bypassing the public auction and rather exercise their "forkjøpsrett" instead. For the remainder of this thesis, we will use the terminology "Seniority Purchase Option", or SPO. We want to study if and how the SPO might have an influence on housing prices, and if so, with what sign. We believe there might be aspects related to this practice that can act as a dampener on the price levels in the market, but also side effects that might inflate the prices. Later we will go more into detail about the economic forces that we believe come

in to play. First we will do a brief overview of the dynamics of a sale in the Norwegian housing market, with focus on the housing cooperatives and the SPO.

2.1 Transactions in the Norwegian housing market

Used apartments in Norway are generally sold through English auction with a reserve price. The object for sale is first appraised and then put on the open marked where potential buyers can review. The appraisal often acts as a basis for a guiding price estimate or asking price. However, the final price results from the auction alone, and can differ greatly from the price estimate. In general, the auction follows shortly after the public viewing. Interested buyers make their interest known to the seller, generally represented by a real-estate agent who manage the following auction. The auction is similar to an English auction, in ascending fashion where the highest bid (normally) wins the auction, implying the bid gets accepted by the seller assuming he has reached his reserve price. If he has not, the seller is entitled to decline the offer.

Note here that this is the general dynamic. On a side note, a topic in the Norwegian housing price debate however is an increasing trend of buyers by-passing the realtor, and making a high "take it or leave it" bid directly to the seller, trying to convince him to sell prior to the general auction. This however will not be given much attention in our thesis, since we believe it falls somewhat on the outside of what we wish to study. For our purposes, we will simply assume housing is sold purely in the general manner, with a public auction.

2.2 Ownership structure: housing cooperatives and privately owned housing

The Norwegian housing market consists of objects with a somewhat different ownership structures, especially the market for apartments. We will distinguish between privately owned housing, where one have legal ownership of your apartment, and housing cooperatives where you merely purchase a share in a larger joint ownership, typically of an entire building or a series of apartment buildings. As long as you own the share, the apartment is at your disposal. One very important feature with housing cooperatives in Norwegian cities is that many are organized as part of a larger, region wide, cooperative. For instance, in Oslo we have OBOS and USBL which acts as parent organizations to the multiple single cooperatives all

over the city. So when one becomes a member of one single cooperative, one is automatically registered as a member in the parent organization with all the member benefits that follows. OBOS is considered to be the largest cooperative in Norway today, with 415 000 members and manage over 200 000 houses/apartments, most in Oslo but some also across the country (obos.no).

There are appealing aspects of both ownership structures that might make buyers choose either. Private ownership might offer a higher independence to do what you want with your apartment, for instance subletting it. However, there is a 2,5% national tax (current rate, kartverket.no) on purchase. Buying in on a cooperative housing is not affected by this tax. Although, in a housing cooperative one must conform to regulations set by the cooperative. One of which is the right for members of the cooperative to exercise their SPO.

2.3 The seniority purchase option (SPO)

The SPO gives existing members of the cooperative the right to buy used apartments that are put up for sale at the price determined by the public auction (the winning bid) without having to participate in the auction themselves. The dynamic is as follows. At some point prior or after to the auction, there is a deadline for cooperative members to report their interest in using their seniority to purchase a specific apartment that is put up for sale. After the deadline, the member with the longest seniority gets the option to purchase the apartment. If he decides not to exercise his option, the member with the second highest seniority gets a chance, and so on. The SPO cannot be exercised later than 20 days past the auction (Borettslagsloven §4-15). However, according to OBOS' own website it generally takes no more than 5 days after the winning bid is made (obos.no).

With new apartments, which are generally sold at a fixed price set by the house building cooperative, the seniority option can still be applied to acquire the apartment before other buyers have their chance. However, our focus will be solely on used apartments since our focus is on the price effect of the SPO. That is, how the presence of the SPO affects the auction. Thus, new apartments sold at fixed prices will not be relevant for our study.

Theoretically, we can regard the SPO as a long position in a call option, where the highest bid from the auction is equivalent to the strike price. From the senior members´ perspective, the payoff will be equal to the difference between the strike price and his valuation of the apartment. For simplicity we assume that he will exercise the option as long as the payoff is larger or equal to zero.

According to Norwegian housing cooperatives´ advocacy group, NBBL, the use of SPO has varied between 14% - 25% of all cooperative housing sales from 2006 to 2015 (NBBL statistical rapport 2015). For OBOS housing the number is generally higher, peaking at 39,2% in early January according to NBBL.

3.1 Literature review

McAfee and McMillan (1986) tackle the question whether or not the other bidders know the number of bidders in the auction changes the revenue for the seller. They question the result provided by Milgrom and Weber (1982) that show that it is in many circumstances in the best interest of the seller to release information about the number of bidders in an auction to the other bidders. McAfee and McMillan show that if the bidders are risk averse the seller's expected revenue in a first-price sealed-bid auction is higher if the bidders do not know how many bidders there are than if they do know this. However, if the bidders are risk-neutral it doesn't matter if the number of bidders is revealed, especially if the auction is an English or a second-price sealed-bid auction, because here the bidders will bid their full valuation of the auction object regardless, and end up with a price equal to the second highest evaluation. Their 3rd theorem state that: "Concealing the number of bidders in the first-price sealed-bid auction does not lower the ex ante expected selling price, and strictly raises it if the bidders are risk averse and the distribution of the number of bidders is nontrivial." This means that concealing the number of bidders is pareto-optima to revealing it.

Hungria-Gunnelin (2010) empirically tested the effect of the number of bidders on the sale price of condominium apartments in Stockholm. The empirical analysis is based on 512 closed transactions of condominiums apartment units in the inner-city Stockholm during the period January-November 2010. The dataset, collected from a website made for brokers to make sales more transparent, include price, property

attributes, condominium fee, geographical location, brokerage firm, and the actual number of bidders that participated in the auction. Hungria-Gunnelin also review a number of other research papers in the area, but there are few countries that use the English auction system when selling condos, so her paper contributes new links between auction theory and dwelling prices. It's only the other Scandinavian countries plus Australia, Scotland and Singapore that follow the same mechanism of open-bid English auction for residential properties. The estimated hedonic regressions show a positive significant relationship between number of bidders and sale price.

Han and Strange (2012) study bidding wars in housing auctions based on US data. They find that bidding wars are more common during housing booms. But they do also study other contributing factor, among others buyer irrationality and the asking price.

Bulow and Klemperer (1996) compare auctions to negotiations. They show that a simple competitive auction with n +1 bidders will yield the seller more expected revenue than he could expect to earn by exploiting his monopoly selling position against n bidders. Their reasoning and argumentation is in regards to selling and buying of companies. However, this is a general result, and it shows that a seller is in most circumstances better off if he can attract one more buyer participating in the auction.

Lewin and Smith (1994) – This is a theoretical study of auction dynamics when there are costs affiliated with entering the auction (information processing, bid preparation, cost of effort etc.). Thus, the number of bidders (n) is determined endogenously, which is "a step further" than the previous articles studying the price effect of an exogenously determined n. However, this study should be regarded as an extension to existing (preceding) theory on auction dynamics, not a critique, as the authors conclude that conclusions from previous literature on the topic still hold. One of the key findings from this study is that that with the presence of entry costs, high number of potential bidders (thick market) might reduce the final price achieved and also the social surplus. Thus, there exists a socially optimal $n^* < N$. An economic interpretation of this is that thick markets reduce incentives to enter the auction.

Quan (1994) provides a general review of theory and empirics on real estate auctions. We will use parts of the theory reviewed, since it provides a brief and to-the-point survey of relevant theory for our thesis. A key objective in the article is to review theory on both common value and private value auctions, and how both apply for housing market studies. The article states that real estate auctions in general cannot be classified as either of the two, that there exist both private and common value to housing. Thus, the economic effects described by theory on both private and common value auctions will apply for real estate auctions. This will be a key theoretical result for our study. Also, with regards to common value auctions, we find the section on winners curse somewhat relevant for our purposes. The article points to conflicting (theoretical) effects when the number of bidders increases. On the one hand, higher N should result in more aggressive bidding (less bid shading). On the other hand, this increases the likelihood of falling victim to a winners´ curse if winning the auction.

The article also review empirically based evidence and critique on the theories. This is clearly relevant for our thesis, but when addressing empirical findings, we will try to refer to the actual study rather than this review article.

4.0 Economic forces surrounding the SPO

Our main research question is: How does the presence of the SPO affect the price of cooperative housing? We want to see if we can identify indicators that suggest that the presence of the SPO drive prices, and if so, with what sign? There are several economic forces that we believe come into play here, suggesting both positive and negative sign to the overall price development of cooperative housing.

4.1 SPO acts as a dampener on prices

Standard auction theory for English auctions states that the winning bid is increasing in the number of bidders participating in the auction (Bulow & Klemperer, 1996). The idea is, simply put, that all the bidders draw their independent personal valuation of the apartment from a uniform distribution. These valuation range between a theoretical maximum valuation and a minimum valuation of the apartment. The more bidders that are participating in the auction the higher the probability that one of the bidders have a personal valuation close to

the theoretical maximum. Therefore, the expected revenue for the seller is higher the more buyers he can attract.

There are several aspects that suggest that the presence of the SPO should reduce the number of bidder in the auction, and thus lowering the price. Firstly, and perhaps most obvious, one or more potential buyers with seniority can choose to sit out the auction to exercise the SPO instead. This reduce the number of active bidders in the auction. Secondly, the presence of the SPO might deter potential buyers with no or low seniority from entering the auction. They might focus their attention on housing with no SPO due to the risk of losing the apartment to cooperative members with seniority. Thirdly, the time that it takes to clarify whether a senior member want to exercise his option or not, can potentially hold one or more buyers of the market for a certain period of time. Situations might occur where one or more senior members as well as the auction winner await clarification on the SPO. The wait can be up to 20 days after the auction is held. In this period of time, all waiting parties are prevented from participating in the market since they must await the SPO to be clarified before they can place bid on other apartments.

4.2 SPO inflates prices

In contrast, we argue that the presence of SPO might also create incentives for bidders (with no or short seniority) to bid stronger in order to deter potential senior buyers from exercising their SPO. In standard auction theory with ascending bids the auction winner will be the one with the highest valuation of the object. Since the auction winner only have to outbid his opponents, the winning bid will be marginally higher than the second largest valuation. This is when all participants are risk neutral and rational (Quan 1994). With the presence of the SPO however, the auction winner know that there might be agents outside of the auction, with an unknown valuation, that might be higher than the winning bid. This can give him an incentive to bid stronger to deter the outside agents.

Theoretically, we can regard this as a separate game succeeding the public auction. When the auction ends, the winner gets payoff is equal to the difference between his own valuation (V1), and the winning bid (V2), which is marginally higher than the second highest evaluation. This payoff is now his available budget for the

succeeding game against the outside player(s), holding the SPO. For the auction winner, the second game will be similar to a "first price sealed bid" auction. The outside player(s), holding the SPO, do not have to bid themselves. They only have to decide whether or not to exercise the SPO at the price determined by player one´s bid. Thus, player one bids against the outside players´ willingness to pay for the specific object.

We assume now that the outside players draw their valuation of the apartment with a uniform distribution between V2 and a true (but unknown) maximum valuation (Vm). Theory now state that the the bidder should now shade his maximum bid with (Vm)*n-1/n+1 (Pepall et al, 2013). The more outside-players he assumes there to be, the closer his bid should be to his maximum valuation V1. Note that we say "assumes there to be" here. Player one do not necessarily know how many outside players (if any) that are actually interested in the apartment. This depends on the time the deadline for senior cooperative members is to report their interest.

5.0 Data collection and methodology

Our topic of study seems to be somewhat unexplored in the general housing statistics. Consequently, we must take a wide approach in our hunt for relevant data. When it comes to data manipulation, we believe there are multiple methods that could be applied to achieve testable statistics. However, all are conditional on what we are able to collect of data. In this section, we will mention three approaches, the data they require and how we plan/try to collect the data.

5.1 Difference in difference approach

Early in our thesis work, what came up as a simple approach that could give robust result, was to compare a region or a rage of buildings that have previously had a SPO and then repealed it. In practice, we need to search for housing cooperatives who have changed their ownership structure so that the SPO do no longer apply. We have spoken to realtors who state that such cases exist. If we were to collect data on this, we could use a panel data design and look at difference-in-difference to compare prices before and after the change. However, our research this far have yet to uncover any relevant cases of cooperatives where the SPO has been repealed. It is very likely that this approach to our thesis will be abandoned.

5.2 Studying auction dynamics

We are currently in contact with several major realtors in and around Oslo with hopes to acquire (anonymized) bidding journals, that is logs of all submitted bids from auctions on specific objects for sale. We try to collect data for an appropriate sample of completed housing sales, both with and without the presence of a SPO. Our objective is to study the auction dynamics of the two types of housing. According to our hypothesis (chapter 3) we should be able to see significant differences in terms of number of bidders between the two groups. Also, if the dynamics described in chapter 3.3 holds, we should expect to see a larger degree of jump-bidding when SPO is present. This is a somewhat experimental approach but we believe it could give us good answer to our research questions. An issue with this method that we should control for other observables that could affect demand. We need to take location, size etc. into account, as well as the fact that there are demand effects caused solely by the ownership structure. Also, there might be less quantifiable attributes that affect the "desirability" of an apartment, such as view, technical standard etc. This is difficult to control for. However, with a large enough sample size we can perhaps assume that the differences in "desirability" is randomly distributed, implying that there are (in expectation) equally many desirable apartments with the SPO as there is without.

The process of collecting data from bidding logs is currently moving slow but steadily. Some realtors have declined our request, while we are still in dialog with others. We hope some of them will grant us the necessary access to data so that we are able collect a suitable sample. Our best hope at the moment is Aktiv Eiendomsmegling Grønland, where in particular one senior real estate agent seems very eager to help us.

5.3 Study of price levels

Our perhaps safest approach to this study is to use price level data where we compare housing with and without SPO. Here we plan to compare cooperative housing with and without ties to a large parent cooperatives, like OBOS. The idea is that since the number of SPO holders and frequency of SPO use is much higher with the OBOS cooperatives, we should be able to isolate a price effect caused by the SPO.

We will use hedonic regression where we control for relevant observables that could cause price differences (as in 5.2). The usual way to represent a hedonic regression is to have price as a function of different attributes of the dwelling. We have yet to decide how to define the dependent variable, but to use price per square meter is an often used measure (Hungria-Gunnelin, R.,2013). The attributes that are typically included are size, age, location, number of rooms etc. The attribute of interest for our study is the presence of SPO or rather the coefficient in front of the dummy variable. However, this method will reveal little or nothing about the inner dynamics of the auction. It can only tell us if there is a statistically significant difference in price between apartments sold when SPO is present and when it is not.

We are in contact with Erling Røed Larsen in hopes of getting access to his price level data. We know that previous master thesis students have gotten access to this data, so we believe it should not be a problem. We have gotten a positive response from Larsen, but we do not know the specifics of the data he plans to provide us.

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