The fundamentals of the Amsterdam housing market

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Preface

“There are no real Amsterdammers left in Amsterdam,” is one of the many platitudes that is often used by regular customers of the pubs in Amsterdam that I like to visit. As a student Management in the Built Environment, I am aware that the house prices and rent levels are rapidly rising. However, the cliche kept repeating in my mind. Would the rising house prices also influence the incumbent residents of Amsterdam? Would they still be able to pay their taxes? From here, I started to develop my research, which has resulted in this thesis.

During the research, everyone seemed to be an expert on the topic and shared their opinions. Often, this was very helpful, since it forced me to explain my approach and methods and to take different perspectives on the topic. My colleagues at Cushman & Wakefield were very forthcoming about the ground lease situation in Amsterdam, and they provided me with an enjoyable working environment.

This thesis is the capstone of my time as a student in Delft, and the process a final endurance test. This accomplishment is made possible by the great help of many, of which I would like to thank some explicitly. Firstly, I would like to thank the NVM for the provision of their data. For the academic support, I would like to thank my mentors Harry Boumeester and Philip Koppels with their helpful insights, their kindness and their patience. For the mental support, I must thank Joy.

Jan Ruttenberg
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Management summary

Background

Because of the constant growth in Amsterdam house prices over the past years, the gap between Amsterdam and the Dutch national average has been increasing (CBS, 2018a). This gap is much discussed in media as well as academic literature. However, it is apparent that a part of the price development is not yet explained or explanations are not substantiated with models (Droës, Houben, & Van Lamoen, 2017, p. 543). In all literature however, housing prices are described as the result of macro-economic factors and dwelling characteristics. It is possible that there are macroeconomic developments that cause Amsterdam to be an exceptional location for dwellings. In addition, the dwellings themselves can have certain characteristics that cause the prices to rise. Mapping these factors is one of the main goals of this thesis. However, it is not all, because rising house prices have far-reaching consequences for current and future residents.

The position of residents will function as the motivational factor for this research, since the value of a house influences the levels of tax and rent, which makes a valuation based on non-economic reasons pervasive. Building on the assumption that housing is an essential need (Beer & Faulkner, 2011, p. 1), this research wants to investigate the foundation underneath the house prices in the capital, and see which part of the price can be economically or otherwise explained, or is the result of a bubble or a so-called hype. The relation between the price and the consequences in tax or other policies for residents is the main focus of this thesis and will become apparent throughout the thesis.

Graduation company and master track

This thesis is conduction within the master track Management in the Built Environment (MBE). The research is combined with an internship at Cushman & Wakefield, an internationally operating real estate advisor (Cushman & Wakefield, n.d.).

Research question

The main research question asked in this thesis is: how are the housing costs of incumbent residents of Amsterdam influenced by the fast-increasing house prices in Amsterdam?" The underlying question that takes up the biggest part of this thesis is what the economic foundations under the housing price increase are. For this, the main differences between Amsterdam and the rest of the country have to be explained.

Method

Time frame

Important for this question is the notion that housing prices in Amsterdam have been growing more substantially than in the rest of the country since the financial crisis of 2008 (CBS, 2018a). Before that, the growth was more or less similar. This gives reason for suspicion about the accumulation of the prices after the financial crisis and consequently, the fairness of corresponding taxes and rent policies. The value that is determined for the Valuation of Immobable Property Act (VIPA-value; Dutch: Wet waardering onroerende zaken (WOZ)-waarde) is an essential term within this research. However, the VIPA-value only came into existence in 1995. This means that 1995 is the starting point of the research. The availability of data doesn't allow this study to go beyond 2016. Concisely this means that the research covers the time period between 1995 and 2016.

Object of comparison
Because Amsterdam will be compared to the rest of the Netherlands, an object of comparison must be made tangible. Therefore, Nijmegen is chosen as the representation of the national average. This is because Nijmegen, together with Breda is closest to the Dutch average, but because Nijmegen houses a university, it makes the comparison to Amsterdam a bit more evident.

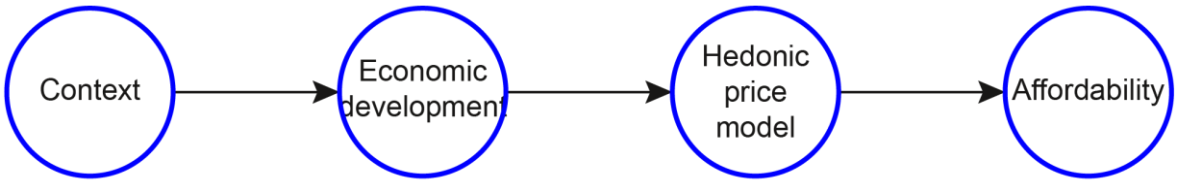
Three steps


Figure i: Flowchart of mapping and testing the formed hypothesis (own illustration)

As shown in Figure i, the method of this thesis basically consists out of three steps. The first two steps are based on the notion that house prices are influenced by macroeconomic factors and by dwelling characteristics. To find out the macroeconomic factors, which are named 'Economic development' in Figure 2-1, a literature study was conducted, of which the outcomes will be discussed in a later paragraph.
The second step is the microeconomic factors or the dwelling characteristics. The influence of these conditions will be presented by the use of a hedonic price model, therefore this step is called 'Hedonic price model'.
The third step is to find out what the relation between the transaction price, the VIPA-value and the appraised value is. This step is called 'Affordability', because it focuses on the relation between these three concepts to map the consequences for the affordability of the Amsterdam housing market for current residents.
When all steps are taken, it is possible to formulate an answer to the main question.

Hedonic price model
The use of the hedonic price model has pros and cons. First, it is a very reliable and repeatable method. However, much data is needed for it to be effective and reliable. In addition, the model is always a simplification of reality, since it can't encompass differences between buyers and sellers and the interplay between the two. Still the hedonic price model can be used for the purpose of this research.

Dataset
With the hedonic price model it is possible to take a closer look at the house prices in Amsterdam and Nijmegen. The dataset that was used, was provided by the NVM or National Association of Real estate brokers. It contained 172,804 transactions in Amsterdam, and Nijmegen, which after filtering out the unreliable data, was limited to 147.110 transactions, of which 121.849 were in Amsterdam.

Function
A hedonic price model is based on the assumption that prices are the result of quality characteristics that can be tangible or intangible (Monson, 2009, p. 64). This ranges from the number of rooms a dwelling has up to the proximity of schools or the architectural style of a building. The outcome of the model is the price Pi, which is the function of the characteristics and the appreciation of these characteristics (Baranzini et al., 2008).

$$P_i = \beta_0 + f(\beta * X_i) + \varepsilon_1$$

Where
P_i = dependent variable at location i
$\beta*X_i$ = parametric part of regression
f_i = smooth function
x_i = regressor
ε_1 = error term (Visser & Van Dam, 2006, p. 124)

However, this is not the whole function, because in the hedonic price model designed, time dummies will also be added in the form of $\beta_{Ti}*T_i$. This is because the time is significant in the development of prices. With the addition of time dummies, the function looks as follows (Baranzini et al., 2008):

$$P_i = \beta_0 + f(\beta*X_i) + \beta_{Ti}*T_i + \varepsilon_1$$

Factors

The factors that have been used in the model are the substrate of five different papers on hedonic price modelling. These factors can be subdivided into physical dwelling characteristics, physical environmental characteristics, social environmental characteristics and functional environmental characteristics. The first two might speak for itself, but the social aspects can for example be measured by the social status score, which is built up using income, education and employment rate. The functional characteristics refer to the different utilities that are accessible.

Five models

As explained, Amsterdam is the main focus of this thesis, but in order to have a clear picture, the city will be compared to Nijmegen. However, there are significant differences between Amsterdam and Nijmegen that cannot be ignored. To prevent distortion when it comes to the different build-up of the cities, the different boroughs of Amsterdam will be examined separately as well. Furthermore, the rising prices in the Amsterdam housing market have been most significant after the financial crisis. Therefore, January 1st of 2008 is demarcated as a turning point. To get a clearer picture of the difference between the period before the financial crisis and after, the model will also be divided into two time periods. This results in the making of five models, which is visualised in Figure ii.

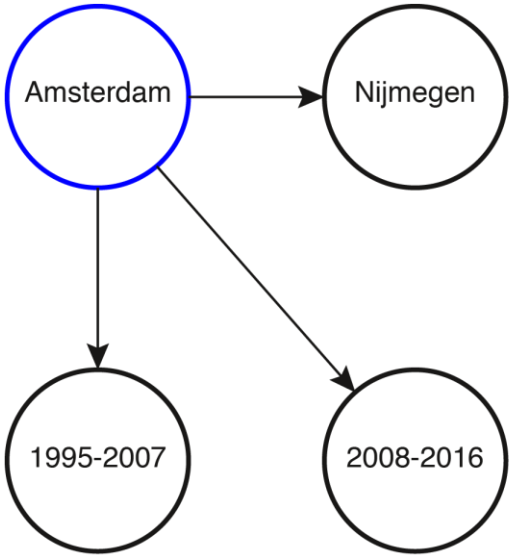


Figure ii: Build-up of model and application on different sub datasets (own illustration)

Steps
The model is divided into three steps: first, the dwelling characteristics are added. These characteristics are added in steps, so that it is possible to see which "proportion of the data can be explained by the steps of the model. The second step of the model is the addition of postal code areas. Here the distinction between the different city boroughs of Amsterdam can become apparent. Finally, the time dummies are added.

Results

Macroeconomic
For the macroeconomic factors that influence the Amsterdam housing market, compared to the national average represented by the city of Nijmegen, this research first gives an overview of the historical developments of both cities. What is apparent is that both cities are founded as medieval towns, but that this is better preserved in Amsterdam. Furthermore, Nijmegen has a very equally divided housing stock in terms of different dwelling types and tenure. In Amsterdam, this is less the case with many upstairs-apartments and big differences between different boroughs.

Main macroeconomic developments
- First of all, there is a high dem and for dwellings in Amsterdam with many young people moving to the city either for education of jobs. At the same time, less people move out of the city once they get children.
- Another important factor in Amsterdam is the presence of many international businesses that come to Amsterdam for the excellent infrastructure and the cultural character. These businesses bring expats and jobs to the city.
- The impact of Airbnb is also discussed. However, this is a little bit ambiguous. Although authors name Airbnb as a potential disruptive force to the Amsterdam housing market, its effect is not been quantified.
- A very important factor is the presence of real estate investors on an large and a smaller scale. Investors buy up the dwellings for the favourable yield which drives up the prices for house seekers.
- The factors that are mentioned up till now are mostly related with the demand. However, there is also a big reason on the supply-side of the market which makes the house prices go up. Over the last years, the amount of newly built dwellings was very low and even lower than policy prescribed.

Microeconomic
Out of five different hedonic price models the main dwelling characteristics are distilled. This can roughly be divided into physical dwelling characteristics, physical environmental characteristics, social environmental characteristics and functional environmental characteristics (Visser and Van dam, 2006; Lazrak et al., 2014; Bosker et al., 2016; Buitelaar et al., 2014; Vastmans, 2016 and Belfius Bank, 2007). These categories are further divided into characteristics such as the usable floor area or the presence of a parking place. Some of these features are very basic, while others give a more refined image of a dwelling. As said, the hedonic price model works in steps. In the different steps, more features of the dwelling are added in the following order:

Step 1	*Step 2*	*Step 3*	*Step 4*	*Step 5*
UFA	Dwelling type	Maintenance level	Heating system	Lift
Number of rooms		Garden orientation	Monument	Balcony
Building period			Ground lease	Roof terrace
			Sale construction	Parking

Table i: Sequence of entrance own hedonic price model (own illustration)

With this, the first 5 steps of the model are covered. However, in step 6 the postal code comes into the equation. In the final step, the time dummies are added.

Findings

First of all, it is important to note that the accuracy of the model is promising. For example, the R2, which shows the accuracy is 0.901 which is high (Visser and Van Dam (2006, p. 126). An important variable is the floor area and the number of rooms, which are of course closely related. The second most important influence comes from the location and the period of sales is third. The fitness of the general model of Amsterdam are summarized in Table ii, whereas Table iii displays the results of the.

Model summary	*Amsterdam*	*Nijmegen*	*Amsterdam < 2008*	*Amsterdam ≥ 2008*
N	119,734	24,914	56,215	63,519
R	0.948	0.938	0.950	0.947
R^2	0.900	0.880	0.903	0.898
Adjusted R^2	0.900	0.879	0.903	0.898
Std. error of the Estimate	0.178	0.161	0.176	0.169
Degrees of Freedom 1	87	87	51	35
Degrees of Freedom 2	119,542	24,771	56,061	63,381

Table ii: Model summaries of the four models (own illustration)

Variable	*Amsterdam*		*Nijmegen*		*Amsterdam < 2008*		*Amsterdam ≥ 2008*	
	Coeff.	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*
Constant	11.821	0.006	11.481	0.020	11.481	0.020	11.838	0.008
Primary features								
UFA (m^2)	0.007	0.000	0.005	0.000	0.006	0.000	0.007	0.000
Number of rooms	0.042	0.001	0.025	0.001	0.037	0.001	0.045	0.001
Building period								
1500-1905	0.032	0.002	0.036	0.007	0.028	0.003	0.035	0.002
1906-1930	-	-	0.058	0.005	-	-	-	-
1931-1944	-0.003**	0.002	0.094	0.005	-0.007*	0.003	-0.001**	0.003
1945-1960	-0.083	0.003	0.009*	0.004	-0.089	0.005	-0.074	0.004
1961-1970	-0.149	0.003	-	-	-0.151	0.004	-0.154	0.004
1971-1980	-0.100	0.004	-0.007**	0.005	-0.093	0.006	-0.113	0.005
1981-1990	-0.036	0.002	0.051	0.005	-0.017	0.004	-0.055	0.003
1991-2000	0.051	0.003	0.156	0.005	0.067	0.004	0.036	0.003
2001-	0.051	0.003	0.121	0.007	0.062	0.006	0.059	0.004
Dwelling type								
Single family	0.096	0.003	-	-	0.076	0.004	0.095	0.004
Mansion	-0.011	0.004	0.046**	0.005	0.008**	0.005	-0.068	0.006
Upstairs apartment	-	-	-0.174	0.006	-	-	-	-
Ground floor apt.	0.037	0.002	-0.101	0.006	0.019	0.003	0.048	0.003
Maisonette	0.017	0.003	-0.191	0.008	0.022	0.004	0.011	0.004
Porch apartment	-0.023	0.002	-0.151	0.005	-0.025	0.003	-0.009	0.003
Gallery flat	-0.050	0.003	-0.187	0.007	-0.049	0.003	-0.046	0.004
Other	0.086	0.004	0.057	0.005	0.055	0.005	0.103	0.005
Maintenance level inside								
Worse	-	-	-0.083	0.003	-	-	-	-
Better	0.098	0.002	-	-	0.089	0.003	0.101	0.003
Maintenance level outside								
Worse	-	-	-	-	-	-	-	-
Better	0.063	0.003	0.047	0.004	0.069	0.004	0.035	0.004
Garden orientation								
Good orientation	0.055	0.002	0.007**	0.004	0.058	0.003	0.071	0.003
Bad orientation	0.069	0.002	-0.001**	0.004	0.067	0.003	0.059	0.003
Heating								
Central heating	-	-	-	-	-	-	-	-
Gas/coal	-0.145	0.002	-0.085	0.005	-0.127	0.003	-0.131	0.004
Sun	0.113	0.031	0.146**	0.161	0.336	0.124	0.076*	0.030
Ground lease								
Ground lease	-0.015	0.002	-0.236	0.013	-0.011	0.002	-0.011	0.002
No ground lease	0.032	0.002	0.007*	0.003	0.016	0.002	0.016	0.002
Type of transaction								
K.k.	-	-	-0.078	0.016	-	-	-	-
V.o.n.	-0.011	0.003	-	-	0.111	0.007	-0.012	0.003
Secondary features								
Monument	0.065	0.003	0.053	0.018	0.079	0.005	0.055	0.004
Lift	0.070	0.002	0.072	0.005	0.058	0.003	0.064	0.002
Balcony	0.021	0.001	0.027	0.003	0.010	0.002	0.030	0.002
Roof terrace	0.088	0.002	0.041	0.004	0.062	0.003	0.094	0.002
Parking	0.102	0.002	0.135	0.003	0.121	0.003	0.075	0.003

Table iii: Unstandardized coefficients of the variables; *: p>0.01; **: p>0.05 (own illustration)

Different housing stock

An important difference between Nijmegen and Amsterdam is the different composition of the housing stock. Upstairs apartments make up almost half of the stock in Amsterdam and the same applies to single-family homes in Nijmegen. In addition: in Amsterdam, almost half of the dwellings were built before 1930. Where in Nijmegen the building periods are much more varied. At the same time, the difference within a borough are bigger in Nijmegen. This might be the reason that in Nijmegen the borough is a less important factor. However, it both cities dwellings from before the Second World War are widely appreciated. The same goes for building built after 1990. The period is between is much less valued.

Regional difference in criteria for buyers

When looking at the most common dwellings in both cities and the average size of a dwelling, it is apparent that buyers in Amsterdam have a different focus from buyers in Nijmegen. In Amsterdam the variance is mostly explained by the size and the location of a dwelling. In Nijmegen on the other hand, much more attention is given to other features of a dwelling such as the orientation of the garden or the presence of a parking place. This can be partly explained by the abundance of apartments in Amsterdam and the limited options that come with this, square meters become the most crucial factor.

In addition, in Nijmegen apartments of all sorts have a much more negative impact on the price than in Amsterdam. The price difference between single-family dwellings and apartments leads up to almost 20% in Nijmegen, wherein Amsterdam it is only 10%.

Effect of the postal codes

In Amsterdam, a big effect on the price comes from the postal code or location. In Figure iii the positive price effect is plotted on the map of Amsterdam. It becomes clear that areas within the ring are generally very positively valued, whereas the areas outside usually aren't.

Effect of the time

The effect of the time dummies on the model might be the most significant. What becomes apparent is that the price development of Amsterdam and Nijmegen is somewhat similar before the financial crisis. After 2008 however, a clear difference in price development between the two cities is visible. The Amsterdam market skyrockets while Nijmegen stays behind. This is visualised in figure 5-13. It turned out that the price development in Nijmegen is four quarters of a year behind on that in Amsterdam. A correlation was reached of 0.842 when the period dummies were lagged one year. Another effect of the time is that the location becomes more important. The price difference between the least appreciated neighbourhood and the best appreciated neighbourhood went from factor 2.32 to 2.62.

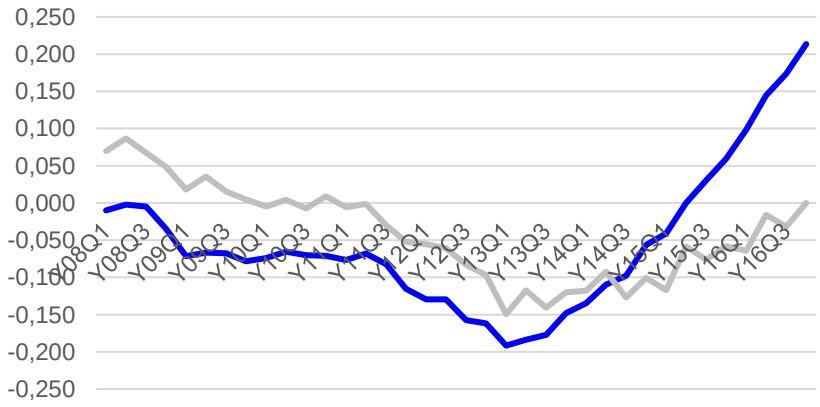


Figure iii: House price development of Nijmegen (grey) and Amsterdam (blue) since 2008 (own illustration, based on NVM dataset)

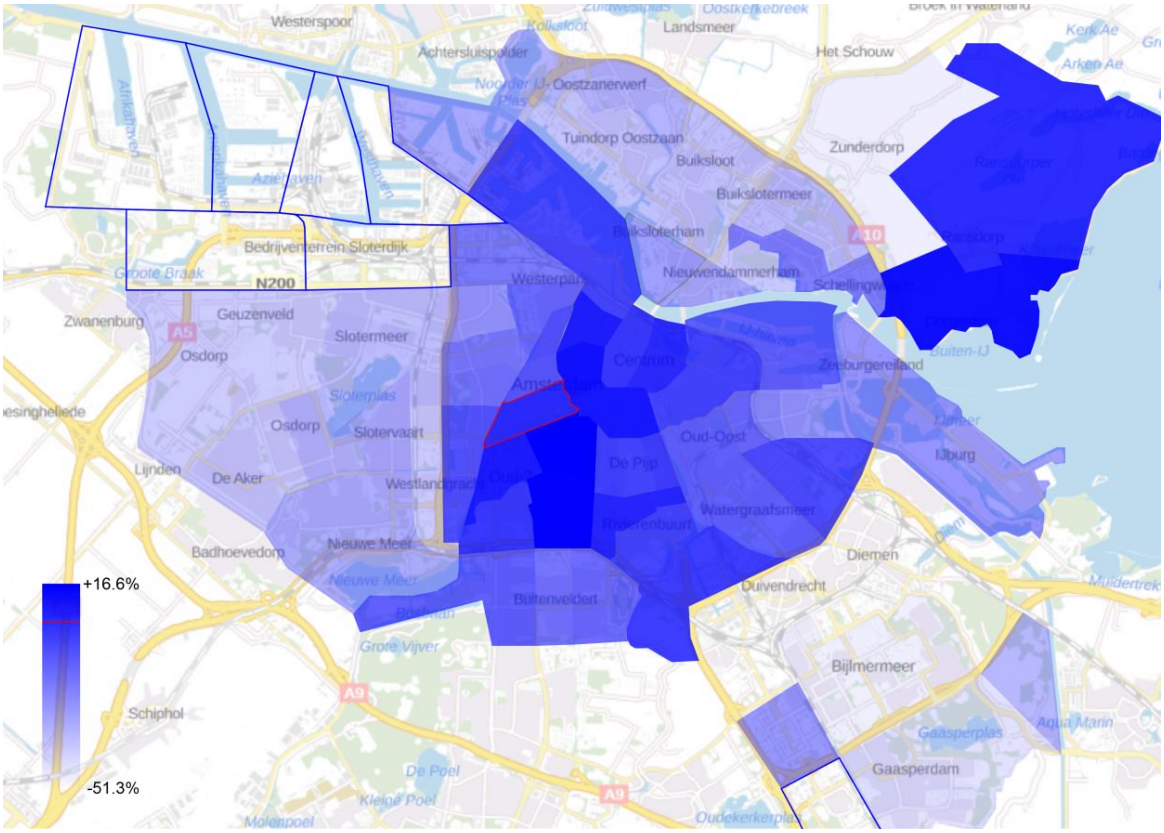


Figure iv: Coefficients of postal code dummies in Amsterdam (own illustration; background map from Google Maps (2018a))

Conclusion

The results show that the combination of a rather homogeneous housing stock, wherein pre-war apartments dominate, and the limited dwelling size in Amsterdam lead to different selection criteria than in Nijmegen, where the stock is more varied on an urban and neighbourhood level and the average dwelling size is almost twice as large as in Amsterdam. In Amsterdam, the primary features are more important than the secondary features, whereas in Nijmegen, the secondary features largely contribute to the explained variance.

Besides, the location proves to be very important for the dwelling price in Amsterdam. The western and southern parts of the canal district as well as parts of the borough Zuid are more than 2.5 times as expensive than most parts of Zuidoost. Besides Zuidoost, Nieuw-West and Noord are the boroughs that have a low price level. In Nijmegen, the price level is more evenly spread amongst the different parts of the city. The socio-economic differences between the neighbourhoods in Amsterdam presumably form an important reason for the price difference, although the socio-economic aspects are not explicitly covered in the hedonic price model. Moreover, the difference in price level shows a pattern that coincides on the popular opinion that the city stops existing outside the ring.

Finally, the results show that since 2013, the price development in Amsterdam has taken a flight when compared to Nijmegen, which is lagging a year. The house price development as shown in Figure iii occurred whilst the hedonic price model corrected for the dwelling and locational characteristics, meaning that the development is neither based on quality nor on the location of the dwelling.

Concluding, the location seems to be overly important in Amsterdam, and the price increase since 2013 is not the result of an increase in the dwelling quality, but rather of the aspects as found in the literature study, such as the growing popularity amongst students and young professionals and an increasing investment volume.

Relation between transaction price, appraised market value and VIPA-value

Concepts

The previous chapter discussed the build-up of the house prices. However, this research tries to find the consequences of the rising house prices on the affordability of housing. To review this, it is first important to see how the transaction price works in relation to the appraised market value and the VIPA-value.

The transaction price is the sum of money paid for an estate in an individual transaction (Ten Have, 1993, p. 5). If there would be a perfect market – which would mean all actors act rationally and with full knowledge about the housing market -, the transaction price would be similar as the market value. However, this is not the case, because both buyers and sellers are limited by their lack of knowledge and don't always act rationally (Ten Have, 1993, p. 5). The market value is "the estimated amount for which an asset (…) should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction (…)" (International Valuation Standards Council, 2017, p. 18).

The affordability can be defined as the reasonable percentage of an income's budget that is spend on housing. There are different guidelines for lenders and buyers and this also depends on the level of income (Warnaar & Bos, 2016, pp. 24-25).

Taxes

The VIPA law was introduced in 1995 for local (real estate) taxing purposes and describes how the Dutch council for Real Estate Assessment values real estate. This valuation, referred to as the VIPA-value, is then used for different purposes, among which are taxes and ground lease policies. The relation between the transaction price, market value and VIPA-value is visualised in Figure v.

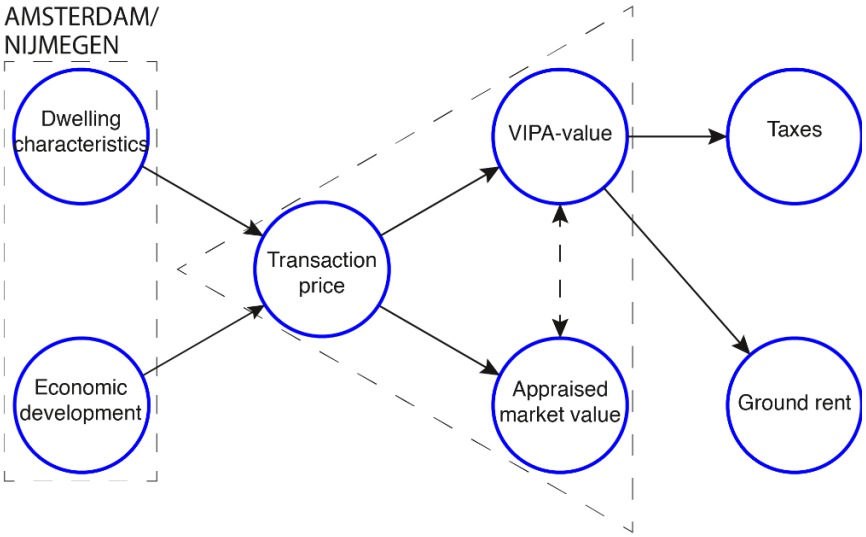


Figure v: Conceptual model (own illustration)

For taxing purposes, the VIPA-value is used for taxes such as municipal taxes, water system charges, governments taxes, maximum rent level and determination of ground rent. The taxing purposes differ per type of tenure. For owner-occupiers the price increase leads to an increased VIPA-value and thereby influences real estate taxes and ground lease contracts. The social housing renters are mostly affected by the House Value Rating System, which uses the VIPA-value as one of the criteria to determine the maximal reasonable rent with a point system. When the number of points exceeds the limit due to the increase in VIPA-value, it could become part of the private rental sector, where less regulations apply.

VIPA-values therefore have different consequences for different residents. In addition, it is important to note that the connection between the VIPA-value and the taxes is not always straightforward. The most important connections between VIPA-value and taxes are set out.

Property tax

An example of this is that the property tax (Dutch: OZB) is that it decreases when house prices increase, which means that the VIPA-value barely changes the property tax (Allers & Hoeben, 2011; Municipality of Amsterdam, 2016).

Ground lease

A whole different relation can be found between the VIPA-value and the ground lease (Dutch; erfpachtcanon). The determination of the ground lease consists of various steps, which are dependent on the VIPA-value and the so-called neighbourhood street quote (Municipality of Amsterdam, 2017). For the target groups the building periods are selected with a ground lease that will shortly expire.

Maximum rent

Social housing is given a maximum rent price which is determined by using the House Value Rating System. This is a point system which is party based on the VIPA-value. When a dwelling exceeds the maximum, it is possible that the housing corporation releases the dwelling into the free sector or sells the property.

Costs

In Figure vi, the steps that are taken to calculate the effects on affordability are visualised. The step from transaction price to the VIPA-value has already been explained. Now, the average difference between Amsterdam and the national average is calculated. This is done on the level of the seven different boroughs in Amsterdam. Then, the extra costs per dwelling are calculated. Finally, the total effect within the city is shown.

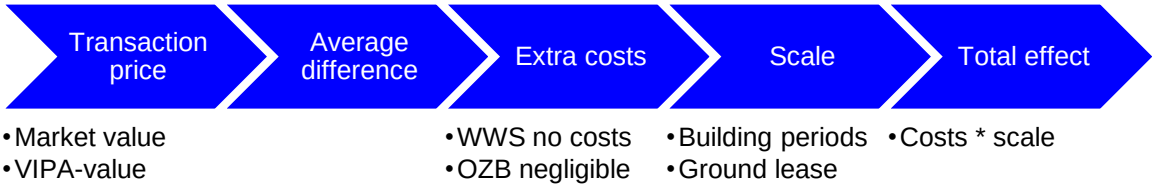


Figure vi: Road map towards the determination of the additional costs for incumbent residents (own illustration)

Ground rent

The prediction is that in 2018, the VIPA-values in the Amsterdam boroughs will have developed an average 37% surplus in comparison to the national average (OIS Amsterdam, 2016, 2017). From there, the average costs for buying of the ground rent per borough will be calculated. For this, an estimation of the BSQ, the ground rent percentage and the VIPA-value are made. The results are shown in table 6-6. However, three more filters must be applied to come to the actual increase of costs in ground lease. First, the tenure must be determined since only homeowners pay ground lease. Second, with the dataset of the NVM, the percentage of owner-occupied dwellings that are built on municipal ground are traced. Thirdly, the dwellings that will shortly have a ground lease revision are included. The total effects of this within the city are shown in Table iii. Here the additional costs per dwelling are multiplied with the number of dwellings that are within the target group. Besides, the total costs of a fictional buy-out are calculated, which is calculated by dividing the total costs per annum by the ground lease percentage (Dutch: canonpercentage), which is currently set at 2.39%.

Borough	*Additional costs (€)*	*No. dwellings*	*Total costs per annum (€)*	*Total costs buy-out (€)*
Amsterdam	191.88	6,032	1.157.392	48.426.453
Centrum	587.71	371	217.926	9.118.238
West	233.03	1,196	278.806	11.665.504
Nieuw-West	61.06	151	9.195	384.719
Zuid	460.86	957	441.146	18.458.007
Zuidoost	5.03	1,539	7.737	323.726
Oost	173.30	569	98.644	4.127.368
Noord	55.30	869	48.044	2.010.193

Table iii: Overview of the total costs per annum and the total additional costs for buy-outs (own illustration)

Maximum rent

The difference in VIPA-value also lead to additional points in the House Value Rate System. The number of extra points is easily calculated by dividing the difference in VIPA by 8,747, which is used as the standard amount for one point. The results are shown in table iv. The danger of the extra points is that the maximum rent is exceeded and the dwelling may no longer be used as social housing.

Borough	*VIPA-value 2016 (€)*	*Alternative VIPA 2016 (€)*	*Extra points*
Amsterdam	290,000	236,478	6
Centrum	410,000	316,322	10
West	281,000	216,000	7
Nieuw-West	208,000	185,289	2
Zuid	401,000	315,299	9
Zuidoost	152,000	146,389	-
Oost	304,000	239,545	7
Noord	210,000	179,147	3

Table iv: Additional points for social rented dwellings (own illustration)

Conclusions

Causes and consequences as described by existing literature

The research started out by mapping the causes of the increasing house prices in Amsterdam already apparent in existing literature. The presence of universities, a major airport and many international businesses are labelled as important factors. In addition, many people leave the city in a later phase of their adult lives. Furthermore, the low interest rate and lack of alternative investment possibilities make investments into the housing market attractive. Finally, the influence of Airbnb was discussed.
These are all factors that explain the higher demand in Amsterdam compared to the rest of the country. On the other hand, the supply in Amsterdam was severely limited due to increasing inaccessibility of the housing market and the lack of expansion plans.

However, it is important to note that the macroeconomic developments described have not entirely explained the house price development in Amsterdam within research. However, it is not unthinkable that the influence of investors and the increasing demands of tourists and young adults would lead up to the increase in prices. However, this foundation for the price increase could be an undesirable basis to form valuations on, especially for the residents.

Influence of micro economic factors

The hedonic price model has shown that the average dwellings in Amsterdam are smaller and more expensive than the national average. It seems that therefore the average buyer in Amsterdam has pays more attention to square meters and location, while the buyers in Nijmegen take the secondary characteristics more into account.
At the same time, the large difference between the boroughs cannot be explained by the factors in the model. This could form the basis of a sociological research into the characteristics of certain boroughs.

Finally, the time development was of great importance to the model, because it showed that Amsterdam was one year ahead of the national average and showed a rapid increase that Nijmegen had not yet shown. The large influence of the time development means that the price development is neither based on the location nor the dwelling characteristics.

Transaction price, market value and VIPA-value

Because the VIPA-value is leading for the determination of taxes, the maximal reasonable rent and the in Amsterdam frequently occurring ground rent, the translation from house prices to the concepts of market value and VIPA-value is made.

An important reason for the three concepts interact is that the valuation of a dwelling is largely based on comparable transaction of a similar dwelling. Therefore, the transaction price strongly influences the market value and VIPA-value. A correlation of 0.982 was found, with n = 45 and p = 0.000. Hence, the found house price development that were found can be used to determine the (future) development of the VIPA-value.

Affordability of incumbent residents

To date, it seems that the price increase did not affect the affordability for incumbent resident as such. When it comes to the ground lease, the rising price do not influence the affordability (yet) because the VIPA-value for 2014 or 2015 is used. However, if we would look ahead at the next years, it is possible that these years will no longer be used, leading to an increase that lead up to 10% or 20% per annum. Hence, the affordability will most likely be worsened due to the increased ground rent. The current opportunity to switch to eternal ground rent with beneficial conditions can best be exercised as soon as possible to prevent the expiration of the current conditions and get around a future increase of the VIPA-value and its additional costs.

Limitations

Naturally, there are limitations to this research due to scope, time and means. However, there are also specific limitations that have to be mentioned.
The data that is used, which was collected by the NVM, needs several remarks. Although the data is exhaustive, it is used by several other hedonic price studies is well. Therefore, it is not compared to perhaps contradicting data from other sources. Moreover, the input shows a bias on subjective topics.

Furthermore, the time and location of the data is limited. The data focusses on Amsterdam and Nijmegen which might have other particularities than described which cannot be generalized. Furthermore, the data doesn't contain the most recent years, which can make a model of the housing market look substantially different.In addition, the NVM covers approximately 70% of the Dutch transactions, but private transactions or transactions without an affiliated broker are missing.

Other limitations can be found in the literature and the methodology. Although there is much literature available on the workings of the housing market and Amsterdam in particular, it is mostly not substantiated by quantitative research. A similar fault can be found in the

methodology. Many of the macroeconomic factors described could not be fitted within the hedonic model, which is why these two were separated. However, this makes the connection between the macro and the micro unclear and mostly built on assumptions.

Recommendations

Future research

For future research it could be fruitful to include the effects of large or small investors who own properties for buy-to-let constructions. Although this is already generally described in literature, the pricing techniques, portfolio forming and level of engagement with their assets remain unclear, which can greatly influence the housing market.

In relation to this, the influence of the social housing stock is also left out of this thesis, but could potentially have a great effect on the housing market. The more so, because more than half of the dwellings in Amsterdam are not on the market, but are artificially rented out for less than €711,- per month.

Policy recommendations

As described, the consequences of the VIPA-value which for a large part are based on the transaction price are of great consequence to incumbent residents. Mostly so, because the market in Amsterdam is rising fast and might even be influenced by factors that aren't economically founded. Therefore, there two policy changes are recommended. Firstly, the determination of the taxes and the ground lease could be executed on a similar way as the maximum rent: through the House Value Rating System, wherein the value of the dwelling is only considered as part of the rating. Secondly, the national and local government should focus on achieving the targets with regard to the building volume.

Contents

Index of figures and tables

Figures

Tables

1 Introduction

This introductory chapter explains the background and context of the conducted research, which aroused my interest in the subject. Subsequently, the theoretical and societal relevance is set out, which leads to the main question. Besides, information about the graduation company is given, as well as a reader's guide to apprehend the structure of this thesis.

1.1 Background and context

Figure 1-1: Collage of headlines (AT5, 2017; Couzy & Van Dun, 2017; RTL Z, 2017; Van der Laan, 2017)

The media have been extensively reporting about the Amsterdam housing market for the last years, discussing the constant period of growth from the first quarter of 2015, and a staggering 12.9% annual increase since the first quarter of 2013. Only last quarter the house prices in Amsterdam showed a decline (Rooijers, 2017). A quick comparison of house prices with the Dutch average tells us that, although Amsterdam has had a premium, the gap has been increasing since 2012 from 20.1% or €42,955 to 54.8% or €144,375 (CBS, 2018a). Figure 1-2 displays the detachment of the Amsterdam house prices in comparison to the national average, which has increased from 2013 onwards.

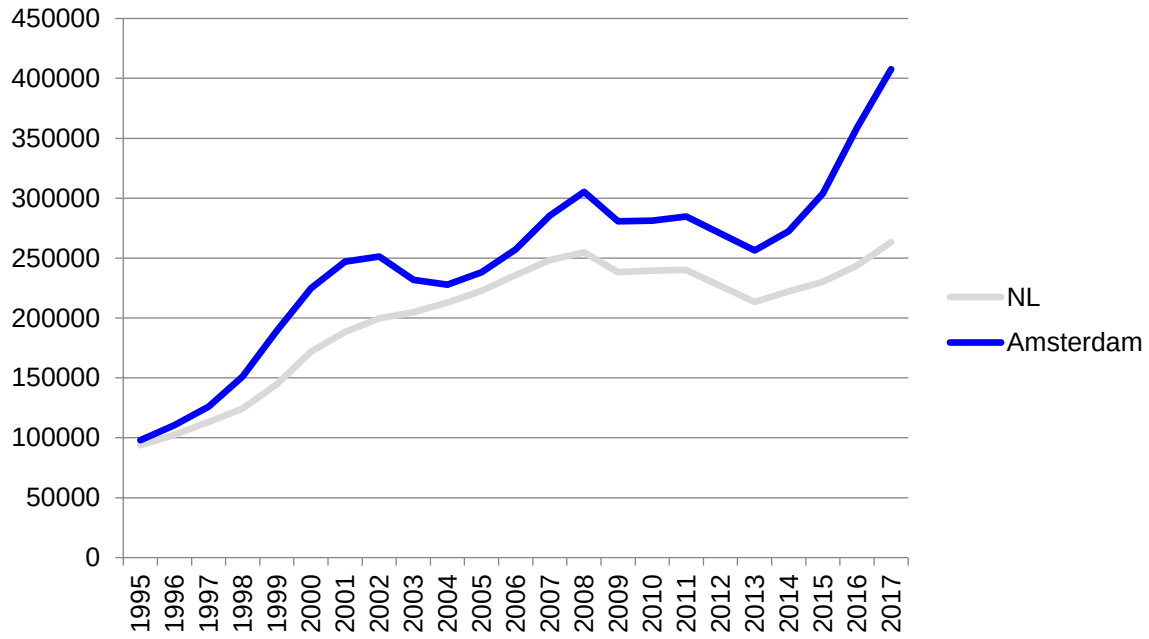


Figure 1-2: Annual average prices 1995-2017 (CBS, 2018a)

What is interesting is that the gap between Amsterdam and the rest of the Netherlands has not been fully economically explained, which is made visible in figure 1-3. Although the gap is widely recognized, the gap between ‘standard macroeconomic factors’ and the actual prices are not yet quantified by models (Droës, Houben, & Van Lamoen, 2017, p. 543) In addition, there are plenty models designed in existing literature, but they mostly do not cover local housing markets and date from before the financial crisis, even though much of the increase in Amsterdam has taken place after the recovery from the crisis. Furthermore, the (partial) economical explanation of the current trends is something that arouses the interest of many researchers.
Amsterdam would make an interesting case study to test the existing literature on and see if it can be amplified.

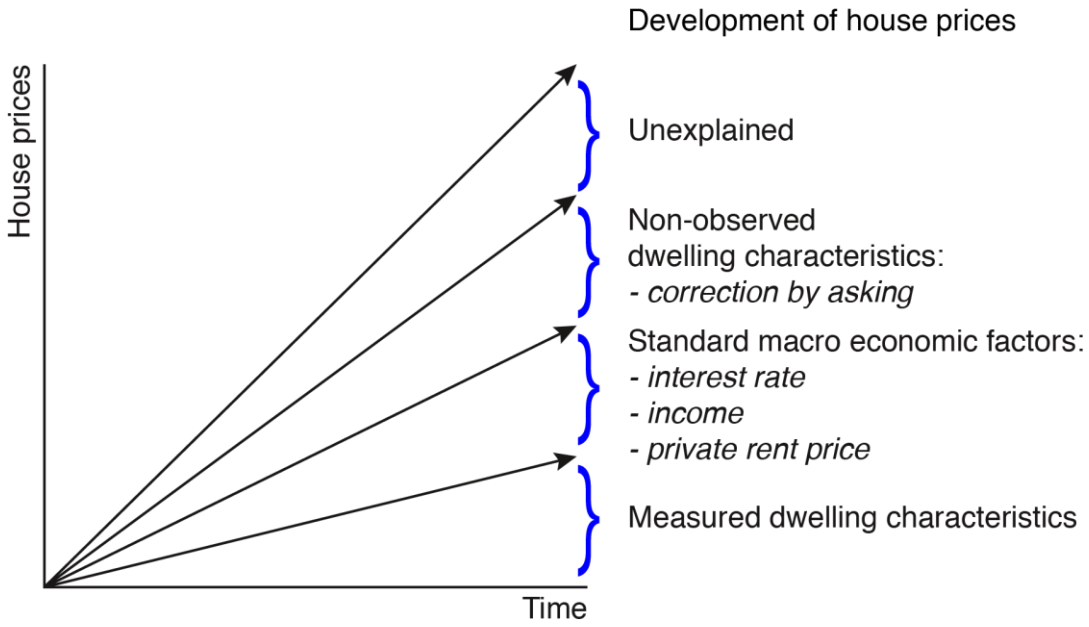


Figure 1-3: ‘The dissection of house price increases’ (Droës et al., 2017, p. 541)

1.2 Societal relevance

That the gap between Amsterdam and the national average is not yet fully explained, leaves an opportunity for this thesis to try and elaborate on this. However, next to the theoretical significance, the rising prices have also become of interest in terms of their consequences for society. Social researchers have written a lot about the consequences of affordability of housing. The question rises what the whether or not justified increase of house prices means in a societal context.

‘Housing remains one of the fundamental pillars of both life and lifestyle for us as individuals’ (Beer & Faulkner, 2011, p. 1). Since ‘housing is an essential need’ (Beer & Faulkner, 2011, p. 2) and the house prices are increasing excessively and the affordability is endangered, it is important to investigate the economic foundation beneath and the tenability of the current situation. The three institutions that keep track of the housing market in a triennially report, namely the Amsterdam Real Estate Brokers Association, Municipality of Amsterdam, and Amsterdam Federation of Housing Associations (2016, p. 5) note a unique situation, wherein the interest rate is

historically low, the lead time (Dutch: doorlooptijd) is less than a month and house seekers (Dutch: woningzoekenden) are driving up the prices in their despair. This could form a bubble in the house prices (Himmelberg, Mayer, & Sinai, 2005), although this is not yet detected by the De Nederlandsche Bank, the Dutch National Bank (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017).

But apart from the difficulties in the search of an affordable and suitable dwelling, which is unequivocal, the situation of incumbent residents could also be worrisome due to the potential increase of housing costs in the form of taxes and ground lease that are the result of a higher PIVA-value (Dutch: WOZ-waarde). This liability could have an extra dimension when the house prices turn out to develop without a profound economical basis. The latter issue is the central concern in this research.

Summarizing, the house prices on the Amsterdam housing market have a substantial influence in both societal and theoretical sense. Therefore, the main subject of this thesis is the Amsterdam housing market. This falls within the graduation track of 'housing market analysis'. The topic of this graduation track falls within the master of Management in the Built Environment (MBE) (Koutamanis & Veenhof, 2017).

1.3 Main research question

As explained, this thesis will look at the foundation under the rising house prices in Amsterdam. Although interesting in its own right, this is not the main focus of the research. This lies on the consequences of this rise for the current residents. Therefore, the research question of this thesis is: "how are the housing costs of incumbent residents of Amsterdam influenced by the fast-increasing house prices in Amsterdam?" In the reader's guide below the steps for answering this question will be further explained.

1.4 Graduation company

During the graduation course, research is combined with an internship at internationally operating real estate advisor Cushman & Wakefield. The company has 45,000 employees globally and belongs to the 'largest commercial real estate service firms' (Cushman & Wakefield, n.d.). Valuations & advisory is the service division in which the internship took place. Besides the graduation research, activities contain the valuation of a large variety of properties, amongst which are dwellings.

A large benefit of the internship is the presence of colleagues who are involved in the Dutch and Amsterdam housing market daily and have extensive practical experience with the valuation and price formation of dwellings. This was a fruitful complementation besides the academic knowledge of the mentor team from the TU Delft.

1.5 Dissemination and audiences

For the company where the research will be conducted, it is favourable that the research is helpful for their activities. Two scenarios could be beneficial to the organisation: potential improvements of their model are pointed out or their current model will be confirmed as a fair and honest representation of reality.

Besides, the findings of the final part of this thesis, wherein the additional housing costs in terms of taxing and ground rent are demonstrated could form an interesting point of discussion for the national and local policy makers.

Depending on the outcome of the research, it could be an opportunity to adjust Cushman & Wakefield's VIPA-value model for the expected objectively unfunded madness on the Amsterdam housing market.

Lastly, the NVM, which kindly granted the data request to conduct this research, will be provided with a concise summary of the findings of this study as part of made agreement. This information will possibly be shared with their members to improve the quality of their work, either as real estate brokers or appraisers.

1.6 Structure of the report

To provide an insight in the build-up of this thesis, this paragraph will concisely describe the content of the seven upcoming chapters, and explain the connection between the chapters.

The second chapter contains the method of this study. Here the build-up of the thesis will be further explained and the sub questions are formulated. Furthermore, the method to answer the sub questions are discussed. The focus lies mostly on the hedonic price model which forms a crucial part in answering the second question about microeconomic factors.

The third chapter presents the theoretical framework of the study. What is most important here is to come to the different factors that are generally important on a macro and a micro economic level. This works on a general level, but will be further set out in the answering of the three sub questions in the following chapters.

The fourth chapter contains the answer to the first sub question, which concerns the macroeconomic factors that influence the Amsterdam housing market. First, the historical and socio-economic background of Amsterdam and the chosen reference city will be set out. The objective herein is to discover which fundamentals can explain the growth spurt of the house prices in Amsterdam since the financial crisis in 2007/2008

The fifth chapter contains the hedonic price model, which is used to answer sub question 3. The chapter begins with an introduction of the used dataset and the applied filter. Subsequently, a hedonic price model is made based on the cases that are in Amsterdam. This model is then tested on the cases in the reference city. Finally, the cases in Amsterdam are divided to compare the housing market before and after the financial crisis

The sixth chapter makes the transition between the price, the market value and the PIVA-value to discover whether the incumbent residents of Amsterdam are charged with additional housing costs due to the (disproportionate) increase in house prices.

Finally, the seventh and final chapter briefly summarised the findings of the previous chapters and answers the research (sub)questions. The chapter includes a discussion about the conducted research and recommendations for future research.

2 Research method

2.1 Research goal

The overall research goal of this report is to gain insight in the Amsterdam housing market and discover whether there is an economically unfounded trend that leads to overprizing or there is an actual economic or qualitative foundation of the years long price increase, and provide this to the main (expected) contributors: Cushman & Wakefield, TU Delft and NVM, as well as the Municipality of Amsterdam, since their housing market is the main research area. For Cushman & Wakefield and the NVM, the outcome could have consequences for their valuing method. For the Municipality of Amsterdam, it could lead to a confirmation or review of their tax policy, since it would be unfair to residents to let their taxes depend on economically irrational/irresponsible behaviour

2.2 Methodological outline

To be able to answer this main question, other steps must be taken first. First of all, the foundation beneath the Amsterdam housing prices has to be researched. As said in the introduction, macroeconomic developments are essential in this. That is why, the first sub question formulated will be: “are there economic (e.g. income, capital, income spent on housing) factors that can explain the wedge between the Amsterdam housing market and the Dutch average?” This question will be answered by first providing a general overview of the different ways a housing market can function in relation to macroeconomics. Therefore, in Chapter 4 the first sub question will be answered by further scrutinizing the existing literature on this topic. Here the focus lies on specific factors that are seen as (part of) the cause of the extreme rise of house prices in Amsterdam since the financial crisis.

However, macroeconomic factors are not solely responsible for the build-up of house prices; the dwelling itself and the environmental characteristics have a significant influence on the price as well. Therefore, the second step is to zoom in on microeconomic factors at play in the Amsterdam housing market. This concerns factors such as the size of the dwelling, its building period and the proximity to different facilities. The third sub question asked is “can the dwelling characteristics (number of rooms, floor area, age, garden, housing type etc.) explain the difference between the Amsterdam market and the Dutch average?” However, in the case of the current Amsterdam housing market, the microeconomic factors are not yet fully demonstrated. That is why, in this thesis, there is opted for the design of a hedonic price model. Since this method requires further explanation, the hedonic price model will be further explained in the following paragraph. Finally, the hedonic price model and its conclusions will be presented in Chapter 5 as an answer to the third sub question.

To conclude with, when the economic foundation – or lack thereof – underneath the Amsterdam housing market is researched, there is still a question left. Since this research wants to look at the consequences of the rising prices for current residents, a link must be made between the transaction price and the value that is used for taxing purposes. That is why, the fourth sub question is as follows: “how do transaction price, market value and VIPA-value interact with each other?” Here, the literature will be consulted once more, but this is also linked to the data from the CBS (Central Bureau of Statistics) and the NVM (National society of real estate brokers).

Chapter 6 will provide an analysis of this. The steps as previously described are visualised in Figure 2-1.

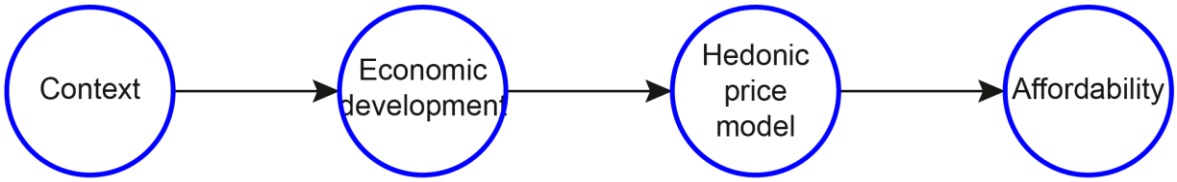


Figure 2-1: Flowchart of mapping and testing the formed hypothesis (own illustration)

2.3 Microeconomic factors and the hedonic price model

This paragraph will introduce the most important method that will be used in this thesis and which describes the micro economic factors that determine the house prices. Firstly, the working of the model is explained. Subsequently, the conditions that should be met are set out and the advantages and disadvantages of the hedonic price model are weighed.

2.3.1 Basics of the hedonic price model

"Hedonic prices are defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them" (Rosen, 1974, p. 34). "It can be described as the "functional relationship between the price and its quality characteristics" (Baranzini, Ramirez, Schaerer, & Thalmann, 2008, p. 1; Whalley, 1985, p. 276). The Hedonic Price Model (short: HPM) uses tangible and intangible building characteristics and other influencing factors to determine the real estate value (Monson, 2009, p. 64). The heterogeneity of property values is used to determine the influence of each characteristic (Yoo, Im, & Wagner, 2012, p. 293). The concept of a hedonic price model can be described as follows:

$$P_{house} = \sum characteristics*unit\ price$$ **Equation 2-1**

Wherein the price of a dwelling, P_{house}, is the function of the characteristics and the appreciation of this characteristics, which is described as 'the concept of unit price' by Baranzini et al. (2008, p. 2). When Equation 2-1 is formalised, the basic form of a hedonic price model has the same build-up as the before mentioned equation but with an added intercept and an error term (Baranzini et al., 2008, p. 103). It goes as follows:

$$P_i = \beta_0 + f(\beta * X_i) + \varepsilon_1$$ **Equation 2-2**

Where
P_i = dependent variable at location i
$\beta * X_i$ = parametric part of regression
f_i = smooth function
x_i = regressor
ε_1 = error term (Visser & Van Dam, 2006, p. 124)

The research period is 21 years, which makes it necessary to take the price development as previously described into account. This can be done in two ways: by the repeat sale method or by including time dummies. Since the average length of residence (Dutch: woonduur) is fifteen years (De Vries, 2014), the possibility of using a repeat sale method like Droës and Van de Minne (2015) is minimized. For this research, the sample would be too small. Therefore, the time dummies remain the most practical solution. These dummies indicate the general price development during the research period (Baranzini et al., 2008, p. 2). This will provide the opportunity to distil the price development and will be used in Chapter 5 to determine the wedge between the Dutch average and Amsterdam and its neighbourhoods. When applied on a longer period, this would improve the accuracy. Therefore, time dummies are added to the hedonic function. With the addition of the time dummies in the form of $\beta_{Ti}*T_i$, the function looks as follows:

$$P_i = \beta_0 + f(\beta*X_i) + \beta_{Ti}*T_i + \varepsilon_1$$ **Equation 2-3**

2.3.2 Conditions

According to Visser and Van Dam (2006, pp. 124-125), a multiple regression model must comply to 'four important conditions'. The first condition is that the variables need to be measured on an interval or ratio scale. Besides, one can use dichotomous (binary) independent variables. These binary variables provide the possibility to also use both nominal and ordinal variables. To do so, the nominal and ordinal variables need to be transformed into dummy variables; one dummy for each nominal or ordinal value.

Secondly, only variables without a strong correlation can be used, since it is impossible to verify the individual contribution of the independent variables to the dependent variable. To prevent this, the output of the model will be checked for the variance inflation factor (VIF), which indicates the correlation between one explaining variable and others (Visser & Van Dam, 2006, pp. 124-125). About the VIF, Field (2009, p. 224) explains that although there are no standard rules, as a rule of thumb variables with a VIF higher than 10 should be excluded. Herein, it is important to identify which variable is least explanatory and/or are categorised as a subjective variable. This theory is applied in Chapter 5.

The third stipulation concerns the normal distribution of the dependent. In the case of the dependent variable, the normality is improved by using the natural logarithm of the transaction price. The natural log corrects for the positive skewness of the transaction price (Field, 2009, p. 155), which shouldn't be larger than 1,96 (Field, 2009, p. 140). Moreover, the transformation to a natural logarithm makes it possible to interpret the results as percentage, although this approximation loses its accuracy when the rate of changes becomes larger than 10% (Nymoen, 2013). Therefore, the final function that will be used is the following (Baranzini et al., 2008):

$$\ln P_i = \beta_0 + f(\beta*X_i) + \beta_{Ti}*T_i + \varepsilon_1$$ **Equation 2-4**

A disadvantage of the transformation into a natural logarithm is the difficult interpretation of the effects (Visser & Van Dam, 2006, p. 123). To prevent this difficulty for other variables, the choice is made to let the other variables, although sometimes skewed, remain in their current form. The final condition that needs to be

met is that the residuals are normally distributed (Visser & Van Dam, 2006, pp. 124-125).

2.3.3 Advantages and disadvantages

The creation of a hedonic price model has its pros and cons. The reliability and repeatability of the method is an advantage. However, a disadvantage of the hedonic price method is the extensive amount of data that needs to be available and accessible (Visser & Van Dam, 2006, pp. 25-26). In the next paragraph, the collection method is discussed further.

Another problem with the hedonic pricing is that it assumes a basic situation in which the commodity is what it is on the one hand and the purchaser is what he is on the other (Bowden, 1992, p. 625). However, as Bowden points out in his research, there is a problem in this. Namely, goods and consumers influence each other and prices therefore are always dependent on two indexes of factors and not one (Bowden, 1992, pp. 632-633).

S. Jansen et al. (2016) name another disadvantage: the model can only take the used characteristics into account. This means that the used dwelling and environmental characteristics determine the quality and robustness of the model. Variables and categories that are not used as input could lead to a less accurate model. To prevent this loss of explained variance, the regression factors are derived from existing literature, which can be found in Paragraph 3.3.5. The input characteristics are also listed in this paragraph.

Another problem that arises has a relation with the market imperfection: most buyers on the housing market have a limited budget, which withholds them from choosing the optimal house. Moreover, these ‘budget constraints’ have a non-linear form, which obligates a careful handling of ‘income effects’ (Rosen, 1974, p. 54).

2.3.4 Dataset

The used dataset that was provided by the NVM initially contained all transactions in the period 1995-2016 in the municipalities of Amsterdam and Nijmegen. The initial dataset contained 172.804 transactions and 61 variables, varying from the monumental status to the maintenance level and was sent in a format that is suitable for IBM SPSS. With this software package for statistical analysis, the data was processed and the model was created. All prices before the introduction of the euro are converted by the original exchange rate of approximately 2,20 (De Nederlandsche Bank, n.d.). The full list of the provided variables can be found in Appendix C, where a short description of the variable is given, as well as the filter that is applied to filter the data.

2.3.5 Application of the model

2.3.5.1 Comparison Nijmegen

Because Amsterdam is compared to the Dutch national average, this average somehow should be fitted into the model. Therefore, Amsterdam is compared, not to the whole of the Netherlands, but to a specific city that is closest to the average. This way, the data could be used of that particular city to make a comparison to Amsterdam. After a comparison among 22 Dutch cities, based on the quarterly updated transaction data from the NVM, Breda and Nijmegen showed the most

similarities between themselves and the Dutch average in the last quarter of 2017 in terms of housing stock, average transaction price and shortage indicator, a concept that will be explained in Paragraph 4.4.4. Although Breda scores marginally better concerning the sales time in days, the transaction price and the transaction price per square meter, the distribution of the number of transactions per dwelling type is in favour of Nijmegen. Moreover, Nijmegen houses a university and Breda does not, which makes the comparison with Amsterdam somewhat easier. The detailed results of the comparison between the 22 cities can be found in Appendix B.

2.3.5.2 Subgroups in Amsterdam

Since Amsterdam is the main subject of this thesis, the initial and main hedonic price model is based solely on the cases that are located in Amsterdam. By isolating the transactions, distortion of the cases in Amsterdam and Nijmegen is prevented. This distortion is a result of the different compositions of the housing stock, building periods and the different appraisal of these characteristics by the inhabitants of both cities and people in general (Blije, Van Hulle, Poulus, Van Til, & Gopal, 2009) Subsequently, the developed model is applied on the cases in Nijmegen. The model specifications and the coefficients that derive from this exercise will be compared with the specifications from the general Amsterdam model. This could reveal differences in housing preferences between inhabitants of both cities.

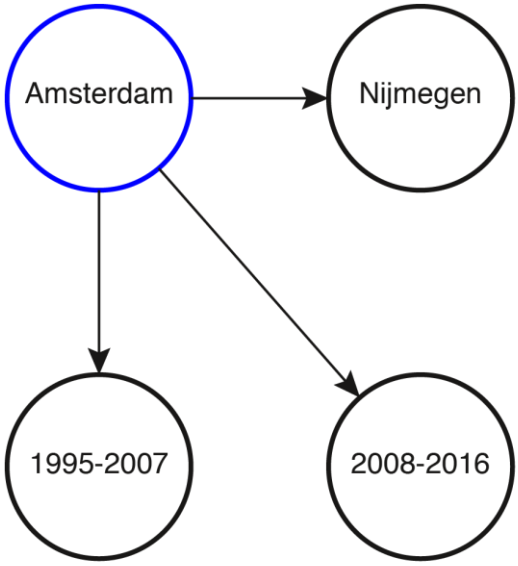


Figure 2-2: Application on different sub datasets (own illustration)

Next to the comparison with Nijmegen, the cases in Amsterdam will be divided in two sales periods: before and after the financial crisis. This division is derived from the moment of growing apart of the average housing price in the Netherlands in general and that of Amsterdam in particular. In the introduction, the growing wedge is already detected. The date that is set to demarcate this turning point is January 1st of 2008. For the final chapter, the model is used to distil the price development of the different boroughs and use that as input for the calculations on the extra costs. The expectation is that the period after the crisis shows

In Chapter 5, a hedonic price model will be designed and tested on different subgroups of the dataset. In Paragraph 3.3, the scientific basis will be laid: five hedonic price studies will be analysed: the variables that are used in these models will be categorised and reviewed and the sequence in which the variables will be entered in the model will be determined. With this model, the second sub question will be answered.

2.4 Summarizing

In short, the research is divided into three sub questions which require their own methods of answering. The sub questions are:

- Which causes and consequences of fast-rising house prices are already described by the existing scientific literature?
- Are there economic (e.g. income, capital, income spent on housing) factors that can explain the wedge between the Amsterdam housing market and the Dutch average?
- Can the dwelling characteristics (number of rooms, floor area, age, garden, housing type etc.) explain the difference between the Amsterdam market and the Dutch average?
- How do transaction price, market value and VIPA-value interact with each other?

In Chapter 3, the theoretical framework of these three questions will be further set out. Then, in Chapter 4, the first and second sub questions will be answered by the use of the existing literature and models concerning the Amsterdam housing market. Chapter 5 tries to answer sub question 3, using a hedonic price model. Here, the variables used in other hedonic price models are taken as a starting point. This chapter results in five models which not only show Amsterdam compared to the national average, but also the influence of location and time. Finally in Chapter 6, the fourth sub question is answered which makes the link between the transaction price – that is scrutinized in Chapters 4 and 5 – and the VIPA-value which is used for all sorts of taxes and policies. This is a combination of theory and calculations for which the CBS-data and the NVM-data will be used.

3 Theoretical framework

As mentioned in the introduction, this study attempts to discover the consequences of the fast-increasing housing prices in Amsterdam on incumbent residents of the city. Firstly however, this chapter wants to explain some of the concepts that are related to the housing market. Then, an overview will be provided of five studies on house price models that describe the development of the house prices on a macro and/or meso economic level. Subsequently, a similar overview will be presented on previously conducted hedonic price studies that focus on the microeconomic factors. In both instances, key concepts will be explained. Finally, the relation between the transaction price, appraised market value and VIPA-value will be defined.

3.1.1 Housing market

One of the key terms in this thesis is 'housing market'. Therefore, it is important to know the differences between a perfect market and the actual real estate/housing market. First, the three conditions for a perfect market are briefly described, followed by a more extensive explanation of why these conditions do not apply for the real estate market.

A market is perfect when the following three conditions are met:

- There are many buyers and sellers who can negotiate freely
- The traded goods are uniform (Manganelli, 2015, p. 8)
- Every actor 'has full knowledge of the characteristics of the asset' (Manganelli, 2015, p. 8)
- The actors and resources are 'mobile'. Hence, the market is easy to enter and leave, without high costs, needed licences or patents (McEachern, 2006, p. 166)

When these conditions are met, the price isn't determined by buyers or sellers, but by demand and supply (McEachern, 2006, p. 166).

The foremost reason that the real estate market is not perfect is the heterogeneity of the product: the size, location, age, usage etc. differ per object. A second reason for the imperfection is the 'lack of transparency' of the market forces that are of influence (Manganelli, 2015, p. 9), although digitalisation and digitisation have made information easier accessible for every actor. Beer and Faulkner (2011, p. 3) add that 'the housing market is a matter of requirement and not choice', which complicates the perfect market, since this limits the free negotiations and the mobility of actors.

3.2 Macro and meso economic factors

3.2.1 Introduction

We have established the housing market as an imperfect market. However, this is not the only reason prices can deviate. Different economic factors influence the market in different ways. These factors are usually divided into macro/meso and micro. This paragraph will look at the housing market on a macro and meso level. This paragraph will review house price models, whereby the used variables are explained and collected in a summary table. Besides, the variables will be analysed on an appropriate scale level: sometimes variables are only covered on a national level, whereas other variables have available data on municipal or even borough level. The data is sorted in different categories, which are as follows:

3.2.1.1 Income related
Income related factors concern the welfare of market players. This is based on the notion that an increase in welfare, increases the demand in houses. This is usually based on the GDP in a country, although there are several limitations to this. Therefore, some authors prefer to look at wage income as an indicator of welfare. The income related factors within the Netherlands and Amsterdam will be further researched in Paragraph 4.4.

3.2.1.2 Costs related
Cost related factors refer to loan capacity and fiscal treatment surrounding mortgages. This is becoming more important in recent years because the financial crises has put more emphasis on the loan policies of banks and governments. Therefore, this will be further explained in Paragraph 4.4.3.

3.2.1.3 Supply
The supply relates mostly to the building volume. Especially since the Netherlands is known for its planned spatial development. In Paragraph 4.4.2 a light is thrown on the history of spatial development policies and recent developments within this field. Furthermore, the unemployment rate in relation to the supply is discussed.

3.2.1.4 Others
Other factors that are brought in in the literature such as auto-regression and seasonal correction are discussed in Paragraph 4.4.5 and 4.4.6.

These factors will not be comprehensively discussed here, because they are merely the factors that are generally at play within the macroeconomic sphere. However, they still have to be applied to Amsterdam, which will happen in Chapter 4.

The development of the housing market expresses the interplay between households selling their houses and potential buyers looking for a bargain. In this process, the market isn't continuously cleared, which then may cause 'inertia in prices' (De Wit, Englund, & Francke, 2013, p. 220). Therefore, Verbruggen, Kranendonk, Van Leuvensteijn, and Toet (2005) distinguish a short-term and a long-term price model since the short-term prices can deviate from the long-term prices substantially and for a longer period. When this occurs, a correction steers the price 'towards the long-term level' (Verbruggen et al., 2005, p. 22). However, none of the models in the first part of their research meets their used definition of long-term, which is set around a century long (Verbruggen et al., 2005, p. 25). The papers that are used in this part also form the basis of the rest of this review. This is complemented with more recent bodies of work (Droës & Van de Minne, 2015; Francke, Van de Minne, & Verbruggen, 2015).

	Verbruggen et al. (2005)	De Vries and Boelhouwer (2005)	De Wit et al. (2013)	Droës and Van de Minne (2015)	Francke et al. (2015)
Income related					
Available wage income/GDP per capita	X	X			
Consumer price index (CPI)	X	X	X	X	X
Nominal net additional capital	X				
Population				X	
Unemployment rate/labour force			X	X	
Costs related					
Real rental price		X			
Loan capacity					X
Mortgage interest rate	X	X	X		
Supply related					
Vacancy					X
Construction costs				X	X
Volume of housing stock	X			X	
Rate of sales			X		
Others					
Time regression components	X				
Seasonal correction		X			

Table 3-1: Variables for long-term and short-term house price equations (own illustration)

Table 3-1 presents an overview of the bodies of work and the different factors that were used in the respective models. Although the period of time that will be researched in this thesis is not universally seen as long term, the global financial crisis could be considered as a correction towards the equilibrium (Himmelberg et al., 2005, p. 69). Similarly, the current price increase relative to the development of the foregoing variables is startling, although there are several developments, mentioned either in this chapter or the following, that could form starting points for further research.

3.2.2 Implementation

For the theoretical framework an attempt has been done to map the different factors at play on a macroeconomic level. With this, the connection to Amsterdam can be made. Therefore, the factors are generally described here and then implemented on a smaller scale in the next chapter. To do this, five papers are assessed and graphically displayed in Table 3-1.

3.3 Microeconomic factors

Besides from macroeconomic factors, certain characteristics of dwellings can also influence the housing market. Are the dwellings in Amsterdam different from the rest of the country and can this account for the gap? In this paragraph the literature concerning microeconomic factors will be discussed. This concerns the environmental characteristics of a dwelling and its own characteristics. Finally, an overview is given of the relevant characteristics that can be used to apply to the case of Amsterdam.

3.3.1 Physical dwelling characteristics

The physical dwelling characteristics contain information about the dwelling itself, like the usable floor area (UFA) or the building period of the dwelling. Bosker et al. (2016) use as much dwelling characteristics. However, their method aims to use these characteristics merely to demonstrate the similarity of the housing stock of their reference areas in comparison to the researched earthquake area in Groningen. Therefore, the price effects of the dwelling characteristics are not expressed.

Luckily however, Lazrak, Nijkamp, Rietveld, and Rouwendal (2014, p. 10) also use the physical dwelling characteristics, although to limited extent. They find that the size of the dwellings, either in UFA, volume or number of rooms positively contributes to the price. This corresponds with the results of Visser and Van Dam (2006, p. 55), although they find less convincing results regarding the number of rooms.

Regarding the building period, which is the only other dwelling characteristic that is included in the results of Lazrak et al. (2014), the outcome is remarkable: the older the dwelling is, the worse is the effect on the price. The Belgian study conducted by Vastmans (2016) has a similar result. However, Visser and Van Dam (2006, p. 55) find that dwellings built before 1945 have a positive price effect. Dwellings built between 1945 and 1990, which includes the reference period, have a negligible influence on the price. Dwellings built after 1990 have a positive price influence that is comparable to the dwellings built before the Second World War.

A category that is included in all models is the dwelling type, although the range of accuracy differs from a distinction between apartments and houses to numerous dwelling types with specific characteristics. Intuitively, the house types that have a positive influence on the price per square meter are (semi)-detached houses (Buitelaar, Schilder, Bijlsma, & Bellaard, 2014; Visser & Van Dam, 2006, p. 55). This is due to the preference of private areas of most people (Blije et al., 2009).

3.3.2 Physical environmental characteristics

The physical environmental characteristics are used to provide information about the proximity of parks, forests and water, as well as the location in a busy street. Although these characteristics will not be explicitly added to the model but instead indirectly through the postal code area, which also accounts for the social and functional characteristics, it is helpful to review the five studies on the outcomes to learn which environmental characteristics (partly) define the price.

To return to these results of the earlier mentioned examples: the presence of ‘green’ and ‘blue’ adds value (Visser & Van Dam, 2006, p. 71), whereas the intuitively

undesirable proximity of business parks or busy roads indeed decreases the price (Lazrak et al., 2014, p. 15; Visser & Van Dam, 2006, p. 71).

More specific is the study of Lazrak et al. (2014), who added a variable specially for their research to measure the influence of the proximity of monuments on the house prices. They concluded that the presence of monument in the direct surroundings positively influences the price. Remarkably, Bosker et al. (2016, p. 75) also include monuments as a characteristics. Moreover, they differentiate different architectural icons, such as 'Zeilenbau', building blocks, Vinex and garden villages (Dutch: tuindorpen). However, the results are, once again, not reported.

Lastly, the density, either in population or in addresses, is mentioned by both Lazrak et al. (2014) and Visser and Van Dam (2006). The outcome is mixed. Lazrak et al. (2014) find that density negatively contributes to the price, whereas Visser and Van Dam (2006) see a difference between houses and apartments. For houses, increased density leads to an increased price. For apartments, it is the other way around. It seems that there is optimum whereby the density leads to a clustering of facilities, but crowdedness is prevented.

3.3.3 Social environmental characteristics

Apart from the physical and functional aspects, social aspects can be used to differentiate in house prices. An example that is integrated in one of the models is the social status score, which is built up using income, education level and unemployment rate (Visser & Van Dam, 2006, pp. 46-47). These indicators have the effect that one would expect: high incomes and education levels and a low unemployment rate positively affect the price. Similarly, the share of non-western immigrants has a negative effect, even when corrected for the earlier mentioned social status score (Visser & Van Dam, 2006, p. 82). This corresponds with the results of (Lazrak et al., 2014, p. 15).

Vastmans (2016) uses a socio-economic ground layer that categorizes the municipalities in the province of Flanders, which is derived from the Belgian Belfius Bank (2007, pp. 59-62). In the overview, both models are combined. Although this model is based on the Belgian housing sector, a comparison of the model's build-up is viable. A disadvantage of the socio-economic ground layer is that the model generalizes a full municipality without clear identification of the internal differences.

3.3.4 Functional environmental characteristics

For the functional environmental characteristics, the proximity of different utilities is measured (Bosker et al., 2016; Lazrak et al., 2014; Visser & Van Dam, 2006). Like the other environmental characteristics, these will be implicitly covered by the usage of the postal code areas. The extent in which the functional environmental characteristics are used differs per study. Whereas Bosker et al. (2016, pp. 77-78) and Visser and Van Dam (2006, p. 48) use multiple variables concerning the accessibility (e.g. public transport, jobs) and proximity of utilities (e.g. schools, shopping malls), Lazrak et al. (2014, p. 10) only take the distance to the city center into account.

The results of the price effects show a similar pattern as the density in Paragraph 3.3.2: proximity of schools and highways is appreciated, but if it too close (within 100 metres), the price effect turns out negative (Visser & Van Dam, 2006, p. 92). The

accuracy of the postal code areas will likely not address the negative price effect when certain facilities are too close, since this is something that should be measured on dwelling level. However, the scale level does suit the other end of the scale, wherein distance exceed the size of the postal code areas.

3.3.5 Overview and conclusion

The previous paragraphs have explained the build-up of five different hedonic price studies, along with concise descriptions of the results. Table 3-2 shows the five different categories, along with its underlying factors that are used by the five studied hedonic price models. It becomes clear that both the study topic and the approach lead to a different emphasis of the hedonic price model. Moreover, the level of detail in the model plays an important role. This is especially noticeable in the research of architectural styles within Vinex neighbourhoods: herein, Buitelaar et al. (2014) don't use physical, social and functional environmental aspects in their analysis. They believe that the homogeneity of the spatial planning and the building method are so similar, that the main difference between dwellings lies in the façade and the atmosphere.

	Visser and Van Dam (2006)	Lazrak et al. (2014)	Bosker et al. (2016)	Buitelaar et al. (2014)	Vastmans (2016) and Belfius Bank (2007)
Transaction-related characteristics					
Transaction price	X	X	X	X	X
Transaction year				X	X
Leasehold		X			X
Newly-built house		X	X		
Sell condition (seller)		X			
Sell condition (auctioned)		X			
Ground lease				X	
Physical dwelling characteristics					
Dwelling type	X	X[1]	X	X	X
Usable floor area	X	X	X	X	X
Capacity/volume		X	X		
Plot area				X	X
Rooms	X	X			X
Shape of living room			X		
Building period	X	X	X		X
Heating			X		
Garden	X		X		X
Maintenance level (internal and external)			X	X	X
Parking	X[2]		X	X	
Monument		X	X		
Swimming pool			X		
Physical environmental characteristics					
Province	X				X
Busy street		X			
Proximity water area	X	X	X		
Proximity parks/recreational ground	X		X		
Proximity of business parks	X		X		
Population density		X	X		X
Dwelling types in area	X[3]		X		
Monumental buildings		X	X		
Iconic urbanism			X		
Situated next to (within 25m) … [4]					
Social environmental characteristics					
Population density	X				X
Percentage ethnical	X	X			X
Social status score	X				
Unemployment rate	X				X
Educational level	X				X
Income	X				X
Criminal activity			X		
Functional environmental characteristics					
Distance to center	X	X			
Distance to supermarkets/shops	X		X		
Distance to highway exit	X				
Distance to public transport	X		X		
Accessible jobs	X		X		
Distance to cultural amenities			X		

Table 3-2: Used parameters in hedonic price models (own illustration)

[1] Not reported in the results

[2] Only presence of garage

[3] Presence of high rise, freehold dwellings and single-family homes

[4] E.g. rail track, road, airport, public services, graveyards, sports grounds, construction site

3.3.6 Implementation

The categorisation of the variables is derived from *De prijs van de plek* by Visser and Van Dam (2006, p. 8). They 'distinguish four dimensions' when it comes to the appreciation of a dwelling's characteristics, which will form the foundation of the overview and the input for the hedonic price model:

- Physical dwelling characteristics
- Physical environmental characteristics
- Social environmental characteristics
- Functional environmental characteristics

The hedonic model that will be designed in this thesis uses a similar build-up as Visser and Van Dam (2006). In this model, the dwelling characteristics are separated from the environmental characteristics: in first instance, solely the physical characteristics of the dwelling itself are used. Subsequently, the neighbourhood dummies provide the other three dimensions, which are related to the environmental characteristics. Thirdly, the period dummies will be added to the model, which will improve the model by correcting for the house price growth. In Chapter 5, which processes the results of previous conducted hedonic price studies, the dwelling characteristics that (negatively) contribute to the price are ranked on importance. This results in division of the dwelling characteristics in five tranches.

These characteristics will be supplemented with the transaction-related characteristics, which is used by Lazrak et al. (2014) , and are discussed in this sequence within the previous paragraphs.

Table 3-2 will be used to determine the sequence in which the different characteristics will be entered into the price model that will be designed in Chapter 5. The entering will be performed in seven tranches, of which the latter two will be saved for the location characteristics and the economic development and not included in the overview that will be presented in that chapter, done on the example of Visser and Van Dam (2006). It becomes clear that the usable floor area, the building period and the dwelling type are indispensable and hence will be entered in the first two steps. The usable floor area, the number of rooms and the building period are entered in the first step. Since the variable dwelling type contains a large variety of categories, this variable is added in the second step. Then, the maintenance level and the garden orientation are entered, followed by less impactful variables which are divided amongst the last two steps. Table 3-3 provides a short overview of the variables that are entered in the five steps that are dedicated to the dwelling characteristics.

Step 1	*Step 2*	*Step 3*	*Step 4*	*Step 5*
UFA	Dwelling type	Maintenance level	Heating system	Lift
Number of rooms		Garden orientation	Monument	Balcony
Building period			Ground lease	Roof terrace
			Sale construction	Parking

Table 3-3: Sequence of entrance own hedonic price model (own illustration)

3.4 Relation between transaction price, appraised market value and VIPA-value

As explained in the introduction, the foundation of the housing market is not only relevant for theoretical purposes. The build-up of the price is of great significance for the current and future residents within the Amsterdam housing market, since the price has further impact on other manners of taxing and policy. Therefore, this paragraph will provide an introduction of these concepts along with their internal relationship

3.4.1 Transaction price

The price is the sum of money that is paid for an estate in an individual transaction (Ten Have, 1993, p. 5). When all conditions as stated in the presented definition of market value are met, the transaction price and the market value should emerge in the same sum (Hooijmaijers, 2012).

However, the definition of market value is stuffed with conditions that complicate the perfectly align the market value and the transaction price. Especially the last sentence of the definition provides reasons for buyers and sellers to deviate from the market value. Both buyers and sellers normally don't have the education and (housing market) knowledge to comprehend the precise forces that work on a real estate market (Shapiro, Mackmin, & Sams, 2013, p. 11; Ten Have, 1993). Moreover, buyers and sellers all have their 'own views, desires and judgement on the value' (Shapiro et al., 2013, p. 4). Ten Have (1993, p. 5) adds three more reasons for the transaction price to deviate from the market value:

- The parties are acting irrationally and imprudently
- The financing method and financeability
- The duration an estate is offered for sale

These 'imperfections' can lead to a transaction price that deviates from the market value.

3.4.2 Market value

In the 2017 edition of the International Valuations Standard (IVS), *market value* is defined as follows:

> Market Value is the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion. (International Valuation Standards Council, 2017, p. 18)

The conceptual framework that lies beneath this definition, is attached in Appendix A.

Although this definition should ideally be reflected in the actual paid price and the VIPA-value (Hooijmaijers, 2012; Waarderingskamer, n.d.-b), this does seldom happen in practice. The reasons for this disparity are already partly explained in the upcoming parts, but the methodology to determine the market value, along with the cause of this disparity between market value, VIPA-value and the transaction price is studied in greater depth in Chapter 6.

3.4.3 VIPA-Value

The Valuation of Immovable Property Act (VIPA) (Dutch: Wet waardering onroerende zaken; short: Wet WOZ) is a 1994 law that describes the valuation of real estate by the Dutch Council for Real Estate Assessment (Dutch: Waarderingskamer), and its related procedures for the composition of the council, objection and data management. The municipalities of The Netherlands are responsible for the execution of the VIPA. The result, value for the purposes of the VIPA (VIPA-value; Dutch: WOZ-waarde), is used for different (taxing) purposes. The VIPA-value of dwellings and other real estate is released annually.

The VIPA-value uses the market value as a starting point. To prevent differences between neighbouring properties, the following assumptions are made:

- That there is full and unencumbered ownership of the property
- That the possessor can use the property immediately in its current state and to full extent (Waarderingskamer, n.d.-b)

3.4.4 Taxes and ground lease

The VIPA-value that is determined by the Dutch municipalities is used for several taxing purposes (Waarderingskamer, n.d.-a):

- Municipal taxes
    - Sewerage and waste collection levies (Dutch: riool- en afvalstoffenheffing)
    - Property tax (Dutch: onroerendezaakbelasting (OZB))
- Water system charge (Dutch: watersysteemheffing)
- Government taxes
    - Notional rental value for owner-occupiers (Dutch: eigenwoningforfait)
    - Capital gains tax (Dutch: vermogensrendementheffing)
    - Gift and inheritance tax (Dutch: Schenk- en erfbelasting)
- Maximum rent level of social rented dwellings
- Determination of ground rent (Dutch: erfpachtcanon)

This shortly described the relationship between the transaction price VIPA-Value and market value and the consequential taxes, but these taxing purposes each have their own tariffs or rates that are changed over time. Hence, this change needs to be incorporated in a model to determine the actual costs in the sixth chapter. However, a simplified overview of the internal relation is presented in Figure 3-1. Apart from the tariffs or rates that change, the PIVA-value has also undergone a development during the research period. The combination of both changes will be used to determine what the additional costs per household are, spread out over the different neighbourhoods of Amsterdam. Additionally, an indication of the total costs is made.

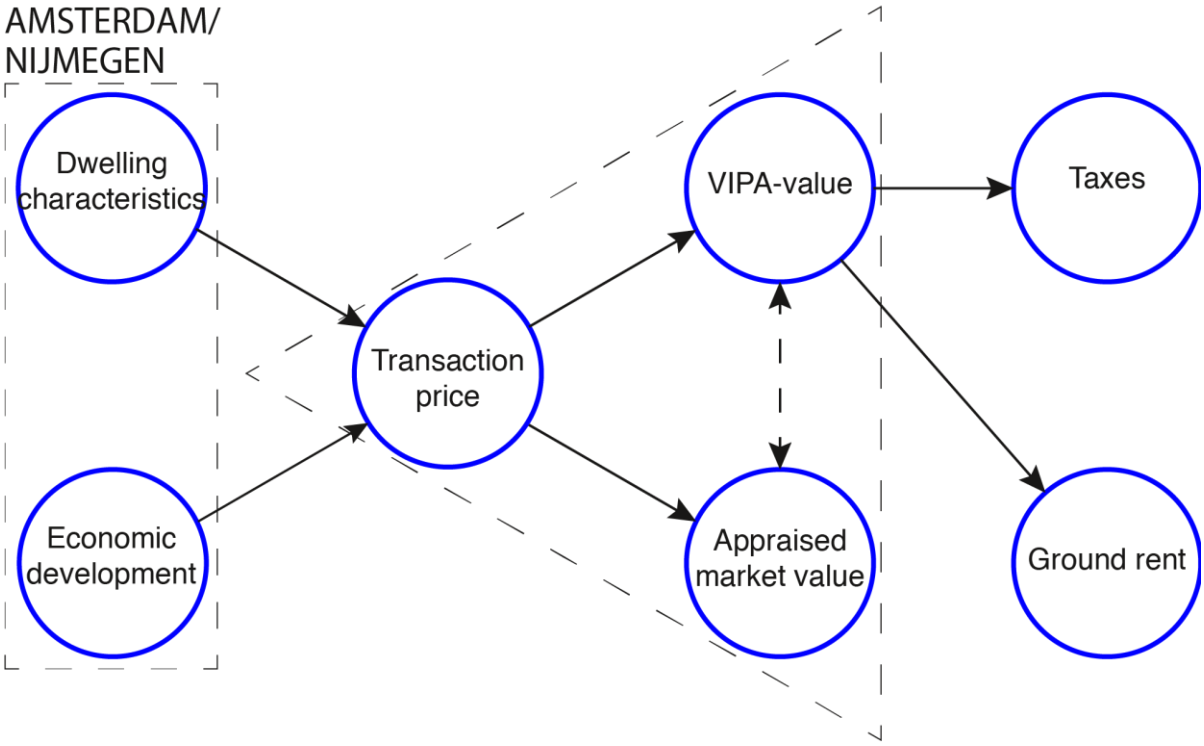


Figure 3-1: Relation between transaction price, VIPA-value and market value

In Chapter 6, the relationship between the transaction price, the VIPA-value and the taxes will be further explained. Here, the calculations will be shown that connect the VIPA-value to for example ground rent and other taxes. Then, the calculations will be used to show the effect of the rising house prices and consequently the VIPA-value for incumbent residents. The residents will be divided into different categories such as social housing, private owners and renters.

3.5 Conclusion

This chapter has given a theoretical framework from where to start this research. It is shown that the housing market in general responds to macroeconomic developments such as income and GDP. In addition, the specific characteristics of a dwelling or the microeconomic factors are significant. This has led to the first two sub questions of this research. However, to be able to answer the main question, a link must be made between the economical foundation for the rising prices and the consequences for residents. The final sub question will shed light on this. To summarize once more, the three sub questions of this research are:

1. Which causes and consequences of fast-rising house prices are already described by the existing scientific literature?
2. Are there economic (job type, income, capital, income spent on housing) factors that can explain the wedge between the Amsterdam housing market and the Dutch average?
3. Can the dwelling characteristics (number of rooms, floor area, age, garden, housing type etc.) explain the difference between the Amsterdam market and the Dutch average, in this case represented by the city of Nijmegen?
4. How do transaction price, market value and VIPA-value interact with each other?

This chapter has embedded the question within the existing literature, but most importantly has formed the starting point for answering the questions. Firstly, the

main factors that work on a macroeconomic level are discussed. This will form the starting point for the research in Chapter 4. Furthermore, a similar framework has been set up for the microeconomic factors. However, this is done for the build-up of the hedonic price model. Finally, the concepts transaction price, VIPA-value and market value are explained and form the basis for Chapter 6, which will analyse the financial consequences for incumbent residents.

4 Macroeconomic factors

4.1 Introduction

This chapter tries to answer the first sub question “are there economic (job type, income, capital, income spent on housing) factors that can explain the wedge between the Amsterdam housing market and the Dutch average?”. As explained in the method (Chapter 3), the Dutch average is represented by the city of Nijmegen. Furthermore, in the Chapter 2 a general account is given about the workings of a housing market. This chapter builds on that theory, but goes more into depth about the place specific factors. Therefore, this chapter starts with the spatial development of Amsterdam and Nijmegen. In the histories, information is included about the current state of the different areas. Subsequently, the causes and consequences for the specific development of the Amsterdam housing market are qualitatively described. Herein, a division is made between the demand and supply. Subsequently, several macro-economic factors that are used by studied house price models are reviewed. The chapter ends with an overview of the findings.

4.2 Development of Amsterdam

To get an understanding of the role and character that each part of the city has, this paragraph will chronologically walk through the build-up of Amsterdam, which is largely based upon *1000 jaar Amsterdam: Ruimtelijke geschiedenis van een wonderbaarlijke stad* by Fred Feddes (2012). Herein, the contemporary state of the area plays a key role, which includes information about the housing stock. This is based on the received dataset from the NVM, the socio-economic status of its inhabitants and the proximity or accessibility of facilities like education, shops and jobs.

4.2.1 1000-1600

The first settlers arrived in the area that later would become Amsterdam around 1000 AD. The area was part of a large swamp that stretched all over North and South Holland. The land needed to be cultivated for agricultural purposes. The cultivation was normally achieved by digging drainage ditches in rectangular shapes. This pattern is still visible in the alleys within the city centre and the street pattern of the Jordaan. The drainage slowly led to subsidence of the peat land and caused the IJ to ascent. Part of the measures was the construction of two dykes along the banks of the IJ. The north part of this dyke is now part of the old villages of Buiksloot, Nieuwendam, Schellingwoude and Durgerdam (Feddes, 2012). The latter village is the only one that is not incorporated in Amsterdam Noord, although it officially is part of that borough. Another measure was the connection of two rivers, which led to a straight part in the Amstel river (Feddes, 2012). This part of the river forms the division between the boroughs of Zuid and Oost, which is visualised in Figure 4-1.

Around 1250, a dam was constructed between the banks of the Amstel. This dam was situated on the same place as the current Dam, which became the epicentre of the city when the town hall, which is currently in use as a palace, was established in the 1650s. A few centuries later, the central station was built at the waterfront of the IJ. The rail track that connects the station with the rest of the network lies along the south bank of the IJ (Feddes, 2012). Nowadays, this is mostly seen as the touristic centre of Amsterdam.

The part as described is located within the postal codes 1011 and 1012 in Figure 4-2. The area houses the most important shopping area of Amsterdam and forms the touristic core of Amsterdam, which causes nuisance for residents of this part of the city (Van Benthem, Fijnje, Koopmans, & Tieben, 2017).

Only 22% of the dwellings in this area are owner-occupied. 64% of the dwellings are rented out by landlords, not being a housing corporation (CBS, n.d.).
Most of the cases in this area are apartments (92.4%, n=3,154) that are constructed between 1500 and 1905 (58.3%), but dwellings built after 1991 (22.8%) are also widely available.

4.2.2 1600-1850

The most famous part of the city is the result of the urban expansion that was realised in the seventeenth century, an area that nowadays is known as the 'canal district'. The characteristic form of the area is based on military, economic and juridical conditions and was developed in four tranches. The plots were sold to the growing elite, who could design their houses individually. Besides the fan-shaped part, the Jordaan - which follows the old drainage ditch pattern and was a working-class district - and the Eastern and Western islands were developed. After the completion in the early eighteenth century, the shape of the city remained unchanged for approximately 150 years (Feddes, 2012).

The canal district, the Jordaan and the islands are all filled with shops, bars, restaurants and other cultural and recreational enterprises (CBS, n.d.). In the canal district, this is mainly centred on the transverse streets, whilst the realty along the canals is mostly in use for living and offices.

The division of tenure is fairly equally divided amongst the three types of tenure: 31% of the dwellings is owner-occupied, 30% is rented out by housing corporations and the remaining 37% is rented out by other landlords (CBS, n.d.). Of the 12,320 cases that are located in the postal code areas 1015 up to and including 1018, 51.9% is built before 1905 and 26.9% is built after 1980. Most canal houses have been split up in apartments, which makes the share of apartments in the housing stock 92.2%.

4.2.3 1850-1900

From the 1850s onwards, the city copes with a fast-growing number of inhabitants due to the industrial revolution that boosts the economy and the expanding harbour in particular, but the government is hesitant in the making of expansion plans and the housing conditions are terrible. The elite of Amsterdam initiates the planting of the Vondelpark, and they construct large country houses for themselves alongside. Besides, they start the development of the former green area of the plantation (Feddes, 2012).

As a countermovement, medical doctor Sarphati attempts to develop an expansion plan that offers place for the working class, but it lasts until 1877 until a plan made by the department of Public Works (Dutch: Publieke Werken) is approved by the local government. The plan consisted of a new belt around the city centre, which was built in the old polder pattern. The implementation of this plan is started immediately, although large elements are only done in the first years of the twentieth century, totalling in 100,000 dwellings built between 1877 and 1914. The dwellings were erected as jerry-buildings (Dutch: revolutiebouw), which were developed by investors

and speculators and can be summarised as poorly built and noisy. Only in the last four decades this building style received positive attention. At the end of the century the local government regained control on the quality of the housing by the introduction of the ground lease policy and an aesthetics committee (Dutch: welstand) (Feddes, 2012).

The dwellings in the neighbourhoods that were mainly built in between 1850 and 1900 are owner-occupied in approximately 27% of the dwellings, whereas housing corporations own 39%. Other landlords own the remaining 34% (CBS, n.d.). From cases that are derived from the NVM dataset that are located in this expansion area (n=21,960) are almost all apartments (98.1%), and their building period is also very clearly defined: 37.2% is built before 1905, while 42.2% dates from 1906 until 1930. Dwellings built between 1931 and 1980 appear seldom in these areas.

4.2.4 1900-1940

(Feddes, 2012) merged this period and the following years to one part in his book, but to accentuate the spatial, architectural and socio-economic differences between the two periods, a division is made around the Second World War.
From 1901 onwards, the housing law (Dutch: Woningwet) came into effect. From now on, the municipality could set requirements for the quality of housing. The new law also entailed that cities were obligated to make expansion plans. Between 1914 and 1926 this led to expansion in the East, South and West of Amsterdam (Feddes, 2012, pp. 227-228). Crucial to these expansions were the members of the Amsterdam School, a new architectural movement, and architect H. P. Berlage. The new neighbourhoods were almost completely designed by a combination of these two. Plan South (Dutch: Plan Zuid) covered the Rivierenbuurt, Apollobuurt en Stadionbuurt, which in Figure 4-2 is postal code areas 1076 till 1079. In the West, the expansion covered post code areas 1055 till 1059. Distinctive for these areas is a street plan with many straight narrow streets and long building blocks. They intersect with a few main axes which provide space for shops, bars and restaurants (Hoekstra, 2012, p. 188).

The second part of the expansion plan contained the design and construction of the garden villages (Dutch: Tuindorpen). These neighbourhoods sprang up in the North of Amsterdam and in Watergraafsmeer in the 1920s and 1930s, respectively with postal code areas 1022 till 1035 and 1097 (Feddes, 2012, p. 97). Still, these garden villages are popular amongst home seekers because of their spacious and green living environments, while being not far located from the city centre (Kingma, 2012, p. 14).

The expansions around the old city centre will be discussed in three parts: East, South and West. The Eastern part consists of the postal code areas 1092, 1094 and 1095 and almost entirely concerns apartments. In these areas, 23% of the dwellings (n≈16,000) is owner-occupied, 61% is rented out by housing corporations. 15% is owned by other landlords (CBS, n.d.). The analysis of the cases (n=5,897) contain a remarkable result: 60.4% of the dwellings is built before the Second World War, but due to the bad quality of the dwellings, redevelopments in the 1980s and 90s account for 31.2% of the housing stock.

Plan Berlage shows remarkable differences between its different parts concerning the different tenures: in the Apollobuurt, 51% of the dwellings (n≈3,900) is owner-

occupied, whilst social-rented dwellings are almost non-existent in this neighbourhood. The Rivierenbuurt and the Stadionbuurt are more similar: here 21% of the dwellings (n≈22,000) is owner-occupied. The housing corporations have a share of 37%, whereas 41% is rented out by other parties (CBS, n.d.). In South, 89.6% of the cases (n=8,885) is constructed in the described period. Another 5.7% is built between 1945 and 1960. This leaves 418 cases or 4.7% for the last 56 years.

In West, approximately 52,500 dwellings are located. The housing stock is almost entirely built up out of apartments (99%). 30% of the dwellings is owner-occupied, whilst the rental dwellings are equally divided between housing corporations and other landlords (CBS, n.d.). Of the 16,100 cases that are located in West, 89.7% is built before 1940. After the war, there is no particular time period that stands out.

In the aforementioned garden villages, the percentage of social housing is close to the municipality's average: of the approximately 55,000 dwellings, 60% is owned by housing corporations. Owner-occupiers possess 28% of the dwellings. The remaining 12% is owned by other landlords (CBS, n.d.). The dataset contains 9,110 cases in these neighbourhoods. In these areas, the division between the building periods shows an atypical distribution. 26.5% is constructed before the Second World War. The 1960s, 70s, 80s and 90s contribute respectively 30.2%, 11.0%, 12.9% and 12.8% to the housing stock. These post-war dwellings are mainly located in housing projects that date from the respective periods. The garden villages belong to the few areas that contain a fair share of houses (38%) in addition to the apartments (62%).

4.2.5 1940-1970

Amsterdam was never bombed during the Second World War, but the war did not leave the city untouched. One of the most visible results of the war is the 1960s architecture in postal code 1011, which was formerly a part of the old Jewish neighbourhood in Amsterdam. A big part of this neighbourhood got destroyed at the end of the war and was bulldozered down to make way for social housing and new apartments (Feddes, 2012).

After the Second World War, Amsterdam had to deal with an enormous housing shortage. To cope with this, the national and local governments installed a housing system which consisted of subsidized housing, low rents, and allocation based on waiting lists. The percentage of social housing in Amsterdam grew from 1% in 1900 to 56% in 2000 (Van der Vlist & Rietveld, 2002, p. 9).

Another way of handling the housing shortage was by designating so-called 'growth cities', which had to prevent unlimited urban sprawl (Van der Vlist & Rietveld, 2002, p. 9). Surrounding cities like Almere and Lelystad were appointed to become growth cities, which led to a huge outflow of households with children in the 1970s and 80s. In Paragraph 4.4.2.1 this will be further discussed.

Thirdly, in post-war Amsterdam, the city commenced with many elaborate projects, of which the most famous is the Bijlmermeer. It is also a great example of the many high-rise building projects that were initiated in the 1960s in Europe (Helleman & Wassenberg, 2004, p. 4). Initially, the area was promoted as modern and innovative. However, nowadays, it is mostly associated with criminality, pollution and social isolation (Helleman & Wassenberg, 2004, p. 3). In Figure 4-2, the Bijlmermeer is indicated with postal codes 1101 to 1109.

A returning theme in the architecture of the 1960s is the fact that much of the appreciation for the architecture was lost very quickly (Bervoets, 2015, p. 180). It was quickly after construction deemed anonymous and technocratic. This is not the case for all dwellings from this period of course and many people have sought for a new appreciation of these building. However, this division in appreciation between pre-war buildings and 1960s architecture and is still very much apparent.

The state of the current housing stock in the areas that were largely constructed will be discussed in three parts: borough Nieuw-West, Buitenveldert, which is a part of Zuid, and borough Zuidoost. The first one in line is Nieuw-West. This borough contains approximately 64,000 dwellings, of which a quarter are single-family dwellings and the other three quarters are apartments. The tenure is divided as follows: 29% is owner-occupied, 51% is possessed by housing corporations and 19% is owned by other landlords (CBS, n.d.). When looking at the cases (n=14,057) in Nieuw-West, 47.8% is built between 1945 and 1970. A second construction spurt that started in the 1990s, accounts for 42.8% of the dwellings.

The second expansion that will be discussed is Buitenveldert. In this neighbourhood, the different tenures are nicely divided amongst the three categories that are already often mentioned in this chapter: 37% is owner-occupied, 28% is social rented and 34% is rented out by other parties (CBS, n.d.). In Buitenveldert, 74.8% is built between 1961 and 1970 (n=5,126). An additional part of the neighbourhood was built between 1981 and 1990, which consists of 12.1% of the dwelling stock.

Zuidoost, which formerly formed a separated municipality, has a similar dwelling stock as Nieuw-West, with a 25/75 ratio of single-family and multiple-family homes and a tenure division that also resembles Nieuw-West: here the division is 29% owner-occupied, 58% social rented, and finally 12% for other landlords (n≈38,500) (CBS, n.d.). The 7,137 cases in Zuidoost are primarily (86.1%) built between 1970 and 1990.

4.2.6 1970-present

It was in the 1980s that the socio-economic level of the population of Amsterdam started to improve again, especially in the downtown neighbourhoods (Van der Vlist & Rietveld, 2002, p. 4). Signs of gentrification processes started showing and the percentage of social housing dropped. Because this topic will be covered in Paragraph 4.4.2.1 of this chapter, it will not be further elaborated here.

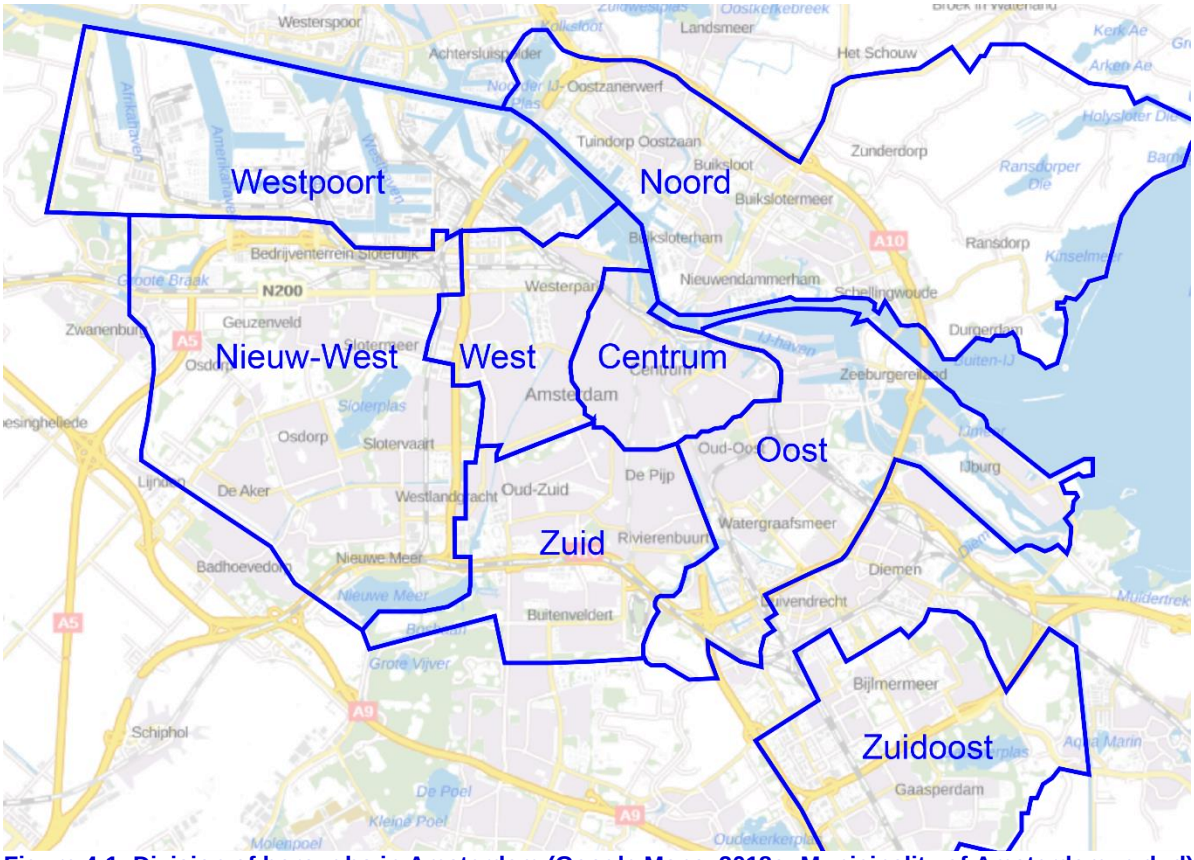


Figure 4-1: Division of boroughs in Amsterdam (Google Maps, 2018a; Municipality of Amsterdam, n.d.-d)

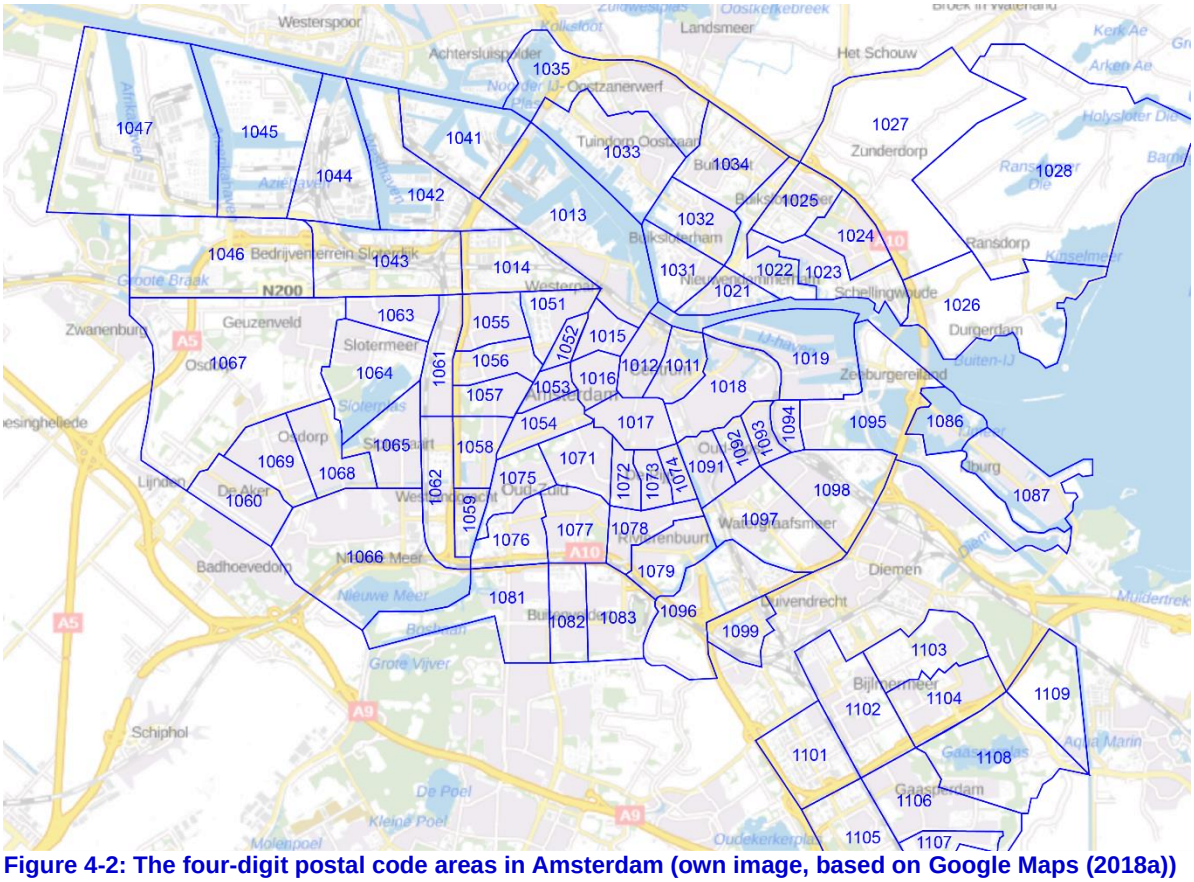


Figure 4-2: The four-digit postal code areas in Amsterdam (own image, based on Google Maps (2018a))

4.3 Development of Nijmegen

This paragraph will concisely present the development of the city of Nijmegen, to have a deeper understanding of the way the current city is build up. The overview is for the most part based on the three parts of *Nijmegen: Geschiedenis van de oudste stad van Nederland*, of which the final editing is done by Lisenka Fox. Although the edition covers Nijmegen in a very broad array of subjects, this paragraph focusses on the origin and position of the different urban areas and their dwellings.

4.3.1 Until 1500

Nijmegen is often called 'the oldest city in the Netherlands'. This has mostly to do with the Roman history of Nijmegen, or Noviomagus as it was called by the Romans. Starting out as a strategically located army camp, Noviomagus got Roman city rights around the year 100 (Willems, Enckevort, Haalebos, & Thijssen, 2005, p. 52). After the Romans left, Nijmegen fell back to an agricultural society which lasted until 1230, when it got medieval city rights (Kuys & Bots, 2005, p. 150).

4.3.2 1500-1874

For the purpose of this paper, the history of Nijmegen becomes relevant again in the 16th century. In this time, Nijmegen became one of the fortified towns that were part of the defence strategy of the Dutch Republic. This meant that they were not allowed to break down the city walls, which were erected around 1520. This situation lasted until 1874, when the city finally received permission to remove the walls. The area surrounded by these walls, is in figure 3 named 'centrum' or centre.
Between 1500 and 1800, the population of Nijmegen remained at around 10,000 people. As a comparison, Amsterdam grew from almost 40,000 to more than 200,000 in the same period (Kuys & Bots, 2005, p. 330). It was only after 1800 that the population of Nijmegen started rising. However, the city could still not grow because of the walls and consequently was convicted to an increase in the density of buildings. Therefore, this part of the city is characterised by a maze of little streets, with building erected in many different times (Kuys & Bots, 2005, p. 293).

Nowadays, the centre harbours the shopping centre of Nijmegen and is often divided into the upper city (Dutch: bovenstad) and the lower city (Dutch; benedenstad).

4.3.3 1875-1910

In 1875, Nijmegen finally got permission to dismantle the city walls. This was a key moment, for the decades following this event, are usually seen as an unprecedented period of degradation and construction (Kuys, Bots, & Brabers, 2005, p. 190). Within thirty years, the city almost doubled in population (Voorden, van 206). Around the centre, a semi-circle of boulevards and parks were erected, surrounded by new new city quarters (Van Voorden, 1995, p. 204). All these expansions went according to city plans, which were very focussed on giving Nijmegen a new grandeur (Kuys et al., 2005, p. 250). Because many of the richer residents left the city centre for the new areas, poverty increased in the centre (Van Voorden, 1995, p. 209).

From 1900 onwards, the city of Nijmegen started working on large building schemes for the many workers that the city attracted. This consisted of large scale housing projects for working-class families. In Figure 4-3, this area of the city is named Oud-West. The expansion went side by side with the construction of railways, water pipelines, sewage and gas supply (Kuys et al., 2005, p. 277).

4.3.4 1910-1940

After 1910, growth in Nijmegen stagnated. This had mostly to do with the First World War and the economic crisis in the 1930s. However, in 1923, the Roman Catholic University was founded (now: Radboud University). It was the beginning of Nijmegen as a student city and the university grew fast (Kuys et al., 2005, p. 414). Nowadays the University has almost 20.000 students. Another big project was the bridge over the Waal (Dutch: Waalbrug), which was finished in 1935 (Kuys et al., 2005, p. 528). Both project gave new impulses to the city, but did not cause substantial population or spatial growth.

4.3.5 1940-present

On the 22nd of February in 1944, the historic centre of Nijmegen was bombed, destroying the upper city. A new, modern centre was built and in the 1970s and 1980s big parts of the lower city were also renewed. The result is a city centre made up of a mix of historical building and modern buildings (Van Voorden, 1995, p. 205). Not only the city centre was new after the war. In the 1950s the new neighbourhoods Hatert, Hees en Neerbosch arose, respectively with postal code areas 6534-6535, 6542 and 6544 (Kuys et al., 2005, p. 558).

Not much later, in the sixties, the large expansion areas called Dukenburg and Lindenholt were constructed. They are visible on Figure 4-3. By the nineties, these areas were almost completely covered and Nijmegen sought for new ways to expand.

A solution was found across the water. In 1998 the building started of a VINEX-housing complex north of the Waal. 12.000 dwellings were built at a very short distance from the city centre (Kuys et al., 2005, pp. 574-575). Other developments in the second half of the 1990s were the reconstruction of the Valkhof borough from the 12th century. This was supposed to give the city back some sense of its historical roots, which is thought of as a big part of the charm of Nijmegen.

Currently, Nijmegen has a very equally divided housing stock (n≈78,500); not only in terms of single-family (53.5%) and multi-family (46.5%) houses, but also in terms of tenure: 40% is owner-occupied, 39% is rented out by housing corporations and the remained is rented out as well, but then by other landlords. The differences between the different boroughs are relatively small compared to the differences in Amsterdam (CBS, n.d.). This finding is strengthened by the build-up of the housing stock in Nijmegen, which is much more mixed up in terms of building period than Amsterdam. In the borough Centrum for example (n=16,100), buildings older than 1905 seldom appear. However, the share of pre-war dwellings in the housing stock is 89.8%. Newer dwellings are evenly spread over the remaining building periods.

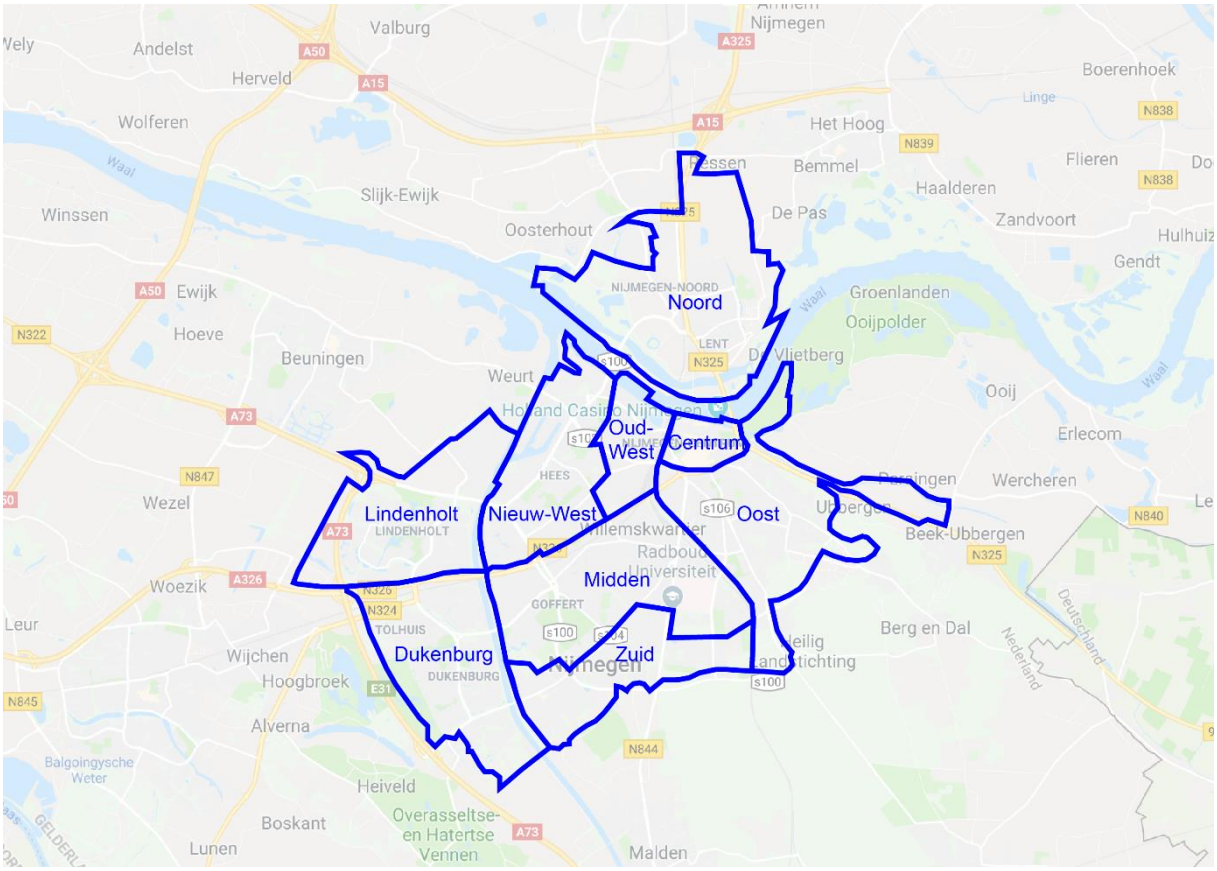


Figure 4-3: Division of boroughs in Nijmegen (own illustration; based on Google Maps (2018b))

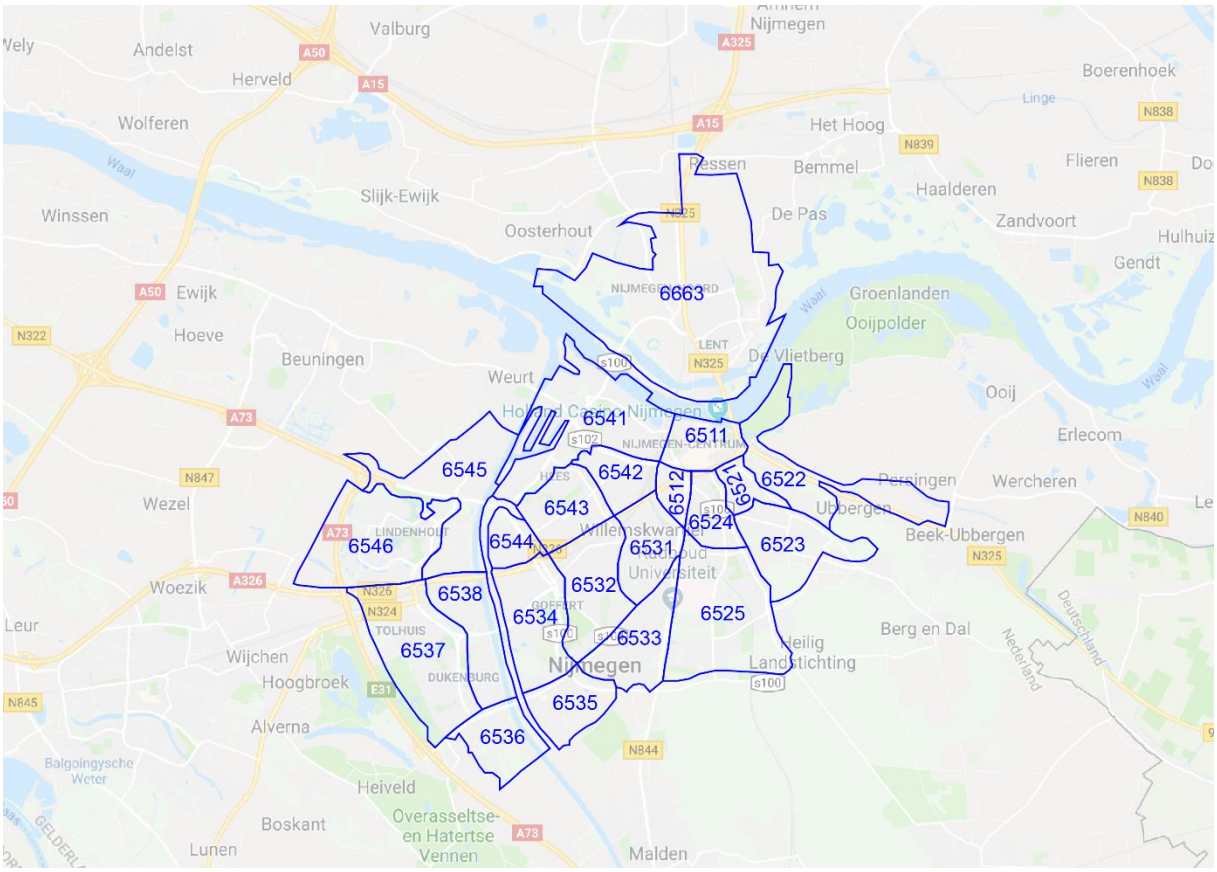


Figure 4-4: The four-digit postal code areas in Nijmegen (own illustration; based on Google Maps (2018b))

4.4 Causes of unique position

This paragraph discusses the various causes for the house prices increase in Amsterdam. The causes are divided into demand and supply. When possible, an additional distinction among the three different tenures (owner, private rent, social rent) that are applicable in Amsterdam and Nijmegen is made and the link is made with the building developments in the cities as described. Subsequently, two paragraphs will discuss the different costs and income related factors, which are derived from existing house price models as described in Table 3-1 in the previous chapter.

4.4.1 Demand

This paragraph identifies some demand-driven causes for the rising house prices in Amsterdam. The causes are split in national and international demand.

4.4.1.1 Decision making and place utility

Beer and Faulkner (2011, pp. 31-32) create a 'housing transition framework' that divides several events into five 'dimensions' that are of important (potential) influence of housing decisions. These 'dimensions' concern the following topics:

- Life course
- Health
- Housing history
- Economic resources
- Aspirations

Subsequently, the dimensions are linked to the different life phases individuals go through. Although the financial and demographic constraints that once were in place are slowly fading (Beer & Faulkner, 2011, p. 32), there are still some often-occurring events that form important reasons for housing transitions. This is exemplified by young adults leaving their parents' home: education, employment and relationships are important reasons to do so (Beer & Faulkner, 2011, p. 64).

This life cycle approach is used by Wolpert (1965), who is one of the progenitors of the housing decision making theory. A connection is made between this approach and decision making: the decision to migrate is made when the utility weighs up against the difficulties caused by the change (Wolpert, 1965, p. 161). This threshold is 'subjectively determined', and evaluates if the social and economic efforts are worth the 'attainment'. The threshold is adjusted to the 'attainable'. Hence, satisfaction lowers the 'level of attainment', whilst dissatisfaction tends to lead to active searching (Wolpert, 1965, pp. 161-162). Within this utility, *'place utility'* is the component that is obtained from the 'attainment' of the stationary place. Place utility is based upon the concept of Herbert Simon's 'intendedly rational' man (as cited in Wolpert, 1965, p. 161), who is, despite being limited to 'perceive, calculate, and predict' the environment, capable of choosing between different alternatives by estimating the utility. The 'attainment' depends on the experience of the man itself and his peers (Wolpert, 1965). Beer and Faulkner (2011, p. 30) notice a similar relationship between identity and the 'role of housing' herein.

4.4.1.2 Urbanisation

Since day and age, young adults are moving to the cities to follow education, and subsequently find a job and a partner (PBL, 2015). Whilst (the large) Dutch cities hardly grew during the 1970s and 1980s because the countryside formed an attractive environment to raise children, the past 25 years show an upheaval: the cities' population is growing fast (Hekwolter of Hekhuis et al., 2017, p. 26; PBL, 2015). This has partly to do with family formation: Dutch women have an average maternity age of 29, which is amongst the highest in the world, and over five years older than in 1975 (PBL, 2015). This causes young people to reside in the city for a longer period.

Another reason for the population increase is the migration surplus of young adults between 18 and 29. In 2010, this surplus was over 10,000 people, a number which is steadily growing since 2000. The younger half mainly migrates to Amsterdam for educational reasons, whereas the older half comes to the city for employment (J. Jansen & Slot, 2011). This corresponds with the findings of Beer and Faulkner (2011) that are described in the previous paragraph.

4.4.1.3 International business

Next to the national inflow of young adults and the drying stream of (expecting) families leaving the city, Amsterdam is also becoming more popular for immigrants from upcoming countries, such as Brazil, Russia, India and China (the so-called BRIC countries). J. Jansen and Slot (2011, p. 5) confirm this, but add that most immigrants come from Western Europe and the United States. The attraction of these immigrants is led by the strong international position of Amsterdam (Burgers & Van der Waal, 2007, p. 436; Sassen, 2001). Sassen (2001, p. 125) points out that the service economy was already subject to globalisation in the 1990s, but the instream of immigrants is becoming even stronger in the last two decades (CBS, 2018b). Of all Dutch cities, Amsterdam was able to develop this position due to the proximity of an international airport, high-speed train connections and its historical and cultural character (J. Jansen & Slot, 2011, pp. 12-13).

4.4.1.4 Airbnb

A recent and still growing phenomenon is Airbnb (AirDNA, 2018a). This 'peer-to-peer platform offer[s] tourist accommodation in private homes' (Adamiak, 2018), and currently lists 13,000 listings in Amsterdam and 1,250 in Arnhem and Nijmegen (AirDNA, 2018a, 2018b), which is respectively 15.4 and 3.8 per 1,000 inhabitants (CBS, 2017d). With this number of listings, Amsterdam occupies a tenth place in Europe. In 74% of the listings in Amsterdam, the listing concerns an entire home (AirDNA, 2018a). Often, this is thought of as a harmful gentrifying process which leads to an increase in house prices and social cohesion. Ioannides, Röslmaier, and Van der Zee (2018) however, are critical about the harmfulness of the uprise of Airbnb. In their case study in a gentrifying neighbourhood in Utrecht, they are uncertain whether Airbnb 'causes any tangible or intangible negative effects on, for example, the housing market' (Ioannides et al., 2018, p. 15). A similar prudent conclusion is drawn by Sheppard and Udell (2016, pp. 39-40), who discover a 6% to 11% increase in house prices when the number of Airbnb listings double but nuance this by stating that rising prices may 'not diminish community well-being' and that this topic 'requires deeper analysis'.

4.4.1.5 Real estate investors

The final demand-driven cause that will be discussed concerns the influence of real estate investors, either private or institutional. Janssen (2017, p. 15) explains that the current rent level in Amsterdam provides a high initial yield for investors, but that these investors are profit driven and therefore will choose an alternative when other investments turn out to be more rewarding. Home-owners in Amsterdam with a portfolio containing 2 to 9 dwellings are estimated to buy more than 15% of the total number of dwellings (Janssen, 2017). The market share of larger (institutional) investors is indistinct. However, in the United States, real estate investors of different scales buy dwellings with a discount of 8.0% to 13.6% (Allen, Rutherford, Rutherford, & Yavas, 2017), which makes it likely that in the Netherlands, a same effect is occurring. Moreover, in the Netherlands, the financialization and the process of quantifying real estate assets has taken a leap forward, which means that the role of the underlying real estate has become less important to these investors (Van Loon & Aalbers, 2017). On this scale level, the individual dwelling price and value does not necessarily matter anymore, as long as the portfolio pays off.

Besides their direct influence on the actual market, investors also influence the housing market indirectly by their role in the determination of the house prices and market value (Crosby, Devaney, Lizieri, & McAllister, 2015). For example, during the financial crisis, real estate investors (in the United Kingdom) did the latter: depending on their interest - which may be either long-term or short-term - investors influenced independent appraisers by steering towards their desired depreciation of their real estate (Crosby et al., 2015).

4.4.1.6 Unemployment rate

Subsequently, strong relations are found between interest and unemployment on the one hand and transaction price, ‘the ratio of list price to transaction price’ and the rate of sales. From these relations, three main conclusions are drawn. The first conclusion is that the ‘demand depends on price, unemployment and interest’ (De Wit et al., 2013, p. 227), whilst ‘supply depends on price’ (De Wit et al., 2013, p. 227).

The third and last conclusion is that a high level of unemployment also leads to a lower list price (De Wit et al., 2013, p. 227). However, the negative influence of unemployment and/or high interest on the price is contradicted by Genesove and Mayer (2001, p. 1235), who found that on Boston’s declining housing market during the 1990s, prices for apartments are set 25-35% above the expected selling price to limit a potential loss. This loss aversion resulted in higher selling price of 3-18% of the before mentioned percentage (Genesove & Mayer, 2001, p. 1255).

Figure 4-5 shows the development of the unemployment rate during the period from 1995 until mid-2017. Since there is not one dataset covering the whole period, the two sets that do cover the complete period are shown with their overlapping period, so the difference between registered unemployment (CBS, 2010) and actual unemployment (CBS, 2017b) becomes clear. The unemployment rate shows clear signs of cyclicality. This is confirmed by Elsby, Michaels, and Solo (2009), who find that both the inflow (job losers) and outflow (job finders) contribute to the concept of cyclical unemployment.

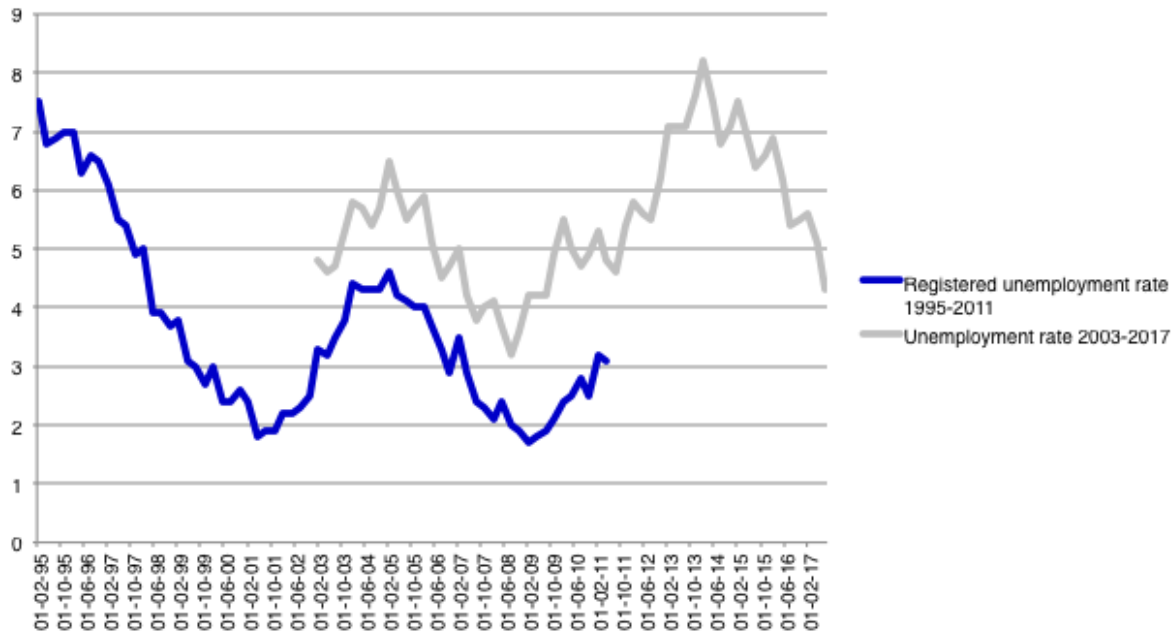


Figure 4-5: Unemployment rate 1995-2017 (own illustration, based on (CBS, 2010, 2017b))

4.4.2 Supply

4.4.2.1 Building volume

The Dutch government has an extensive influence on the realised building volume (Boelhouwer & Lamain, 2012, p. 4). The Netherlands have a rich history of well-planned spatial development, of which the seventeenth century Amsterdam canals, Berlage's Plan Zuid dating back to 1917 and the 1934 General Extension Plan (Dutch: Algemeen Uitbreidingsplan) are typical examples (Bakker, 2008). This paragraph concisely describes the developments of the Dutch spatial planning policy since the 1970s, along with its drivers and the consequences for the Netherlands in general and Amsterdam in particular. Lastly, the most recent developments are briefly set out.

On a national scale and with a similar time range as this research, Van der Wouden (2016a) created an overview that covers the leading policy documents, their origin and their consequences. This paper will form the basis of this paragraph, and is supplemented by another work of (Van der Wouden, 2016b) and Sociaal-Economische Raad (2001), to create a complete picture. A decade after World War 2, when the housing shortage was getting solved, the fear of 'unmanageable metropolises' and thereby the decay of the surrounding nature zones (Ministry of Infrastructure and Environment, 2012, p. 20). This is why urban planners started thinking about 'bundled de-concentration' of the large Dutch cities (Van der Wouden, 2016b, p. 10). It took until 1972, when the Second Spatial Planning Note (Dutch: Tweede Nota Ruimtelijke Ordening) was introduced, to substantiate this idea. To de-concentrate the large cities, multiple towns were appointed as 'growth centres' (Dutch: groeikernen) to grow substantially to accommodate thousands of families. The municipalities of Almere, Haarlemmermeer and Purmerend are examples of this policy (Ministry of Infrastructure and Environment, 2012). The execution led to a severe decrease of the number of inhabitants of Amsterdam (Van der Wouden, 2016a, p. 14).

After this period of suburbanisation with the emphasis on a righteous division of utilities throughout the country, the upcoming rivalry between cities and the disappearance of large industrial employment from the larger cities caused a diversion in the ‘national spatial strategy’: the Fourth Spatial Planning Note mainly aims to restore the economical position of the urban environments. This meant that aside from the growth centres, plans were made for inner-city (re)development and the construction of residential areas attached to the city. Besides, the government stepped aside from its pro-active role and adverted public-private partnerships as a new way of working (Van der Wouden, 2016b, p. 14). The Eastern Docklands and Nieuw Sloten are examples of either development. Van der Wouden (2016a, pp. 19-20) concludes that the persuasiveness of its urgency and the implementation on different policy scale levels is the main achievement of the Fourth Spatial Planning Note. Besides, the inner-city development is positively judged by both the (local) government and its inhabitants.

The Fifth (and so far the last) Spatial Planning Notes abandons the idea of an engineerability of the built environment and chooses a process-based approach wherein quality and policy-making are important themes (Sociaal-Economische Raad, 2001). However, the policy never came into force (Van der Wouden, 2016b, p. 17).

Most recently, the building volume in the Dutch cities is too low to cope with the inflow of young adults. Although cities are often able to work as a sponge, for example by splitting dwellings, the growth can’t be fully met within their former or current housing stock (PBL, 2015). This mechanism however is partly due to the lack of building volume: the number of households grows faster than the number of dwellings. The expectation is that the sponge effect will turn around when the number of newly built dwellings exceeds the growth in households (PBL, 2015, p. 144).

In Amsterdam, the number of newly built dwellings since 2012 varies between 2,449 in 2013 and 5,362 in 2015, with an average of 3,908 dwellings per annum (CBS, 2018c). This is not enough to reach the prolonged target of 50,000 dwellings in the period of 2016-2025 (Municipality of Amsterdam, 2016c, p. 57), although a clear difference can be noted between the period 2012-2014 (average of 2,670 dwellings;) and 2015-2017 (average of 5,146 dwellings) (CBS, 2018c).

4.4.3 Costs

4.4.3.1 Fiscal treatment and loan capacity

Another relation with the house price development that is found by Boelhouwer (2001, p. 76), is the loan capacity; this hypothesis is backed by the period 1982-1998, wherein this relationship is strongly visible.

The loan capacity depends on a number of factors (Boelhouwer, 2001, p. 69):

- Interest rate
- Credit terms
- Income

The household income will be discussed in Paragraph 4.4.4.2, whereas the interest rate will be reviewed in the following paragraph. That leaves the credit terms, which is determined by banks, whether or not directed by the government (Boelhouwer, 2001; Francke et al., 2015).

Francke et al. (2015) explain that the mortgage lending policy relaxed in the 1990s and 2000s, which was due to new financial products and legislation that allowed the second income to be partly included in the maximum loan capacity. After the financial crisis, certain financial products were (partly) excluded from mortgage interest deduction (Dutch: hypotheekrenteaftrek) or even completely banned, and the Loan-to-value ratio (LTV) was lowered to a maximum of 100% of the asset value. The influence of the credit terms explained 28% of the house price developments in the period 1995-2007. The fall of house prices after the crisis also coincides with the stricter lending policy.

Apart from indirect influence of government policy on the previously discussed causes, Boelhouwer and Lamain (2012, p. 4) distinguish their influence on the capital markets. Herein, an alteration in the ‘fiscal treatment’ is mentioned as an example (Boelhouwer & Lamain, 2012, p. 11). In an earlier work of Boelhouwer (2001), this example and others are elaborated upon.

4.4.4 Interest rate

Another parameter is the long-term interest rate. This rate is derived from the coupon rent that is given on a ten-years to maturity government bond. Normally, this rate is provided annually, and the bond is redeemed by the government at maturity. The long-term rent is important for the housing market, since this rent forms an essential part of the mortgage interest rate and is heavily correlated (Koijen, Van Hemert, & Van Nieuwerburgh, 2009, p. 293). The mortgage interest rate is for example used by Verbruggen et al. (2005) and De Vries and Boelhouwer (2005). Since January 1995, the rate lowered from 7.59% to -0.006% in July 2016 (Investing.com, 2017). Droës and Van de Minne (2015) use a similar macro-economic statistic in their long-term house price model: the opportunity cost of capital (OCC). The used OCC is based on the 5-year-annuity mortgage interest rate combined with an addition of 2% for ‘rental returns minus maintenance expenditures’, wherefrom the inflation is deducted (Droës & Van de Minne, 2015, p. 11). De Wit et al. (2013, p. 227) conclude that when interest rates are high, waiting for a purchase loses revenue, which causes the list price to lower and the rate of sale higher.

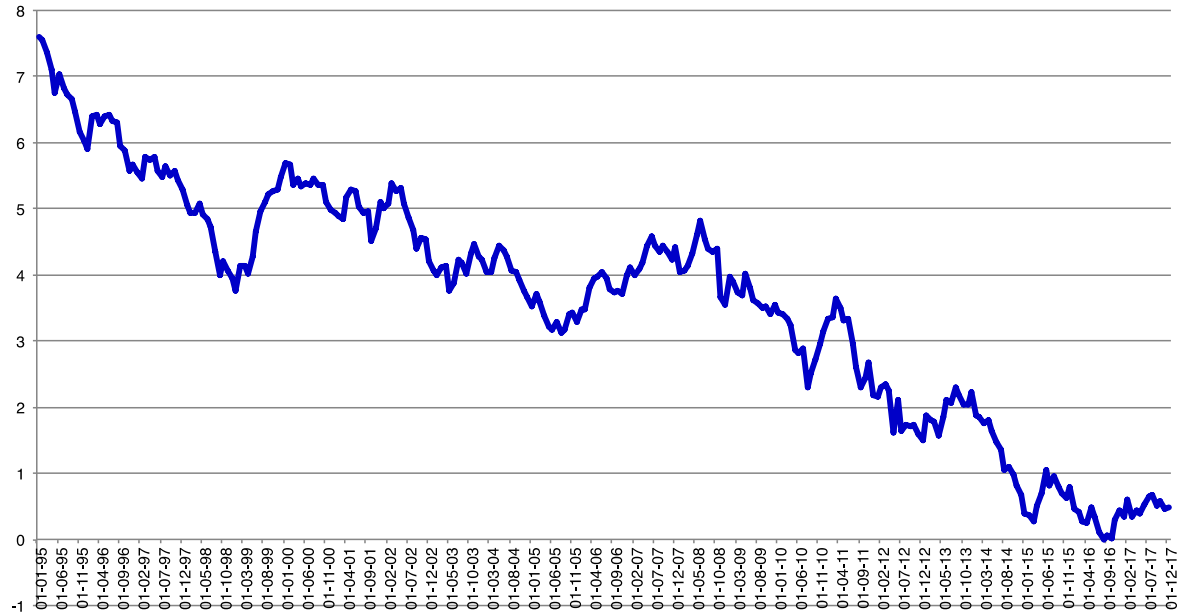


Figure 4-6: Ten-year treasury bond 1995-2017 (own illustration, based on Investing.com (2017))

4.4.4.1 Rate of sale

A descriptive statistic that is only used in one model is the rate of sale. The rate of sale expresses the market liquidity and is calculated by dividing the number of houses sold in the current month' by 'the houses on the market at the start of the month'. Figure 4-7 displays the rate of sale for the period of 1986-2007. The rate of sale went from 20% in the 1980s to nearly 50% in 1999. Shortly after, the rate dropped back to under 20% in 2002 (De Wit et al., 2013, p. 225).

The NVM (n.d.) makes use of a similar rate: the housing shortage indicator (Dutch: krapte-indicator), which is the result of dividing the supply in the middle of a quarter by the number of transactions in that quarter; it is a reversed variant of the rate of sale used by De Wit et al. (2013, pp. 224-225). The outcome is sorted in one of three categories:

- If the indicator is below 5, there is a seller's market
- If the indicator is between 5 and 10, there is a balanced market
- If the indicator is above 10, there is a buyer's market

Currently, the national housing shortage indicator is 3,8 (Boumeester, 2018), which indicates a seller's market. This corresponds to a rate of sale of 0,26, as used by De Wit et al. (2013, pp. 224-225). The current rate of sale or shortage indicator tells us that the current house price development will probably last for another period (Boumeester, 2018, p. 1).

It is remarkable that Verbruggen et al. (2005, p. 11) finds that the only period that t showed a discrepancy (of 14%) between he previously mentioned wage income, capital and the interest rate one the one hand and the house price on the other was in the year 2000, when the shortage was extreme.

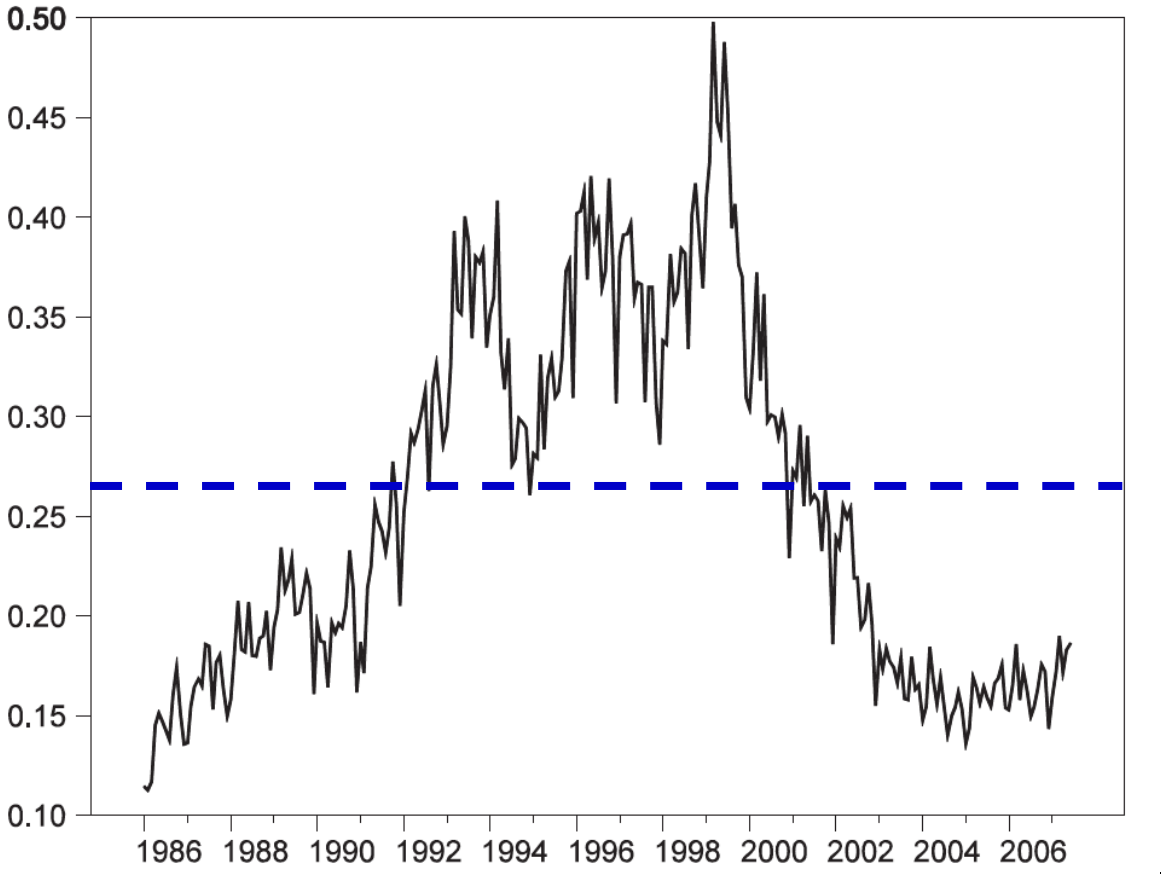


Figure 4-7: Rate of sale, with the current housing shortage indicator score (Boumeester, 2018; De Wit et al., 2013, p. 225)

4.4.4.2 Household income (GDP)

The Gross Domestic Product (GDP) is an indicator of the economic performance of a country (Lepenies, 2013). The GDP of The Netherlands has been rising almost constantly in the period from 1995 until 2016, with a small decline in 2009 and 2012. Since 2009, the average annual growth is 1.2%, whereas the previous period, the average was 5.3% per annum. Corrected for the population growth, these percentage decrease to respectively 0.77% and 4.9% (CBS, 2017c, 2017f). Droës and Van de Minne (2015) use the GDP per capita to integrate welfare growth in their house price model. Increase in welfare increases the demand in housing, which consequently drives up the house prices.

A similar concept is the business cycle, which is a macroeconomic concept that explains the recurrent pattern of upswings and recessions that occur in economic activities (Aimar, Bismans, & Diebolt, 2016, p. 1). Different economists have developed models that describe this business cycle, who tend to assign a bandwidth of time to the reoccurrence of the cycles (Grinin, Korotayev, & Tausch, 2016, p. 5). The cycle consists of four phases: expansion, recession, contraction and revival (Aimar et al., 2016; Grinin et al., 2016, p. 5). In the period that will be subject to this thesis, from 1995 until 2017, the different phases clearly show, with the global financial crisis in 2007-2008 as the most important example of a recession. De Bandt, Knetsch, Peñalosa, and Zollino (2010, p. 120) find that the EU aggregate housing market greatly correlates with the GDP, which is largely due to the business cycle. However, they also find that the housing market partly depends on country-specific aspects.

Instead of the GDP per capita, Verbruggen et al. (2005) use wage income to express the welfare of market players. Since the income distribution – in the USA in 2010, the richest 10% have a share of more than 45% in the national income (Piketty, 2014) – could cause a troubled vision, the approach of Verbruggen et al. (2005) appears more correct. Within a historical analysis, the 8% annual price increase could be largely explained by the welfare growth (Verbruggen et al., 2005, p. 11).

Looking at Amsterdam, the income distribution in the different boroughs shows an obvious connection with two elements: the share of social housing in the borough and the average house price. When a borough contains more than 50% social housing, the average income is fairly low compared to the average house prices in that area (CBS, n.d.).

4.4.5 Consumer price index

Besides the review of five price models, Verbruggen et al. (2005) make a model themselves. Herein, the Consumer Price Index (CPI) plays an important role. The CPI is the Dutch standard for measurement of the inflation rate. Since 1995, the CPI shows an average annual growth of 1.95%. Over a 21-year period, this accumulated to a growth of nearly 50%. During this full period, no decline of the CPI occurred; this most recently happened in 1987 (CBS, 2017e). The CPI is included in all reviewed models to deflate for example the housing costs or the GDP (Droës & Van de Minne, 2015, p. 9). Hence, this variable will not help to explain the wedge between Amsterdam and the Dutch average.

4.4.6 Psychological effects

The last factor that will be discussed is the auto-regression: Verbruggen et al. (2005) and De Vries and Boelhouwer (2005) find that house price development is partly based on the (recent) historical developments: the buyers expect a similar growth in the future and do not want to miss out on the value increase or pay more in the future. In the model of De Vries and Boelhouwer (2005, p. 83), the lagged price level had an explained variance of 47%.

4.4.6.1 Seasonal correction

For their short-term model, De Vries and Boelhouwer (2005) correct for the seasonal effects in their model. They base this on earlier work of Boelhouwer (2001, p. 57), who states that the sale price fluctuates more in the first half of the year than in the latter half.

4.5 Consequences of unique position

4.5.1 Wealth inequality

Arundel (2017, pp. 182-184) identifies rising house prices as one of the drivers that lead to ‘housing wealth polarisation’. Since housing is most people’s largest financial asset, homeownership contributes considerably to one’s equity (Arundel, 2017, p. 179); in the Netherlands, homeowners have a median equity of €116,500, against €2,800 for renters (CBS, 2017g). Although this disparity can partly be explained by the difference in income, as set out in Paragraph 6.2.1, this is also due to the wealth inequality caused by (the lack of) homeownership. However, homeownership is mainly accessible for higher income groups. This leads to inequality on two levels: the increase of property value leads to more wealth for insiders, as well as a ‘greater

barrier' for market entrance. However, this is contradicted by the situation before the GFA, wherein the possibility of lower income groups to become homeowners by more easily acquiring loans enabled homeownership. However, this movement led to this financial crisis, which led to more restrictions on mortgage distribution (Arundel, 2017, p. 183).

4.5.2 Displacement (Dutch: verdringing) and segregation

Segregation is described as the degree of clustering by a certain population category within an urban area (Van Dam et al., 2010, p. 31). The transition from an industrial economy towards a service economy caused a large redistribution of income between different groups. Moreover, different waves of immigration led to a multi-ethnical society (Van Dam et al., 2010, p. 30).

There are two explanations for the origination of segregation: the first reason is that people from one category like to live together and act on that. The second reason is that people can't live wherever they can, and thus are forced to live in a number of areas of a city (Van Dam et al., 2010, p. 37). The latter explanation can be the result of rising house prices.

Although the level of segregation is minimal in an international context, there are clear signs of displacement on the Dutch housing market, whereby the success rate of willing house buyers diminishes (Dol & Kleinhans, 2011). These house buyers will start seeking elsewhere. This goes back to the earlier statement of Van Dam et al. (2010) that people can't live wherever they want anymore.

4.6 Conclusion

Both cities are founded as medieval towns, which is better preserved in Amsterdam than in Nijmegen when looking at the building periods in the respective cities. While Amsterdam expanded the city during the 17th century, Nijmegen remained unchanged until the end of the 19th century. Both cities pass through a period of growth during the first decades of the 20th century, which is continued after the Second World War. In Nijmegen, the growth stagnates in the 70s, whilst Amsterdam executes inner-city developments. The last decades, Nijmegen hopped over the river Waal, where a village was annexed and a Vinex-neighbourhood was developed. In Amsterdam, the artificial islands of IJburg and the development of the 'Houthavens' in the former wood docks are the latest examples of expansion.

Besides, there are several demonstrable causes of the fast-increasing house prices. This list of causes is not exhaustive, but provides a good indication of the many forces that work on the housing market.

- Decision making and place utility: people choose to move when the new dwelling have more place utility then costs. Moreover, they tend to compare themselves with peers and strive for a certain identity. Besides, education and employment are widely available in Amsterdam.
- Urbanisation: the attraction of mainly young adults is an old phenomenon and due to the decreased popularity and the associated delayed parenthood, the number of young adults is accumulating.
- International business: Amsterdam has a great international connectivity, with a large airport and many internationally operating organizations who choose

Amsterdam as (one of) their location. This attracts expats from upcoming and renowned countries.
- Airbnb: 2.5% of the dwelling is rented out through Airbnb. This drives up the prices, although the extent is doubted by researchers.
- Real estate investors: financialization of real estate by large (institutional) investors and the favourable yields for smaller (particular) investors have a disruptive force on the market, both directly and indirectly.
- Building volume: the previous points concerns the increasing demand of dwellings in Amsterdam. The supply on the other hand depends on national and local politics and on investors and construction companies that initiate new, large scale projects. The last years, the amount of newly built dwellings was lower than policy documents described. However, even more recent, the building volume started increasing.

The increasing prices also have consequences for the city and its inhabitants:
- Wealth inequality: the increasing house prices leads to capital inequality in two ways: firstly, low income groups are unable to foreclose a mortgage. Secondly, high income groups who do have this ability, build capital when the value of their house increases.

Displacement and segregation: the people who can't afford dwellings on their preferred location anymore, are being displaced to less favourable areas. When certain socio-economic groups start clustering in a neighboorhood, this is called segregation. In an international context, the level of segregation in the Netherlands is fairly limited.

5 Hedonic price model

The development of a statistical model includes several steps before the actual model can be built: firstly, the data needs to be collected; subsequently it can be checked for irregularities, filtered and structured. These actions are not predetermined, which makes an explanation and justification of the decisions taken helpful. Although this is party been done in the method, this chapter will commence with a further explanation of the data use and the filter applied.

Then, the actual model is discussed. The creation of the final model is accomplished after multiple previous versions were made and reviewed. The preliminary models were reviewed by a comparison with the results of the literature study, whilst taking the 'danger of over-fitting' (Field, 2009, p. 213) and the practical relevance of the regressors – what price difference would be created between an open and a closed porch compared to all other features of a house have? - in consideration. The final model is the result of a stepwise regression performed on the cases that are located. Subsequently, this model is tested on three other subsets: on the one hand the cases in Nijmegen, which depicts the Dutch average; on the other hand, it is applied to the cases in Amsterdam again, but this time with a partition of the cases that were sold before and after the crisis, using the first of January 2008 as the demarcation point. This division is made to find evidence for the changed house price relationship between Amsterdam and the rest of the Netherlands that is witnessed since the crisis. Figure 5-1 provides a graphical representation of the process.

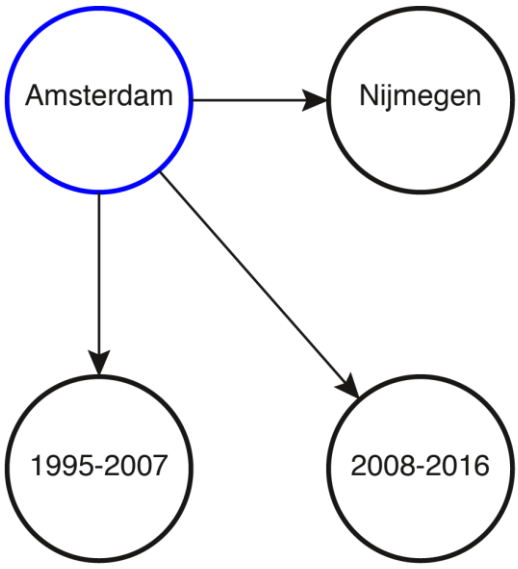


Figure 5-1: Model creation and validation on different subsets (own illustration)

In this chapter, the designed hedonic price model will be presented, taking the different steps of the creation as a guideline. To do so, firstly, the original dataset and its source are mentioned, and the processing of the dataset and the application of filters will be described. Subsequently, the results of the descriptive statistical tests will be set out and a division of objective and subjective variables will be made. In Paragraph 5.3 discusses the composition of the model and the process that leads to the final result. Finally, the model will be presented. Herein, the specifications of the general Amsterdam model are discussed first. Then, the main differences between Amsterdam and Nijmegen are set out. The paragraph ends with the comparison of the situation in Amsterdam before and after the financial crisis. The chapter finishes

with a conclusion that answers the sub question: “can the dwelling characteristics explain the difference between the Amsterdam market and the Dutch average?”

Unless stated otherwise, all figures and tables that are presented in this chapter are derived from the filtered dataset as provided by the NVM.

5.1 Data processing and filter application

When performing statistical analysis on a dataset, it is important to suppress the unwanted influence of outliers that occur among the cases (Field, 2009, pp. 215-219). In this paragraph, a concise explanation about the process, along with some examples, is presented.

When the data was submitted to a first scan, two reoccurring conspicuities emerged: missing and/or incorrect data and the difference in objective and subjective variables. Both issues are discussed in this paragraph.

Firstly, there were numerous cases with missing or incorrect data, which has been checked by creating several new variables that express the ratio between two variables. An example is the ratio between the volume and the floor space, which approaches the average floor height, whose range is set between two and seven metres, since this covers the minimum headroom and a height that only occurs in luxurious homes. Similar ranges and filters are applied on other variables. Another example concerns the mean number of bathrooms in both Amsterdam and Nijmegen is smaller than one. A closer look at the frequency table learns that according to the delivered dataset, 19,797 or 12.7% of the remaining cases would not have a private bathroom and a similar number of cases wouldn’t feature a toilet. For the latter one, it is possible that only separate toilets are inserted in the database of the NVM, but this can’t be the cause for the number of bathrooms. Hence, both variables display serious amounts of missing data and therefore are excluded from the model.
The detailed description of these examples and the rest of this process can be found in Appendix C.

The second noteworthy issue probably derives from the negligence of the real estate brokers who entered the data and mainly appears at more subjective variables. The subjective variables are based on the judgment of the concerned broker and include topics as the indoor and outdoor maintenance level, the monumental looks of the dwelling and the positioning, but also more objective topics as the orientation of the garden and the insulation topics are mainly checked and filled in when it positively affects the price. This didn’t only affect the filtering process, wherein cases missing data concerning these subjective variables were excluded, but it also influences the model, since the remaining cases show a clear bias towards certain values. This will be explained in the next paragraph.

Finally, SPSS provides the option to identify duplicate cases, based on the variables that are selected by the user. By using the postal code, house number including suffix and the entry date, several duplicate cases were discovered and removed from the dataset.

After all filters were applied and missing and duplicate data were excluded, 147,110 cases remained, or 85.1% of the initial dataset. The descriptive statistics of the

remaining cases are elaborated upon in the following paragraph. Of these cases, 121,849 are in Amsterdam, whereof 57,840 are sold before the first of January 2008 and 64,009 after. 25,261 cases are from Nijmegen.

5.2 Descriptive statistical tests

In this paragraph, an overview of the descriptive statistics, along with some annotations of remarkable outcomes, is given. Herein, a division between numeric and nominal data is made. The numeric data is presented first in a concise table. The nominal data will be reported more extensively, since for these variables the data does not have a numerical order (Field, 2009, p. 22). Besides this division, the data will be split based on location to show the differences between the two cities. For the descriptive statistics of the cases in Amsterdam before and after the crisis, the differences are minor and therefore are ignored during the analysis.

Variable	*Mean*		*Median*		*Std. dev.*	
	Amsterdam	*Nijmegen*	*Amsterdam*	*Nijmegen*	*Amsterdam*	*Nijmegen*
Sales time (days)	83	94	48	52	92	105
Original price (€)	288,045	213,062	225,000	180,605	228,712	123,758
Transaction price (€)	278,008	201,631	219,000	172,500	215,737	110,337
Usable floor area (m^2)	88	115	79	110	44	44
Price per m^2	3,135	1,779	3,010	1,747	1,252	601
Volume (m^3)	249	349	212	335	139	157
Plot size (m^2)	44	154	0	139	234	283
Number of floors	1.49	2.30	1	2	.78	.96
No. of rooms	3.28	4.28	3	4	1.31	1.40
No. of balconies	.55	.35	1	0	.50	.54
No. of dormers	.02	.15	0	0	.15	.37
No. of roof terraces	.12	.07	0	0	.33	.25
No. of attics	.04	.23	0	0	.19	.42
No. of lofts	.01	.06	0	0	.11	.25
Presence of lift	.18	.07	0	0	.39	.25
No. of indoor parking	.02	.03	0	0	.15	.18

Table 5-1: Overview of descriptive statistics of numeric variables (own illustration)

5.2.1 Transaction price

Looking at the mean and median of the price in Table 5-1, it stands out that in both cities, the median is lower than the mean, which is a sign that the data is not normally distributed, but instead has a positive skew. In Figure 5-2, this becomes clearer: the bulk (~50%) of the transaction prices lies between €165,000 and €330,000 and €136,000 and €236,000 in respectively Amsterdam and Nijmegen. However, there also are thousands of dwellings that are sold for more than €1,000,000, which causes the standard deviation to be nearly the same size as the average transaction price.

Figure 5-2: Frequency of transaction prices in Amsterdam and Nijmegen (own illustration)

5.2.2 Plot size

Another variable where an interesting difference between de mean and the median appears is at the plot size. Here, the median in Amsterdam is 0, which in practice means that more than half of the sold properties does not concern full ownership but a condominium (Dutch: appartementsrecht). This condominium "includes a share in the commodities that are involved in the division into the condominium, which gives the authority to the exclusive use of determined parts of the building", according to art. 5:106 lid 4 BW. The outcome of the median is congruent with the frequency of the variable 'CATEGORIE', which consists of four categories - house, apartment, development land and garage box - of which the latter two are excluded. A more detailed breakdown of the different dwelling types is available in Paragraph 5.2.6.

City	*Category*	*Frequency*	*Percentage*
Amsterdam	House	16,082	12.4%
	Apartment	113,742	87.6%
Nijmegen	House	15,918	61.0%
	Apartment	10,166	39.0%

Table 5-2: Division of houses and apartments in Amsterdam and Nijmegen (own illustration)

The large share of apartments also strongly influences the standard deviation of the plot size that is larger than the mean itself, especially in Amsterdam.

5.2.3 Other dwelling characteristics

The remaining numeric descriptive statistics mainly involve the dwellings' characteristics, expressed in the number of floors, attics, et cetera, and the presence of indoor parking and a lift. Except for the number of floors and the number of rooms, which, the presence of the relevant variable is marginal since they behave dichotomous and the features are often absent – the median is mostly 0 – but nonetheless statistically relevant. This binary character also impacts the standard deviation, which becomes relatively large in relation to the mean.

The number of floors clearly corresponds with the dwelling type: in Amsterdam, where the fast majority of the dwellings are apartments, the median number of floors

is 1. In Nijmegen the median number of floors is 2, which on its turn matches with the 61,0% share of houses in the total number of transactions.

Finally, the number of rooms is larger in Nijmegen than in Amsterdam, which seems a natural consequence of the larger usable floor area in Nijmegen. The result from the Spearman's rho correlation test is 0.738, which is on the brink of the maximum correlation that Field (2009, p. 224) suggests (0,8-0,9) and thus should be kept an eye on. However, this will be ironed out during the model making by using the previously described VIF methodology (Paragraph 2.3.2).

5.2.4 Building period

The first nominal variable that will be discussed is the building period. This variable is categorized as 'objective', since the building periods largely correspond with the data of the overall housing stock by the CBS (2017h). In Amsterdam, most of the cases are built before the 1930s, whereas in Nijmegen most dwellings are constructed after the Second World War.

City	*Period*	*Frequency*	*Percentage*
Amsterdam	1500-1905	23,056	17.8%
	1906-1930	38,067	29.3%
	1931-1944	11,392	8.8%
	1945-1960	5,921	4.6%
	1961-1970	12,629	9.7%
	1971-1980	4,940	3.8%
	1981-1990	12,494	9.6%
	1991-2000	14,448	11.1%
	2001-	6,877	5.3%
Nijmegen	1500-1905	1,180	4.5%
	1906-1930	3,736	14.3%
	1931-1944	2,355	9.0%
	1945-1960	4,072	15.6%
	1961-1970	5,385	20.6%
	1971-1980	3,592	13.8%
	1981-1990	2,741	10.5%
	1991-2000	1,917	7.3%
	2001-	1,106	4.2%

Table 5-3: Building period of the cases, divided by city (own illustration)

5.2.5 Location

The location of the cases is initially based on the four-digit postal code, which approaches the district (Dutch: wijk) level of the CBS statistics that provides information about the demography and utilities (CBS, 2017a). When a clear division on a higher scale level (e.g. borough (Dutch: stadsdeel)) becomes noticeable during the creation of the model, this also will be researched.

In Figure 5-3 and Figure 5-4, the distribution of the cases in Amsterdam and Nijmegen is set out on the map. The degree of overlay indicates the number of cases in that postal code area. The neighbourhood that is fully covered contains the most cases, which is 4,530 and 1,933 for respectively Amsterdam and Nijmegen. The distribution roughly derives from the combination of the number of dwellings and the percentage of these dwellings that is owned by housing corporations (CBS, 2017a).

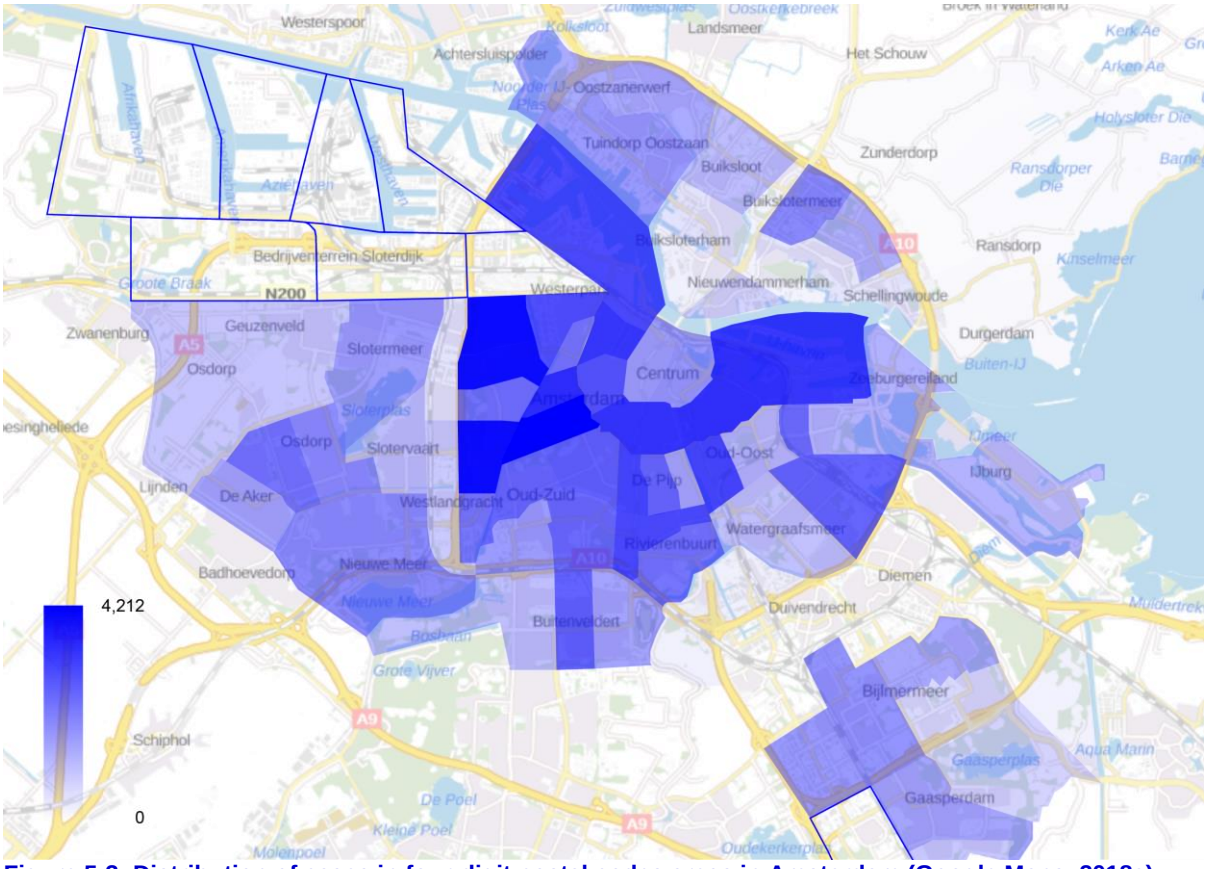


Figure 5-3: Distribution of cases in four-digit postal codes areas in Amsterdam (Google Maps, 2018a)

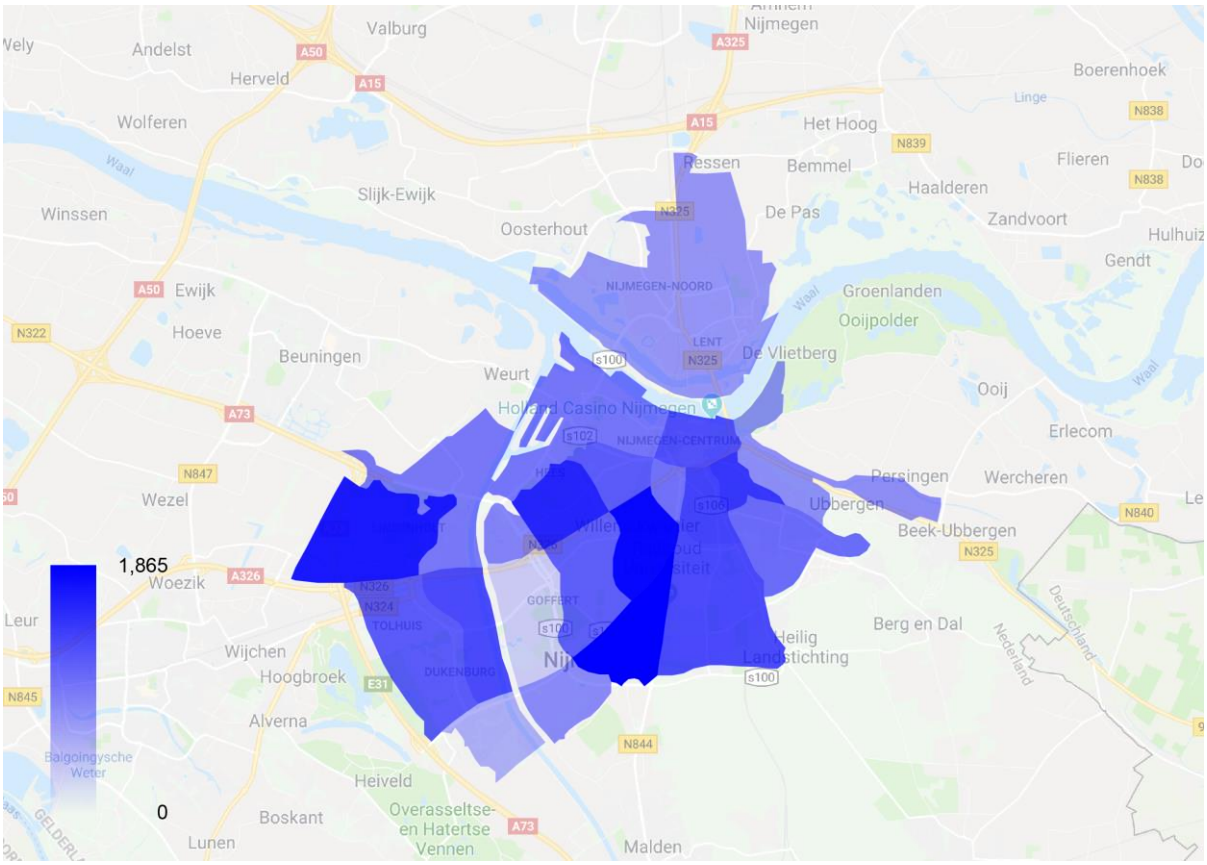


Figure 5-4: Distribution of cases in four-digit postal codes in Nijmegen (Google Maps, 2018b)

5.2.6 Dwelling type

A variable wherein the subjectivity of the categories and the real estate brokers that appoint them becomes visible is the variable ‘dwelling type’. The difference between a mansion and a canal house is debatable, just as the indication ‘simple’ can be applied to most other dwelling types. Nevertheless, it becomes clear that Amsterdam mostly consists of upstairs apartments and ground floor apartments. Whereas Nijmegen has mostly single-family homes.

City	*Period*	*Frequency*	*Percentage*
Amsterdam	Single-family	10,270	7.9%
	Mansion	3,288	2.5%
	Ground floor apartment	16,967	13.1%
	Upstairs apartment	68,389	52.7%
	Maisonette	4,580	3.5%
	Porch apartment	12,074	9.3%
	Gallery flat	10,391	8.0%
	Other	3,865	3.0%
Nijmegen	Single-family	12,660	48.5%
	Mansion	1,860	7.1%
	Ground floor apartment	1,387	5.3%
	Upstairs apartment	1,945	7.5%
	Maisonette	545	2.1%
	Porch apartment	4,676	17.9%
	Gallery flat	1,562	6.0%
	Other	1,449	5.5%

Table 5-4: Dwelling type per city (own illustration)

5.2.7 Maintenance level

The maintenance level of the dwellings is divided in the inside and outside maintenance level and is the first and most striking example of the negligence of the real estate brokers that enter the information in the NVM database. In both cities, there are hardly any dwellings that are appraised as bad or mediocre, while 88.7% of the dwellings in Amsterdam and 79.0% in Nijmegen are labelled good or excellent. This lack of reliability and diversity make this variable undesirable to use in the model. By recoding the variable into two categories, wherein ‘bad’ up to and including ‘reasonable to good’ are merged, as well as the three remaining categories, the expectation is that a clear difference between maintenance levels will become visible.

City	*Maintenance level*	*Frequency*	*Percentage*
Amsterdam	Bad to reasonable	14,727	11.4%
	Good to excellent	115,097	88.7%
Nijmegen	Bad to reasonable	5,489	22.1%
	Good to excellent	20,595	79.0%

Table 5-5: Maintenance level inside (own illustration)

City	*Maintenance level*	*Frequency*	*Percentage*
Amsterdam	Bad to reasonable	5,535	4.3%
	Good to excellent	123,189	95.8%
Nijmegen	Bad to reasonable	2,761	14.5%
	Good to excellent	22,323	85.6%

Table 5-6: Maintenance level outside (own illustration)

5.3 Model composition

The model is mainly created in three steps, which is loosely based on the hedonic price study by Visser and Van Dam (2006) and is already described in Chapter 3:

1. Dwelling characteristics
2. Environmental characteristics
3. Period/economic characteristics

The gradual steps provide circumstances that are beneficial for the model. Firstly, the addition of regressors checks for the robustness of the model. When the remaining regressors behave constant, this is usually a sign that the regressors are reliable (Lu & White, 2014, p. 194). Besides, it offers the opportunity to study the effects of the different variables without the immediate suppression by the environmental and/or the economic characteristics.

In contrast with Visser and Van Dam (2006, p. 121), who presume that all households have similar preferences concerning the dwelling and location characteristics, the used structure of the model, as displayed in Figure 5-1, provides the opportunity to differentiate per city. Hence, the model assumes that this 'homothetic' (Visser & Van Dam, 2006, p. 121) behaviour only occurs within the different subsets, but that the preferences can deviate per city or period.

For the first step, the findings of the literature study formed the basis of the stepwise implementation of the different variables. Firstly, the usable floor area, the number of rooms and the building period were entered. Subsequently the dwelling type was added, and so on. The full overview can be found in the next paragraphs, wherein the respective coefficients of the different categories and or variables are shown, together with their standard deviations and their significance. The second and third step were added sequentially, whereby firstly all environmental dummies were entered and in the final step the periodic dummies.
Because the dwelling characteristics are entered in seven tranches, which is based on the literature study in Chapter 3, the development of the overall quality of the model can be traced by the R^2, which represents the 'proportion of data explained by the model' (Field, 2009, p. xxxii), the degrees of freedom (Field, 2009, p. 37) and the standard error of estimates, which indicates the difference between the model's prediction of the dependent variable and the actual dependent variable. Hence, for each step, the R^2 change displays the added explained variance (Field, 2009, p. 236). This gives insight in the influence of the variables in the concerned step and provides the opportunity to compare this influence among the four different models.

For the location dummies, the four-digit postal code area is used. Subsequently, the model was tested by using clusters of postal code areas or boroughs (Dutch: stadsdelen), but this didn't improve the accuracy of the model. However, a couple of areas are merged due to the size of the areas and/or the number of transactions in the area. These mergers are listed in Table 5-7.

New postal code area	*Old postal code areas*
1033	1033, 1036
1035	1035, 1037

Table 5-7: Postal code mergers (own illustration)

5.4 Results Amsterdam

The results of the first and foremost model, which is based on all transactions in the municipality of Amsterdam between the first of January 1995 and the last of December 2016 and including approximately 80% of the dataset, are promising. The different steps in the model each contribute to the explained variance, and the final R^2 of 0.901 is high, according to Visser and Van Dam (2006, p. 126). The model summary is displayed in Table 5-8, whereas the full model is shown Table 5-9. The findings are set out after these tables.

Model summary	*Step 1*	*Step 2*	*Step 3*	*Step 4*	*Step 5*	*Step 6*	*Step 7*
R	0.750	0.795	0.801	0.818	0.826	0.865	0.948
R^2	0.563	0.633	0.641	0.669	0.682	0.748	0.900
Adjusted R^2	0.563	0.633	0.641	0.669	0.682	0.748	0.900
Std. error of the Estimate	0.373	0.341	0.338	0.325	0.318	0.283	0.178
R^2 Change	0.563	0.070	0.009	0.028	0.013	0.066	0.152
F Change	15,427	3,241	1,440	1,671	813	428	2,094
Degrees of Freedom 1	10	7	2	6	6	73	87
Degrees of Freedom 2	119,723	119,716	119,714	119,708	119,702	119,629	119,542
Significant F Change	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5-8: Model summary Amsterdam (n=119,734) (own illustration)

5.4.1 Dwelling characteristics

Looking at Table 5-8 and Table 5-9 simultaneously, it is interesting to determine which variables substantially contribute to the 'R^2 change'. It becomes obvious that the first step, which includes the usable floor area, the number of rooms and the building period, leads to the greatest improvement of the R^2 (0.514). The location and the period of sales have the second and third most influence on the R^2, with a change of 0.089 and 0.151. All the changes can be found in Table 5-8, wherein the coefficients of the different categories and or variables are shown, together with their standard deviations and their significance.

When looking at the coefficients that derive from the different tranches, multiple outcomes are notable. For instance: for the usable floor area, the effect per square meter is limited, but when multiplying the effect with the average size of dwellings in both cities, the total effect is 5.28 in Amsterdam and even higher in Nijmegen: 6.9.

Besides, it is typical that the building period and reference category (1906-1930) that is most common in Amsterdam performs well: only dwellings built before 1905 or after 1990 have a positive price effect, all other periods have a negative price effect compared to the reference category.

Subsequently, the appreciation of the dwelling type deserves attention. Hereby, there are types that 'switch sides': the positive or negative price relative to the reference category changes when the location dummies are added to the model. This happens for the single-family homes and the other dwellings, which is a collection of the less present dwelling types (e.g. house boats, canal houses). The reason for this to occur is the absence of single-family homes in the most popular neighbourhoods, except for a small part of Zuid, and a relatively large share in Noord, Nieuw-West and Zuidoost, which are all three less appreciated neighbourhoods.

The maintenance levels show a result that corresponds with one intuition: a well or excellently maintained dwelling is better appreciated than a mediocre maintained one. The same goes for the heating system: compared to central heating, a gas or coal heater is less current, whilst the presence of solar panels saves energy costs and thus leads to a higher house price. The secondary features also lead to a price increase, just as the presence of a garden. Herein, the orientation of the garden doesn’t matter; to own a garden in Amsterdam is already exceptional.

Variable	*Step 1*		*Step 2*		*Step 3*		*Step 4*		*Step 5*		*Step 6*		*Step 7*	
	Coeff.	*SE*	*Coeffi.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*
Constant	11.667	0.003	11.650	0.003	11.399	0.006	11.460	0.007	11.434	0.007	11.554	0.007	11.821	0.006
Primary features														
UFA (m^2)	0.008	0.000	0.008	0.000	0.008	0.000	0.008	0.000	0.007	0.000	0.006	0.000	0.007	0.000
Number of rooms	0.031	0.001	0.043	0.001	0.047	0.001	0.046	0.001	0.044	0.001	0.055	0.001	0.042	0.001
Building period														
1500-1905	0.097	0.003	0.106	0.003	0.106	0.003	0.073	0.003	0.077	0.003	0.043	0.003	0.032	0.002
1906-1930	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1931-1944	-0.290	0.005	-0.070	0.004	-0.066	0.004	-0.053	0.004	-0.055	0.004	0.004**	0.004	-0.003**	0.002
1945-1960	-0.452	0.004	-0.186	0.005	-0.179	0.005	-0.173	0.005	-0.182	0.005	-0.065	0.005	-0.083	0.003
1961-1970	-0.470	0.006	-0.237	0.004	-0.236	0.004	-0.244	0.004	-0.279	0.004	-0.120	0.005	-0.149	0.003
1971-1980	-0.288	0.004	-0.344	0.005	-0.350	0.005	-0.361	0.005	-0.406	0.005	-0.103	0.006	-0.100	0.004
1981-1990	-0.081	0.004	-0.203	0.004	-0.214	0.004	-0.215	0.004	-0.219	0.004	-0.060	0.004	-0.036	0.002
1991-2000	0.078	0.005	0.011	0.004	-0.008*	0.004	-0.013	0.004	-0.065	0.004	0.032	0.004	0.051	0.003
2001-	0.078	0.005	0.139	0.005	0.120	0.005	0.116	0.005	0.053	0.005	0.156	0.005	0.051	0.003
Dwelling type														
Single family			-0.253	0.004	-0.243	0.004	-0,230	0,005	-0.154	0.005	0.052	0.005	0.096	0.003
Mansion			-0.299	0.007	-0.278	0.007	-0,262	0,007	-0.208	0.007	-0.110	0.006	-0.011	0.004
Upstairs apartment	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground floor apt.			0.029	0.003	0.032	0.003	0,032	0,004	0.099	0.004	0.109	0.003	0.037	0.002
Maisonette			-0.125	0.005	-0.125	0.005	-0,122	0,005	-0.124	0.005	-0.072	0.005	0.017	0.003
Porch apartment			-0.218	0.004	-0.213	0.004	-0,198	0,003	-0.191	0.003	-0.159	0.003	-0.023	0.002
Gallery flat			-0.537	0.004	-0.532	0.004	-0,516	0,004	-0.510	0.004	-0.464	0.003	-0.050	0.003
Other			-0.113	0.006	-0.082	0.006	-0,072	0,006	-0.018	0.006	0.061	0.006	0.086	0.004

Maintenance level inside														
Worse	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Better					0.128	0.004	0.076	0.004	0.067	0.003	0.075	0.003	0.098	0.002
Maintenance level outside														
Worse	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Better	-	-	-	-	0.136	0.006	0.094	0.005	0.088	0.005	0.089	0.005	0.063	0.003
Garden orientation														
Good orientation					-0.002**	0.004	-0.007*	0.004	-0.001	0.004	-0.005	0.004	0.055	0.002
Bad orientation					0.000**	0.004	-0.006**	0.003	-0.010**	0.003	-0.009**	0.003	0.069	0.002
Heating														
Central heating	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas/coal							-0.346	0.004	-0.331	0.004	-0.318	0.004	-0.145	0.002
Sun							0.242	0.056	0.220	0.055	0.242	0.049	0.113	0.031
Ground lease														
Ground lease							0.057	0.003	0.059	0.003	0.101	0.003	-0.015	0.002
No ground lease							0.141	0.003	0.143	0.003	0.111	0.003	0.032	0.002
Type of transaction														
K.k.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V.o.n.							-0.079	0.005	-0.035	0.005	-0.035	0.004	-0.011	0.003
Secondary features														
Monument							0.083	0.005	0.092	0.005	0.052	0.005	0.065	0.003
Lift									0.078	0.003	0.086	0.003	0.070	0.002
Balcony									0.068	0.002	0.075	0.002	0.021	0.001
Roof terrace									0.175	0.003	0.164	0.003	0.088	0.002
Parking									0.065	0.004	0.098	0.003	0.102	0.002

Table 5-9: Unstandardized coefficients of the variables; *: p>0.01; **: p>0.05; location and time dummies are added in steps 6 and 7 but are not included in these table. The coefficients of these dummies are included in Appendix D (own illustration)

5.4.2 Environmental characteristics

To prevent a long list of postal codes with coefficients, the environmental characteristics, in the form of four-digit postal code dummies, are plotted on the cities' map to give a clear picture. The opacity of the colour blue displays the range between the most positively perceived neighbourhood and the worst perceived one. The difference between these two forms the scale. The percentages as displayed in the legend show the differences with respect to the reference postal code area, which is demarcated with a red line. With respect to the refrence categories, the best perceived neighbourhood is 16.6% more expensive, with all other features remaining constant. For the completeness, the full list of location coefficients is available in Appendix D.

In Amsterdam, the canal district, the western part of Berlages extension plan for Amsterdam Zuid and the neighbourhoods around the Vondelpark clearly stand out from the rest of the city in terms of positive price effect. The rest of the areas that lie within the ring, except for the area north of the IJ and Bos and Lommer, also show high environmental values. The Bijlmer. New West and North score much lower than the rest of the city. Most remarkable is the area in the northeastern part of the municipality of Amsterdam, where the area that includes the villages of Durgerdam. Holysloot and Ransdorp also show very high values for their environment: the rustic environment and the proximity of Amsterdam are very highly valued.

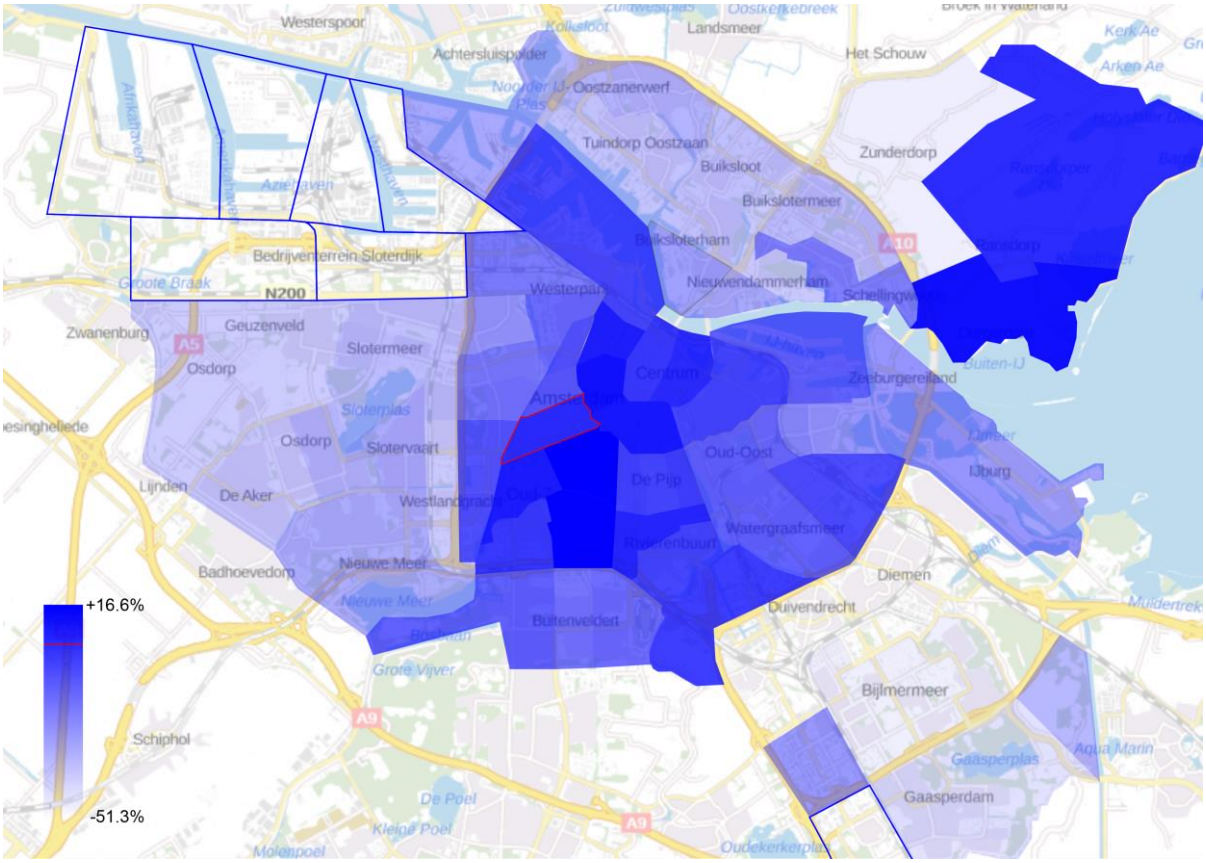


Figure 5-5: Coefficients of postal code dummies in Amsterdam (own illustration; background map from Google Maps (2018a))

5.4.3 Economic development

The dummies for the 88 quarters that fall within the period 1995-2016 are simultaneously added to the model in the last step. The addition of the dummy variables provides the model with the possibility to add the sales period to the price composition. The coefficients that derive from the time dummy variables provide information of the house price development, with all other features remaining constant. Hence, a positive development means that house buyers are willing to pay more for the same dwelling on the same location. The explained variance that the addition of the time dummies contributes indicates the relative importance of the sales period in relation to the dwelling features and the location.

As previously described in Chapter 5, the economy and the housing market have undergone severe changes in this timeframe, which in Amsterdam has led to a development as depicted in Figure 5-6. What differentiates Amsterdam from the Dutch average is the brief period of decline between 2002 and 2004 on the one hand, and the rapid growth since 2013 on the other hand.

During this first period, the economic development of Amsterdam shows a period of 'cooling down', which, according to De Nederlandsche Bank (2003, p. 12) would lead to a healthier housing market. This could be seen as a correction towards the equilibrium, a concept that is also used by Verbruggen et al. (2005) and Himmelberg et al. (2005).

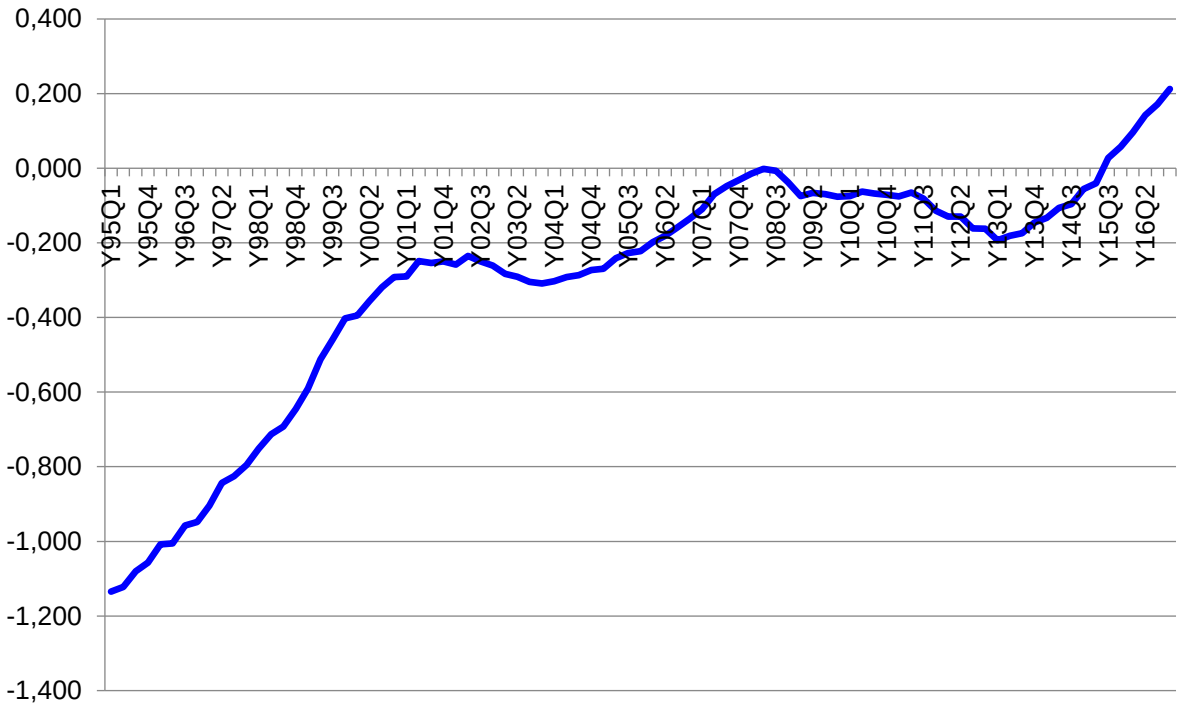


Figure 5-6: Economic development of Amsterdam; coefficients per quarter (own illustration)

5.5 Nijmegen

This paragraph will discuss the results of the hedonic price model that is applied on the cases that are located in Nijmegen. In the previous paragraphs, many results have already been discussed, so this paragraph will be confined to the findings that differentiate from these results.

5.5.1 Dwelling characteristics

Table 5-9 presents the model summary, which already leads to the first noteworthy findings. The explained variance of the different tranches shows the aggregate effect of the variables that are in these tranches, and herein, Nijmegen shows different results than Amsterdam. In Nijmegen, the heterogeneity of the housing stock – the building periods and the dwelling types are more equally divided – leads to more attention for secondary characteristics, maintenance level and garden orientation. Moreover, the differences between the neighbourhoods are smaller, which leads to a large share of the explained variance by the economic development.

Model summary	*Step 1*	*Step 2*	*Step 3*	*Step 4*	*Step 5*	*Step 6*	*Step 7*
R	0.707	0.717	0.730	0.738	0.764	0.793	0.938
R^2	0.500	0.515	0.533	0.545	0.584	0.629	0.880
Adjusted R^2	0.500	0.514	0.532	0.545	0.583	0.628	0.879
Std. error of the Estimate	0.327	0.322	0.316	0.312	0.299	0.282	0.161
R^2 Change	0.500	0.015	0.018	0.013	0.038	0.045	0.251
F Change	2,489	107	484	115	381	131	593
Degrees of Freedom 1	10	7	2	6	6	23	87
Degrees of Freedom 2	24,902	24,895	24,893	24,887	24,881	24,858	24,771
Significant F Change	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5-10: Model summary Nijmegen (n=24,914) (own illustration)

When taking a closer look to the coefficients of the different amenities, the results show many similarities with Amsterdam: the appreciation of the UFA, the number of rooms and the building period has the same pattern. The secondary characteristics again all have a positive price effect.

A difference however is observed at the price effects of the different dwelling types: the (negative) price effect of apartments of either sort is larger than in Amsterdam. In Amsterdam, the difference between the different dwelling types is either 0.096 for single-family homes and -0.055 for gallery flats. Remembering the interpretation rule of natural logarithms by Nymoen (2013), this means that this means that the price increase of single-family homes is approximately 10%, whereas gallery flats lead to a lower price by roughly 5.5%. In Nijmegen, these differences lead up to almost 20%, whereby most apartment types have a similar negative effect.

Dwelling type	*Amsterdam*		*Nijmegen*	
	Coeff.	SE	Coeff.	SE
Single family	0.096	0.003	-	-
Mansion	-0.011	0.004	0.046	0.005
Upstairs apartment	-	-	-0.101	0.006
Ground floor apt.	0.037	0.002	-0.174	0.006
Maisonette	0.017	0.003	-0.191	0.008
Porch apartment	-0.023	0.002	-0.151	0.005
Gallery flat	-0.050	0.003	-0.187	0.007
Other	0.086	0.004	0.046	0.005

Table 5-11: Coefficients of dwelling types in Amsterdam and Nijmegen (own illustration)

5.5.2 Environmental characteristics

In Nijmegen, the distribution of the location dummy variables corresponds with the historical build-up of the city as explained in Chapter 3. This is shown in Figure 5-7. The overall effects of the location are lower than in Amsterdam. In Amsterdam, the difference between the best and worst perceived postal code area is a factor of 2.40, whereas in Nijmegen this difference is only 1.60. This means that in Nijmegen, the price difference between the neighbourhoods is smaller. For buyers in Nijmegen, the location is of less importance than for buyers in Amsterdam.

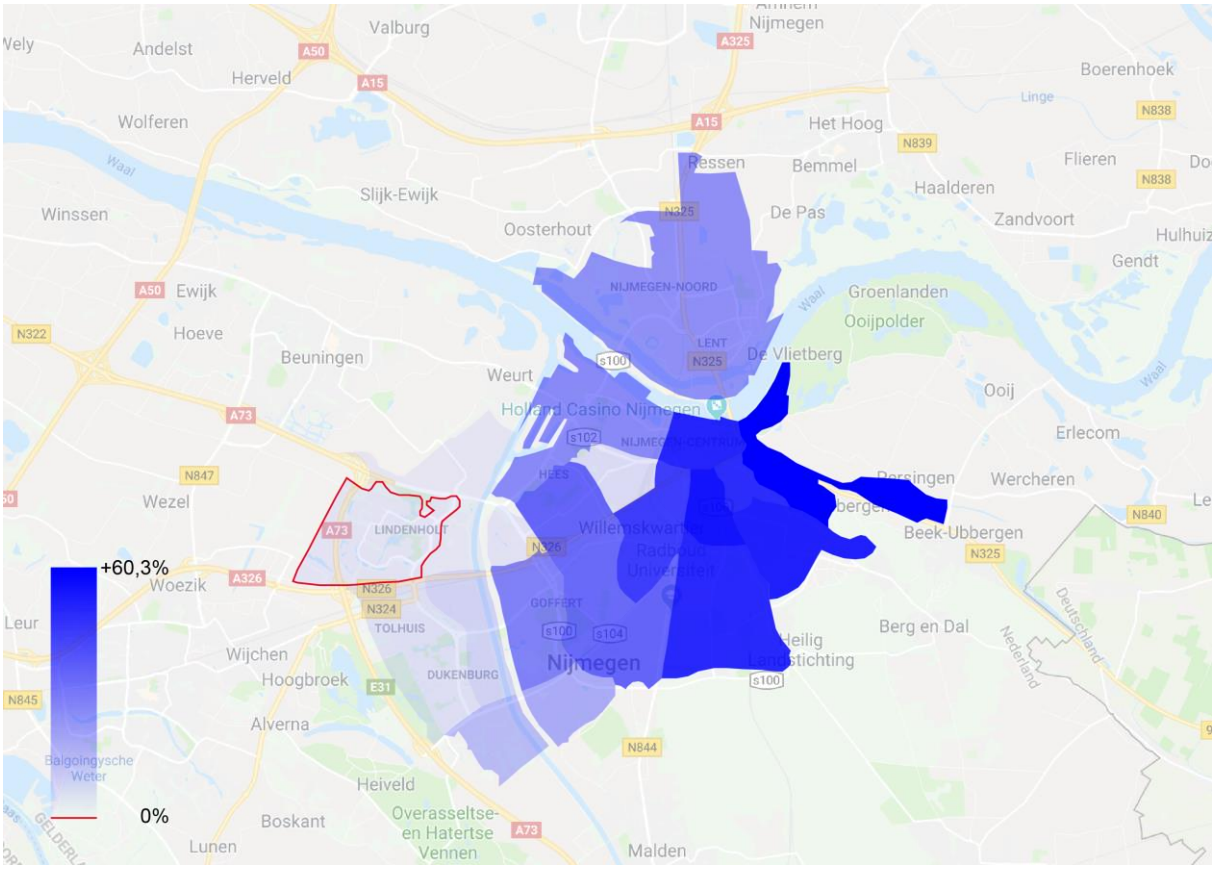


Figure 5-7: Coefficients of postal code dummies in Nijmegen (own illustration; background map from Google Maps (2018b)

5.5.3 Economic development

When looking at the model summary, it becomes clear that the economic development, or the explained variance that is derived from the addition of time dummies to be precise, plays an important role in Nijmegen. As already stated, this has presumably to do with the variety of the housing stock.

Although De Nederlandsche Bank (2003, p. 12) detects a nationwide decline starting in 2002, this doesn't seem to affect Nijmegen. When compared to Amsterdam, that mainly deviates in the previously mentioned period between 2002 and 2004, wherein Nijmegen's average house prices keep rising, as shown in Figure 5-8. Besides, the recovery from the financial crisis in 2008 takes longer in Nijmegen. Whereas Amsterdam knows a rapid recovery from 2013 onwards, in Nijmegen the price level flounders.

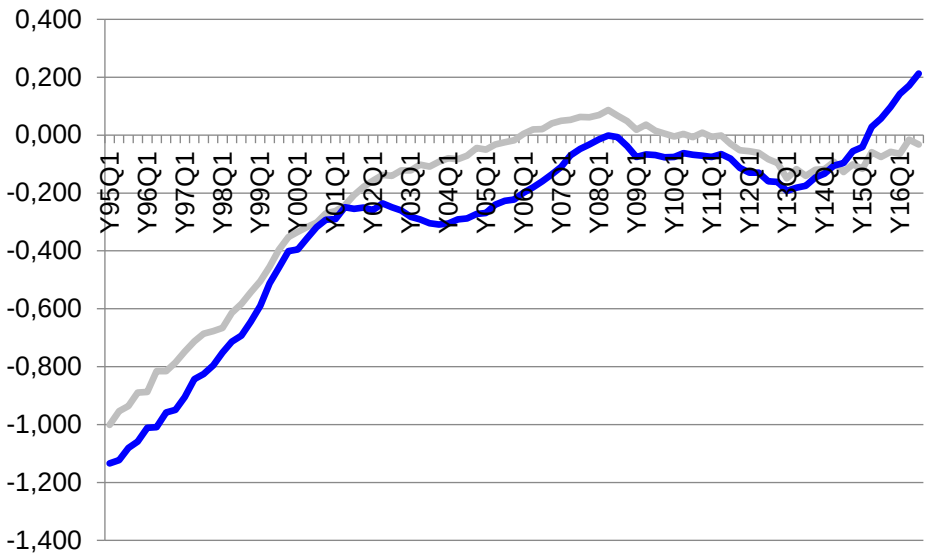


Figure 5-8: Economic development of Nijmegen (grey) and Amsterdam (blue) (own illustration)

5.6 Amsterdam before and after the crisis

This paragraph is dedicated to bring the similarities and differences of Amsterdam before and after the financial crisis in 2007/2008. Alike the previous paragraphs, the build-up will be as follows: firstly, the model summary is discussed, followed by the review and comparison with the overall results in Amsterdam of the dwelling characteristics, the environmental characteristics and the economic development.

The model as presented in the previous paragraph is basically a merger of the price models that describe the house price before or after the financial crisis.

Model summary	*Step 1*	*Step 2*	*Step 3*	*Step 4*	*Step 5*	*Step 6*	*Step 7*
R	0.739	0.803	0.809	0.822	0.830	0.864	0.950
R^2	0.547	0.645	0.654	0.675	0.688	0.746	0.903
Adjusted R^2	0.547	0.645	0.654	0.675	0.688	0.745	0.903
Std. error of the Estimate	0.379	0.336	0.331	0.321	0.315	0.284	0.176
R^2 Change	0.547	0.098	0.010	0.021	0.013	0.057	0.157
F Change	6,779	2,218	775	597	401	178	1,783
Degrees of Freedom 1	10	7	4	6	4	71	51
Degrees of Freedom 2	56,204	56,197	56,195	56,189	56,183	56,112	56,061
Significant F Change	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 5-9: Model summary of Amsterdam before 01-01-2008 (n=56,215) (own illustration)

5.6.1 Dwelling characteristics

When comparing Amsterdam before and after the crisis, two tranches of the model have more effect on the explained variance of the cases after the crisis: step 1, which includes the UFA, the building period and the number of rooms, and step 6, which adds the postal code areas to the price model. On the contrary, the effect of the economic development and most other characteristics is reduced. This means that the importance of the size and the location of the dwelling has become more important after the crisis, whereas the other conditions are of less interest for the buyers in this period.

Model summary	*Step 1*	*Step 2*	*Step 3*	*Step 4*	*Step 5*	*Step 6*	*Step 7*
R	0.850	0.857	0.861	0.872	0.875	0.929	0.947
R^2	0.722	0.735	0.742	0.760	0.766	0.862	0.898
Adjusted R^2	0.722	0.735	0.742	0.760	0.766	0.862	0.898
Std. error of the Estimate	0.279	0.272	0.269	0.259	0.256	0.196	0.169
R^2 Change	0.722	0.013	0.007	0.019	0.007	0.096	0.035
F Change	16,488	451	402	822	398	622	625
Degrees of Freedom 1	10	7	4	6	4	71	35
Degrees of Freedom 2	63,508	63,501	63,497	63,491	63,487	63,416	63,381
Significant F Change	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 5-10: Model summary of Amsterdam since 01-01-2008 (n=63,519) (own illustration)

5.6.2 Environmental characteristics

The influence of the location has increased in comparison to the pre-crisis model. Moreover, the differences between the neighbourhoods have been enlarged. By transforming the coefficient to the precise percentage, the difference between the best and worse appreciated postal code areas can be calculated. This can be executed by entering the coefficient in the following function:

$$\%\Delta P_i = 100 \cdot (e^{\beta i} - 1)$$ **Equation 5-1**

Before the crisis, the less appreciated neighbourhood led to a price decrease of 39.6% compared to the reference neighbourhood, whereas the best performing neighbourhood boosted the price by 40.1%. This led to a factor in the price difference of 2.32. After the crisis, this gap only got larger: one must multiply the cheapest neighbourhood with 2.62 to reach the price level of the most expensive neighbourhood.

The growth of the gap between the neighbourhoods also shows a spatial pattern: Oost and Noord have found a connection to Centrum, Zuid and West, whilst the difference between these parts and Zuidoost and Nieuw-West has only become larger. To be able to compare the environmental characteristics before and after the crisis, they are displayed on the same page, whereby Figure 5-11 shows the coefficients of the postal code dummies before 2008 and Figure 5-12 the coefficients since 2008.

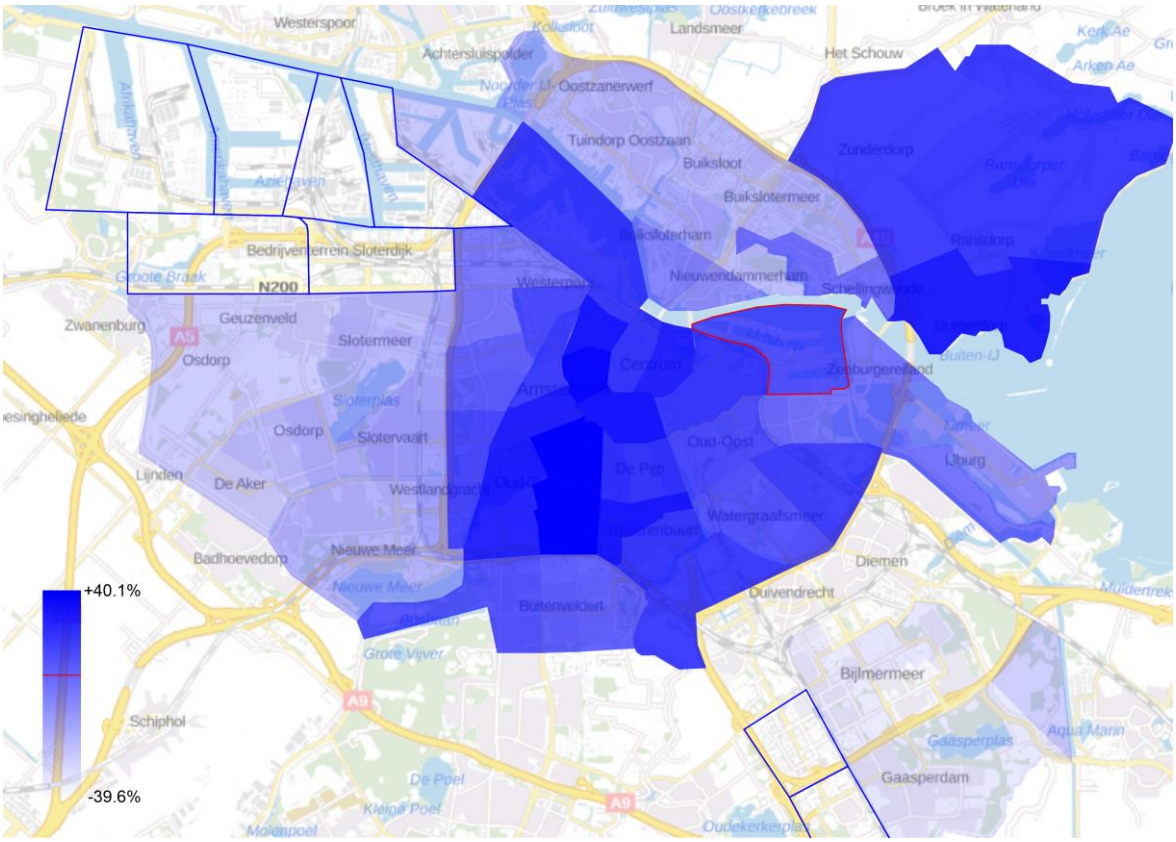


Figure 5-11: Coefficients of postal code dummies in Amsterdam < 2008 (own illustration; background map from Google Maps (2018a))

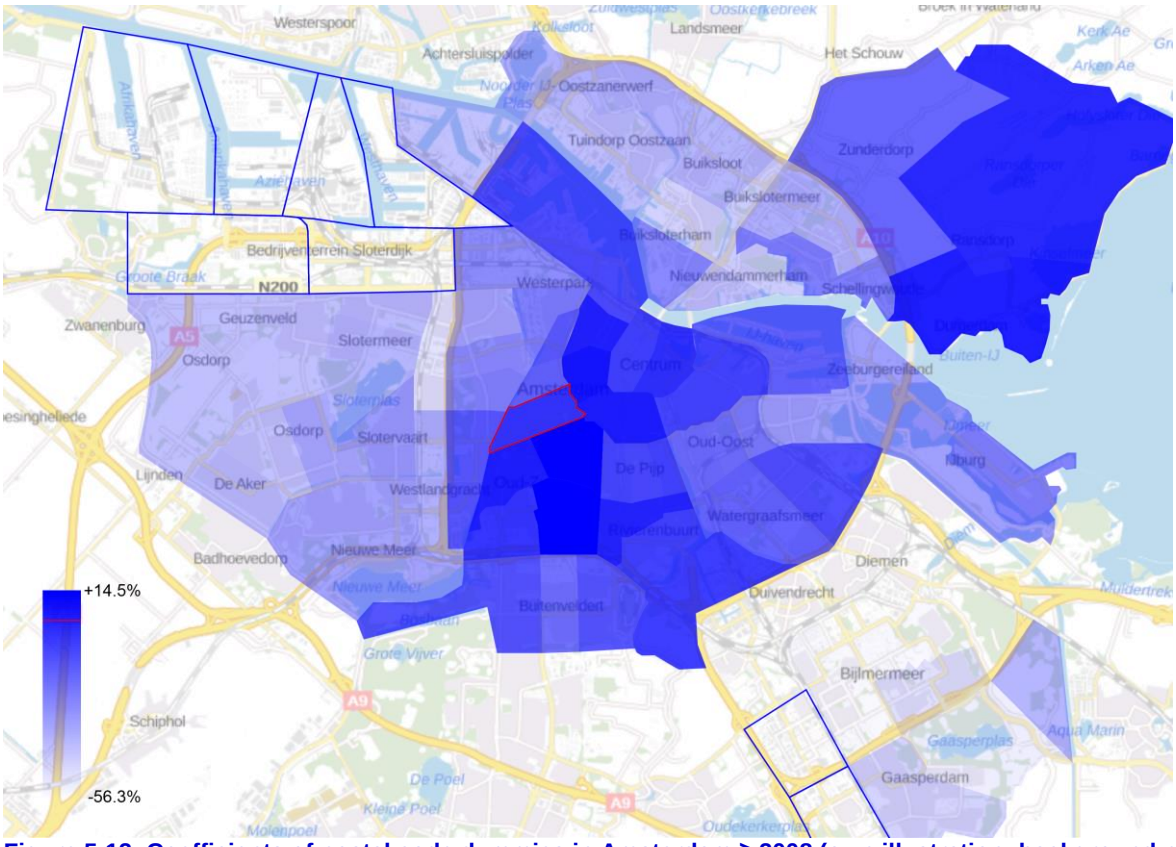


Figure 5-12: Coefficients of postal code dummies in Amsterdam ≥ 2008 (own illustration; background map from Google Maps (2018a))

5.6.3 Economic development

The economic development of Amsterdam after the crisis shows an ambiguous development. The first four years are characterised by standstill and deterioration, whereas the following three years show an incredible growth. In Nijmegen, a similar pattern is visible, be it that the growth is less excessively than in Amsterdam. It is remarkable that the growth doesn't seem to slow down after three years, but rather shows a convex development.

This development is caused by different drivers, of which numerous already have been described in Chapter 3. Janssen (2017) concludes that the current increase can be explained by fundaments, but that the risk of a price correction is increasing due to the presence of 'volatile drivers'.

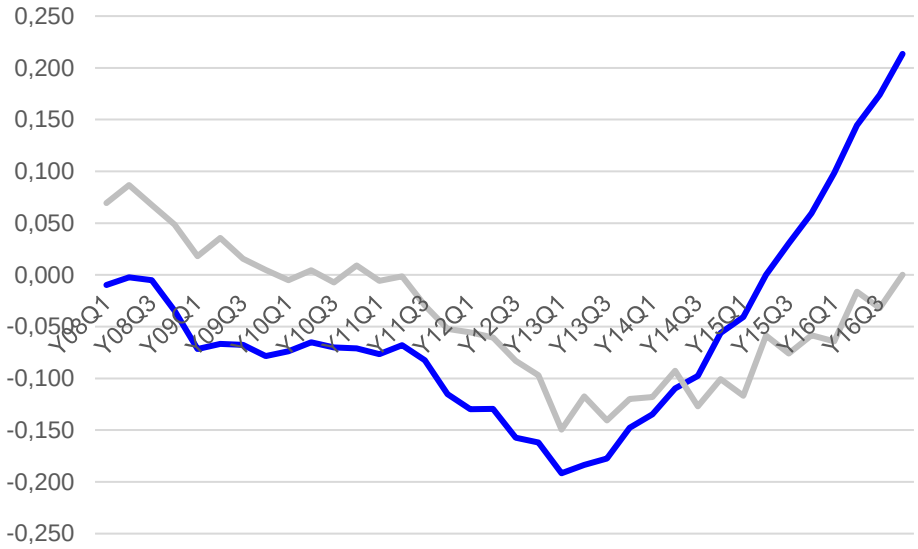


Figure 5-13: Economic development of Nijmegen (grey) and Amsterdam (blue) since 2008 (own illustration)

5.7 Conclusion

After looking at the four different models, clear similarities and differences are observable. In this paragraph, these observations will be made more tangible: the results of the different models will be compared and interpreted, preferably by referring to the conclusions from the literature study.

5.7.1 Different housing stock

A clear difference between Amsterdam and the comparative city of Nijmegen lies in the build-up of the housing stock. In Amsterdam, almost half (47,1%) of the cases is built between 1505 and 1930, whereas Nijmegen's housing stock is more evenly distributed over the different building periods. Moreover, the different dwelling types are also more diverse, although the single-family homes form a vast majority (48.5%). This diversity occurs in all neighbourhoods of Nijmegen. One could say that in Nijmegen, 'unity in diversity' connects the different boroughs and reduces the differences between the neighbourhoods in comparison to Amsterdam.

In both cities the appreciation of the building periods shows a similar pattern - which is depicted in Figure 5-14 as well: dwellings built until the Second World War are widely appreciated, whilst buildings constructed between 1945 and 1990 have a worse reputation. Finally, newly built dwellings (after 1990) have a positive price effect, which is even higher than the pre-war properties. This suggests that the price effect of the building periods does not interact with the supply from that same period, but rather depends on the architectural, structural and locational characteristics that are specific to that building period. Especially the locational characteristics of the dwellings of certain building periods are hard to ignore, since in major parts of Amsterdam the housing stock is very homogenous with respect to the building period and building type – in some neighbourhoods more than 98% of the dwellings is constructed in one building period. Attempts to leave out the building period and/or the dwelling type shift the explained variance to the next variable.

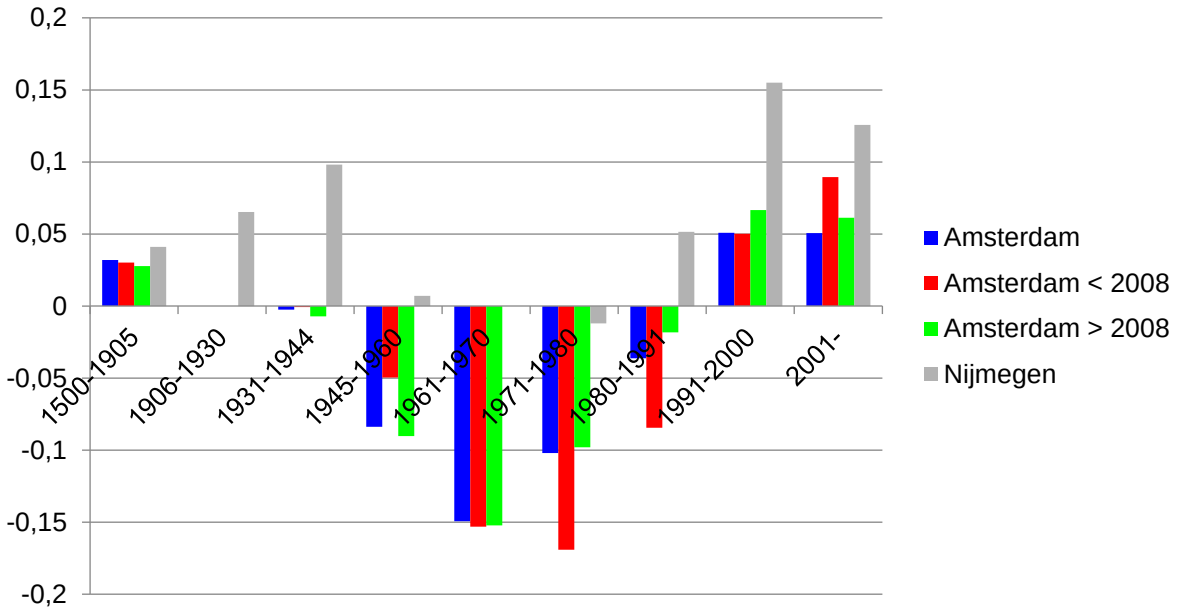


Figure 5-14: Price effect of the building period per model (own illustration)

As said, the same overlap also occurs when looking at the dwelling types. Both cities already have one dwelling type that devours almost half of the housing stock, which are upstairs apartments and single-family homes for respectively Amsterdam and Nijmegen. When looking at the diversity of dwelling types within the postal code areas, the overlap is less distinctive than between the building periods and the postal codes, but nonetheless apparent. This connection also exists between the dwelling type and the building period, which altogether causes a circular reference. Herein, it is difficult to exclude any of the variables from the model, since they all individually show results that answer to the drawn conclusion, which was already set out in Chapter 3. Therefore, the building period variable is maintained.

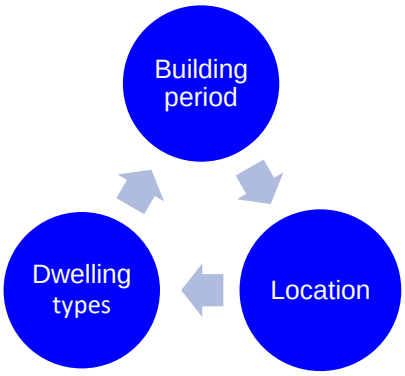


Figure 5-15: Circular referencing among three important variables (own illustration)

5.7.2 Different criteria

What derives from the most common dwelling types for both cities and the average size of the dwellings is the different focus of buyers. In Amsterdam, the majority of the housing stock consists of rather small apartments, whilst in Nijmegen most dwellings are larger single-family houses, as shown in Table 5-1. Therefore, in Amsterdam, most variance is explained by the size of the dwelling, the location and the possible presence of ground lease constructions. On the other hand, in Nijmegen the maintenance level, the orientation of the garden and the presence of a garage or carport. This difference even is reflected in the explained variance of the first step, which only contains the UFA, the building period and the number of rooms: in Amsterdam, this explains more than in Nijmegen. It seems to be a logical contrast: in Amsterdam, each square metre counts and the abundance of apartments makes it possible to be selective about the location of the dwelling. Moreover, apartments typically have fewer particularities than single-family homes. In Nijmegen, the secondary characteristics play a more important role: renovation works on a single-family home are normally more expensive than for an apartment, simply due to the size and the multiple facades.

5.7.3 Same price development until 2008

In the period between 1995 and 2008, the periodic dummies of both cities show a very similar pattern, apart from the small dip in the Dutch housing market between 2002 and 2004, which apparently has had no effect on the price development in Nijmegen.

When looking at the state of the housing stock, it is clear that Nijmegen has a substantially better housing stock in terms of size, whilst this city also has lower house prices. A great difference in attention is made concerning the primary and secondary features: in Amsterdam, each square meter matters, whereas in

Nijmegen, the focus is more directed towards the maintenance level and the presence of features like a garden with a good orientation, a parking space or a balcony.

5.7.4 Amsterdam leading the way since 2008

The most remarkable result from the hedonic price model is found in the periodic dummies, which show a clear break with the past since the global financial crisis, when the global housing market was rocked to its foundation. The crisis had a long aftermath, but after five years the recovery commenced. Herein, the city of Amsterdam quickly took a leading role within the Netherlands. Although the movement of the graphs of Nijmegen and Amsterdam displayed large similarities, the initial correlation only was 0.502 (n=32; p=0.000). This relatively low correlation in combination with the similar shape of the graph solicited for a closer inspection. Hereby, the period dummies for Amsterdam were lagged for one or more quarters, until the correlation was optimised. This optimum was reached when the period dummies were lagged by four quarters or one year. Then, a correlation of 0.842 was reached, which is displayed in Figure 5-16.

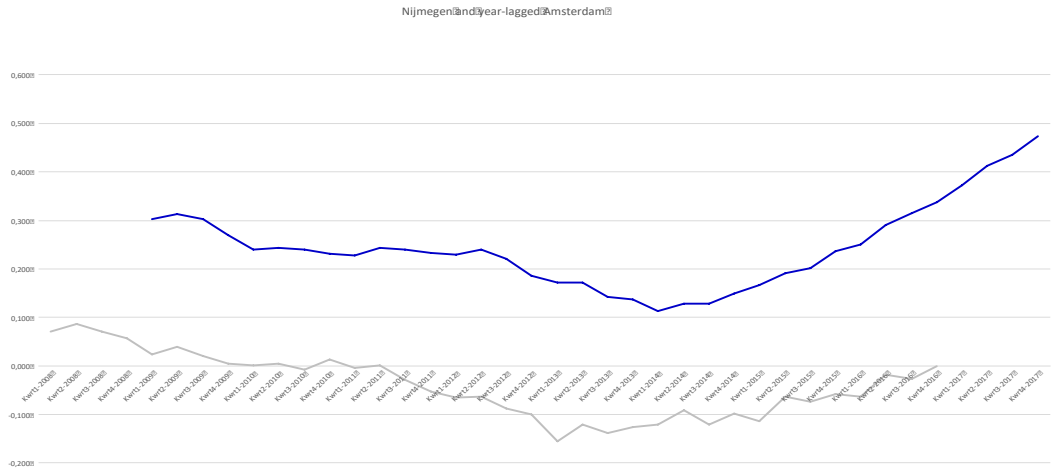


Figure 5-16: Significant correlation between Nijmegen and Amsterdam when lagged four quarters; *r* (32) = 0.842, p = 0.000 (own illustration)

This can be seen as the pioneering role that Amsterdam has taken in the housing market recovery, in a similar way that other capitals (e.g. London) have been doing since the crisis (Lennartz, 2018; Watt & Minton, 2016). The development of this has already been discussed in Paragraph 4.4.1.5. The pattern in Amsterdam will most likely be shortly followed by the other big cities of Utrecht, Rotterdam and The Hague, before it affects the more peripheric areas of the Netherlands, of which Nijmegen is part. The target area of real estate investors increases when the original area can't process the investment volume by lack of supply. These theoretical underpinnings are already set out in Paragraph 4.4.1.5.

5.7.5 More emphasis on size and location in Amsterdam

The last conclusion that is drawn in this chapter concerns the increased attention for the size of the dwelling and its location. This is already an indication that the additional quality of the dwelling is more and more disregarded by the buyers. Besides, the importance of location connects with the housing preferences, whereby the dwelling and the location must comply to a minimum level (Blije et al., 2009, pp. 42-43). As the old saying goes: 'location, location, location!'

This preference for certain neighbourhoods does not necessarily correspond to the level of facilities, the proximity of jobs or other economic factors that might cause this wedge. Although there might be a less attractive social environment in these neighbourhoods, this is unfortunately not explicitly demonstrable with the current model. Besides, these social characteristics might not fully explain the difference between the neighbourhoods and boroughs. This conclusion will be used in the final chapter to take a more precise look to the differences of the boroughs, and study their individual development over time.

On the contrary, the effect of the economic development in the form of the period dummies has decreased. This would mean that the period of sales would say less about the transaction price. However, the explained variance could also have declined for the economic development because the growth rate is so high – an average of 2.7% with a high of 4.7% per quarter is realized – that the difference between the beginning and the end of the quarter already causes noise for the period dummies.

6 Costs and affordability for incumbent residents

6.1 Introduction

The previous chapter has shown that since the financial crisis of 2008, the Amsterdam housing market has recovered faster than the rest of the Netherlands, and that the period 2013-2016 shows signs that can't be fully explained by either the quality or the economic development. In this chapter, the consequences in terms of taxes, ground rent and affordability will be estimated for the aforementioned period. To do so, several steps and assumptions will have to be made. Firstly, the steps will be set out, which is visually supported by Figure 6-3.

This chapter will start with an introduction of the concept 'affordability' and subsequently, the different value-VIPA-based costs will be mapped. Then, the road map, as displayed in Figure 6-3, comes into force: the transaction prices as found in the previous chapter are connected to the VIPA-value. Then, the difference between Amsterdam and the Dutch average is calculated. This is executed on a more detailed scale level, namely that of the seven different boroughs in Amsterdam. This is done because of the differences in market value and VIPA-value and economic development in these different parts. Subsequently, the extra costs are calculated per dwelling, which is followed by an estimation of the scale level of these effects. Finally, a calculation is made to project the total magnitude of the additional costs.

6.1.1.1 Assumptions

The following assumptions will be made to generalize and clarify the calculations that will be made in Paragraph 6.4. Please be aware that these assumptions might deviate from reality.

- The average VIPA-value, with reference date January 1st, 2016, per borough as stated on (CBS, n.d.) will be used for the calculation example
- The VIPA-value of social-rented dwellings and freehold dwellings is the same.
- The development of VIPA-value between January 1st, 2013 and January 1st, 2016 is assumed to have (roughly) followed the same pattern as the price development of the concerning region, although the value is only calculated annually.
- Only the dwellings that are dealing with an expiring ground lease period within the next five years are included in the costs calculations; the ground lease system is so complex and varied that further estimations are (almost) impossible to make.
- The additional costs are based on the difference between the growth in the boroughs of Amsterdam and the Dutch average.
- The average transaction prices in 2013 are all carried by fundamental drivers. The wedge between Amsterdam and the Dutch average thus does not exist at this point, but makes an entrance in 2014 and continues to grow from there.

The first assumption, as will be explained in Paragraph 6.2.2.3, is made to get an impression of the impact. Currently, it is still possible to use the VIPA-value of January 1st, 2014, which is hardly higher than after the financial crisis. This would downplay the whole calculation.

The second assumption is made because it is difficult to trace the value difference between social-rented dwellings and freehold dwellings on the desired scale level, since this difference can mainly be found either on individual address level, in an all-inclusive value as is used or on municipal level.

6.2 Affordability and costs

6.2.1 Affordability

An important consequence of the rising house prices is the affordability. This paragraph will start with an introduction and definition of affordability. Subsequently, the affordability will be reviewed from the perspective of the different tenures. People who have recently bought or rented a house in the free sector are disregarded, since they had or have the freedom of choice of entering the market.

Nibud, the Dutch National Institute for Budget Information, annually provides a guideline for lenders on the financing costs for households. For the lower income groups (until €28.000 per annum), the percentage of their budget that can be spent on housing rapidly rises from 10% to 22%, which forms the general benchmark for a large range of incomes, varying from the previously mentioned €28.000 until around €48.000, given the current interest rates. Higher incomes can spend up to 27% of their budget on financing costs (Warnaar & Bos, 2016, pp. 24-25).

The CBS measures the total housing expenses (Dutch: woonquote), which shows that owners spend a smaller part of their budgets on housing than tenants. However, their absolute costs are higher. This means that on average, homeowners have a higher income than renters do (CBS, 2016). Note that the first two columns in Table 6-1 include taxes and utilities.

Owner/tenant	Housing expenses (%)	Housing costs (€)	Net housing expenses (%)	Net housing costs (€)
Owner	28.3	894.9	21.2	670.0
Tenant	38.8	654.4	29.2	492.1
Private rent	42.1	810.6	33.2	638.3
Social rent	37.8	605.8	27.9	446.6
Average	*32.5*	*798.8*	*22.7*	*599.0*

Table 6-1: the differences in housing expenses among owners and different types of renters (CBS, 2016)

6.2.1.1 Owner-occupiers

In Amsterdam, 31% of the dwellings is owner-occupied (OIS Amsterdam, 2017). As already explained in Paragraph 4.4.3.1, owners are very dependent on their maximum loan capacity. The loan capacity is based on income, the number of earners, and the interest rate (Francke et al., 2015, p. 427).

For owner-occupiers, the price increase has consequences for their taxes and potentially for their expiring ground lease contracts. Both expenses are discussed in the following paragraph.

6.2.1.2 Social tenants

The social rented sector in Amsterdam covers more than half (57%) of the housing stock. The municipality also gathers dwellings owned by private landlords with a monthly rent below €711 under this category (OIS Amsterdam, 2017, p. 336). In Paragraphs 6.2.2.4 and 0, the consequences, which comes in the form of the House

Value Rating System (Dutch: woningwaarderingsstelsel) for inhabitants of social housing are discussed.

6.2.1.3 Private tenants

Private renters are often confronted with an income requirement that demands a gross salary that is four times more than the basic rent (Dutch: kale huur) (Francke, Schilder, De Vries, & Conijn, 2018, p. 11). This means that to exceed the maximum rent in the social rented sector, an individual should earn €34.112 per annum. According to Francke et al. (2018, p. 11), only the highest 25% of the incomes can afford rents higher than the liberalisation limit. In 2015, 12% of the housing stock in Amsterdam consisted of dwellings in the private rented sector (OIS Amsterdam, 2017, p. 336).

In Paragraph 6.3, wherein the transition from the transaction price to the VIPA-value is explained, the link with the private rental sector is made.

6.2.2 Costs

After discussing the affordability, this paragraph will discuss the costs that depend on the VIPA-value of a dwelling. The affordability for residents who recently moved is disregarded. As explained in Paragraph 3.4.3, the VIPA-value is used for different taxing purposes (Waarderingskamer, n.d.-a). Besides, the VIPA-value is used for the determination of the maximum rent level of social rented dwellings. This will be addressed in the final part of this paragraph.

6.2.2.1 Property tax

One of the taxes that is depending on the VIPA-value is the property tax (Dutch: onroerendezaakbelasting (OZB)). which is expressed as a percentage of the VIPA-value. In Amsterdam, the percentage of the property tax for homeowners since 2014 is set out in Table 6-2. The third row of the Table shows the annual decrease in property tax percentage.

Year	2013	2014	2015	2016	2017	2018
Percentage	0.05950	0.06309	0.06228	0.05719	0.04901	0.04139
Mutation	+3.97%	+6.03%	-1.28%	-8.17%	-14.3%	-15.5%

Table 6-2: OZB percentage since 2014 (Allers & Hoeben, 2011, 2012; Municipality of Amsterdam, 2013, 2014, 2015, 2016b, n.d.-f)

6.2.2.2 Ground lease

The VIPA-value can also be used to determine the ground rent (Dutch: erfpachtcanon). The ground lease system was introduced in 1824, and 'became part of the Dutch Civil Code'. In Amsterdam, the ground lease became effective in the last decade of the 19th century (Feddes, 2012). In a ground lease construction, the ground is owned by a lessor, who let a lessee hold and use the land against a payment (Ploeger & Bounjouh, 2017, p. 79). In the case of Amsterdam, the municipality owns the ground. Altogether, Amsterdam owns approximately 80% of the ground within municipal boundaries (Amsterdam Development Company, 2008, p. 7). Amsterdam, together with The Hague and Utrecht, is one of the remaining cities that has an active ground lease policy (Nelisse, 2008, p. 43).

The ground lease system consists of different general provisions (Dutch: Algemene Bepalingen), which, among other things, states the validity and the annual adjustment and the revision period of the ground rent. The large quantity of general

provisions and their differences make it difficult to generalise the tariffs and arrangements. Moreover, the durations until revision moments – 10 or 25 years - or expiration – 50 or 75 years - differ and are of course depending on the building period of the dwelling that is the subject of the ground lease contract. The first general provisions for example do not mention the determination of the ground rent increase (1896, p. 342; 1915, p. 317): this is only included in the later editions of the general provisions. Buying off the ground rent until the end of the duration is possible since 1994 (Municipality of Amsterdam, 1994), and it is only since 2016 that the ground lease as eternal is introduced (Municipality of Amsterdam, 2016a).

Figure 6-1 displays the ground lease areas in Amsterdam. It is remarkable that the canal district, the Pijp and the neighbourhoods around the Vondelpark aren't fully charged with the ground lease construction, whereas the rest of the city is almost entirely covered. When referring to the historical build-up of the city as described in Paragraph 4.2, the reason why these areas are exceptions is that most of the building plots in the canal district were sold to wealthy tradesmen before 1896. The area around the Vondelpark was constructed by the elite just decades before the introduction of the ground lease system. The areas in the Pijp fell victim to real estate investors and developers, once again just before the ground lease system was introduced.

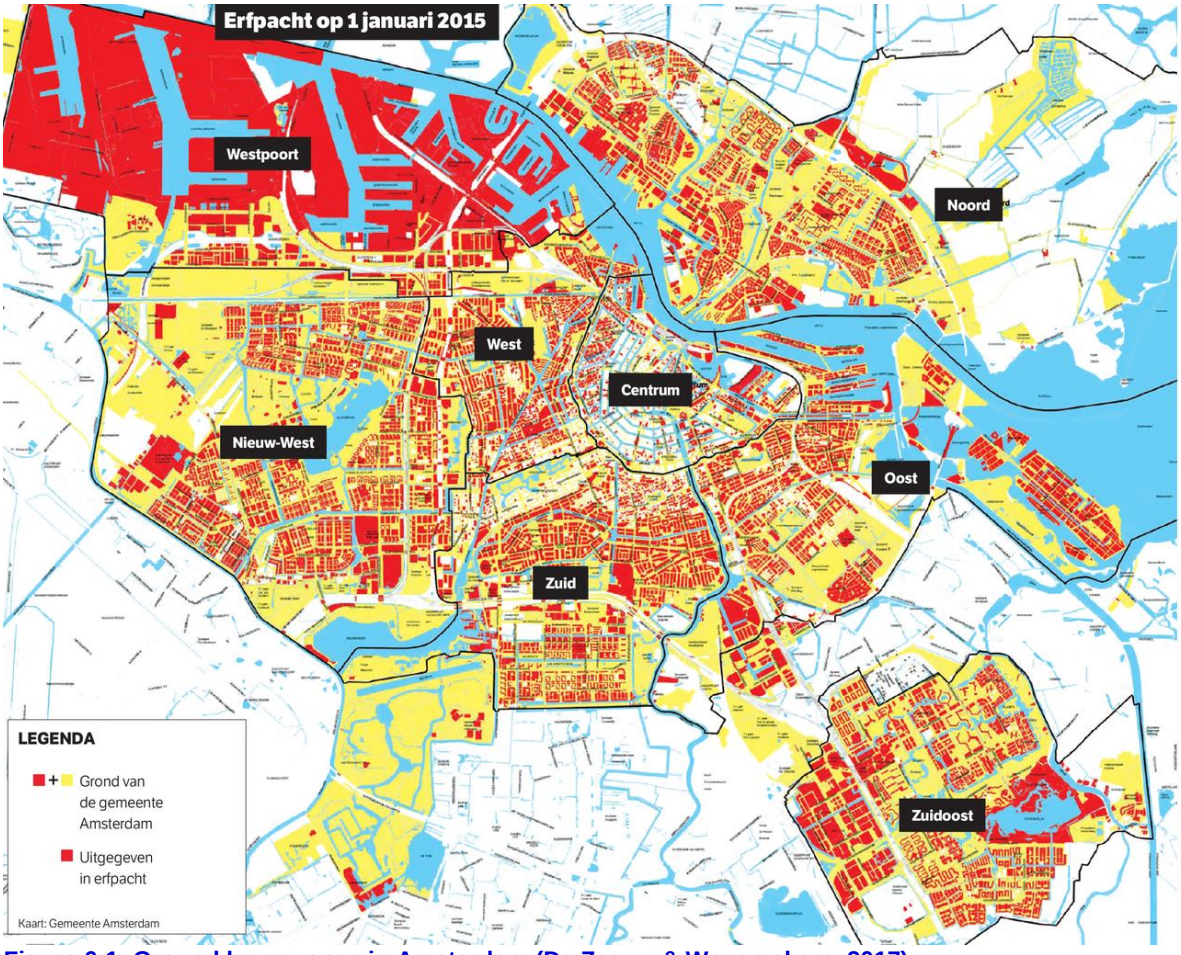


Figure 6-1: Ground lease zones in Amsterdam (De Zeeuw & Wagemakers, 2017)

6.2.2.3 Transfer to everlasting (bought off) ground rent

The Municipality of Amsterdam currently offers an everlasting ground lease, which rises along with the previously mentioned CPI, instead of a revision every 50 or 75 years that is based on the market value of the ground (Municipality of Amsterdam, n.d.-h). The determination of the ground lease consists of various steps that are described in this paragraph. The ground lease is the result of the multiplication of the VIPA-value and the so-called neighbourhood street quote (Dutch: buurtstraatquote; short: BSQ), after which a 10% depreciation discount is given (Municipality of Amsterdam, 2017). The formula is given below:

VIPA-value * BSQ – depreciation = ground value **(Equation 6-1)**

Subsequently, the ground value can be used to determine the amount of ground lease that needs to be paid to the municipality (Municipality of Amsterdam, n.d.-b):

Ground value * ground lease percentage = ground lease **(Equation 6-2)**

The formation of the VIPA-value is explained in Paragraph 3.4.3. For the VIPA-value, the municipality gives another discount: when transferring to the everlasting ground rent, one may choose the lowest possible VIPA-value from 2014 and 2015. As will be shown in Table 6-4, these VIPA-values hardly show an increase since the financial crisis.

The BSQ lies between 4% and 50% and expresses the percentage of the VIPA-value that is defined by the ground value. The city centre is assigned to the higher percentages; it lowers towards the outskirts of the city. The exact percentage can be found online (Municipality of Amsterdam, n.d.-a); a global overview is displayed in Figure 6-2. For the calculations, a conservative estimation of the BSQ per borough is made. These can be found in Table 6-6. Due to limited resources, it was impossible to trace the more than thousand BSQs in Amsterdam and calculate the averages per borough.

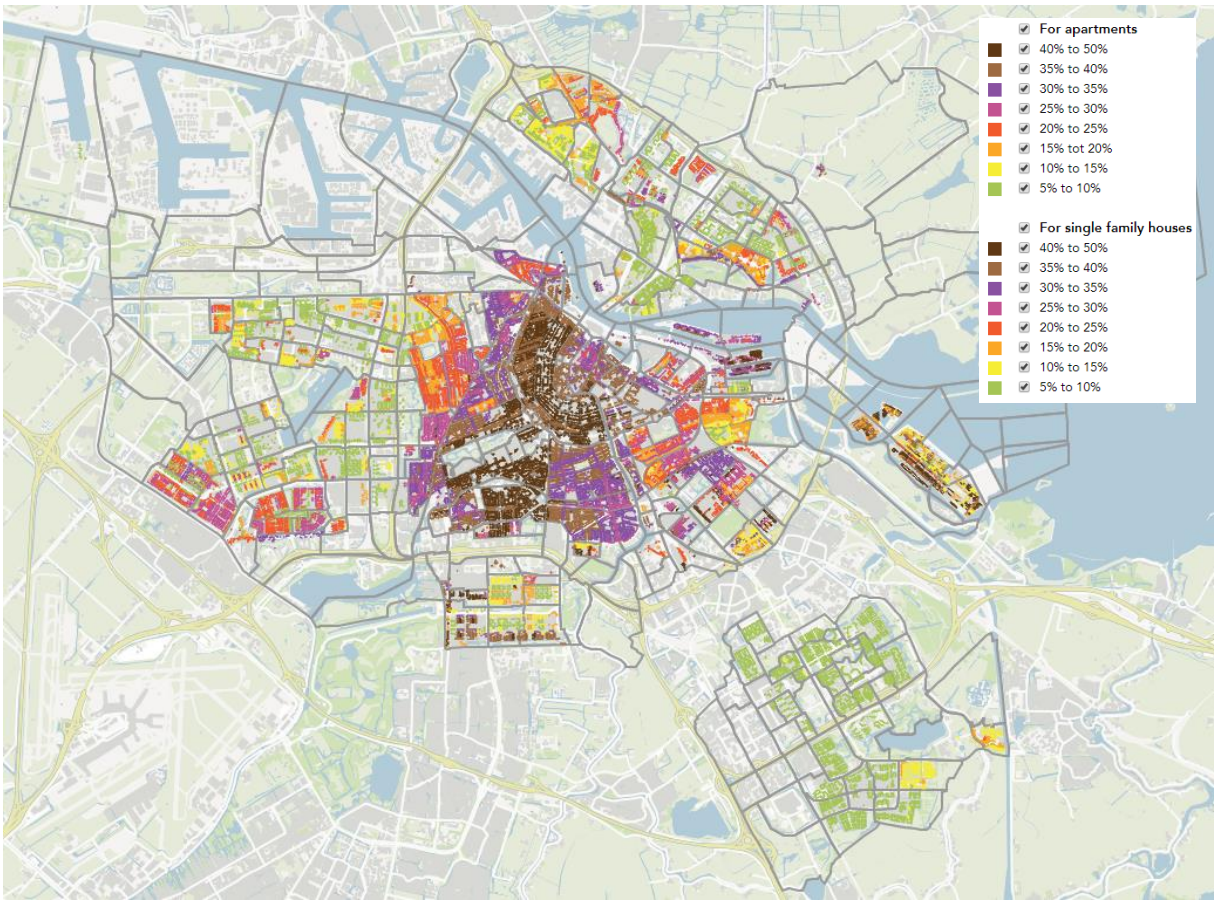


Figure 6-2: Overview of BSQ (Municipality of Amsterdam, n.d.-a)

The depreciation is incorporated to compensate the ground value for the already developed property, which causes a decrease of value, compared to a vacant plot. The depreciation is 25% of the determined ground value (Municipality of Amsterdam, n.d.-c).

Three experts, mostly brokers or appraisers, determine the ground value of each property. The ground value is influenced by three elements (Municipality of Amsterdam, n.d.-b):

- The size of the property
- The zoning plan (Dutch: bestemmingsplan)
- The location of the ground

This methodology matches the development method, wherein bare land or land with properties that need to be refurbished or redeveloped. Simply put, the residual (land) value is the ‘proceeds of sale’, deducted with the costs of the development and the profits (Shapiro et al., 2013, p. 146). The ground lease percentage depends on several factors and lies between 0.94% and 4.0%. Factors are differences in duration, the security period (annually alteration, ten years secured or 25-years secured) of the percentage and the general conditions of the ground lease (Van Rossum, 2017). The ground lease percentage moves along with the CPI (Municipality of Amsterdam, n.d.-b).

For the calculation in this chapter, the focus group consists of dwellings that are dealing with an expiring ground lease period. Hereby the regular duration of 75 years

as mentioned by the general provisions of 1915, 1934 and 1937 (Municipality of Amsterdam, 1915, 1934, 1937) and the duration of 50 years as stated in the general provisions of 1966 (Municipality of Amsterdam, 1966) play an important role. This means that the building periods that are coping with upcoming expirations are either from 1931 to 1944 or from 1971 to 1980. Moreover, the dwellings that are built before 1905, which in the dataset covers a period of nearly four ages, have reoccurring expirations every 50 years, which makes that approximately 10% of the dwellings does so in the next five years. These three building periods will be used to determine the target group of the freehold dwellings that are not obliged, but nonetheless strongly recommended to transfer to the newest general provisions of eternal ground lease, which, according to the Municipality of Amsterdam (n.d.-i) is resistant to house price developments.

The other building periods are disregarded, since these have a less urgent situation and can continue their current ground rent arrangement.

6.2.2.4 Maximum rent

Another application of the VIPA-value is the determination of the maximum rent price by using the House Value Rating System (Dutch: woningwaarderingsstelsel (WWS)) (Municipality of Amsterdam, n.d.-e; Rijksoverheid, n.d.-a). The HVRS is based on a point system, where points are awarded for the UFA, the presence of heating, the energy efficiency, the facilities of the kitchen(s) and bathroom(s) etcetera. For each €8.747 of the VIPA-value, one point is added. For an average social rented dwelling, the VIPA-value on average contributes 30.07 points (Huurcommissie, 2017) or around €155 per month (Rijksoverheid, n.d.-a) to the maximum rent level, taken into account the average VIPA-value of €137,000 (Aedes, n.d.) and an average area of 80m^2 (Aedes, 2015) of a social rented dwelling. When a dwelling exceeds 144 points, the maximum rent level for social rented dwellings is transcended. When this happens, the housing corporation has three choices what to do with the dwelling when the tenants leaves:

- Keep renting out the dwelling with a rent lower than the liberalisation limit (Dutch: liberalisatiegrens) of €710.68
- Start renting out the dwelling in the free rental sector with a rent higher than €710.68
- Sell the dwelling to either the incumbent tenant or another party

The second option is limited, since housing corporations have to comply to strict European regulations when executing commercial activities (Rijksoverheid).

In Paragraph 0, the influence of the price increase on the number of points is calculated.

6.3 From price to VIPA-value

The results from the previous chapter are based on the transaction price. In Paragraph 3.4, the connection between the transaction price, the market value and the VIPA-value is already concisely explained, along with reasons for deviations between the concepts. This paragraph will make the transition between these concepts and this will result in a generalised and simplified overview of the VIPA-value and the wedge between Amsterdam and the Dutch average, which will be used to calculate the additional costs of incumbent residents in the following paragraph.

6.3.1 Transaction price

The transaction price forms the starting point of this chapter. In 2013, prices in Amsterdam were already 19.5% higher than the Dutch average. As already explained in the previous chapter, the differences within Amsterdam are also very large. However, from 2013 onwards, the price increase in Amsterdam sky rockets. In three years' time, the price increase in Amsterdam was 46.0%, against the Dutch average of 14.3% (CBS, 2018a). In Table 6-3, the price development between 2013 and 2016 is set out.

Year / Location	*2013*	*2014*	*2015*	*2016*	
	Avg. Price	*% increase*	*% increase*	*Avg. price*	*% increase*
Amsterdam	254,971	+7.93%	+15.15%	372,356	+17.51%
Centrum	399,208	+3.47%	+13.50%	549,185	+17.14%
West	238,277	+7.20%	+15.89%	351,185	+18.64%
Nieuw-West	186,400	+5.99%	+11.94%	257,165	+16.28%
Zuid	335,721	+12.75%	+18.39%	520,050	+16.04%
Zuidoost	132,567	+2.53%	+9.20%	173,560	+16.93%
Oost	246,694	+10.68%	+16.92%	378,853	+18.68%
Noord	176,680	+6.82%	+12.33%	263,804	+24.44%
The Netherlands	213,353	+4.16%	+3.59%	243,837	+5.93%

Table 6-3: Transaction price development 2013-2016 (own illustration; partly based on (CBS, 2018a))

6.3.2 Market value

As already set out in Paragraph 6.3, the market value "is the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction (…)" (International Valuation Standards Council, 2017, p. 8). To determine the market value, several methods can be used. Shapiro et al. (2013, pp. 12-15) distinguish five principal methods of valuation:

- Comparative method
- Investment method
- Development method
- The profits approach
- Contractor's method

For residential real estate, the comparative method is the method that is predominantly used. Within the comparative method, the value is based on a comparison with similar objects and their prices. This method is based on the expectation that the objects are more or less interchangeable and hence have a comparable value (Shapiro et al., 2013, p. 36). However, properties are unique when looking at the location, physical state and tenure, and more valuation specific the time of valuation or sale/lease and the purpose of the valuation (Shapiro et al., 2013, pp. 36-37).

In the case of Amsterdam, the transaction prices of dwellings in the neighbourhood of the appraised dwellings are used as comparable objects and assessed for the quality of the interior and exterior. Hence, the current trend of outbidding (Lennartz & Vrieselaar, 2018) quickly finds its way to the market value.

6.3.3 Valuation of Immovable Property Act (Dutch: Wet waardering onroerende zaken)

The origin and the determination of the VIPA-value are already set out in Paragraph 3.4.3, so in this paragraph the focus will lie on the analysis of the collected data. Table 6-4 displays the VIPA-value of January 1st, 2013 and January 1st, 2018, along with the percentage development in the intermediate years. It becomes clear that each borough performs better than the Dutch average, with only the least appreciated neighbourhoods of Nieuw-West and Zuidoost showing a small decline from 2013 to 2014.

Unfortunately, the division between the VIPA-values of social rented and freehold dwellings is only made at either individual level or on municipal level, which makes that the difference in VIPA-value is disregarded in this chapter. This means that a remark must be made about the results: in general, the effect on the point system for social rented dwelling is amplified and the effect on the ground rent is toned down.

Year / Location	*01-01-2013*	*01-01-2014*	*01-01-2015*	*01-01-2016*	
	Avg. VIPA-value	*% increase*	*% increase*	*Avg. VIPA-value*	*% increase*
Amsterdam	231,000	+0.70%	+9.03%	290,000	+14.34%
Centrum	309,000	+3.24%	+10.97%	410,000	+15.82%
West	211,000	+1.42%	+11.21%	281,000	+18.07%
Nieuw-West	181,000	-0.55%	+6.67%	208,000	+8.33%
Zuid	308,000	+0.00%	+9.42%	401,000	+18.99%
Zuidoost	143,000	-1.40%	+1.42%	152,000	+6.29%
Oost	234,000	+0.43%	+10.21%	304,000	+17.37%
Noord	175,000	+0.57%	+7.39%	210,000	+11.11%
The Netherlands	211,000	-2.37%	+1.46%	216,000	+3.35%

Table 6-4: VIPA-value per borough (own illustration; based on CBS (n.d.) and (OIS Amsterdam, 2016, 2017))

6.3.4 Coherence

Although both the transaction price and the VIPA-value should reflect the market value, there are different reasons this is not the case in practice. The price doesn't correspond to the market value, because of the individuality of the eventual transaction. The same goes for the VIPA-value: the assumptions about for example the full ownership drive a wedge between the pursued connection with the market value and the realised value. since they suggest a different reality then the actual situation (Hooijmaijers, 2012).

When comparing the VIPA-values to the transaction prices of Amsterdam and its boroughs and the Netherlands for the period 2012-2016, a significant positive relationship is found; $r = 0.982$, $n = 45$, $p = 0.000$. However, it remains important that the VIPA-value has a one-year delay herein. Hence, the price increase of 2016 will only be incorporated in the taxes in 2017.

6.4 Results of price increase

As already explained, this paragraph will calculate and estimate the additional costs of incumbent residents of the city of Amsterdam. Firstly, the influence on the property tax will be estimated.

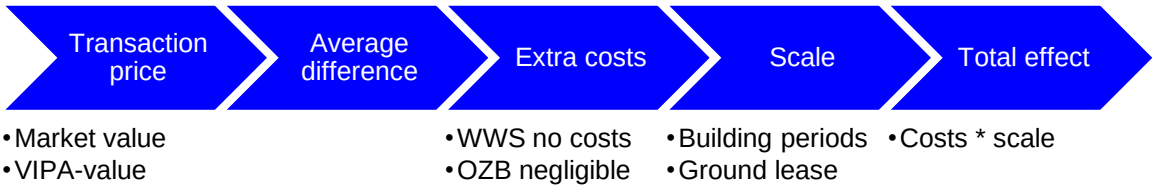


Figure 6-3: Road map towards the determination of the additional (ground rent) costs for incumbent residents (own illustration)

In the second part, the ground rent is discussed. To estimate the additional costs, several steps will be taken, which are visualised in Figure 6-3. First, the gap between Amsterdam and the rest of the Netherlands will be calculated, using the development of the VIPA-value. Subsequently, this growth difference will be applied on the ground rent. To do so, the made assumption about the BSQ per borough will be used. Then, the number of affected will be determined, which is done by applying three filters to the total housing stock. Finally, the additional costs per borough and for the residents of Amsterdam will be estimated.

The chapter finishes with the calculation of the extra points that are assigned in the House Value Rate System due to the increase in VIPA-value.

It is important to denote that the situation displays the expected situation of 2020.

6.4.1 Property tax

The first impression on the decrease in OZB is that it corresponds to the increase in house prices. A closer look, of which the evidence can be found in Table 6-4 learns that this is indeed the case: the VIPA-value of 2015, which has January 1st, 2014 as a reference date, is approximately 0.70% higher than the previous year. Hence, the property tax remains almost equal. Moreover, the property tax is both relatively and absolutely amongst the lowest of the country (Hoeben, De Natris, Allers, & Veenstra, 2018, p. 40). Concluding, the change of the VIPA-value does barely affect the property tax.

6.4.2 Gap between Amsterdam and the Dutch average

Now the positive correlation is ascertained, this chapter will start with calculating and documenting the gap. Herein, we will take 2013 as a benchmark: both Amsterdam and its boroughs and the Netherlands hit rock bottom and there is no ‘air’ in the former housing bubble anymore. From there, the bubble starts inflating once again. In Table 6-5, the emerging gap is shown, whereby the size is cumulatively calculated to provide insight in the total size. On average, Amsterdam will have developed a surplus of more than 37% in comparison to the Dutch average. Once again, the differences within the city are obvious: Zuidoost and Nieuw-West stay behind the rest of the boroughs. However, they still ‘outperform’ the rest of the Netherlands.

Year / Location	2013	2014	2015	2016	2017*	2018*
	Δ% to NL	Δ% to NL	Δ% to NL	Δ% to NL	Δ% to NL	Δ% to NL
Amsterdam	-%	+1.59%	+4.79%	+12.61%	+24.59%	+37.18%
Centrum	-%	+2.70%	+8.59%	+18.78%	+33.11%	+46.62%
West	-%	+1.83%	+5.78%	+15.96%	+32.47%	+39.52%
Nieuw-West	-%	+0.15%	+2.02%	+7.26%	+12.43%	+22.84%
Zuid	-%	+2.04%	+4.52%	+12.72%	+29.78%	+42.75%
Zuidoost	-%	+0.76%	+1.76%	+1.72%	+4.62%	+18.22%
Oost	-%	+0.53%	+3.41%	+12.34%	+27.58%	+48.81%
Noord	-%	+2.18%	+5.26%	+11.41%	+19.78%	+41.04%
Netherlands	-%	-%	-%	-%	-%	-%

Table 6-5: Cumulative difference of the VIPA-value between Amsterdam and the Netherlands; * = prediction (own illustration; based on CBS (n.d.) and (OIS Amsterdam, 2016, 2017))

6.4.3 Ground rent

After determining the gap between Amsterdam and the Dutch average, it is now time to calculate what the ground rent would be if a dwelling would transfer to the eternal ground lease system. To do so, an estimation of the BSQ, the ground rent percentage and the VIPA-value are essential; for the latter, the VIPA-value is given in twofold: one displays the actual situation, the other is an indication of the VIPA-value when it would have been following the Dutch average since 2013. The ground rent percentage is fixed at 2.39% (Municipality of Amsterdam, n.d.-g). Moreover, the 25% discount (Municipality of Amsterdam, n.d.-g) that is valid in 2018 is included.

Borough	*VIPA-value 2016 (€)*	*Alternative VIPA 2016 (€)*	*BSQ*	*Annual ground rent (€)*	*Alt. ground rent (€)*	*Difference (€)*
Amsterdam	290,000	236,478	20%	1,039.65	847.77	191.88
Centrum	410,000	316,322	35%	2,572.24	1,984.53	587.71
West	281,000	216,000	20%	1,007.39	774.36	233.03
Nieuw-West	208,000	185,289	15%	559.26	498.20	61.06
Zuid	401,000	315,299	30%	2,156.38	1,695.52	460.86
Zuidoost	152,000	146,389	5%	136.23	131.20	5.03
Oost	304,000	239,545	15%	817.38	644.08	173.30
Noord	210,000	179,147	10%	376.43	321.12	55.30

Table 6-6: Annual ground rent as determined in 2016; two scenarios (own illustration)

The results show that the difference in costs in 2018 is very modest. Only the two most expensive neighbourhoods, Centrum and Zuid, have a severe cost increase of respectively €49 and €38 per month due to the price increase.

To calculate the extra costs regarding buy-off of the ground rent, the annual ground rent must be divided by 2.39%. The bandwidth of this calculation lies between €210 and €24,590 at additional costs.

6.4.3.1 Maximum rent

When reusing the difference in VIPA-value, the additional points for the House Value Rate System are also easily calculated: the difference in VIPA-value will be divided by 8,747, which is the benchmark for an extra point. The extra points mean that the maximum rent is increased and thus the position as a social rented dwelling is endangered. Table 6-7 presents the additional points, based on the average VIPA-value. As previously mentioned, the average value exaggerates the effects on social rented housing, since they normally have a lower value.

Borough	*VIPA-value 2016 (€)*	*Alternative VIPA 2016 (€)*	*Extra points*
Amsterdam	290,000	236,478	6
Centrum	410,000	316,322	10
West	281,000	216,000	7
Nieuw-West	208,000	185,289	2
Zuid	401,000	315,299	9
Zuidoost	152,000	146,389	-
Oost	304,000	239,545	7
Noord	210,000	179,147	3

Table 6-7: Additional points for social rented dwellings (own illustration)

6.4.4 Affected dwellings

The ground rent per borough is determined. However, this increase does not apply to a large part of the total housing stock. Therefore, three filters need to be applied. Firstly, it is important to determine the tenure: social or private rented dwellings don't pay ground lease since this is done by their homeowner. Hence, only freehold dwellings are included. Secondly, as Figure 6-1 already depicted, not all dwellings are built on ground that is leased by the municipality. Using the NVM dataset, the percentage of freehold dwellings that fall under the ground lease system are traced. Lastly, only dwellings that will soon have a ground rent revision will be included in the calculation. As already explained, the building periods of these dwellings fall in the period 1500-1905, 1931-1944 and 1971-1980. Because not all dwellings in these periods will be affected within the coming years, an abatement is applied to these building periods of respectively 87%, 70% and 50%.

These percentages are estimated with the assumption that dwellings built between 1500 and 1905 have a revision every 50 years, which causes approximately 13% of the dwellings to have an upcoming revision in the near future. For the other two building periods, percentages that display the share of dwellings that face revision. Since the housing stock and its ratios (e.g. building periods, tenure) are hardly changed in the research period, the data of 2016 is used in this calculation. The results of these different filters are clearly presented in Table 6-8.

Borough	*Dwellings*	*% Freehold*	*% ground rent*	*% building period*	*No. dwellings*
Amsterdam	427,820	30.3%	65.6%	7%	6,032
Centrum	54,026	32.2%	23.2%	9%	371
West	78,465	30.1%	54.9%	9%	1,196
Nieuw-West	64,838	30.2%	88.9%	1%	151
Zuid	80,036	32.3%	53.8%	7%	957
Zuidoost	40,665	27.5%	94.2%	15%	1,539
Oost	67,430	29.9%	71.7%	4%	569
Noord	42,360	28.5%	88.7%	8%	869

Table 6-8: Estimation of the ground rent target group (own illustration; partly based on CBS (n.d.))

6.4.5 Total costs

Finally, the total costs are easily calculated: the additional costs per annum are multiplied with the number of dwellings that face a revision of their ground rent. Annually, the extra costs in Amsterdam add up to slightly more than one million euros. When everyone would choose to buy out, this would lead to extra costs of nearly fifty million euros. Table 6-9 provides an overview of the additional costs per borough.

Borough	*Additional costs (€)*	*No. dwellings*	*Total costs per annum (€)*	*Total costs buy-out (€)*
Amsterdam	191.88	6,032	1.157.392	48.426.453
Centrum	587.71	371	217.926	9.118.238
West	233.03	1,196	278.806	11.665.504
Nieuw-West	61.06	151	9.195	384.719
Zuid	460.86	957	441.146	18.458.007
Zuidoost	5.03	1,539	7.737	323.726
Oost	173.30	569	98.644	4.127.368
Noord	55.30	869	48.044	2.010.193

Table 6-9: Overview of the total costs per annum and the total additional costs for buy-outs (own illustration)

6.5 Conclusion

The conclusion will start off with once again stating that the shown calculation is not representative for the current situation. In reality, the VIPA-value with reference date January 1st, 2014 can still be used, which is hardly higher than the value of 2013, which formed the lowest point in multiple years.

When looking at the extra costs per household, the 'damage' seems to less than initially expected. When looking back to Paragraph 6.2.1, where the affordability is discussed, it seems that most owner-occupier can suffer the additional costs. The average owner-occupier already has relatively lower housing-related costs than renters do. This is mostly because they generally have a higher income, but this also means that they can undergo a small costs increase. Moreover, in contrary to renters, owner-occupiers build up capital through the price increase. Hereby, it should be said that owner-occupiers should not be financially obliged to move out because they can't afford the additional costs. The following paragraph will explain the possible future consequences.

Finally, this chapter assumed that the price increase since 2013 has a flawed economic foundation and the additional costs for inhabitants of Amsterdam are unreasonable. However, given the results of the previous chapters this cannot be fully endorsed, since the research simply does not give a decisive answer on the presence or absence of an economic foundation.

6.5.1 The future

The discussed results are based on a non-existing scenario, but it is very likely that in the upcoming few years the lowest possible VIPA-value is one that stems from the financial crisis, but rather from the years that show an annual growth of 10% to 20%. Looking at the expected VIPA-value increases in Table 6-4, it is likely that the additional costs, that are now estimated on fifty million euros, will show a similar growth rate as these VIPA-value. Hence, the additional costs will increase to 65 to 80 million euros in total.

Naturally, the same goes for the individual residents of Amsterdam: their costs also will increase to sums that approach €1,000 per annum. Hence, the current price increases will have its effect sorted in the near future. Then, the first post-war dwellings will also have a revision upcoming, as well as the dwellings that are built in the late 1970s.

7 Conclusions

Whilst the conclusion of the previous chapter already has raised the corner of the veil, this chapter will shortly recapitulate the findings of the previous parts. Subsequently, the reviewed theory, the applied method and limitations of this research will be discussed: what would have induced a clearer and more definitive result of the study? Finally, recommendations for future research and policy-making will be made that include legal intervention on the application of the Valuation of Immovable Property Act.

7.1 Conclusions

In this paragraph the answers on the sub questions will be given. Most of these answers are already extensively reported in the concerned chapters.

7.1.1 Which causes and consequences of fast-rising house prices are already described by the existing scientific literature?

The following topics influence the high demand in Amsterdam and do less often occur in other parts of the Netherlands and hence could drive up the prices:

- The presence of two major universities, and numerous universities of applied sciences (Dutch: hogescholen) and many job opportunities attract young adults to Amsterdam.
- (Aspiring) parents leave the city in a later stadium due to delayed parenthood or not at all because of the decreased popularity of the suburbs and the countryside.
- The advantageous situation of Amsterdam near a major airport hub and the presence of a large historic centre attracts international businesses and their employees.
- Due to the low interest rate and lacking alternative investment opportunities, investors – from small private investors to large institutional investors – inject their money in the housing market. Often, they receive discount on their purchases and comprise almost a fifth of the housing market.
- Airbnb provides a platform to use private rooms and apartments to house the growing tourist flow in Amsterdam. Their impact on Amsterdam belongs to the largest in Europe.

Although this list is not at all exhaustive, it outlines the special position of Amsterdam within the Dutch housing market. Despite the growing demand, the building volume in Amsterdam has been insufficient for multiple years, if not, decades. The increasing demand and the inadequate development of additional supply has its consequences on the socioeconomic relationships within the city:

- The wealth inequality between homeowners and renters is expanding. The rising prices accumulate the wealth of ‘insiders’, whilst the homeownership market becomes harder to access.
- The high prices and the housing shortage lead to lower success rates when buying or renting houses. This causes displacement of lower income group, which, in extreme events, could lead to segregation.

7.1.2 Are there economic factors that can explain the wedge between Amsterdam and the Dutch average?

The economic factors that were derived from the literature study and analysed in greater depth in the fourth chapter does not provide a definitive answer on the question whether the macro and meso economic developments fully support the house price development in Amsterdam. Although none of the quantitatively studied topics shows a growth or decline that interacts with the current price development in Amsterdam, they might add up to the historic and current development. Besides, the growth seems to have also partly derived from qualitatively described drivers, such as the influence of investors and Airbnb, which are not yet extensively researched and quantified, besides from Anglo-Saxon countries.

The fast increase of the house prices in Amsterdam since 2013 in contrast to the moderate recovery of the housing market in Nijmegen seem to be carried by an increase of investments by private and institutional parties. This is triggered by the low interest rate that eases capital endowment in combination with the already high and still increasing demand by young adults and tourists in Amsterdam, which makes buy-to-let transactions attractive. The extraordinary demand in Amsterdam causes this phenomenon to appear there first. Although these upcoming trends do have an economic foundation, this foundation is no part of the actual inhabitants of Amsterdam or the dwellings they buy and hence form an unwanted stimulus of the house prices.

7.1.3 Can the dwelling characteristics explain the difference between Amsterdam and the Dutch average?

The findings of the hedonic price model show that the average dwelling in Amsterdam is smaller and more expensive than in Nijmegen. Hence, the dwelling characteristics are generally in favour of Nijmegen. Only the positive price effects of the building periods that are available on a large scale in Amsterdam could help explaining the higher house prices in Amsterdam. When choosing a dwelling, the attention of the buyers in Nijmegen is more directed towards the secondary characteristics of the dwelling, such as the maintenance level and the presence of a parking space. In Amsterdam, the primary features – the UFA, the building period and the number of rooms – prevail. Moreover, these features have become more important since the financial crisis.

However, the environmental characteristics are also important in the choice of a dwelling. In Amsterdam, the number of amenities (e.g. school, shops) is much higher than in Nijmegen. Moreover, the job opportunities in Amsterdam and its surroundings are greater than in Nijmegen. This surplus of facilities in Amsterdam does not explain the large differences in the price effects of the postal code dummies within Amsterdam. Looking at economic factors at macro and meso level, the proximity of jobs and the presence of facilities, this difference cannot be explained. Probably, social environmental characteristics could explain this difference, but these characteristics are unfortunately not explicitly included in the scope of this research.

Finally, a comparison of the growth period of Amsterdam and Nijmegen since 2013, at which is experimented with lagged versions of Amsterdam’s growth curve, the correlation of the two curves was maximized when the delay was set on one year, meaning that Amsterdam’s recovery lays one year ahead of Nijmegen. These nuances the fast increase of the average house price in Amsterdam.

7.1.4 How do the transaction price, market value and VIPA-value interact with each other?

Not only theoretically, but also practically, the transaction price, the appraised market value and the VIPA-value show much similarities. Because the valuation of dwellings is largely based on comparable transactions of a similar dwelling in the proximity of the appraised dwelling, the realised transaction prices quickly find their way to the market value and thus will become the new standard. Since the VIPA-value attempts to use the same approach, but with disregard of eventual ground rent constructions and the presence of contracts that complicate full and unencumbered ownership and direct use of the property, the VIPA-value greatly correlates ($r = 0.982$; $n = 45$; $p = 0.000$) with the transaction price and the market value.

In the case of Amsterdam, where approximately 80% of the ground is owned and rented out by the municipality of Amsterdam, the negligence of the ground rent should theoretically lead to more differentiated transaction prices, because the impact of the ground rent can be of great influence on the costs and thus the affordability and the loan capacity. However, the shortage causes buyers to ignore these potential costs to live in their preferred location.

7.1.5 How are the housing costs of incumbent residents of Amsterdam influenced by the fast-increasing house prices in Amsterdam?

The ongoing price increase didn't affect the affordability of the incumbent residents of Amsterdam to date. The OZB tariff countermoves to the VIPA-value by adjusting almost the exact percentage that the VIPA-value has developed. For the House Value Rating System, the consequences are hard to predict, but the price increase leads to point increase, except for Zuidoost.

In case of the ground lease, this is mainly due to the delay of the VIPA-value - the value is always determined for the previous year – and the 'generosity' of the municipality of Amsterdam that, apart from a 25% discount, also provides the opportunity to choose the lowest VIPA-value of 2014 or 2015. Especially the VIPA-value of 2014 does hardly transcend the value level after the financial crisis.

However, the next years, these low VIPA-value will be taken out of the equation, and several years with an annual increase of 10% to 20% are inbound. Hence, it seems like the best moment for residents to transfer to the everlasting ground lease is now.

7.2 Discussion

Naturally, this thesis is limited in its literature study, scope, results and conclusion. This is due to limited time, resources, skills and knowledge, although the latter two certainly developed during the writing of this thesis. In this paragraph however, more conquerable contentions and shortcomings will be discussed.

7.2.1 Theory

The theoretical framework as presented in Chapter 3 does provide a comprehensive overview of the previously conducted research and the three parts of this thesis and their connection. Unfortunately, not every part that tries to encompass the current situation in Amsterdam is supported by quantitative data that can be directly applied to the economic development.

7.2.2 Methodology

The used methodology did not fully result in the desired outcome of the research. Although the macro and meso economic factors showed interesting trends and developments, the (lack of) available data made it difficult or impossible to directly connect the found economic forces on the different economic scale levels to the hedonic price model. Therefore, the connection between the first and the second part of this thesis is too much based on assumptions and indirect relations.

The results of the model itself were satisfactory: they correspond with the findings of previous hedonic price models. However, this is also a weakness of the conducted research: nor the methodology, nor the results are innovative but rather are an addition in the breadth of this research field.

For the final part, wherein an estimation of the additional costs is made, the approach is purely quantitative. Hereby, the perspective of the actual residents is disregarded. This would make the research more comprehensive.

7.2.3 Limitations of research

7.2.3.1 Limitation of variables

The used dataset that was collected by the NVM is very exhaustive, not only in the number of cases but also in the many variables per case. However, these variables are used by most other hedonic price studies as well (Bosker et al., 2016; Buitelaar et al., 2014; Lazrak et al., 2014; Visser & Van Dam, 2006). The potential shortcomings of the data collection therefore are seldom contradicted by the results of other datasets.

7.2.3.2 Limitation of time and location

The conducted research only targets a limited period (1995-2016) and even more limited target locations. Amsterdam as an exception and Nijmegen as ‘the average Dutch municipality’ both have particularities that limit the generalizability of the results. Besides, the research period shows a capricious pattern, of which the last few years since the financial crisis are yet to be submitted to thorough research. Although the first studies that include the crisis and the period after, the trend is not fully disclosed.

Zooming in on the model, the areas within the city have shortcomings. Various studies elaborate on the location characteristics by, for example, the nearby supermarkets and number of jobs (Bosker et al., 2016; Visser & Van Dam, 2006), whereas the postal code areas only implicitly indicate these characteristics. This addition would quantify and amplify the results that are derived from the location dummies.

7.2.3.3 Sample within housing stock

Secondly, the supplied dataset only contains transactions conducted by real estate brokers that are members of the NVM. Although the NVM covers approximately 70% of the Dutch transactions (NVM, 2018), there is still a considerable part of the transactions that stays uncovered. De Wit et al. (2013) also comment on this small deficiency, but dismiss it since they could not find a connection between the market share of the NVM and the price increase. Historically seen, the coverage of the NVM raised from 25-30% during the 1990s and 2000s until it reached the current level.

Usually, urban environments have better coverage than more rural areas (De Wit et al., 2013, p. 223). Besides the limited coverage by the NVM, all dwellings that were not sold in the research period are disregarded. This could lead to a biased dataset, wherein dwellings with obsolete characteristics or locations are lacking.

Although this problem probably doesn't affect the general outcomes, it could marginalise the measurable influence of large (institutional) real estate investors, as discussed in Paragraph 4.4.1.5, on the housing market. These parties often act on a higher scale levels, wherein not merely individual dwellings are bought and sold, but rather complete housing complexes that are rented out to individuals (Francke, Schilder, Teuben, Conijn, & Buffing, 2014). These transactions are conducted between investors and therefore are not reported at the NVM.

Besides the (institutional) investors, the housing stock of Amsterdam and Nijmegen also contains a lot of (social) rental dwellings (Municipality of Nijmegen, 2016; OIS Amsterdam, 2017), which has a similar influence on the housing market, but with a different business angle.

7.3 Recommendations

7.3.1 Policy

The results as presented in the Chapter 6 show a clear picture: the impact of the growing wedge between Amsterdam and the Dutch average will probably have a tremendous influence on the affordability of incumbent inhabitants of large parts of the cities. Expiring ground lease terms can cost individuals up to €1,000 per annum extra, only because they live in a popular neighbourhood.

Apart from the long-running discussion about the fairness and contemporaneity of the ground lease policy that applies on the major part of Amsterdam, the local and/or national government should consider a ground lease policy that nuances the special position of Amsterdam – and possibly other municipalities where this is applicable. This could be achieved by using an average growth rate, which is already applied in Chapter 6 to demonstrate the difference in housing costs between the different neighbourhoods in Amsterdam and the national average. By doing so, the costs develop according to macroeconomic trends and correct for unfounded local price increases.

7.3.2 Future research

The conducted research largely is a composition of previously conducted studies, but applied on a different scale level and with a different purpose, namely to discover the additional costs for incumbent residents. However, there are still similar subjects that are not covered in this research but certainly deserve attention.

The first topic that is eligible for further research is the inclusion of investment volumes of both small private investors and large institutional investors who own many properties in buy-to-let constructions. Although (international) studies have already displayed the influence of these investors on and an estimation of their share in the current sales volume is known, it remains unclear how their pricing techniques, portfolio forming and their level of engagement with their assets pressures the overall price level of the housing market.

Secondly and similarly, the influence of the social housing stock on the price level of the dwellings that are either in the private rental sector or freehold sector is disregarded in this thesis. However, since more than half of the dwellings in Amsterdam is (artificially) rented out for less than €711 per month, the consequences of releasing the restrictions on the rent level of these dwellings are almost unforeseeable.

Lastly, Chapter 6, which describes the financial consequences of the rapidly increasing prices for existing residents of Amsterdam, only provides a general insight in the surplus of housing costs in Amsterdam compared to the Dutch average. However, the ground lease system has many provisions and durations. The municipality of Amsterdam has access to this information and could investigate the effects of the price increase after the financial crisis on an individual level.

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Appendices

Appendix A: Conceptual framework market value

The definition of Market Value must be applied in accordance with the following conceptual framework:

a) "The estimated amount" refers to a price expressed in terms of money payable for the asset in an arm's length market transaction. Market Value is the most probable price reasonably obtainable in the market on the valuation date in keeping with the market value definition. It is the best price reasonably obtainable by the seller and the most advantageous price reasonably obtainable by the buyer. This estimate specifically excludes an estimated price inflated or deflated by special terms or circumstances such as atypical financing, sale and leaseback arrangements, special considerations or concessions granted by anyone associated with the sale, or any element of value available only to a specific owner or purchaser.

b) "An asset or liability should exchange" refers to the fact that the value of an asset or liability is an estimated amount rather than a predetermined amount or actual sale price. It is the price in a transaction that meets all the elements of the Market Value definition at the valuation date.

c) "On the valuation date" requires that the value is time-specific as of a given date. Because markets and market conditions may change, the estimated value may be incorrect or inappropriate at another time. The valuation amount will reflect the market state and circumstances as at the valuation date, not those at any other date.

d) "Between a willing buyer" refers to one who is motivated, but not compelled to buy. This buyer is neither over eager nor determined to buy at any price. This buyer is also one who purchases in accordance with the realities of the current market and with current market expectations, rather than in relation to an imaginary or hypothetical market that cannot be demonstrated or anticipated to exist. The assumed buyer would not pay a higher price than the market requires. The present owner is included among those who constitute "the market".

e) "And a willing seller" is neither an over eager nor a forced seller prepared to sell at any price, nor one prepared to hold out for a price not considered reasonable in the current market. The willing seller is motivated to sell the asset at market terms for the best price attainable in the open market after proper marketing, whatever that price may be. The factual circumstances of the actual owner are not a part of this consideration because the willing seller is a hypothetical owner.

f) "In an arm's length transaction" is one between parties who do not have a particular or special relationship, eg, parent and subsidiary companies or landlord and tenant, that may make the price level uncharacteristic of the market or inflated. The Market Value transaction is presumed to be between unrelated parties, each acting independently.

g) "After proper marketing" means that the asset has been exposed to the market in the most appropriate manner to effect its disposal at the best price reasonably obtainable in accordance with the Market Value definition. The method of sale is deemed to be that most appropriate to obtain the best price in the market to which the seller has access. The length of exposure time is not a fixed period but will vary according to the type of asset and market

conditions. The only criterion is that there must have been sufficient time to allow the asset to be brought to the attention of an adequate number of market participants. The exposure period occurs prior to the valuation date.

h) “Where the parties had each acted knowledgeably, prudently” presumes that both the willing buyer and the willing seller are reasonably informed about the nature and characteristics of the asset, its actual and potential uses, and the state of the market as of the valuation date. Each is further presumed to use that knowledge prudently to seek the price that is most favourable for their respective positions in the transaction. Prudence is assessed by referring to the state of the market at the valuation date, not with the benefit of hindsight at some later date. For example, it is not necessarily imprudent for a seller to sell assets in a market with falling prices at a price that is lower than previous market levels. In such cases, as is true for other exchanges in markets with changing prices, the prudent buyer or seller will act in accordance with the best market information available at the time.

i) “And without compulsion” establishes that each party is motivated to undertake the transaction, but neither is forced or unduly coerced to complete it. (International Valuation Standards Council, 2017, pp. 18-20)

Appendix B: Average city comparison

	Nederland		Arnhem			Nijmegen			Rotterdam			Delft			Amsterdam			Den Haag			Dordrecht			Amersfoort		
Aantal transacties																										
Tussenwoning	12112	28%	180	23%	82%	245	29%	103%	605	26%	93%	114	37%	133%	315	13%	47%	481	22%	81%	279	40%	144%	268	34%	123%
Hoekwoning	6051	14%	106	14%	97%	115	13%	97%	265	11%	81%	42	14%	98%	111	5%	33%	157	7%	53%	116	17%	119%	134	17%	123%
2-onder-1	6755	16%	108	14%	89%	146	17%	110%	126	5%	35%	13	4%	27%	42	2%	11%	87	4%	26%	56	8%	52%	94	12%	77%
Vrijstaand	6787	16%	74	9%	60%	122	14%	92%	72	3%	20%	12	4%	25%	62	3%	16%	68	3%	20%	24	3%	22%	71	9%	58%
Appartement	11678	27%	314	40%	149%	224	26%	98%	1265	54%	201%	127	41%	153%	1878	78%	290%	1347	63%	234%	221	32%	118%	214	27%	102%
Totaal	43383		782		96%	852		100%	2333		86%	308		87%	2408		79%	2140		83%	696		91%	781		97%
Transactieprijs				Std.dev	33%		Std.dev	7%								Std.dev	118%								Std.dev	29%
Tussenwoning	232	86%	193	85%	98%	198	80%	92%	250	112%	129%	296	118%	137%	441	109%	127%	327	116%	134%	208	102%	118%	275	88%	102%
Hoekwoning	253	94%	218	96%	101%	236	95%	101%	270	121%	128%	0	0%	0%	474	118%	125%	376	133%	141%	238	117%	124%	311	99%	105%
2-onder-1	299	111%	321	141%	126%	285	115%	103%	397	177%	159%	0	0%	0%	0	0%	0%	585	207%	186%	382	187%	168%	432	138%	124%
Vrijstaand	406	151%	464	203%	135%	408	165%	109%	569	254%	168%	0	0%	0%	893	222%	147%	758	268%	178%	0	0%	0%	637	203%	134%
Appartement	217	81%	164	72%	89%	197	79%	98%	165	74%	91%	210	84%	104%	376	93%	116%	212	75%	93%	136	67%	83%	204	65%	81%
Totaal	269		228		110%	248		101%	224		135%	251		120%	403		128%	282		146%	204		99%	314		109%
Transactieprijs/m2				Std.dev	20%		Std.dev	6%								Std.dev	59%								Std.dev	21%
Tussenwoning	2073	90%	1785	89%	99%	1879	89%	99%	2169	101%	112%	2610	102%	113%	3620	78%	87%	2503	102%	114%	1916	99%	110%	2334	90%	100%
Hoekwoning	2115	92%	1835	92%	100%	1996	94%	103%	2233	104%	113%	0	0%	0%	3711	80%	88%	2716	111%	121%	2077	107%	117%	2622	101%	110%
2-onder-1	2182	95%	2384	119%	126%	2108	99%	105%	2738	127%	134%	0	0%	0%	0	0%	0%	3444	141%	148%	2584	133%	141%	2991	115%	121%
Vrijstaand	2416	105%	2684	134%	128%	2399	113%	108%	3028	140%	134%	0	0%	0%	4729	102%	98%	3622	148%	141%	0	0%	0%	3427	132%	126%
Appartement	2650	115%	1880	94%	82%	2298	108%	94%	2027	94%	82%	2516	98%	85%	4839	105%	91%	2278	93%	81%	1740	90%	78%	2477	95%	83%
Totaal	2305		1998		107%	2119		102%	2157		115%	2560		99%	4621		91%	2451		121%	1942		89%	2601		108%
Verkooptijd in dagen				Std.dev	20%		Std.dev	5%								Std.dev	41%								Std.dev	17%
Tussenwoning	35	67%	36	79%	103%	33	77%	94%	36	92%	103%	31	98%	89%	27	110%	77%	34	102%	97%	39	94%	111%	25	74%	71%
Hoekwoning	41	79%	32	71%	78%	37	86%	90%	43	110%	105%	0	0%	0%	30	123%	73%	34	102%	83%	37	89%	90%	28	83%	68%
2-onder-1	54	104%	64	141%	119%	40	93%	74%	47	120%	87%	0	0%	0%	0	0%	0%	78	235%	144%	71	170%	131%	32	94%	59%
Vrijstaand	118	227%	104	229%	88%	93	217%	79%	109	279%	92%	0	0%	0%	77	315%	65%	92	277%	78%	0	0%	0%	108	319%	92%
Appartement	36	69%	35	77%	97%	31	72%	86%	35	90%	97%	32	102%	89%	22	90%	61%	27	81%	75%	40	96%	111%	25	74%	69%
Totaal	52	109%	45	119%	97%	43	109%	85%	39	138%	97%	32	40%	89%	24	127%	69%	33	160%	95%	42	90%	89%	34	129%	72%
				Std.dev	15%		Std.dev	8%								Std.dev	32%								Std.dev	12%
					7%		Std dev av	8%			22%			15%			26%			32%			5%			7%
					102%		Avg.	97%			108%			99%			92%			111%			92%			96%

Ede			Breda			Den Bosch			Zwolle			Enschede			Almere			Tilburg			Eindhoven			Lelystad		
180	23%	82%	351	32%	115%	180	23%	82%	246	35%	127%	180	23%	82%	272	47%	169%	180	23%	82%	387	34%	122%	180	23%	82%
106	14%	97%	139	13%	91%	106	14%	97%	136	20%	140%	106	14%	97%	95	16%	118%	106	14%	97%	194	17%	123%	106	14%	97%
108	14%	89%	202	19%	119%	108	14%	89%	106	15%	98%	108	14%	89%	54	9%	60%	108	14%	89%	176	16%	100%	108	14%	89%
74	9%	60%	165	15%	97%	74	9%	60%	110	16%	101%	74	9%	60%	34	6%	38%	74	9%	60%	117	10%	66%	74	9%	60%
314	40%	149%	234	21%	80%	314	40%	149%	96	14%	51%	314	40%	149%	122	21%	79%	314	40%	149%	261	23%	85%	314	40%	149%
782		96%	1091		100%	782		96%	694		104%	782		96%	577		93%	782		96%	1135		99%	782		96%
	Std.dev	33%		Std.dev	16%		Std.dev	33%		Std.dev	34%		Std.dev	33%		Std.dev	48%		Std.dev	33%		Std.dev	24%		Std.dev	33%
193	85%	98%	228	82%	95%	193	85%	98%	199	79%	91%	193	85%	98%	222	98%	113%	193	85%	98%	242	88%	102%	193	85%	98%
218	96%	101%	256	92%	98%	218	96%	101%	236	94%	99%	218	96%	101%	240	106%	112%	218	96%	101%	270	98%	104%	218	96%	101%
321	141%	126%	314	113%	102%	321	141%	126%	300	119%	107%	321	141%	126%	332	146%	131%	321	141%	126%	343	125%	112%	321	141%	126%
464	203%	135%	461	166%	110%	464	203%	135%	410	163%	108%	464	203%	135%	0	0%	0%	464	203%	135%	510	186%	123%	464	203%	135%
164	72%	89%	205	74%	91%	164	72%	89%	176	70%	86%	164	72%	89%	181	80%	99%	164	72%	89%	174	63%	78%	164	72%	89%
228		110%	278		99%	228		110%	252		98%	228		110%	227		91%	228		110%	274		104%	228		110%
	Std.dev	20%		Std.dev	7%		Std.dev	20%		Std.dev	9%		Std.dev	20%		Std.dev	13%		Std.dev	20%		Std.dev	16%		Std.dev	20%
1785	89%	99%	2058	89%	99%	1785	89%	99%	1983	92%	102%	1785	89%	99%	1944	96%	107%	1785	89%	99%	2085	94%	104%	1785	89%	99%
1835	92%	100%	2166	94%	102%	1835	92%	100%	1979	92%	100%	1835	92%	100%	2019	100%	109%	1835	92%	100%	2130	96%	104%	1835	92%	100%
2384	119%	126%	2308	100%	105%	2384	119%	126%	2158	100%	106%	2384	119%	126%	2166	107%	113%	2384	119%	126%	2322	104%	110%	2384	119%	126%
2684	134%	128%	2696	116%	111%	2684	134%	128%	2696	125%	120%	2684	134%	128%	0	0%	0%	2684	134%	128%	2626	118%	112%	2684	134%	128%
1880	94%	82%	2526	109%	95%	1880	94%	82%	2197	102%	89%	1880	94%	82%	2136	106%	92%	1880	94%	82%	2275	102%	89%	1880	94%	82%
1998		107%	2315		102%	1998		107%	2152		103%	1998		107%	2022		84%	1998		107%	2229		104%	1998		107%
	Std.dev	20%		Std.dev	6%		Std.dev	20%		Std.dev	11%		Std.dev	20%		Std.dev	9%		Std.dev	20%		Std.dev	9%		Std.dev	20%
36	79%	103%	30	67%	86%	36	79%	103%	27	63%	77%	36	79%	103%	23	96%	66%	36	79%	103%	24	70%	69%	36	79%	103%
32	71%	78%	41	92%	100%	32	71%	78%	33	77%	80%	32	71%	78%	26	108%	63%	32	71%	78%	30	87%	73%	32	71%	78%
64	141%	119%	43	96%	80%	64	141%	119%	32	75%	59%	64	141%	119%	28	117%	52%	64	141%	119%	35	101%	65%	64	141%	119%
104	229%	88%	108	241%	92%	104	229%	88%	97	227%	82%	104	229%	88%	0	0%	0%	104	229%	88%	106	307%	90%	104	229%	88%
35	77%	97%	26	58%	72%	35	77%	97%	47	110%	131%	35	77%	97%	23	96%	64%	35	77%	97%	21	61%	58%	35	77%	97%
45	119%	97%	45	111%	86%	45	119%	97%	43	110%	86%	45	119%	97%	24	83%	49%	45	119%	97%	34	125%	71%	45	119%	97%
	Std.dev	15%		Std.dev	11%		Std.dev	15%		Std.dev	27%		Std.dev	15%		Std.dev	6%		Std.dev	15%		Std.dev	12%		Std.dev	15%
		7%		Std dev av	8%			7%			8%			7%			21%			7%			16%			7%
		102%		Avg.	97%			102%			98%			102%			79%			102%			94%			102%

Appendix C: Variable description, categories and filters

Name variable	Original	Value	Categories	Description	Input	Filter
obj_PC6Code	Yes.	String.		Postal code with the letters of the postal code (1234 AA) transformed to the number of their position of the alphabet (A=01, B=02, etc.).	No; will be used to determine the 4-digit postal code.	No.
obj_PC6_id	Yes.	String.		Postal code with the letters of the postal code (1234 AA) transformed to the number of their position of the alphabet (A=01, B=02, etc.).	No.	No.
obj_PC4Code	No.	String.		Postal code with only the four digits.	Yes.	No.
obj_prov_ID	Yes.	Nominal.	6 Gelderland 8 Noord-Holland	Province in which the dwelling is located.	No.	No.
obj_wijk_ID	Yes.	Nominal.		Borough in which the dwelling is located.	No.	No.
obj_buurt_ID	Yes.	Nominal.		Neighbourhood in which the dwelling is located.	No.	No.
obj_hid_HUISNUMMER	Yes.	Nominal.		House number.	No.	No.
obj_hid_HUISNUMMERTOEVOEGING	Yes.	Nominal.		House number suffix.	No.	No.
obj_hid_POSTCODE	Yes.	Nominal.		Postal code.	No.	No.
obj_hid_WOONPLAATS	Yes.	Nominal.	Amsterdam Amsterdam Zuidoost Ressen (Nijmegen) Oosterhout (Nijmegen) Lent (Nijmegen) Nijmegen	The municipality in which the dwelling is located.	No.	No.
obj_hid_DATUM_AFMELDING	Yes.	Date.		The date that the dwelling is sold.	No.	No.
obj_hid_DATUM_AANMELDING	Yes.	Date.		The date that the dwelling was offered to the public.	No.	No.
obj_hid _VERKOOPTIJD	No.	Continuous.		Number of days between 'obj_hid_DATUMAFMELDING' and 'obj_hid_DATUMAANMELDING'.	No.	Yes; all dwellings than have been for sale for more than 500 days have been excluded.
obj_hid_OORSPRVRKOOPPR	Yes.	Continuous.		Original asking price in euro.	No.	No.
obj_hid_LAATSTVRKOOPPR	Yes.	Continuous.		Last asking price in euro.	No	Yes; dwellings that were sold for 50% more or less than the last asking price are excluded.
obj_hid_TRANSACTIEPRIJS	Yes.	Continuous.		Transaction price in euro.	No.	Yes; all dwellings with asking prices of more than €15 million are excluded.
Obj_hid_LNTRANSACTIEPRIJS	No.	Continuous.		Natural log of the transaction price.	Yes; dependent.	No.
obj_hid_CATEGORIE	Yes.	Nominal.	1 House 2 Apartment 3 Construction ground 4 Garage box	Type of real estate.	No	Yes; only houses and apartments are used; the garage boxes and construction ground are excluded.
obj_hid_BWPER	Yes.	Ordinal.	-1 No building period (no dwelling) 0 Unknown or before 1500 1 1500-1905 2 1906-1930 3 1931-1944	Building period.	Yes	Yes; buildings that were built before 1500 (since these buildings are categorised with 0, the same code as the unknown ones), buildings of which the building period is unknown and buildings of which the construction has been started or will start after the transaction date are excluded.

			4 1945-1960 5 1961-1970 6 1971-1980 7 1981-1990 8 1991-2000 9 2001>			
obj_hid_PERCEEL	Yes.	Continuous.	0 Upstairs apartment/unknown	Plot size in m².	Yes.	Yes; plots larger than 999.000m² are filtered out, together with other unlikely sizes like 99.999m². A filter for the overlap with 'obj_hid_CATEGORIE' is applied to filter out the plot sizes smaller than 15m² of single-family homes and apartments with a larger plot than 500m^2.
obj_hid_WOONOPP	Yes.	Continuous	-1 Unknown	Usable floor area in m².	Yes, but combined.	No.
obj_hid_M2	Yes.	Continuous.	-1 Unknown	Usable floor area in m², used when 'obj_hid_WOONOPP' seemed incorrect by the real estate broker.	Yes, but combined.	No.
obj_hid_WOONOPP_M2	No.	Continuous.	-1 Unknown	Usable floor area in m²; used to collect a combination of the two variables above. 'obj_hid_M2' is primarily used. When this variable is not available, the data from 'obj_hid_WOONOPP' is used.	Yes.	No. However, this variable forms the combination of 'obj_hid_WOONOPP' and 'obj_hid_M2'. A similar filter as for 'obj_hid_WOONOPP' needs to be applied. The filter is set for dwellings smaller than 15m^2 or larger than 600m². Larger dwellings hold a special place in the housing market, which drives up their price excessively.
Obj_hid_METERPRIJS	No.	Continuous.		Transaction price per square meter UFA in euro	No.	Yes; all dwellings with a price per m^2 lower than €500 are excluded.
obj_hid_INHOUD	Yes.	Continuous.	-1 Unknown	Volume in m^3	No.	No; the correlation between 'obj_hid_INHOUD' and 'obj_hid_WOONOPP_M2' is 0,933 with n=162.365, which disputes the recommendations about multicollinearity by Visser and Van Dam (2006, p. 122).
obj_hid_WOONOOPP_INHOUD	No.	Continuous.	-1 Unknown	Average floor height in m^1.	No.	Yes; all dwellings with more than 8 metres or less than 2 metres than average floor height are excluded.
obj_hid_HUISKLASSE	Yes.	Nominal.	-1 No house 0 Other sort of house 1 Simple dwelling 2 Single family dwelling, house boat or recreation dwelling 3 Mansion or canal house 4 Living farm or bungalow 5 Villa 6 Estate	House class.	No.	Yes; the categories 0 and 1 are excluded.
obj_hid_SOORTHUIS	Yes.	Nominal.	-1 No house 0 Other sort of house 1 Mobile home 2 Simple 3 House boat 4 Recreational dwelling 5 Single-family 6 Canal house 7 Mansion 8 Living farm 9 Bungalow 10 Villa 11 Countryhouse 12 Estate	Sort of house.	No.	No; 'obj_hid_SOORTWONING' will be included, which uses the same house sorts as this variable.

obj_hid_KENMERKWONING	Yes.	Nominal.	-1 Unknown 0 No feature 1 Split-level 2 Drive-in 3 Dyke house 4 Semi-bungalow 5 Patio-bungalow	Feature.	No.	No; of the cases that aren't missing (n=31.838), only 1.723 cases (5,4%) have a feature, which makes the variable practically irrelevant.
obj_hid_SOORTAPP		Nominal.	-1 No apartment 0 Other 1 Ground-floor apartment 2 Upstairs apartment 3 Maisonette 4 Porch apartment 5 Gallery flat 6 Welfare flat 7 Ground-floor apartment with an upstairs	Sort of apartment.	No.	No; 'obj_hid_SOORTWONING' will be included, which uses the same apartment sorts as this variable.
obj_hid_SOORTWONING		Nominal.	-1 No dwelling 0 Other 1 Mobile home 2 Simple 3 House boat 4 Recreational dwelling 5 Single-family 6 Canal house 7 Mansion 8 Living farm 9 Bungalow 10 Villa 11 Countryhouse 12 Estate 20 Other 21 Ground-floor apartment 22 Upstairs apartment 23 Maisonette 24 Porch apartment 25 Gallery flat 26 Welfare flat 27 Ground-floor apartment with an upstairs	Sort of house.	Yes.	Yes; objects that are no house (-1) or others (0) are filter out. This category is a combination of 'obj_hid_SOORTHUIS' and 'obj_hid_SOORTAPP' and is filled in for more than 99% of the cases.
obj_hid_NVMCIJFERS		Nominal.	-1 No dwelling or other problem 1 Unknown 2 Mid-terrace house 3 Stepped house 4 Corner house 5 Semi-detached 6 Detached 7 Apartment, building period unknown 8 Apartment, built before 1945 9 Apartment, built between 1945 and 1970 10 Apartment, built after 1970	Dwelling class according to the NVM.	No.	No; this variable shows too much similarities with 'obj_hid_SOORTWONING', which uses a wider range of dwelling sorts.

obj_hid_OPENPORTIEK		Binary.	-1 Not applicable 0 No open porch 1 Open porch	Open or closed porch.	No.	No; only 2% of the cases has an open porch, whereas the remaining cases either has a closed porch or no porch at all.
obj_hid_LIFT		Binary.	-1 No dwelling 0 No lift 1 Lift	Presence of a lift.	Yes.	No.
obj_hid_KWALITEIT		Nominal.	-1 No apartment 0 Simple 1 Normal or not filled in 2 Luxurious	Quality of the apartment.	No.	No; the bias in the distribution makes this variable useless.
obj_hid_VERKOOPCOND		Nominal.	-1 No dwelling 0 Not applicable/rental 1 Purchasing costs payable by the purchaser 2 No additional costs payable by the purchaser 3 Auctioned or sold by public tender 4 Rented per month 5 Rented per year 6 Withdrawn	Sale condition.	Yes.	Yes; dwellings that were auctioned or sold by public tender and dwellings that are rented are excluded. Hence, the categories 1 and 2 are left.
obj_hid_NVERDIEP	Yes.	Ordinal.	-1 Unknown	Number of floors.	Yes.	Yes; all dwellings with -1 or 0 floors or more than 5 floors are filtered out.
obj_hid_NKAMERS	Yes.	Ordinal.	-1 Unknown	Number of rooms.	Yes.	Yes; all dwellings with -1 or 0 rooms are filtered out, as well as all dwellings with more than 10 rooms.
obj_hid_VTRAP	Yes.	Binary.	-1 Unknown	Presence of attic stairs.	No.	No; only 2,3% of the cases has a folding ladder.
obj_hid_ZOLDER	Yes.	Binary.	-1 No hosue 0 No attic 1 Attic	Presence of an attic (Dutch: zolder).	No.	No; only 6,5% of the cases has an attic.
obj_hid_VLIER	Yes.	Binary.	-1 No dwelling 0 No loft 1 Loft	Presence of a loft (Dutch: vliering).	No.	No; more than 98% of the dwellings doesn't have a loft.
obj_hid_WOONKA	Yes.	Nominal	-1 No dwelling 0 Other sort of living room 1 L-room 2 T-room 3 Z-room or U-room 4 Open room (Dutch: doorzonkamer) 5 Room en suite	Sort of living room	Yes.	No.
obj_hid_NBALKON	Yes.	Continuous/binary.	-1 Unknown	Number of balconies	Yes.	Yes; only 1,8% of the cases does have 2 or more balconies, which made it clearer to merge all cases that have any balconies.
obj_hid_NDAKKAP	Yes.	Continuous.	-1 Unknown	Number of dormers	No.	No; frequency: 96,1% doesn't have a dormer; 3,9% has 1 or more dormers.
obj_hid_NDAKTERRAS	Yes.	Continuous/binary.	-1 Unknown	Number of roof terraces	Yes.	Yes; variable has been made binary instead of the original ordinal scale.
obj_hid_NKEUKEN	Yes.	Continuous.	-1 Unknown	Number of kitchens	No.	No; a too large share (23,2%) of the cases appears to have no kitchen, which does not correspond with the reality.
obj_hid_NBIJKEUK	Yes.	Continuous.	-1 Unknown	Number of sculleries	No.	No; frequency: 95,6% has no scullery. 4,4 has 1 or more sculleries.
obj_hid_NWC	Yes.	Continuous.	-1 Unknown	Number of toilets	No.	No; frequency: 13,3% of the dwellings appears to have 0 toilets, which does not correspond with the reality.

						Moreover, 15,6% (25.289) of the dwellings disposes of 5 toilets, which seems fulsome.
obj_hid_NBADK	Yes.	Continuous.	-1 Unknown	Number of bathrooms	No.	No; frequency: 13,2% of the dwellings appears to have 0 bathrooms, which does not correspond with the reality.
obj_hid_PARKEER	Yes.	Nominal	-1 No dwelling 0 No parking space 2 Parking space 3 Carport and no garage 4 Garage and no carport 6 Garage and carport 8 Garage for multiple cars	Type of parking space	Yes; but combined with indoor parking.	No.
obj_hid_INPANDIG	Yes.	Binary.	-1 Unknown 0 Absent 1 Present	Presence of an indoor parking space.	Yes; but combined with 'obj_hid_PARKEER'.	No; frequency: 97,4% of the dwellings doesn't have an indoor parking space.
Obj_hid_PARKING	Yes.	Binary.	0 Absent 1 Present	Presence of a parking space.	Yes.	No.
obj_hid_TUINLIG	Yes.	Nominal.	-1 No dwelling 0 Unknown or no garden 1 North 2 North-East 3 East 4 South-East 5 South 6 South-West 7 West 8 North-West	Orientation of the garden relative to the dwelling.	Yes.	It appears that gardens with an orientation towards the South, Southwest and West, which are the most favourable directions regarding the sun, are overrepresented: more than half of the gardens is located in this direction, which doesn't correspondent with the probability of the orientation. This finding makes it difficult to undoubtedly use this variable as input. To nuance this, the orientations are divided between good (SE-W) and bad (NW-E).
obj_hid_TUINAFW	Yes.	Nominal.	-1 No dwelling 1 No garden 2 Neglected 3 Unknown or normal 4 Well-maintained 5 Very good finishing	Quality of garden finish.	No.	No; the distribution, wherein 86,6% of the cases is marked as 'unknown or normal', makes the distribution uninteresting for further research.
obj_hid_ONBI	Yes.	Nominal.	-1 No dwelling 1 Bad 2 Mediocre to bad 3 Mediocre 4 Mediocre to reasonable 5 Reasonable 6 Reasonble to good or unknown 7 Good 8 Good to excellent 9 Excellent	Indoor maintenance level.	Yes.	No; the distribution seems to behave as if there are five possible answers: bad, mediocre, reasonable, good and excellent are more used than the answers inbetween. Therefore, dummies are made that distinguish good to excellent maintenance level and bad to reasonable maintenance.
obj_hid_ONBU	Yes.	Nominal.	-1 No dwelling 1 Bad 2 Mediocre to bad 3 Mediocre 4 Mediocre to reasonable 5 Reasonable 6 Reasonble to good or unknown 7 Good 8 Good to excellent	Outdoor maintenance level.	Yes.	No; again, the answers behave as a five-point scale rather than a nine-point scale. Again, the maintenance level is brought back to two levels.

			9 Excellent			
obj_hid_ISOL	Yes.	Nominal	-1 No dwelling 0 No insulation 1 1 kind of insulation 2 2 kinds of insulation 3 3 kinds of insulation 4 4 kinds of insulation 5 5 or more kinds of insulation	Kinds of insulation	No.	No; the frequency table shows that of the remaining cases, approximately 30% should have no insulation at all, which contradicts the findings about the insulation of Dutch dwellings by the Ministry of Internal Affairs and Kingdom Relations (2013).
obj_hid_VERW	Yes.	Nominal.	-1 No dwelling 0 No heating 1 Gas stove or coal stove 2 Central heating, hot air heating or city heating 3 Air-conditioning or sun collectors	Kind of heating.	Yes.	Yes; all dwellings that don't have a heating system are excluded.
obj_hid_LIGCENTR	Yes.	Nominal.	-1 No dwelling 0 Outside built area 1 Unknown 2 In residential area 3 In centre	Location relative to the centre.	No.	No.
obj_hid_LIGMOOI	Yes.	Nominal.	-1 No dwelling 0 Unknown 1 Near forest 2 Near water 3 Near park 4 Clear view	Location near a beautiful environment.	No.	No.
obj_hid_LIGDRUKW	Yes.	Binary.	-1 No dwelling 0 On a quiet road 1 Unknown 2 On a busy road	Location relative to busy roads.	No	No.
obj_hid_GED_VERHUURD	Yes.	Binary.	0 Not partially rented out 1 Partially rented out	Partially rented out.	No.	Yes; all dwellings that have been partially rented out will be filtered out.
obj_hid_PERMANENT	Yes.	Binary.	0 Not permanently inhabited 1 Permanently habited	Permanently inhabited.	No.	Yes; all dwellings that aren't inhabited permanently will be filtered out.
obj_hid_ERFPACHT_TONEN	Yes.	Binary.	-1 Unknown 0 No ground lease 1 Ground lease	Presence of a ground lease construction	Yes.	Of 13,6% of the cases (n=162.365), the ground lease construction is unknown. For the remaining cases, the distribution is fairly equal.
obj_hid_STATUS	Yes.	Nominal.	5 Sold	Status of sales process.	No.	No; all cases concern completed transactions.
obj_hid_MONUMENT	Yes.	Binary.	0 No monument 1 Monument	Status as a monument.	Yes.	No.
obj_hid_MONUMENTAAL	Yes.	Binary.	0 Not monumental 1 Monumental	Monumental building.	No.	No.
obj_hid_TYPE	Yes.	Nominal.	-1 No dwelling 0 House type unknown 1 Mid-terrace house 2 Stepped house 3 Corner house 4 Semi-detached 5 Detached	Type of dwelling when it concerns a house.	No.	No; type is unknown for a large part of the cases.

Appendix D: Postal code and period dummies Amsterdam

Variable	Step 7		Variable	Step 7		Variable	Step 7		Variable	Step 7	
	Coeff.	SE		Coeff.	SE		Coeff.	SE		Coeff.	SE
Postal code dummies			**Postal codes continued**			**Time dummies**			**Time dummies continued**		
PC1011	0.000**	0.005	PC1075	0.048	0.005	Y95Q1	-1.134	0.010	Y06Q4	-0.135	0.005
PC1012	-0.067	0.005	PC1076	-0.008	0.005	Y95Q2	-1.123	0.009	Y07Q1	-0.110	0.005
PC1013	-0.094	0.004	PC1077	0.155	0.005	Y95Q3	-1.081	0.008	Y07Q2	-0.070	0.005
PC1014	-0.310	0.045	PC1078	0.045	0.005	Y95Q4	-1.058	0.008	Y07Q3	-0.048	0.005
PC1015	0.042	0.004	PC1079	-0.062	0.005	Y96Q1	-1.011	0.008	Y07Q4	-0.032	0.005
PC1016	0.098	0.005	PC1081	-0.158	0.007	Y96Q2	-1.009	0.008	Y08Q1	-0.015	0.006
PC1017	0.060	0.004	PC1082	-0.222	0.005	Y96Q3	-0.958	0.008	Y08Q2	-0.002**	0.005
PC1018	-0.077	0.004	PC1083	-0.185	0.006	Y96Q4	-0.949	0.008	Y08Q3	-0.007**	0.005
PC1019	-0.176	0.005	PC1086	-0.399	0.013	Y97Q1	-0.905	0.008	Y08Q4	-0.038	0.006
PC1021	-0.436	0.008	PC1087	-0.417	0.007	Y97Q2	-0.844	0.008	Y09Q1	-0.075	0.006
PC1022	-0.557	0.023	PC1091	-0.167	0.004	Y97Q3	-0.826	0.007	Y09Q2	-0.066	0.006
PC1023	-0.274	0.010	PC1092	-0.181	0.006	Y97Q4	-0.795	0.007	Y09Q3	-0.069	0.006
PC1024	-0.480	0.006	PC1093	-0.193	0.006	Y98Q1	-0.752	0.007	Y09Q4	-0.077	0.005
PC1025	-0.479	0.005	PC1094	-0.306	0.005	Y98Q2	-0.714	0.007	Y10Q1	-0.075	0.006
PC1026	0.040**	0.022	PC1095	-0.326	0.006	Y98Q3	-0.693	0.007	Y10Q2	-0.063	0.006
PC1027	-0.181	0.029	PC1096	-0.072	0.013	Y98Q4	-0.645	0.007	Y10Q3	-0.068	0.006
PC1028	-0.028**	0.024	PC1097	-0.178	0.006	Y99Q1	-0.590	0.007	Y10Q4	-0.071	0.006
PC1031	-0.347	0.016	PC1098	-0.110**	0.005	Y99Q2	-0.512	0.007	Y11Q1	-0.075	0.006
PC1032	-0.502	0.010	PC1099	-0.199	0.179	Y99Q3	-0.459	0.007	Y11Q2	-0.065	0.006
PC1033	-0.516	0.006	PC1102	-0.719	0.005	Y99Q4	-0.401	0.007	Y11Q3	-0.081	0.006
PC1034	-0.501	0.006	PC1103	-0.694	0.006	Y00Q1	-0.395	0.007	Y11Q4	-0.114	0.006
PC1035	-0.490	0.006	PC1104	-0.713	0.009	Y00Q2	-0.356	0.007	Y12Q1	-0.129	0.006
PC1036	-0.673	0.038	PC1106	-0.626	0.006	Y00Q3	-0.318	0.007	Y12Q2	-0.129	0.006
PC1037	-0.612	0.179	PC1107	-0.645	0.007	Y00Q4	-0.292	0.007	Y12Q3	-0.160	0.006
PC1041	-0.510	0.103	PC1108	-0.689	0.008	Y01Q1	-0.290	0.007	Y12Q4	-0.162	0.005
PC1051	-0.194	0.004	PC1109	-0.521	0.013	Y01Q2	-0.249	0.007	Y13Q1	-0.193	0.007
PC1052	-0.107	0.005				Y01Q3	-0.254	0.007	Y13Q2	-0.181	0.006
PC1053	-0.132	0.004				Y01Q4	-0.250	0.007	Y13Q3	-0.175	0.006
PC1054	-	-				Y02Q1	-0.259	0.007	Y13Q4	-0.146	0.006
PC1055	-0.347	0.004				Y02Q2	-0.236	0.006	Y14Q1	-0.133	0.006
PC1056	-0.265	0.004				Y02Q3	-0.249	0.007	Y14Q2	-0.106	0.005
PC1057	-0.238	0.005				Y02Q4	-0.260	0.007	Y14Q3	-0.096	0.005
PC1058	-0.142	0.004				Y03Q1	-0.282	0.007	Y14Q4	-0.055	0.005
PC1059	-0.130	0.005				Y03Q2	-0.291	0.006	Y15Q1	-0.041	0.005
PC1060	-0.533	0.006				Y03Q3	-0.304	0.006	Y15Q2	-	-
PC1061	-0.505	0.009				Y03Q4	-0.309	0.006	Y15Q3	0.028	0.005
PC1062	-0.441	0.007				Y04Q1	-0.305	0.006	Y15Q4	0.057	0.005
PC1063	-0.505	0.006				Y04Q2	-0.292	0.006	Y16Q1	0.097	0.005
PC1064	-0.486	0.006				Y04Q3	-0.288	0.006	Y16Q2	0.142	0.005
PC1065	-0.430	0.007				Y04Q4	-0.272	0.006	Y16Q3	0.171	0.005
PC1066	-0.449	0.005				Y05Q1	-0.269	0.006	Y16Q4	0.213	0.005
PC1067	-0.564	0.007				Y05Q2	-0.240	0.006			
PC1068	-0.465	0.006				Y05Q3	-0.227	0.006			
PC1069	-0.539	0.005				Y05Q4	-0.223	0.006			
PC1071	0.154	0.005				Y06Q1	-0.200	0.006			
PC1072	-0.056	0.004				Y06Q2	-0.181	0.006			
PC1073	-0.076	0.005				Y06Q3	-0.160	0.006			
PC1074	-0.055	0.006									

Appendix E: Model Nijmegen

Variable	*Step 7*		*Variable*	*Step 7*		*Variable*	*Step 7*		*Variable*	*Step 7*	
	Coeff.	*SE*		*Coeff.*	*SE*		*Coeff.*	*SE*		*Coeff.*	*SE*
Constant	11.481	0.020	**Postal code dummies**			**Time dummies**			**Time dummies continued**		
Primary features			PC6511	0.326	0.008	Y95Q1	-1.001	0.016	Y06Q4	0.041	0.011
UFA (m^2)	0.005	0.000	PC6512	0.323	0.008	Y95Q2	-0.954	0.015	Y07Q1	0.049	0.011
Number of rooms	0.025	0.001	PC6521	0.376	0.008	Y95Q3	-0.936	0.015	Y07Q2	0.052	0.011
Building period			PC6522	0.472	0.008	Y95Q4	-0.889	0.014	Y07Q3	0.063	0.011
1500-1905	0.036	0.007	PC6523	0.399	0.008	Y96Q1	-0.887	0.015	Y07Q4	0.062	0.011
1906-1930	0.058	0.005	PC6524	0.384	0.008	Y96Q2	-0.815	0.014	Y08Q1	0.069	0.011
1931-1944	0.094	0.005	PC6525	0.334	0.007	Y96Q3	-0.816	0.014	Y08Q2	0.087	0.011
1945-1960	0.009*	0.004	PC6531	0.292	0.007	Y96Q4	-0.785	0.014	Y08Q3	0.067	0.012
1961-1970	-	-	PC6532	0.184	0.007	Y97Q1	-0.748	0.014	Y08Q4	0.049	0.012
1971-1980	-0.007**	0.005	PC6533	0.214	0.007	Y97Q2	-0.712	0.013	Y09Q1	0.018**	0.013
1981-1990	0.051	0.005	PC6534	0.148	0.011	Y97Q3	-0.686	0.014	Y09Q2	0.036	0.012
1991-2000	0.156	0.005	PC6535	0.041	0.009	Y97Q4	-0.678	0.014	Y09Q3	0.016**	0.012
2001-	0.121	0.007	PC6536	0.130	0.009	Y98Q1	-0.666	0.013	Y09Q4	0.005**	0.012
Dwelling type			PC6537**	0.013	0.007	Y98Q2	-0.614	0.013	Y10Q1	-0.005**	0.013
Single family	-	-	PC6538**	0.007	0.007	Y98Q3	-0.584	0.013	Y10Q2	0.004**	0.012
Mansion	0.046**	0.005	PC6541	0.170	0.008	Y98Q4	-0.543	0.013	Y10Q3	-0.007**	0.013
Upstairs apartment	-0.174	0.006	PC6542	0.138	0.007	Y99Q1	-0.505	0.014	Y10Q4	0.009**	0.012
Ground floor apt.	-0.101	0.006	PC6543	0.164	0.007	Y99Q2	-0.455	0.013	Y11Q1	-0.006**	0.013
Maisonette	-0.191	0.008	PC6544	0.038	0.008	Y99Q3	-0.396	0.012	Y11Q2	-0.002**	0.013
Porch apartment	-0.151	0.005	PC6545**	0.005	0.007	Y99Q4	-0.352	0.013	Y11Q3	-0.030*	0.013
Gallery flat	-0.187	0.007	PC6546	-	-	Y00Q1	-0.334	0.013	Y11Q4	-0.052	0.013
Other	0.057	0.005	PC6663	0.196	0.008	Y00Q2	-0.317	0.013	Y12Q1	-0.055	0.013
Maintenance level inside			PC6679	0.088	0.010	Y00Q3	-0.302	0.013	Y12Q2	-0.061	0.013
Worse	-0.083	0.003	PC6683	0.301	0.066	Y00Q4	-0.270	0.013	Y12Q3	-0.083	0.014
Better	-	-				Y01Q1	-0.262	0.012	Y12Q4	-0.097	0.012
Maintenance level outside						Y01Q2	-0.243	0.012	Y13Q1	-0.150	0.015
Worse	-	-				Y01Q3	-0.207	0.012	Y13Q2	-0.117	0.014
Better	0.047	0.004				Y01Q4	-0.178	0.012	Y13Q3	-0.141	0.013
Garden orientation						Y02Q1	-0.158	0.012	Y13Q4	-0.120	0.013
Good orientation	0.007**	0.004				Y02Q2	-0.137	0.012	Y14Q1	-0.118	0.013
Bad orientation	-0.001**	0.004				Y02Q3	-0.141	0.012	Y14Q2	-0.093	0.012
Heating						Y02Q4	-0.122	0.012	Y14Q3	-0.127	0.013
Central heating	-	-				Y03Q1	-0.121	0.012	Y14Q4	-0.101	0.012
Gas/coal	-0.085	0.005				Y03Q2	-0.102	0.011	Y15Q1	-0.117	0.012
Sun	0.146**	0.161				Y03Q3	-0.108	0.012	Y15Q2	-0.059	0.012
Ground lease						Y03Q4	-0.092	0.012	Y15Q3	-0.076	0.012
Ground lease	-0.236	0.013				Y04Q1	-0.080	0.012	Y15Q4	-0.058	0.011
No ground lease	0.007*	0.003				Y04Q2	-0.083	0.011	Y16Q1	-0.064	0.012
Type of transaction						Y04Q3	-0.072	0.012	Y16Q2	-0.016**	0.011
K.k.	-0.078	0.016				Y04Q4	-0.044	0.011	Y16Q3	-0.032	0.011
V.o.n.	-	-				Y05Q1	-0.050	0.011	Y16Q4	-	-
Secondary features						Y05Q2	-0.032	0.011			
Monument	0.053	0.018				Y05Q3	-0.024*	0.011			
Lift	0.072	0.005				Y05Q4	-0.018**	0.011			
Balcony	0.027	0.003				Y06Q1	0.004**	0.012			
Roof terrace	0.041	0.004				Y06Q2	0.020**	0.011			
Parking	0.135	0.003				Y06Q3	0.021**	0.012			

Appendix F: Model Amsterdam < 2008

Variable	*Step 7*		*Variable*	*Step 7*		*Variable*	*Step 7*		*Variable*	*Step 7*	
	Coeff.	*SE*		*Coeff.*	*SE*		*Coeff.*	*SE*		*Coeff.*	*SE*
Constant	11.481	0.020	**Postal code dummies**			**Postal code dummies continued**			**Time dummies**		
Primary features			PC1011	0.170	0.008	PC1082	-0.040	0.007	Y95Q1	-1.116	0.010
UFA (m^2)	0.006	0.000	PC1012	0.110	0.008	PC1083	0.045	0.008	Y95Q2	-1.102	0.009
Number of rooms	0.037	0.001	PC1013	0.080	0.007	PC1086	-0.166	0.051	Y95Q3	-1.066	0.009
Building period			PC1014	-0.135	0.124	PC1087	-0.101	0.021	Y95Q4	-1.039	0.008
1500-1905	0.028	0.003	PC1015	0.218	0.007	PC1091	-0.037	0.007	Y96Q1	-0.998	0.008
1906-1930	-	-	PC1016	0.265	0.007	PC1092	-0.045	0.010	Y96Q2	-0.982	0.008
1931-1944	-0.007*	0.003	PC1017	0.239	0.007	PC1093	-0.082	0.011	Y96Q3	-0.937	0.008
1945-1960	-0.089	0.005	PC1018	0.099	0.007	PC1094	-0.193	0.008	Y96Q4	-0.925	0.008
1961-1970	-0.151	0.004	PC1019	-	-	PC1095	-0.193	0.010	Y97Q1	-0.882	0.008
1971-1980	-0.093	0.006	PC1021	-0.300	0.015	PC1096	0.127	0.016	Y97Q2	-0.823	0.008
1981-1990	-0.017	0.004	PC1022	-0.347	0.059	PC1097	0.003	0.010	Y97Q3	-0.805	0.008
1991-2000	0.067	0.004	PC1023	-0.093	0.016	PC1098	0.067	0.007	Y97Q4	-0.775	0.008
2001-	0.062	0.006	PC1024	-0.258	0.009	PC1099	0.003	0.176	Y98Q1	-0.731	0.008
Dwelling type			PC1025	-0.242	0.008	PC1102	-0.504	0.009	Y98Q2	-0.694	0.008
Single family	0.076	0.004	PC1026	0.232	0.029	PC1103	-0.484	0.008	Y98Q3	-0.669	0.008
Mansion	0.008**	0.005	PC1027	-0.009	0.035	PC1104	-0.408	0.013	Y98Q4	-0.619	0.007
Upstairs apartment	-	-	PC1028	0.193	0.030	PC1106	-0.369	0.008	Y99Q1	-0.563	0.007
Ground floor apt.	0.019	0.003	PC1031	-0.124	0.027	PC1107	-0.372	0.010	Y99Q2	-0.486	0.007
Maisonette	0.022	0.004	PC1032	-0.365	0.020	PC1108	-0.455	0.012	Y99Q3	-0.431	0.007
Porch apartment	-0.025	0.003	PC1033	-0.294	0.009	PC1109	-0.269	0.017	Y99Q4	-0.374	0.007
Gallery flat	-0.049	0.003	PC1034	-0.267	0.009				Y00Q1	-0.369	0.007
Other	0.055	0.005	PC1035	-0.255	0.008				Y00Q2	-0.328	0.007
Maintenance level inside			PC1041	-0.308	0.102				Y00Q3	-0.291	0.007
Worse	-	-	PC1051	-0.093	0.007				Y00Q4	-0.265	0.007
Better	0.089	0.003	PC1052	0.028	0.008				Y01Q1	-0.262	0.007
Maintenance level outside			PC1053	0.002**	0.007				Y01Q2	-0.218	0.007
Worse	-	-	PC1054	0.150	0.007				Y01Q3	-0.226	0.007
Better	0.069	0.004	PC1055	-0.217	0.007				Y01Q4	-0.221	0.007
Garden orientation			PC1056	-0.138	0.007				Y02Q1	-0.230	0.007
Good orientation	0.058	0.003	PC1057	-0.109	0.008				Y02Q2	-0.208	0.007
Bad orientation	0.067	0.003	PC1058	0.030	0.007				Y02Q3	-0.226	0.007
Heating			PC1059	0.044	0.008				Y02Q4	-0.234	0.007
Central heating	-	-	PC1060	-0.291	0.008				Y03Q1	-0.252	0.007
Gas/coal	-0.127	0.003	PC1061	-0.424	0.024				Y03Q2	-0.266	0.007
Sun	0.336	0.124	PC1062	-0.251	0.009				Y03Q3	-0.273	0.006
Ground lease			PC1063	-0.286	0.008				Y03Q4	-0.275	0.006
Ground lease	-0.011	0.002	PC1064	-0.266	0.008				Y04Q1	-0.275	0.007
No ground lease	0.016	0.002	PC1065	-0.188	0.011				Y04Q2	-0.258	0.006
Type of transaction			PC1066	-0.214	0.007				Y04Q3	-0.253	0.006
K.k.	-	-	PC1067	-0.304	0.010				Y04Q4	-0.244	0.006
V.o.n.	0.111	0.007	PC1068	-0.223	0.008				Y05Q1	-0.239	0.006
Secondary features			PC1069	-0.307	0.008				Y05Q2	-0.215	0.006
Monument	0.079	0.005	PC1071	0.329	0.007				Y05Q3	-0.198	0.006
Lift	0.058	0.003	PC1072	0.090	0.007				Y05Q4	-0.196	0.006
Balcony	0.010	0.002	PC1073	0.086	0.008				Y06Q1	-0.171	0.006
Roof terrace	0.062	0.003	PC1074	0.102	0.009				Y06Q2	-0.149	0.006
Parking	0.121	0.003	PC1075	0.228	0.007				Y06Q3	-0.127	0.006
			PC1076	0.154	0.009				Y06Q4	-0.104	0.006
			PC1077	0.337	0.007				Y07Q1	-0.080	0.006
			PC1078	0.209	0.007				Y07Q2	-0.040	0.006
			PC1079	0.110	0.008				Y07Q3	-0.019	0.006
			PC1081	0.052	0.009				Y07Q4	-	-

Appendix G: Model Amsterdam ≥ 2008

Variable	*Step 7*		*Variable*	*Step 7*		*Variable*	*Step 7*		*Variable*	*Step 7*	
	Coeff.	*SE*		*Coeff.*	*SE*		*Coeff.*	*SE*		*Coeff.*	*SE*
Constant	11.838	0.008	**Postal code dummies**			**Postal code dummies continued**			**Time dummies**		
Primary features			PC1011	-0.011**	0.007	PC1075	0.022	0.006	Y08Q1	-0.010**	0.005
UFA (m^2)	0.007	0.000	PC1012	-0.083	0.008	PC1076	-0.018	0.007	Y08Q2	-0.002**	0.005
Number of rooms	0.045	0.001	PC1013	-0.108	0.006	PC1077	0.132	0.007	Y08Q3	-0.005**	0.005
Building period			PC1014	-0.345	0.045	PC1078	0.031	0.006	Y08Q4	-0.034	0.006
1500-1905	0.035	0.002	PC1015	0.028	0.006	PC1079	-0.083	0.007	Y09Q1	-0.072	0.006
1906-1930	-	-	PC1016	0.092	0.006	PC1081	-0.202	0.009	Y09Q2	-0.067	0.005
1931-1944	-0.001**	0.003	PC1017	0.043	0.006	PC1082	-0.244	0.007	Y09Q3	-0.068	0.005
1945-1960	-0.074	0.004	PC1018	-0.098	0.006	PC1083	-0.250	0.008	Y09Q4	-0.078	0.005
1961-1970	-0.154	0.004	PC1019	-0.189	0.006	PC1086	-0.432	0.013	Y10Q1	-0.074	0.005
1971-1980	-0.113	0.005	PC1021	-0.437	0.008	PC1087	-0.453	0.007	Y10Q2	-0.065	0.005
1981-1990	-0.055	0.003	PC1022	-0.588	0.023	PC1091	-0.160	0.005	Y10Q3	-0.070	0.006
1991-2000	0.036	0.003	PC1023	-0.296	0.012	PC1092	-0.174	0.007	Y10Q4	-0.071	0.005
2001-	0.059	0.004	PC1024	-0.536	0.008	PC1093	-0.183	0.007	Y11Q1	-0.077	0.006
Dwelling type			PC1025	-0.547	0.007	PC1094	-0.287	0.006	Y11Q2	-0.068	0.006
Single family	0.095	0.004	PC1026	0.010**	0.033	PC1095	-0.318	0.007	Y11Q3	-0.082	0.005
Mansion	-0.068	0.006	PC1027	-0.118*	0.047	PC1096	-0.119	0.021	Y11Q4	-0.115	0.006
Upstairs apartment	-	-	PC1028	-0.100	0.036	PC1097	-0.200	0.008	Y12Q1	-0.130	0.006
Ground floor apt.	0.048	0.003	PC1031	-0.379	0.018	PC1098	-0.126	0.006	Y12Q2	-0.130	0.006
Maisonette	0.011	0.004	PC1032	-0.507	0.011	PC1102	-0.759	0.007	Y12Q3	-0.157	0.006
Porch apartment	-0.009	0.003	PC1033	-0.562	0.008	PC1103	-0.819	0.010	Y12Q4	-0.162	0.005
Gallery flat	-0.046	0.004	PC1034	-0.564	0.008	PC1104	-0.827	0.011	Y13Q1	-0.192	0.007
Other	0.103	0.005	PC1035	-0.566	0.008	PC1106	-0.737	0.008	Y13Q2	-0.184	0.006
Maintenance level inside			PC1036	-0.697	0.037	PC1107	-0.753	0.009	Y13Q3	-0.177	0.006
Worse	-	-	PC1037	-0.665	0.169	PC1108	-0.754	0.011	Y13Q4	-0.148	0.005
Better	0.101	0.003	PC1051	-0.168	0.006	PC1109	-0.654	0.021	Y14Q1	-0.135	0.005
Maintenance level outside			PC1052	-0.107	0.006				Y14Q2	-0.110	0.005
Worse	-	-	PC1053	-0.129	0.005				Y14Q3	-0.098	0.005
Better	0.035	0.004	PC1054	-	-				Y14Q4	-0.056	0.005
Garden orientation			PC1055	-0.338	0.006				Y15Q1	-0.041	0.005
Good orientation	0.071	0.003	PC1056	-0.251	0.005				Y15Q2	-	-
Bad orientation	0.059	0.003	PC1057	-0.230	0.006				Y15Q3	0.030	0.005
Heating			PC1058	-0.157	0.005				Y15Q4	0.059	0.005
Central heating	-	-	PC1059	-0.148	0.007				Y16Q1	0.099	0.005
Gas/coal	-0.131	0.004	PC1060	-0.652	0.009				Y16Q2	0.144	0.005
Sun	0.076*	0.030	PC1061	-0.508	0.010				Y16Q3	0.174	0.005
Ground lease			PC1062	-0.478	0.010				Y16Q4	0.213	0.005
Ground lease	-0.011	0.002	PC1063	-0.584	0.008						
No ground lease	0.016	0.002	PC1064	-0.563	0.008						
Type of transaction			PC1065	-0.491	0.009						
K.k.	-	-	PC1066	-0.560	0.008						
V.o.n.	-0.012	0.003	PC1067	-0.641	0.009						
Secondary features			PC1068	-0.546	0.007						
Monument	0.055	0.004	PC1069	-0.601	0.007						
Lift	0.064	0.002	PC1071	0.135	0.006						
Balcony	0.030	0.002	PC1072	-0.060	0.005						
Roof terrace	0.094	0.002	PC1073	-0.089	0.006						
Parking	0.075	0.003	PC1074	-0.064	0.007						