THE BEST-OFFER-OVER PRICING METHOD: A BEST-STRATEGY? A CASE-STUDY IN THE ROTTERDAM HOUSING MARKET

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Abstract

As the best-offer-over method has been used increasingly in recent years, this suggests that the method is possibly rising to become the optimal sales strategy for house sellers. This study considers the situation in Rotterdam, where the use of the best-offer-over method has risen to 7.2 percent of all transactions in 2019, from only one application in 2008. Many argue that the best-offer-over method has a positive effect on transaction prices. To examine this, the present study focuses on the effect of the best-offer-over method on transaction prices in Rotterdam. This is done using a hedonic regression analysis of 50,605 transactions over 2008-2019. Due to the attractive force of relatively low list prices, which possibly draws in more potential bidders, it is expected that best-offer-over houses have higher transaction prices than houses that sell using the regular sales approach. Instead, initial findings indicate that, relative to regular home sales, the best-offer-over method has a significant -5.3 effect on transaction prices. In popular neighborhoods the effect is the most negative, and vice versa. There is also evidence that the effect is less negative for multifamily houses than for single-family houses. As this could possibly be explained through a relatively low quality of the houses sold using the best-offer-over method, this study importantly considers two new measures of the internal finishing quality of houses (n = 643). After controlling for internal quality, no significant effect of the best-offer-over method on transaction prices remains.

Keywords: real estate, housing market, sales strategy, sales method, best-offer-over method, hedonic price model, overbidding

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1. INTRODUCTION

In today's housing market, overbidding seems to be more the rule than the exception in major Dutch cities (Algemeen Dagblad, 2019). House sellers and brokers are responding to this development. They regularly place properties on the market where they state in the description that the list price is a best-offer-over price. This implies that the list price is a starting price to initiate the bidding process. Interested parties seem compelled to place a bid for the house that exceeds the list price. By this method, the list price appears to be the absolute lower limit of the transaction price. The number of houses sold using the best-offer-over method has increased sharply in recent years (Algemeen Dagblad, 2019). This development seems to be related to the increased shortage at the housing market. In this situation, sales techniques such as the best-offer-method are argued by many to drive up house prices even further than common list prices would (Trouw, 2017a). Whether this is the case is the subject of this study.

Several studies have already written about the differences between list and transaction prices at the housing market (Horowitz, 1992; Merlo and Ortalo-Magné, 2004; Han and Strange, 2014). Where previously the list price functioned as a price ceiling (Horowitz, 1992), recent studies have shown that this is not necessarily the case (Merlo and Ortalo-Magné, 2004; Han and Strange, 2014). The functioning of a list price as a floor or ceiling has been associated with the phase in the economic cycle (Haurin et al., 2013). During housing booms, sellers change their sales strategy from a list price as price ceiling to an auction-like strategy. In recent years, a limited number of studies have been conducted on the best-offer-over method (Pillen, 2014; Janssen & Bougie, 2018; De la Hayze, 2019). In these studies, the effect of the method on transaction prices has been investigated. However, there is no complete scientific evidence to show in which situation the method is most suitable or effective. In existing studies, differences in the quality of locations and houses themselves have not been investigated, even though these are notoriously challenging to the precision of hedonic models. After all, quality comes at a price. It is unclear how this quality aspect relates to the choice of a sales strategy. This will be investigated in the Dutch context.

As is the case internationally, also for the Netherlands, little research has been done specifically on the best-offer-over method. The share of overbidding the list price in the Netherlands is investigated recently. Especially in major cities, overbidding the list price is common (Koster & Rouwendal, 2017). Pillen (2014) conducted a study for his master's thesis into the best-offer-over method on the Dutch housing market. For this, he investigated 5,316 best-offer-over transactions and 24,582 regular transactions with national coverage in the period from 2009 to 2014. He found that at locations where the method is used more often, it leads to a shorter transaction time and a higher transaction price. Subsequently, Janssen & Bougie (2018) examined a dataset of 49,270 Dutch residential transactions with national coverage. They therefore used a longer period than Pillen from 2009 to the end of 2016.

The results of their hedonic price model showed that in the crisis period, the best-offer-over method led to a 6.2 percent lower transaction price than the regular method. In the recovery period, the effect on the transaction price was positive with 0.8 percent. In addition to the effect of the sales method on the transaction price, Janssen and Bougie also investigated the effect on the transaction time. In both the crisis and the recovery period, the best-offer-over method led to a shorter transaction time than the regular method. However, the difference was larger in a recovery period. De la Hayze (2019) investigated for her master's thesis different price segments. She used a database of 7,583 residential transactions in the municipality of Groningen in the period from 2009 to 2017. The segments she has analysed are based on categorized transaction prices. Her analysis showed that the price effect was significantly positive for houses that fall in the 100,000 to 180,000 euro segment. The best-offer-over method provides a 1.47 percent higher transaction price in this segment than the regular method. This can be explained by the fact that this segment is the most popular. In the most expensive price segment of houses above 500,000 euros, a significant negative effect was found. Houses sold with the best-offer-over method in this segment have a 3 percent lower transaction price than houses sold using the regular method. However, it is possible that when quality attributes of houses and their locations are accounted for, estimates may be different or even absent. This research will answer the following question:

What is the effect of the best-offer-over method on transaction prices in Rotterdam neighborhoods?

This research aims to provide insight into the effect of the sales method compared to the non-best-offer-over method on transaction prices and gives clarity in the relationship between the best-offer-over method and neighborhoods. The research question will be answered by comparing best-offer-over transactions with regular sales method transactions. A frequently used model to build up a transaction price on the housing market is the hedonic price model. This model is suitable because it makes it possible to investigate the effect of different characteristics on transaction prices. The value of a good consists of several elements. Composing the value into all elements makes it possible to gain insight into the influence of each element on the value. With a multiple regression analysis, an unknown value can be predicted based on several known values. The unknown value in this case is the transaction price and the known values are the control variables and the sales method. The method will be applied to different groups to indicate differences. This study can help with the determination of an appropriate sales strategy for houses. Also, real estate agents can use this research to determine their sales strategy and buyers can use it to determine their bid. This research will help various actors to make the right decisions in the sales process in the housing market.

The data used for this research is collected by the Dutch association of estate agents (NVM). This data contains a representative group of housing transactions from the period 2000 to 2019. The data provides insight into transaction prices and various housing characteristics. After a multiple regression analysis of the transaction prices of the whole sample, it will be investigated whether there are differences between housing groups. To do this, the housing transaction sample will be divided by neighborhood. A multiple regression analysis will be performed for each neighborhood to compare the results. It may be necessary to further investigate a quality measure or unit sale by housing associations to explain differences. The database does not provide insight into this.

A case study of the Rotterdam housing market will be used for this study. The increased shortage on the housing market can also be observed in Rotterdam. Where the port city often struggled with its image in the past, the time seems to have turned. Economically, Rotterdam is doing very well. It is the driver of growth in the region and is booming. The popularity of Rotterdam has risen sharply in recent years. The city is considered attractive to live and work. The population is expected to increase by approximately 55,000 people in the next 15 years (Municipality of Rotterdam, 2019). The economic and demographic developments have partly caused a sharp rise in house prices in the city. The shortage at the Rotterdam housing market is reflected in the increased transaction prices, shorter sales times and the decreased supply (NVM/Brainbay, 2020). Less popular neighborhoods, many of which are located in the south, have been increasingly discovered by first-time buyers (Trouw, 2017b). The use of the best-offer-over method has risen sharply. Where in 2008 only one house in Rotterdam was sold with this method, in 2019 this number has risen to 362 houses. In addition, the house values and trends vary enormously between neighborhoods. This makes Rotterdam an extremely suitable and interesting city to use for this study.

2. UNDERSTANDING TYPES OF HOUSE PRICES

2.1. From list price to transaction price

The function of the list price has not always been the same. According to Horowitz (1992) his theory, list prices appear to be price ceilings that preclude the possibility of selling at higher prices. The list price is the price the seller wants to negotiate from and the reservation price is the lowest price the seller will accept. A fixed price is not used because the optimal list price of the seller is not the same as the his reservation price. In the data that Horowitz used for his research, the transaction price was higher than the list price for 3.8 percent of the transactions. However, Horowitz his theory does not explain why transaction prices are higher than list prices. In his theory, it is assumed that only one interested party can bid on a house. In addition, it is indicated that if there are multiple parties, the transaction price may rise above the list price as a result of the bidding process. Merlo and Ortalo-Magné (2004) state that a house does not have to be offered through a formal auction to get the same effect as an auction. They speak of a kind of auction structure when two or more buyers are bidding on the same property on the same time.

Han and Strange (2014) shows that bidding wars in which the transaction price exceeded the list price become much more frequently over the years. This is consistent with the notion that bidding wars are more common in booms. But they found that it is not simply a phenomenon for booms. After a boom the number of bidding wars never decreases to historical levels and there is variation in the occurrence between comparable location. Bidding wars are more likely in areas with stringent land use regulations and in markets with less rational consumers. List prices no longer appear to be price ceilings, contrary to what Horowitz (1992) stated. Han and Strange endorsed this in 2016. They stated that list price can be seen as a strategic instrument. Placing a house on the market with a low list price encourages multiple buyers to make an offer. In this case, there is not only a negotiating position between a buyer and seller. There is also a battle between the buyers. The transaction price can therefore be both higher and lower than the list price as well. Time plays an important role in this. Houses are more often sold above the list price in periods when the market is rising. This is less common in less popular houses (Han and Strange, 2016). Another study came to a similar result. Haurin et al. (2013) researched list and transaction prices in the United Kingdom. Their data showed that selling prices are high compared to list prices during housing booms. They found strong empirical support that in such times the seller changed the strategy from an list price as a price ceiling to an list price as a bottom. They change in good economic times to an auction-like strategy.

In the Netherlands, research has also been conducted into overbidding on the housing market. Koster & Rouwendal (2017) have analyzed Dutch list and transaction prices to gain more transparency in the phenomenon of overbidding. Their analysis has shown that houses that were sold above the list price

were often offered for a relatively low price. This arouses more interest in the house and increases the chance that multiple parties will bid against each other. The transaction price is not only higher than the list price but also higher than the transaction price of comparable houses. It has also been found that houses sold for a higher price than the list price are often sold faster.

Houses with a list price that is too high are more likely to revise the list price (Knight, 2002). It is also more likely that these houses will have long transaction times (Van de Minne & Conijn, 2011). Liu and van der Vlist (2019) researched list price strategies in the Netherlands. They used housing transactions from the conurbation named the Randstad region from 2008 to 2013 for this. They found evidence that house sellers who expected a loss, set their initial list price 10 percent higher than house sellers who did not. Choosing the right sales strategy seems important. Emotion seems to play an important role in the bidding process on houses. Piazzesi and Schneider (2009) showed that in a demanding market, a small number of optimistic investors have a large effect on house prices. Even when they only bought a fraction of the houses, this stood out. This could trigger other buyers to offer more. Malmendier and Lee (2011) showed that bidders at an online auction sometimes pay more for a house than if they did in a regular way on the same website.

2.2. Best-offer-over pricing method

The best-offer-over method is a sales method in which a house is offered with a list price that is intended as a starting price. The transaction price is intended be at least equal to the list price. Only a limited number of studies have been done specifically about the best-offer-over method. Pillen (2014) found that houses that have been sold using the best-offer-over method have a large sales opportunity and are therefore systematically sold faster. The sales time of these houses is significantly shorter, but the sales price is on average 4.4% lower. In markets where the best-offer-over method have been used extensively, the houses are even sold for almost the same price as houses that are sold in the regular way. Probably, because the method has been used longer in these markets and potential buyers are already familiar with the method. Janssen & Bougie (2018) continues on Pillen his investigation. The results of Pillen his research mainly relate to the crisis period in the housing market. Janssen and Bougie wanted to investigate differences between different periods of the economic cycle. They split their dataset into two periods. A crisis and a recovery period. They conclude that in recovering housing markets, the best-offer-over method leads to faster sales periods and higher selling prices. De la Hayze (2019) focused in her master's thesis on the various segments of the housing market. In the most popular price segment, the effect of the method on transaction prices was most positive. Probably, because both starters and investors are interested in this segment. In an exploratory study, De la Hayze inventoried which housing characteristics play a role in the success of the best-offer-over method. The results show that especially multifamily houses are associated with a price increase.

The existing literature is unambiguous about the effect of the best-offer-over method on transaction prices. Also, no clear cause has been given for the differences in transaction prices. Market pressure seems to have a positive effect on the success of the effect. The studies did not address location differences. Also, it is not made clear for which houses the method is specifically applied. For example, the quality of a house has not been linked to the best-offer-over method.

2.3. Hypothesis

The function of a list price has changed over the years. First, it was used as an absolute price ceiling of the transaction price. It has become clear over the years that this no longer has to be always the case. In recent years, a method is created in which the list price has been used as the absolute bottom. This method is named the best-offer-over pricing method. If a house has a list price that is too high, it is more likely that the list price will be revised and the transaction time will be long. A low list price generally arouses more interest from potential buyers. When there are several buyers, bids are made against each other. It can trigger buyers to do a higher bid than they actually wanted.

Based on the literature, it is expected that a house which is for sale through the best-offer-over method will may attract more interested people than regular houses. Namely, the list price of best-offer-over method houses is in general relatively low. Because this, buyers may trigger to do a higher bid and this may could result in a higher transaction price. This research will therefore initially test the following hypothesis:

H1: In Rotterdam, the best-offer-over method leads to higher transaction prices compared to the regular sales strategy and this effect is greatest in the most popular neighborhoods.

It is expected that differences can be observed between different groups. The positive price effect of the best-offer-over method is expected to be greater in more popular neighborhoods. For example, the price effect is expected to be the most negative in the least popular neighborhoods. The information about the transactions is not perfect, there will be an omitted variable bias. For example, for the internal quality because there is no information available about it. It is unclear to what extent this incompleteness will influences the results. This is also a shortcoming in the current literature into the best-offer-over pricing method.

3. DATA & METHOD

3.1. Data

The data used for this research comes from the NVM (Dutch Association of Estate Agents and appraisers in Real Estate) transaction database. With more than 4,300 affiliated real estate agents and appraisers, the NVM is the largest cooperative association in its field in the Netherlands (NVM, 2020). The database contains about 70 percent of all housing transactions in the Netherlands and is therefore very representative (NVM, 2020). The housing details are entered by the selling broker themselves and include among other things a description, list price, transaction price, sales time and housing characteristics. NVM members are expected to enter this data completely truthfully. Due to the reliability, representativeness, size and completeness of the data set, it is extremely suitable for this research.

This research is limited to the city of Rotterdam. The database consists of 85,183 housing transactions that took place from January 2000 to February 2020. Since the data does not provide insight into the sales method of each transaction, a dummy variable has been added to each transaction. This dummy indicates whether or not a house has been sold by the best-offer-over method. To get this information, in the descriptions of the houses is searched for the Dutch word combinations 'biedenvanaf', 'vanafprijs', 'bieden vanaf prijs' and 'bieden-vanaf-prijs'. These word combinations are used in housing advertisements if a house is on the market with the best-offer-over method. The houses that meet these search terms were manually checked for correctness and added to the database. This was extremely labour-intensive work. In this way, only the houses are selected where the housing advertisement clearly describes that a house is for sale using the best-offer-over method. It might be the case that other word combinations have been used in the advertisement to indicate this or that a house is for sale through the method but this is not clearly stated in the advertisement. These houses are incorrectly not classified as best-offer-over method transaction. The first transaction which took place with the best-offer-over method was in 2008. It has been decided to use full transaction years. For this reason, all transactions which took place in transaction years 2008 to 2019 are used for this research.

To make the database usable, transactions that have not been fully or correctly entered have been filtered out. All houses for which the transaction price, list price, address or size was missing has been removed. Some trades are entered by agents two or more times. This could be, for example, because several real estate brokers were involved in the sale trajectory. These transactions have been aggregated. Due to a different tax scheme, transaction prices of existing and new-build houses cannot be compared one-to-one. This research focuses on existing and not on new-build houses. That is why all new-build houses have been omitted from the data. As a result, transaction prices can be compared with each other without a correction. Subsequently, the outliers in the dataset are filtered out. This was done by omitting the

houses whose transaction price, list price, living space, volume, number of rooms and transaction time are not within the 1 and 99 percentiles. This method is a good one to filter out extreme outliers from the dataset (Brooks & Tsolacos, 2010). The transaction and list prices have a skewed distribution. This is a common problem when analyzing sale prices (Brooks & Tsolacos, 2010). The advantage of using Log prices is that scales are better than linear prices and therefore show less severe price increases or decreases (Brooks & Tsolacos, 2010). The variable living space also has a skewed distribution. The transaction and list prices and living spaces have therefore undergone a logarithmic transformation. Because of this, the variables are normally distributed now.

After editing the dataset, the majority of the houses which are sold with the best-offer-over method has been retained. This is reflected in Table 1. After editing, 2.34 percent of the transactions were sold through the best-offer-over method. Compared to the regular sales method, a smaller part of the best-offer-over transactions has been filtered out the dataset. This is mainly because the best-offer-over method was not yet applied in the period before 2008 in Rotterdam. All transactions up to 2008 therefore fall under the regular price method. The edited dataset contains a total of 50,605 unique transactions and will be used for this research.

TABLE 1: FREQUENCY TABLE OF BEST-OFFER-OVER METHOD IN ORIGINAL AND EDITED DATASET

	Original dataset		Edited dataset	
	Freq.	percent	Freq.	percent
Sales method				
Best-offer-over	1,559	1.83	1,182	2.34
Regular	83,624	98.17	49,423	97.66
Observations	85,183		50,605	

Note: Regular method stands for all transactions that are not sold with the best-offer-over method.

3.2. Descriptive statistics

The descriptive statistics in Table 2 summarize some characteristics of the dataset by sales method. The list price of a best-offer-over house is on average 181,477 euro. That is almost 13 thousands euros lower than by the regular sales method with 194,263 euros. It is striking that the list price for the best-offer-over method is on average lower than for the regular method but it is not surprising. The theory has shown that the list price in this method is an absolute bottom and the transaction price is intended to be higher. It would therefore be plausible that houses with the best-offer-over method are offered with a lower list price. The difference in the final transaction price is smaller between both methods. For the best-offer-over transactions it is 190,533 euros and for the regular method 192,124 euros. The transaction price for the best-offer-over method is still lower. It is also noticeable that the standard deviation for best-offer-over transactions is 79,807 compared to 98,580 for regular transactions. This indicates that the spread of best-offer-over transactions is closer to the mean than regular transactions. The difference in transaction prices may come due to the difference in floor space between regular and

best-offer-over transactions. The average floor space is also lower for houses which are sold with this method. The difference may be due to this. Although the descriptive statistics give a first impression of the data, no well-founded conclusions can be drawn from it. Many factors play a role and there is not a correction for these factors. For example, time plays an important role in the height of transaction prices. After all, the real estate housing market is sensitive to the economic cycle. If houses are sold more often by utilizing a specific sales method in economically good times than in economically bad times, the mean differences can not properly be compared with each other. Also, many other housing and environmental characteristics play a role.

TABLE 2: DESCRIPTIVE STATISTICS

	Total		Best-offer-over		Regular	
	mean	sd	mean	sd	mean	sd
Property characteristics						
Transaction price	192,086.60	98,182.23	190,532.60	79,806.92	192,123.70	98,580.12
List price	193,963.80	97,000.78	181,477.10	77,310.12	194,262.50	97,404.01
Floor space	92.06	28.37	87.90	26.52	92.15	28.40
Volume	266.40	91.54	259.06	84.79	266.57	91.68
Number of rooms	3.65	1.09	3.65	1.07	3.65	1.09
Transaction time	127.45	169.26	107.25	159.82	127.94	169.45
Neighborhood						
Charlois	0.11	0.31	0.29	0.45	0.10	0.30
Delfshaven	0.11	0.31	0.09	0.29	0.11	0.31
Feijenoord	0.07	0.26	0.09	0.28	0.07	0.26
Hillegersberg-Schiebroek	0.09	0.29	0.04	0.20	0.10	0.29
IJsselmonde	0.11	0.31	0.19	0.39	0.10	0.31
Kralingen-Crooswijk	0.09	0.29	0.03	0.17	0.09	0.29
Noord	0.15	0.35	0.05	0.22	0.15	0.36
Overschie	0.03	0.16	0.01	0.08	0.03	0.16
Prins Alexander	0.16	0.37	0.18	0.38	0.16	0.36
Stadscentrum	0.08	0.27	0.04	0.19	0.08	0.28
Construction period						
<1945	0.34	0.47	0.31	0.46	0.34	0.47
1945-1970	0.26	0.44	0.35	0.48	0.25	0.44
1970-1990	0.19	0.39	0.15	0.36	0.19	0.40
1990>	0.21	0.41	0.19	0.39	0.21	0.41
Housing type						
Single-family	0.22	0.41	0.23	0.42	0.21	0.41
Multifamily	0.78	0.41	0.77	0.42	0.78	0.41
List price category						
< 100000	0.13	0.34	0.09	0.29	0.13	0.34
100000 - 150000	0.28	0.45	0.28	0.45	0.28	0.45
150000 - 200000	0.22	0.42	0.27	0.45	0.22	0.42
200000 - 250000	0.14	0.35	0.17	0.37	0.14	0.35
>= 250000	0.23	0.42	0.18	0.39	0.23	0.42
Floor space category						
< 70	0.23	0.42	0.28	0.45	0.22	0.42
70 - 85	0.22	0.42	0.20	0.40	0.22	0.42
85 - 110	0.29	0.45	0.32	0.47	0.29	0.45
>= 110	0.27	0.44	0.20	0.40	0.27	0.44
Observations	50,605		1,182		49,423	

Note: Transaction and list prices are in euros. Floor space is in square meters. Volume is in cubic meters. Transaction time is the number of days from listing to the sales of a house. List price categories are in euros. Floor space categories are in square meters.

There are also noticeable features at a neighborhood level. It is striking that in Charlois and Ijsselmonde a relatively large number of houses is sold with the best-offer-over method as sales method. Where these neighborhoods account for 21.3 percent of all transactions, are 48.1 percent of all best-offer-over transactions in these neighborhoods. This difference is limited in Delfshaven, Feijenoord and Prins Alexander. In the other neighborhoods, the share of best-offer-over houses is actually lower. The neighborhoods in which the best-offer-over method is widely used are also the less popular ones. The average income is relatively low and the neighborhoods score poorly in terms of quality of life (CBS, 2015; Leefbarometer, 2018). The descriptive statistics table also shows that in the construction period 1945 till 1970 considerably more houses were sold using the best-offer-over method. This can be explained by delving deeper into the data. There are relatively many houses in Charlois and IJsselmonde which are built within this construction period. Within these neighborhoods, the share of best-offer-over transactions is not higher than the regular method in this post-war construction period. The share of single-family houses is within the group of best-offer-over transactions with 23.10 percent of the transactions slightly higher than in the regular method group with 21.49 percent. This difference is the same for multi-family houses, but vice versa. At first sight, the results in housing type do not seem considerable. This is different concerning the list price categories. It is noticeable that within the best-offer-over transactions, a considerably higher proportion of houses fall within the list price categories 150,000 to 200,000 euros and 200,000 to 250,000 euros than in the group of regular transactions. This difference cannot be traced by analyzing the data on a neighborhood level. The neighborhoods with the highest share best-offer-over transactions (Charlois and Ijselmonde), have an actually low share of transactions in these price categories. However, the share of best-offer-over transactions in these price categories in Charlois and Ijselmonde is actually higher compared to the regular sales method. Concerning the floor space categories, it is striking that in the group best-offer-over transactions the share of houses in the smaller categories, less than 70 square meters and 70 to 85 square meters, is larger than in the group of regular transactions. The share is particularly high in the category below 70 square meters. This is striking because in the two lowest list price categories, the share is the same or lower. This could suggest that the best-offer-over method is used relatively often for houses with a smaller floor space with an average to a slightly above-average list price.

The bar graph in Figure 1 clearly shows that the share of houses sold through the best-offer-over method has increased over the years. Where the method was used sporadically in the years 2008 to 2011. The share jumped in 2012 and gradually increased in the following three years. The share of best-offer-over transactions has risen sharply in the latest years. For the time being, the peak is at over 7 percent of the transactions in 2019. The method seems to be increasingly popular among house sellers. This may coincide with the economic cycle. Figure 2 shows the evolution of the average transaction price of the dataset. When comparing the share of best-offer-over transactions with the average transaction price, it seems that the use of the method increases strongly if the average transaction price also increases.

Figure 1. Bar chart of share of best-offer-over transactions over the years in Rotterdam.

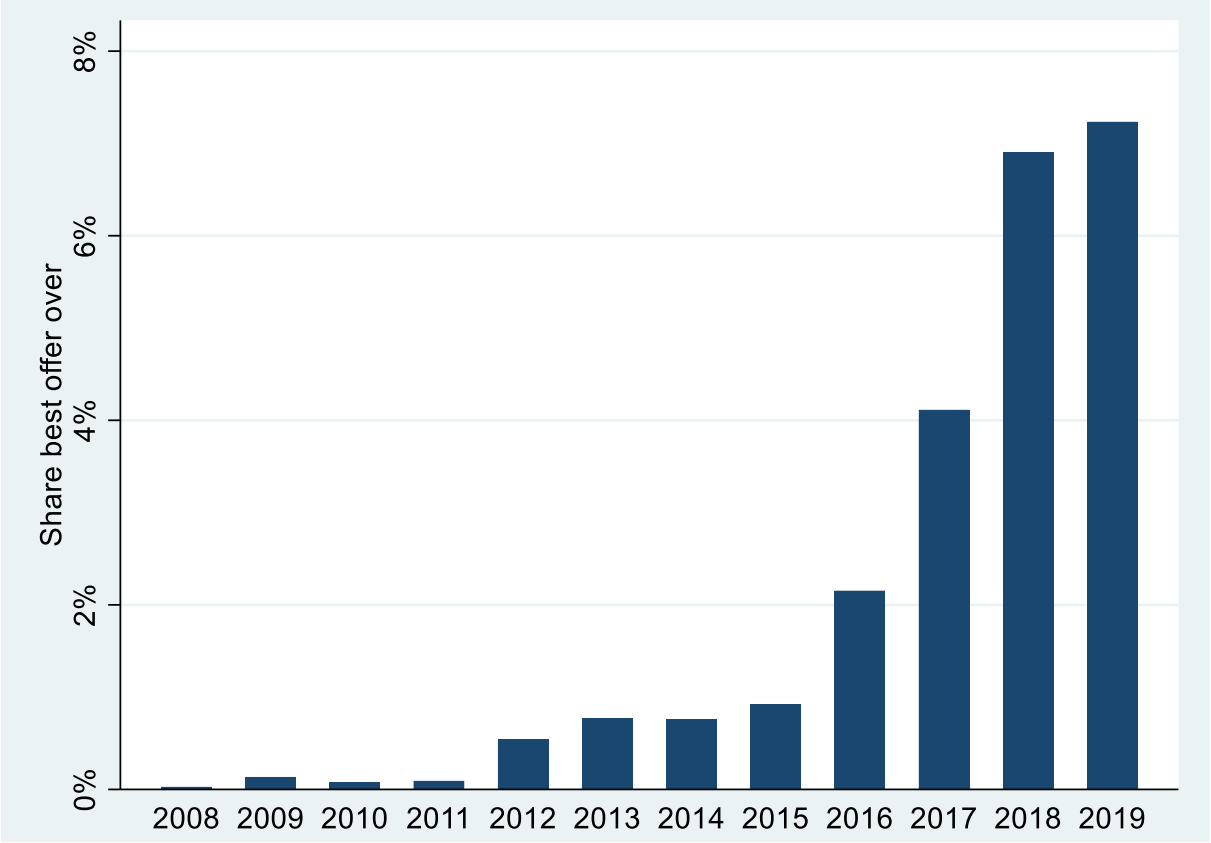
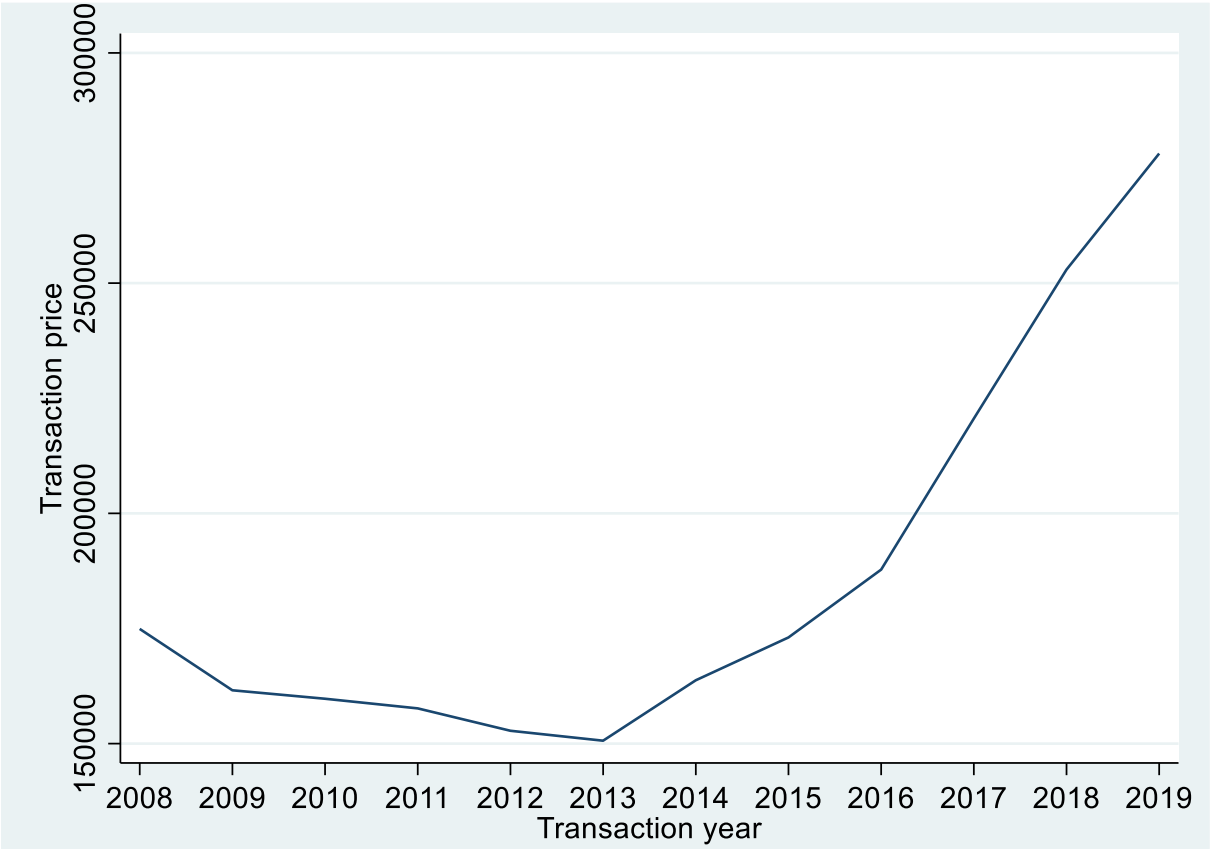


Figure 2. Line graph of the average transaction price over transactions over the years in Rotterdam.



3.3. Hedonic price model

In the previous paragraph, it is attempted to make statements based on descriptive statistics. First, averages were compared with each other. Subsequently, the possible effects of housing characteristics on the share of best-offer-over transactions were investigated. However, no significance can be observed about the effect of this pricing method on transaction prices based on these descriptive statistics. Another method is required to analyze this. As already emerged in the theoretical framework, the heterogeneity of residential real estate is distinguishable by the fact that every house has a different location and individual physical characteristics. The hedonic pricing model will be used to investigate the effect of the different characteristics on the transaction price. To assess this effect, the dependent variable transaction price in combination with the independent variables housing characteristics will be used. The housing characteristics that will be used as control variables are size, sales period, construction period, location and housing type. Unfortunately, there is no information available about the quality or the finishing level of the houses. Therefore, the model cannot control for this. For the size of the property, the floor space in square meters will be used. Time differences will be eliminated by making dummy variables of the quarter and year in which a transaction occurred. The construction years can be categorized according to construction periods. The categories are based on common construction and quality characteristics. In the model, dummies will be created for the different construction periods. By using the postcode of the transactions, dummies per neighborhood will be created. Rotterdam will be divided into 10 neighborhoods that are generally known. For the last control variable, dummies will be created for each housing type. For this, a distinction will be made between single-family and multi-family houses. This research focuses on the effect of the best-offer-over method on transaction prices. This will be investigated utilizing a dummy variable for the sales method. For this variable, a distinction will be made between two sales methods. Namely, "best-offer-over" which contains all best-offer-over transactions and "regular" which contains all other transactions.

3.4. Multiple regression analysis

For this research, a multiple regression analysis will be used. This regression will be done in the statistical software program STATA. In the multiple regression, the dependent variable is the transaction price and the independent variables are the control variables and the sales method. This leads to the following empirical model:

$$\ln TP_i = ß_0 + ß_1 SM1_i + ln ß_2 FS_i + ß_3 CP_i + ß_4 L_i + ß_5 HT_i + e_i \quad (1)$$

where TP_i is the dependent variable transaction price in euros. The independent dummy variable $SM1_i$ is the used sales method. In this case, "1" stands for the best-offer-over method and "0" for the regular method. FS_i controls for the ratio variable floor space. TY_i controls for the time by using dummies based on the year and month in which the transaction took place. In total there are 144 of these periods, so 143 dummies are implemented for this. CP_i controls for building characteristics based on the construction period. Because the building years are categorized in 4 constructions periods, there are 3 dummies for this in the model. L_i controls for locational characteristics by using a dummy for each neighborhood. There are 9 dummies implemented in the model because there are 10 neighborhoods. HT_i controls for housing type. The housing type can be a single-family or multifamily house, a dummy controls for this. $ß_i$ are the estimated coefficients that reflect the effect of the independent variables on the dependent variables. $ß_0$ is the constant and e_i is the error term. Best-offer-over method transactions may have characteristics where is not controlled for in the model. Unfortunately, the dataset does not provide insight into all housing characteristics but how this is accounted for will be explained in section 4.4.

4. RESULTS

4.1. Main results at city level

Table 3 shows the results of different regression models. In the baseline model in Column 1 where only the variable floor space is included as an independent variable. The model has an R-squared of 0.4599. This means that only 46 percent of the variation in the dependent variable is attributed to the independent variable. By adding multiple appropriate variables as control variables to the model, the R-squared can be increased. Column 2 shows the results of the model at which multiple control variables have been added. By adding the control variables, the R-squared has increased to 79.8 percent. The model in the second column therefore explains more variance in transaction prices. The model controls for the factors time, location and housing characteristics. This model is more appropriate to add the best-offer-over dummy variable compared to the first model because the effect of the best-offer-over method can be determined more correctly. In Column 3, the best-offer-over variable is added to the model. The coefficient for the best-offer-over price is -0.054587. It can be concluded that the best-offer-over method has a negative effect on transaction prices at a 99 percent significance level. The best-offer-over method leads to a transaction price that is 5.3 percent ($(\exp^{-0.054587}-1) * 100\%$) lower than when a house is sold in the regular way. This result is surprising because this is not consistent with the literature. Based on the literature, the best-offer-over method would be expected to have a positive effect on the transaction price. Based on these results, the method does not seem to be successful in Rotterdam. The hypothesis of this research is proved to be false. In Rotterdam, the bid-from price method has a negative effect on transaction prices. If the model is only applied in a boom period, a similar effect can be observed. A robustness check has been done for this[1].

TABLE 3: ESTIMATION RESULTS FOR HEDONIC PRICE REGRESSION

	(1)	(2)	(3)
Best-offer-over			-.055*** (.007)
Ln(Floor space)	1.092*** (.005)	.915*** (.004)	.915*** (.004)
Constant	7.158*** (.024)	7.604*** (.024)	7.605*** (.024)
Housing type (1)	No	Yes	Yes
Construction periods (3)	No	Yes	Yes
Neighborhood (9)	No	Yes	Yes
Time effects (143)	No	Yes	Yes
Observations	50,605	50,605	50,605
R-squared	0.4599	0.7976	0.7979

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method. All models include a constant term, fixed effects for log of the floor space in square meters, housing type, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

[1] The literature has shown that outbidding is mainly done in boom periods. The effect of the best-offer-over method may therefore differ in such periods (Koster & Rouwendal, 2017). To verify this, a robustness check is performed by using only transactions in the period from 2014 to 2019. The method also had a negative effect on transaction prices during this period.

4.2. Differences in neighborhoods

To investigate whether differences in the price effect of the best-offer-over method can be observed per neighborhood, the sample has been split. The results of the regressions per neighborhood are shown in Table 4. Based on the coefficients and significance levels for the best-offer-over method, it can be concluded that the effect on the transaction price differs per neighborhood. This indicates that there are spatial differences within Rotterdam. Not all effects are significant on a significance level of at least 90 percent. It is striking that in the neighborhoods where the difference has turned out to be significant, the price effect is always negative. However, the height does fluctuate per neighborhood. Since the effect is not significant in all neighborhoods, it is difficult to conclude about the effects here. Other group compositions may be more representative.

TABLE 4: ESTIMATION RESULTS FOR HEDONIC PRICE REGRESSION BY NEIGHBORHOOD

	(1) Charlois	(2) Delfshaven	(3) Feijenoord	(4) Hillegersberg-Schiebroek	(5) IJsselmonde
Best-offer-over	.016 (.011)	-.117*** (.026)	-.117*** (.028)	-.098*** (.032)	-.007 (.011)
Ln(Floor space)	.658*** (.011)	1.123*** (.012)	.970*** (.018)	1.035*** (.014)	.723*** (.012)
Constant	8.830*** (.078)	6.529*** (.090)	7.473*** (.126)	7.494*** (.087)	8.557*** (.085)
Housing type (1)	Yes	Yes	Yes	Yes	Yes
Construction period (3)	Yes	Yes	Yes	Yes	Yes
Time effects (143)	Yes	Yes	Yes	Yes	Yes
Observations	5,436	5,557	3,793	4,802	5,356
R-squared	0.8054	0.7744	0.7208	0.7884	0.8184

	(6) Kralingen-Crooswijk	(7) Noord	(8) Overschie	(9) Prins Alexander	(10) Stadscentrum
Best-offer-over	.003 (.031)	-.067*** (.026)	-.146* (.086)	.010 (.011)	-.046 (.030)
Ln(Floor space)	1.024*** (.010)	.809*** (.008)	.761*** (.026)	.800*** (.010)	.899*** (.014)
Constant	7.550*** (.065)	8.283*** (.058)	8.483*** (.179)	8.088*** (.052)	7.999*** (.086)
Housing type (1)	Yes	Yes	Yes	Yes	Yes
Construction period (3)	Yes	Yes	Yes	Yes	Yes
Time effects (143)	Yes	Yes	Yes	Yes	Yes
Observations	4,719	7,431	1,358	8,020	4,133
R-squared	0.8287	0.7685	0.8287	0.8622	0.8172

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method. All models include a constant term, fixed effects for log of the floor space in square meters, housing type, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

4.3. Neighborhood popularity

It shown that differences can be observed in the effect of the best offer method on transaction prices between the neighborhoods. However, it has not been investigated whether the method has a different effect in popular neighborhoods than in less popular neighborhoods. For this, a variable from the dataset will be used or there have to be added one. The NVM itself has regional shortage indicators available. These indicators approximate the number of options that a potential buyer has on the housing market. The indicator is calculated as the supply at the beginning of the month divided by the number of transactions in that month. (NVM, 2020) However, no shortage indicator is available that shows differences between housing characteristics and within Rotterdam. This will require an alternative method to be used. Unfortunately, the database used for this research does not provide any insight into the supply of housing. The calculation method for the shortage indicator of the NVM can therefore not be used for the data used for this study. However, another shortage indicator can be made that provides insight into the shortage of an area or housing type. The shortage indicator gives an approximation of the trend in supply on the housing market. The shortage indicator is calculated by dividing the number of houses offered in a period by the number of houses sold in a period. The shortage indicator will therefore be a ratio variable. To avoid seasonality, the shortage will be calculated on an annual basis. The disadvantage of the shortage indicator is that the period for the use must be limited because the indicator will always be 1 in the long term. After all, in the long term, the number of houses that will be offered is equal to the sold number. In addition, policies in the form of sale strategies for housing associations in certain areas may jeopardize the reliability of the indicator. If the strategy is different per neighborhood, this will affect the new supply in a neighborhood and therefore also the shortage indicator. Another disadvantage of the shortage indicator is that it cannot be given to individual transactions. It is only possible for groups. After all, new supply and sales have to be compared and the heterogeneity of real estate do not allow it to compare individuals one-to-one. For this study, the shortage indicator will therefore not be used to compose the most popular group.

Another variable will be used for this. The period between placing a house for sale on the market and the moment of transaction indicates the popularity of a house. After all, a popular house often has a shorter transaction time than an unpopular house. Transaction time will therefore be used as an indicator of popularity. The variable is available in the dataset and differs for each transaction. To determine the most popular group of houses, a multiple regression will be used. This regression is chosen because it controls for other variables that play a role. By comparing averages, this is not the case. In the regression, the dependent variable is transaction time and the independent variables are dummies for the type of house, neighborhood and transaction year. In addition, control variables will be added for the living space, the construction period and the list price category. The results of the regression indicate in which period and neighborhoods and for which housing type the transaction time is relatively the shortest.

The database will be split into three groups. A group of houses in the most popular neighborhoods, a group of houses in the least popular neighborhoods, and a group of houses in the neighborhoods in between. The popularity of the neighborhoods will be measured based on the transaction time. This is the period that a house is for sale from the moment of the offering until the transaction. A shorter transaction time implies a more popular neighborhood. To identify the groups, a regression is used where transaction time is the dependent variable and floor space, transaction price and categorized housing characteristics are the independent variables. Based on this regression, it can be concluded what the effect of every neighborhood is on the transaction time. Transactions with a transaction time of 0 have been omitted from this regressive. These houses have only been reported for statistical purposes and cannot be used for this analysis because they can pollute the results. The results are shown in Table 5. In Column 1, the independent variable sales method is added to the model. The best-offer-over method has a significant positive effect on the transaction time at a 99 percent significance level. When a house is sold with the best-offer-over method, this leads to a transaction time which is 21.5 percent ($(\exp^{0.1949347}-1)*100\%$) longer than if a house is not sold by this method. This is surprising because the theory showed that the best-offer-over method leads to shorter transaction times (Janssen & Bougie, 2018). Since the best-offer-over method has a positive effect on the transaction time, the best-offer-over method transactions will be excluded when assembling the groups. The model is therefore only run on regular sold transactions and is not influenced with best-offer-over transactions. In Column 2 the model is shown with only regular sold transactions. The purpose of this model is to identify the most popular group. This will be done based on the coefficients of the neighborhood dummies. The three neighborhoods with the most positive coefficient will be labelled as least popular and the three neighborhoods with the most negative coefficient will be labelled as most popular. The four intermediate neighborhoods will be classified as in between. Based on this method, the Delfshaven, Noord and Kralingen-Crooswijk neighborhoods are the most popular. Charlois, Overschie and IJsselmonde are the least popular. The neighborhoods Stadscentrum, Feijenoord, Prins Alexander and Hillegersberg-Schiebroek form the in between group. It is striking that the least popular neighborhoods are relatively far from the centre of the city.

TABLE 5: ESTIMATION RESULTS FOR HEDONIC REGRESSION

	(1)	(2)
Best-offer-over	.195*** (.033)	
Ln(Floor space)	.383*** (.029)	.3763834*** (.030)
Ln(Transactionsprice)	-.245*** (.023)	-.2363573*** (.023)
Constant	5.749*** (.228)	5.417734*** (.223)
Charlois	.217*** (.027)	.240427*** (.028)
Delfshaven	-.135*** (.025)	-.1341478*** (.026)
Feijenoord	.016 (.027)	.0168628 (.028)
Hillegersberg-Schiebroek	.100*** (.025)	.104638*** (.025)
IJsselmonde	.156*** (.027)	.1564968*** (.027)
Kralingen-Crooswijk	-.013 (.024)	-.0121874 (.024)
Noord	-.091*** (.024)	-.0904435*** (.024)
Overschie	.155*** (.037)	.1594499*** (.037)
Prins Alexander	.086*** (.024)	.0925017*** (.024)
Stadscentrum	0	0
Housing type (1)	Yes	Yes
Time effects (143)	Yes	Yes
Construction periods (3)	Yes	Yes
Observations	49,571	48,400
R-squared	0.1605	0.1586

Note: Dependent variable is log of the transaction time in days. The reference category includes a multifamily house located in the Stadscentrum neighborhood and sold in the year 2013. All models include a constant term, fixed effects for log of the floor space in square meters, construction periods, location on a neighborhood level, time for year and list price category, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

Regressions are made to investigate the differences in the effect of the best-offer-over method on transaction prices over these groups. Table 6 shows the results of these regressions. The model for the houses in the most popular neighborhoods in Column 1 shows that the effect of the best-offer-over method is more negative than in the pooled sample in Column 4 on a 99 percent significance level. In the most popular neighborhoods, houses that are sold with the best-offer-over method have a 7.8 percent ($(\exp^{-0.08168}-1)*100\%$) lower transaction price than houses that are sold using the regular method. The in between group in Column 2 also shows that the effect is negative at a 99 percent significance level. In this group, the method leads to 5.9 percent ($(\exp^{-0.060314}-1) * 100\%$) lower transaction prices than the regular method. This effect is slightly more negative than the effect in the pooled sample. The model in Column 3 shows that there is no significant effect in the least popular group. The method therefore does not lead to a significantly different transaction price in this group. This is interesting because it suggests that the best-offer-over method leads to the same transaction price as the regular sales method only in the least popular neighborhoods. The expectation was that the best-offer-over method has the most positive effect on transaction prices in the most popular group. However, this is apparently not the case. The effect turned out to be the most negative in the most popular group. On the other hand, it turned out to be the least negative in the least popular group. There was no significant effect in this group.

TABLE 6: ESTIMATION RESULTS FOR HEDONIC PRICE REGRESSION BY POPULARITY

	(1) Most popular	(2) In between	(3) Least popular	(4) Pooled
Best-offer-over	-.082*** (.016)	-.060*** (.011)	.010 (.008)	-.055*** (.007)
Ln(Floor space)	.965*** (.006)	.952*** (.007)	.693*** (.008)	.915*** (.004)
Constant	7.767*** (.039)	7.436*** (.040)	9.041*** (.050)	7.605*** (.024)
Housing type (1)	Yes	Yes	Yes	Yes
Construction periods (3)	Yes	Yes	Yes	Yes
Neighborhood (9)	Yes	Yes	Yes	Yes
Time effects (143)	Yes	Yes	Yes	Yes
Observations	17,707	20,748	12,150	50,605
Where off best-offer-over	204	402	576	1,182
R-squared	0.7775	0.7753	0.8123	0.7979

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method. All models include a constant term, fixed effects for log of the floor space in square meters, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively

4.3. Differences in housing type

Previous research has shown that the effect of the best-offer-over method can differ between housing types (De la Hayze, 2019). Table 7 shows the regression outcomes where the dataset is split in the two housing type groups. On group for multifamily houses and one for single-family houses. The pooled sample is therefore not controlled for this variable. The results show that the effect of the best-offer-over method on transaction prices differs per housing type group. By both groups, the price effect is negative at a 99 percent significance level. The best-offer-over method leads for multifamily houses to a transaction price that is 5.6 percent ((exp-.0571643-1) * 100%) lower than when a multifamily house is sold in the regular way. For single-family houses, the transaction price is 3.4 percent ((exp-.0349796-1) * 100%) lower than when a single-family house is sold in the regular way. The price effect in Rotterdam is therefore more positive for multifamily houses than for single-family houses. This result corresponds with the literature, it has previously been found that the price effect of the best-offer-over method is more positive for multifamily houses than for single-family houses (De la Hayze, 2019).

TABLE 7: ESTIMATION RESULTS FOR HEDONIC PRICE REGRESSION BY HOUSING TYPE

	(1) Multifamily	(2) Single-family	(3) Pooled
Best-offer-over	-.057*** (.008)	-.035*** (.012)	-.057*** (.007)
Ln(Floor space)	.921*** (.004)	.848*** (.009)	.974*** (.003)
Constant	7.729*** (.028)	7.873*** (.074)	7.415 (.024)
Construction periods (3)	Yes	Yes	Yes
Neighborhood (9)	Yes	Yes	Yes
Time effects (143)	Yes	Yes	Yes
Observations	39,713	10,892	50,605
R-squared	0.7891	0.7732	0.7927

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method. All models include a constant term, fixed effects for log of the floor space in square meters, housing type, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

4.4. Additional investigation on the role of the finishing level

The results of this research so far suggest that the best-offer-over method has a negative effect on transaction prices in Rotterdam. An attempt has been made to investigate how this difference can be explained. Possible explanations were sought in the housing characteristics which are present in the dataset. Differences were found between neighborhoods and housing types. However, a clear explanation of the effect is missing. It could therefore be possible that one or more variables which influence the effect are missing in the models. In that case, there can be spoken of an omitted variable bias. It could be the case that the best-offer-over method is more popular by a certain type of house in which the dataset for this study does not provide insight. To inventory this, contact is sought with experts of a leading real estate agency company in Rotterdam. Them is asked to give a possible explanation for the results of this study. It was difficult to give a clear explanation. However, they indicated that the neighborhoods Charlois and IJsselmonde generally have a less wealthy target group than other Rotterdam neighborhoods. In these neighborhoods, the best-offer-over method is most used. In addition, they indicated that there are many social rental houses in Rotterdam. In recent years, many of these houses are unit sold by housing associations. This was the motivation to investigate whether this may explain the difference in transaction prices. Perhaps (former) social rental houses have specific characteristics compared to other houses.

Compared to the Dutch large cities, Rotterdam has the highest percentage of social housing rented out by housing associations. 45 percent of the Rotterdam housing stock is owned by housing associations (CBS, 2016). Nevertheless, the social housing stock has been declining for some time in the Rotterdam region (SvWrR, 2017). Sale of housing association houses, is a considerable share of all housing transactions. In the period from January 2005 to March 2014, it was minimal 20 percent of the transactions (Kadaster, 2014). The main reason for housing associations to sell social housing is the income they needed for investments. The choice between sale per complex or per property is mainly determined by time. If there is enough time, sale per property is preferred because of the higher realizable value, marketability and differentiation (Feitz, 2016). The sale per property is mainly done through a unit sale. Unit sale is a process that occurs specifically in the real estate sector. The term is barely used in the existing literature. The bottom line is that rental properties are sold to current tenants or future residents. The property is hereby transformed from rental property to owner-occupied property and from investment property to individual property (Visschedijk, 2001). In international terms, the quality of social housing is relatively high in The Netherlands (van Kempen & Priemus, 2002). However, the quality of the houses of owner-occupied sellers is generally higher. Owner-occupiers give more value to the maintenance of their house (Beekman et al., 2001, p. 59). In addition, the finishing level of social houses of housing associations is in general simple and certainly not luxurious. After all, housing associations are there to sell or rent affordable housing (Rijksoverheid, 2020).

The finishing level of the house may be the variable that is missing in models so far. If the level of finishing of best-offer-over houses is often below average, then these transactions are difficult to compare with houses that have been sold with the regular method. After all, houses with a low finishing level are worth less than houses with a good finishing level. The houses require an extra investment to get the same finishing level. In that case, the model in this study is not complete. This correction has not been corrected in the models so far. It could be plausible that the negative price effect of the best-offer-over method found in this study could be (partly) explained by this. Unfortunately, in the current data set, no information is available about the finishing level of the houses. Therefore, a different approach has been used. As indicated, houses that are unit sold by housing associations generally have a lower level of finish than sales by owner-occupiers. As a result, the kitchen, bathroom and toilet will generally be simple by these unit sold houses. In addition, the chance of recent renovation is smaller, because the houses were first rented out and in practice it take place less often with rented houses. This provides an entry for a variable that provides an approximation for the finishing level of some houses.

In the same way that the best-offer-over method houses are added to the data by utilizing a dummy variable, this can also be done for houses that have been unit sold by housing associations. In the sales advertisements of the houses, there can be searched for terms that are used only or mainly in advertisements of housing association houses. The terms used for this are 'Corporatie', 'Zelfbewoning', 'Speculatie', 'Projectnotaris', 'Koopcomfort', 'Koopgarant', 'Uitpond' and 'Terugkoop'. If a house has at least one of these terms in the advertisement, they have been taken out separately. In addition, houses that have been sold by a broker who is only be engaged by housing associations have been added[2]. In Rotterdam, housing associations have often given a discount on the sales prices of their houses (Kadaster, 2014). Therefore, houses that have been sold by housing associations with a discount and special buy-back clause have been removed from this selection[3]. After all, these houses cannot be properly compared with other transactions due to the clauses. There remains a selection of houses that have been unit sold by housing associations. A dummy variable has been added to the database, which provides insight into whether a transaction is "1" or is not "0" unit sold by housing associations. Table 8 provides insight into the distribution of this variable among houses that were sold with the best-offer-over or the regular method. This provides interesting insights. Of the houses that were sold using the best-offer-over method, at least 14.2 percent is likely sold by a housing association. Of the houses sold using the regular method, this share is 9.5 percent. Based on this, best-offer-over transactions concern more often unit sold houses of housing associations than regular transactions.

[2] Real estate agent CORPOwonen only offer its services to housing associations.

[3] These are houses with the terms 'Koopcomfort', 'Koopgarant' or 'Terugkoop' in the sales advertisements. These are terms used by housing associations for selling houses to individuals for a reduced price with the guarantee that the associations will be bought back the house later for a reduced price. The housing association has the first right to buy the house if the owner wants to sell it. Previous research has shown that such transactions have a limited negative effect on transaction prices of surrounding houses (Schilder et al., 2014).

TABLE 8: FREQUENCY TABLE OF HOUSING ASSOCIATIONS OR UNKNOWN PARTIES AS SELLING PARTY BY BEST-OFFER-OVER OR REGULAR SELLING METHOD

	Housing association		Unknown		Total	
	Freq.	percent	Freq.	percent	Freq.	percent
Seller						
Best-offer-over	168	14.2	1,014	85.8	1,182	2.34
Regular	4,674	9.5	44,749	90.5	49,423	97.66
Observations	4,842		45,763		50,605	

Note: Regular method stands for all transactions that are not sold with the best-offer-over method.

As an exploration, the dummy variable has been added to the model. The results of this are shown in Table 9. In Column 1, the model in Column 3 of Table 3 is taken as the starting point. In Column 2, the dummy variable for unit sold houses sold by housing associations is added. It can be concluded that the variable has a negative effect on the transaction price at a 99 percent significance level. Houses that are sold by housing associations have a 6.7 percent ($(\exp^{-.0694931}-1)*100\%$) lower transaction price than houses that are sold by an unknown selling party. It can also be seen that the effect of the best-offer-over method is less negative on a 99 percent significance level when the selling party dummy is added to the model. The effect changes from minus 5.3 percent ($(\exp^{-0.054587}-1) * 100\%$) to minus 5.1 percent ($(\exp^{-.0528488}-1) * 100\%$). The effect is less because there is controlled for the selling party. These results show that the finishing level of a house may play a role in the effect of that best-offer-over method on transaction prices. It could be possible that if the finishing level of the transactions is identified, the effect of the best-offer-over method is different because there is controlled for it.

TABLE 9: ESTIMATION RESULTS FOR HEDONIC PRICE REGRESSION WITH SELLING PARTY AS ADDED DUMMIE VARIABLE

	(1)	(2)
Best-offer-over	-.055*** (.007)	-.053*** (.007)
Selling party is a housing association		-.069*** (.003)
Ln(Floor space)	.915*** (.004)	.911*** (.004)
Constant	7.605*** (.024)	7.639*** (.024)
Housing type (1)	Yes	Yes
Construction periods (3)	Yes	Yes
Neighborhood (9)	Yes	Yes
Time effects (143)	Yes	Yes
Observations	50,605	50,605
R-squared	0.7979	0.7996

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method and in Column 2 the house is sold by an unknown party. All models include a constant term, fixed effects for log of the floor space in square meters, housing type, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

To determine whether the finishing level influences the findings, the finishing level of a sample is investigated. Since all transactions will be removed from the Funda sales website over time, only houses sold in the third and fourth quarter of 2019 can be found. Only of these houses are the advertisements online available with photos. This concerns 2,554 transactions of which 174 were sold with the best-offer-over method. To provide a sample of properties that are easy to compare, the best-offer-over transactions are matched with regular sales method transactions based on housing characteristics. Best-offer-over transactions can therefore be compared with regular transactions with identical characteristics. The housing characteristics are floor space category (4), housing type (11), construction period (4) and location (69). After the houses have been matched, the house is internally assessed at the finishing level. The kitchen, bathroom, toilet and overall internal quality of the house is included in the rating. The houses are divided into the categories basic "1", under average "2", average "3", above average "4" and luxurious "5". For this, the ordinal variable finishing level has been added to the dataset and discretized into dummy variables. Figure 3 and 4 show a few housing characteristics and pictures of two transactions. Based on the housing characteristics in the dataset, these houses can be compared with each other. However, the level of finishing differs between the two houses. The transaction in Figure 3 has a lower level of finishing than the transaction in Figure 4. Comparing both houses without correction is therefore not justified. Both houses have therefore received a different rating for the internal quality.

Figure 3. Characteristics with pictures of Aristotelesstraat 89.

Adress	Aristotelesstraat 89 3076 BC Rotterdam
Transaction date	September 15th 2019
Floorspace	70 m^2
List price	€145,000,-
Transaction price	€152,000,-
Per m^2	€2,171,-
Sales method	Best-offer-over
Level of finishing	1

Figure 4. Characteristics with pictures of Georg Hegelstraat 63.

Adress	Georg Hegelstraat 63 3076 RE Rotterdam
Transaction date	September 26th 2019
Floorspace	77 m^2
List price	€175,000,-
Transaction price	€180,000,-
Per m^2	€2,338,-
Sales method	Regular
Level of finishing	3

In total, 643 houses were internally assessed. The other houses fell off after matching and for 17 houses no photos were available. Since the finishing level of a sample of houses is rated, a regression can be made about this sample. Table 10 shows the results of this regression. Column 1 shows the results of all the transactions that took place in quarter 3 and 4 of 2019. In this sample, the best-offer-over method leads to a 4.9 percent ((exp-0.049809-1) * 100%) lower transaction price at a 99 percent level. Column 2 shows the same model with matched transactions. After matching, this effect has fallen to a 2.8 percent ((exp-0.0286649-1) * 100%) lower price at a 95 percent significance level. In these models, there is not controlled for the finishing level of the houses. This has been done in the model in Column 3. After controlling for the finishing level, there is no longer a significant effect of the best-offer-over method on transaction prices. The finishing level has proved to be a determining omitted variable in this sample. This is also reflected in the R-squared . The R-squared also increased from 0.8333 to 0.8849 after adding the variable. For the model in Column 3, 88.5 percent of the variation in the dependent variable is attributed to the independent variables. Houses that have been sold through the best-offer-over method generally have a lower level of finishing than other houses in this sample. It is quite possible that this also applies to the entire data set of this study.

TABLE 10: ESTIMATION RESULTS FOR HEDONIC PRICE REGRESSION

	(1)	(2)	(3)
Best-offer-over	-.050*** (.014)	-.029** (.014)	-.008 (.012)
Ln(Floor space)	.751*** (.014)	.739*** (.030)	.637*** (.026)
Constant	9.352*** (.064)	8.960*** (.139)	9.300*** (.120)
Construction periods (3)	Yes	Yes	Yes
Neighborhood (9)	Yes	Yes	Yes
Time effects (5)	Yes	Yes	Yes
Finishing level (4)	No	No	Yes
Observations	2,554	643	643
Where off best-offer-over	174	121	121
R-squared	0.7877	0.8333	0.8849

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method. All models include a constant term, fixed effects for log of the floor space in square meters, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively

In addition to the regression, a comparative analysis is done. Since the finishing level of a sample of houses is known, it is now possible to match both the housing characteristics and the finishing level. Coarsened Exact Matching is used for this. This matching method improves the estimation of causal effects by reducing imbalance in covariates between treated and control groups (Blackwell et al., 2009). The values of variables have been categorized for this. For example, construction years are divided into construction periods. This makes it possible to compare best-offer-over transactions with regular transactions with the same housing characteristics and a similar level of finish. There are 54 unique matchings and the results are shown in Table 11. When comparing the square meter price of the best-offer-over transactions with the regular transactions, it appears that the difference is minimal. The average price per square meter of best-offer-over transactions is 2,663.70 euros and for regular transactions it is 2,651.50 euros. The almost equal transaction price per square meter suggests that the method has no major impact on transaction prices. This is in line with the results of the hedonic regression model in Table 10.

TABLE 11: INFORMATION ABOUT SQUARE METER PRICE AFTER MATCHING ON FINISHING LEVEL

	Obs.	Mean	Std. dev,	Min.	Max
Sales method					
Best-offer-over	56	2,661.70	605.04	1,714.29	4,936.17
Regular	104	2,651.50	689.44	1,775.00	5,087.72
Total	160	2,655.07	633.71	1,714.29	5,087.72

Note: Regular method stands for all transactions that are not sold with the best-offer-over method.
Square meter prices are in euros.

5. DISCUSSION

5.1. Mixed literature

The literature that studies the best-offer-over method is relatively young and growing, as is the use of the method has increased sharply in the past 12 years. Nowadays, the method seems to be an integral part of the Dutch housing market. It was expected that a house which is for sale with the best-offer-over method, will may attract more interested people because of the low list price compared to regular houses. Because this, buyers may trigger to make a higher bid and this may could result in a higher transaction price. The expectation that the best-offer-over method has a positive effect on transaction prices is not confirmed by the results. The existing literature about the best-offer-over method shows that the overall effect of the method on transaction prices is positive with 4.4 to 5 percent (Pillen, 2014; De la Hayze, 2019). In this study, the method leads to an overall negative effect of 5.3 percent. This may in part have to do with the market that is studied. It should be taken into account that this research is limited to the Rotterdam market. It may be that the nature and functioning of the Rotterdam market differs from other markets, so that the results may be different. Janssen & Bougie (2018) found evidence that best-offer-over transactions has a shorter transaction time than regular transactions. In this study, the method actually leads to longer transaction times, which underlines that the Rotterdam differs from other markets.

5.2. Internal quality

The effect of the best-offer-over method on transaction prices has been examined at various scales. During the research, the focus shifted further from the whole city to the quality aspects of neighborhoods, to housing types, and at the property level. In this study, a link is made for the first time between the internal quality of a house and the best-offer-over method. An investigation on a small group of houses has shown that the internal quality of a house influences transaction prices. After adding the internal quality as a variable to the model, there appeared to be no significant effect of the best-offer-over method on transaction prices. These findings may call into question the reliability and interpretation of other studies into the housing market, studies of listing prices in particular, as well as possibly other real estate types. In other studies, the internal quality of properties has not been investigated and has remained unobserved, see, for example Janssen & Bougie, 2018 and De la Hayze, 2019. This investigation conducted a sample of houses that were sold in the second semester of 2019 because the quality of previous transactions could not be rated. In further research, the impact will have to be refined by investigating a larger group of houses. This makes it possible to investigate whether the findings also hold for a broader representation of the Dutch housing market. In addition, a qualitative study that examines the choice of the best-offer-over method would enrich the existing literature. The literature has always investigated the method quantitatively, but it would be interesting to gain insight into the factors that play a role in the process of choosing a sales method. Based on these results, it may be

possible to better identify the group of houses that have been sold with the best-offer-over method. This can provide new insights with which further quantitative research can be done.

5.3. Recommendations and policy implementations

This research may improve the information based on which homeowners and brokers may choosing the selling method, or help buyers in determining their bid for a house. In addition, this research may help these parties to estimate the potential time that a house is on the market. Overall, a better understanding of how list prices and transaction prices are related to each other can help policymakers and umbrella real estate associations by setting rules and policies in the housing market. Without reading the housing advertisement, it is not clear if a house is on the market with the best-offer-over method and how the list price should be interpreted. The price for which a house is on the market is called the list price for both the best-offer-over method and the regular method. The Dutch Association of Estate Agents could consider encouraging to implement the sales method as part of the housing characteristics. As a result, there will be a variable in the database that provides insight into the sales method. Adding the sales method to the housing characteristics contributes to improving the precision of the results in further research.

6. CONCLUSION

This research has focused on the effect of the best-offer-over method on transaction prices in Rotterdam. The findings are based on a hedonic regression analysis of 50,605 housing transactions over 2008 - 2019. The following research question is answered: “What is the effect of the best-offer-over method on transaction prices in Rotterdam neighborhoods?”. The analysis initially suggests that the best-offer-over method has a significant -5.3 percent effect on transaction prices compared to the prices of houses sold using the regular list price method. In the most popular neighborhoods, the effect is most negative and vice versa. There is also evidence that the effect is less negative for multifamily houses than for single-family houses. However, importantly, an exploratory study is conducted to explain these findings; as part of this, the level of finishing was rated for a group of 643 transactions. After controlling for the internal quality, there is no significant effect of the best-offer-over method on transaction prices anymore. An comparison of transaction prices of best-offer-over transactions with comparable regular transactions with the same level of finishing also showed that the sales strategy does not cause a clear difference in transaction prices.

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APPENDICES

APPENDIX A: NOTATIONAL GLOSSARY

Empirical model

β	Coefficients to be estimated
i	Property i=1,…,N
e	Error term
TP	Transaction price in euros
SM	Sales method
FS	Floor space in square meters
TY	Transaction year
CP	Construction period
L	Neighborhood
HT	Housing type

APPENDIX B: OVERALL HEDONIC PRICE REGRESSION

	(1)	(2)	(3)
Best-offer-over			-.054587*** (.0065621)
Ln(Floor space)	1.092026*** (.0052605)	.9152312*** (.0039821)	.9151735*** (.0039794)
Constant	7.158406*** (.0236034)	7.604418*** (.024465)	7.604952*** (.0244485)
Single-family		.1086889*** (.0030199)	.1084785*** (.003018)
Multifamily		0	0
Charlois		-.1861532*** (.0047745)	-.1845623*** (.0047752)
Delfshaven		-.0119057** (.0046809)	-.0124203*** (.0046782)
Feijenoord		0	0
Hillegersberg-Schiebroek		.2711117*** (.00488)	.2700748*** (.0048783)
IJsselmonde		-.0955226*** (.004908)	-.094904*** (.0049053)
Kralingen-Crooswijk		.3059347*** (.0048821)	.304903*** (.0048803)
Noord		.2230351*** (.0045709)	.2217695*** (.0045704)
Overschie		.033829*** (.0070171)	.0326029*** (.0070139)
Prins Alexander		.0337866*** (.0046342)	.0337182*** (.0046311)
Stadscentrum		.3839417*** (.0050516)	.3829659*** (.0050496)
1945 - 1970		.0471096*** (.0031646)	.0474262*** (.0031627)
1970 - 1990		0	0
1990 >		.2626316*** (.003276)	.2624845*** (.0032738)
< 1945		.0542831*** (.003242)	.0545273*** (.00324)
Time effects (143)	No	Yes	Yes
Observations	50,605	50,605	50,605
R-squared	0.4599	0.7976	0.7979

Note: Dependent variable is the log of the transaction price. The reference category includes a multifamily house in Feijenoord that is sold with the regular sales method in January 2009 . All models include a constant term, fixed effects for log of the floor space in square meters, housing type, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

APPENDIX C: ROBUSTNESS CHECK FOR BOOM PERIOD

	(1) 2014-2019
Best-offer-over	-.0410582*** (.0066029)
Ln(Floor space)	.9061635*** (.0050823)
Constant	8.290884*** (.0267798)
Housing type (1)	Yes
Construction periods (3)	Yes
Neighborhood (9)	Yes
Time effects (143)	Yes
Observations	29,971
R-squared	0.8084

Note: Dependent variable is log of the transaction price. The reference category includes a house that is sold with the regular sales method. All models include a constant term, fixed effects for log of the floor space in square meters, housing type, construction periods, location on a neighborhood level and time for year and month, Standard errors in parentheses with *** , **, * indicating significant at 1%, 5% and 10%, respectively.

APPENDIX D: F STATISTIC CHOW TESTS

Table 6:

$$\text{F statistic } = \frac{\text{RSS}_{Pooled} - (\text{RSS}_M + \text{RSS}_{IB} + \text{RSS}_L)}{\text{RSS}_M + \text{RSS}_{IB} + \text{RSS}_L} * \frac{\text{n} - \text{G} * \text{k}}{\text{G} * \text{k} - \text{k}}$$

$$\text{F statistic } = \frac{2394.78539 - (865.504532 + 954.153629 + 414.143288)}{865.504532 + 954.153629 + 414.143288} * \frac{50{,}605 - 3 * 160}{3 * 160 - 160}$$

$$\text{F statistic } = \frac{160.9839}{2233.801} * \frac{50{,}125}{320} \approx 11.29$$

Critical values (320,50125)

90% ≈ 1.11

95% ≈ 1.15

99% ≈ 1.21

Table 7:

$$\text{F statistic } = \frac{\text{RSS}_{Pooled} - (\text{RSS}_M + \text{RSS}_S)}{\text{RSS}_M + \text{RSS}_S} * \frac{\text{n} - \text{G} * \text{k}}{\text{G} * \text{k} - \text{k}}$$

$$\text{F statistic } = \frac{2394.78539 - (1900.55347 + 401.211203)}{1900.55347 + 401.211203} * \frac{50{,}605 - 2 * 160}{2 * 160 - 160}$$

$$\text{F statistic } = \frac{93{,}02072}{2301{,}765} * \frac{50{,}285}{160} \approx 12.70$$

Critical values (160,50285)

90% ≈ 1.16

95% ≈ 1.22

99% ≈ 1.32

APPENDIX E: FREQUENCY TABLE BY SELLER AND METHOD BY NEIGHBORHOOD

TABLE 10: FREQUENCY TABLE OF HOUSING ASSOCIATIONS OR UNKNOWN PARTIES AS SELLING PARTY BY BEST-OFFER-OVER OR REGULAR SELLING METHOD FOR EVERY NEIGHBORHOOD

	Housing association		Unknown		Total	
	Freq.	percent	Freq.	percent	Freq.	percent
Charlois						
Best-offer-over	21	5.5	322	6.4	343	6.3
Regular	363	94.5	4730	93.6	5093	93.7
Delfshaven						
Best-offer-over	45	5.5	61	1.3	106	1.9
Regular	772	94.5	4679	98.7	5451	98.1
Feijenoord						
Best-offer-over	9	1.9	95	2.9	104	2.7
Regular	454	98.1	3235	97.1	3689	97.3
Hillegersberg-Schiebroek						
Best-offer-over	11	4.6	38	0.8	49	1.0
Regular	228	95.4	4525	99.2	4753	99.0
IJsselmonde						
Best-offer-over	35	6.7	191	4.0	226	4.2
Regular	488	93.3	4642	96.0	5130	95.8
Kralingen-Crooswijk						
Best-offer-over	10	2.4	27	0.6	37	0.8
Regular	401	97.6	4281	99.4	4682	99.2
Noord						
Best-offer-over	15	2.8	46	0.7	61	0.8
Regular	526	97.2	6844		7370	99.2
Overschie				0.0		
Best-offer-over	3	1.7	4	0.3	7	0.5
Regular	174	98.3	1177	99.7	1351	99.5
Prins Alexander						
Best-offer-over	17	1.8	190	2.7	207	2.6
Regular	917	98.2	6896	97.3	7813	97.4
Stadscentrum						
Best-offer-over	2	0.6	40	1.1	42	1.0
Regular	351	99.4	3740	98.9	4091	99.0
Observations	4,842		45,763		50,605	

Note: Regular method stands for all transactions that are not sold with the best-offer-over method.

APPENDIX F: MATCHINGSVARIABLES

Floor space category

70 - 85	< 70
85 - 110	>= 110

Housing type

Eengezinswoning	Portiekwoning
Benedenwoning	Maisonnette
Portiekflat	BenedenBovenwoning
Galerijflat	DubbelBenedenhuis
Penthouse	Tussenverdieping

Construction period

<1945	1970-1990
1945-1970	1990>

Location

Afrikaanderwijk	Kleinpolder	Provenierswijk
Agniesebuurt	Kop van Zuid	Redebuurt
Akker/Haagwinde	Kop van Zuid - Entrepot	Rendier/Navigatiebuurt
Bedrijventerrein Schieveen	Kralingen Oost	Rubroek
Bergboezem	Kralingen West	's Gravenland
Bergpolder	Kralingse Bos	Schiebroek
Bergse Nos	Kralingseveer	Schiemond
Beverwaard	Landzicht	Schieveen
Blijdorp	Liskwartier	Schieweg-Polder
Blijdorpsepolder	Lombardijen	's-Gravenweg/Alexanderlaan
Bloemhof	Middelland	Sint Clarabos
Bolnes	Molenlaankwartier	Smitshoek
Bospolder	Negenhuizen en Zouteveen	Spaanse Polder
BT Cornelisland	Nesselande	Spangen
Carnisse	Nieuw Crooswijk	Sportpark Schenkel
Charlois Zuidrand	Nieuwe Werk	Stadsdriehoek
Cool	Nieuwe Westen	Struisenburg
Cornelisland	Noord Kethel	Tarwewijk
Cs Kwartier	Noordereiland	Terbregge
De Esch	Noordkethelpolder	Tussendijken
Delfshaven	Ommoord	Vlinderstrik
Dijkzigt	Oosterflank	Vreewijk
Dordtsestraatweg	Oud Charlois	Waalhaven
Feijenoord	Oud Crooswijk	Weg en Land
Groot IJsselmonde	Oud IJsselmonde	Witte Dorp
Heijplaat	Oud Mathenesse	Zestienhoven
Het Lage Land	Oude Noorden	Zevenhuizerplas
Hillegersberg Noord	Oude Westen	Zevenkamp
Hillegersberg Zuid	Overschie	Zuiderpark
Hillesluis	Pendrecht	Zuidplein
IJsseldijk	Prinsenland	Zuidwijk
Katendrecht		

APPENDIX G: MATCHING DIFFERENCES

	Best-offer-over			Regular		
	mean	sd	Obs.	mean	sd	Obs.
Matchcode (Finishing level)						
Match A (3)	2,280	.	1	2,317	.	1
Match B (4)	2,803	.	1	3,322	.	1
Match C (3)	2,741	.	1	2,686	.	1
Match D (2)	3,769	.	1	3,863	.	1
Match E (2)	1,888	.	1	1,983	.	1
Match F (1)	2,270	8,320	4	2,388	.	1
Match G (3)	3,349	2,996	2	3,201	.	1
Match H (3)	4,051	.	1	5,087	.	1
Match I (3)	2,252	8,838	2	1,850	.	1
Match J (3)	2,431	547	2	2,269	.	1
Match K (3)	2,675	106	2	2,568	.	1
Match L (2)	2,981	.	1	2,980	.	1
Match M (3)	3,176	3,002	3	3,191	.	1
Match N (3)	2,339	.	1	1,947	.	1
Match O (3)	2,978	1,612	2	3,039	.	1
Match P (1)	2,500	.	1	2,305	.	1
Match Q (1)	1.928	.	1	2,008	.	1
Match R (3)	3,878	2,965	3	3,510	.	1
Match S (3)	2,256	.	1	2,773	.	1
Match T (4)	3,661	.	1	3,345	.	1
Match U (2)	2,147	8,318	2	2,102	.	1
Match V (3)	2,647	.	1	2,386	.	1
Match W (3)	2,115	2,497	6	2,163	938	2
Match X (2)	3,493	.	1	3,972	.	1
Match Y (3)	3,209	.	1	3,132	.	1
Match Z (3)	3,449	2,183	4	3,575	.	1
Match AA (3)	1,936	5,954	2	1,944.	.	1
Match AB (2)	2,538	.	1	2,684	.	1
Match AC (1)	2,168	.	1	2,147	.	1
Match AD (2)	2,980	.	1	2,856	.	1
Match AE (3)	2,599	1,974	8	2,452	.	1
Match AF (4)	3,393	6,709	2	3,333	.	1
Match AG (2)	3,184	.	1	2,968	.	1
Match AH (2)	2,888	1,571	2	2,224	.	1
Match AI (3)	3,592	1,497	3	3,236	.	1
Match AJ (2)	4,936	.	1	4,469	.	1
Match AK (2)	2,462	2,121	3	2,960	.	1
Match AL (2)	2,288	.	1	2,950	.	1
Match AM (3)	2,965	855	2	3,285	.	1
Match AN (2)	2,317	.	1	2,328	2,256	2
Match AO (2)	2,492	.	1	2,554	.	1
Match AP (2)	2,037	.	1	2,225	.	1
Match AQ (3)	2,420	.	1	2,198	.	1
Match AR (2)	2,261	2,245	6	2,261	.	1
Match AS (3)	2,360	152	5	1,909	.	1
Match AT (3)	2,369	.	1	2,740	.	1
Match AU (1)	2,414	6,452	2	1,956	.	1
Match AV (2)	1,826	.	1	1,843	.	1
Match AW (1)	2,239	2,187	3	2,171	.	1

Match AX (3)	2,337	.	1	2,585	.	1
Match AY (3)	2,241	.	1	2,275	.	1
Match AZ (2)	1,937	.	1	1,977	.	1
Match BA (3)	2,104	3,389	3	2,270	.	1
Match BB (2)	2,152	.	1	1,775	.	1
Observations	2,652		104	2,662		56

Note: Means refers to the mean of the transaction price in euros. Level of finishing in parentheses with 1, 2, 3, 4 and 5 indicating basic, under average, average, above average and luxurious respectively. Regular method stands for all transactions that are not sold with the best-offer-over method. Square meter prices are in euros.