Apartment prices, state of the economy and periods suspicious of redlining:

A comparison of a 'good' and 'bad' standing Rotterdam neighborhood

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Apartment prices, state of the economy and periods suspicious of redlining: *A comparison of a 'good' and 'bad' standing Rotterdam neighborhood*

By

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Abstract

This research is an investigation about the relationship of the apartment prices development in two contrasting Rotterdam neighborhoods and the general Dutch economical circumstances. Examined is the price development in the two contrasting neighborhoods during the economical business cycle and its distinct phases. The research period is 1995-2011. For each investigated neighborhood, a weighted repeated sales index is constructed for this period. All this is done in order to come to an answer to the research question: *Is there a relationship between the social status of city neighborhoods and the development of apartment prices, while considering the state of the economy?*

These constructed apartment price indexes are also used to examine the suspicious of redlining for Rotterdam. For this purpose, also a counting table of number of transactions for each neighborhood is developed.

The outcome of this research is that apartment prices in both the 'good' and 'bad' standing neighborhood show the same development, in each distinct general economic circumstance. The suspicious of redlining is not supported by the data used for this investigation.

Keywords: apartment price, real estate, housing, redlining, economic circumstances, recession, upturn, real GDP, the Netherlands, Rotterdam, neighborhood, good standing, bad standing, weighted repeated sales index.

Management summary

In this summary, the steps followed throughout this thesis are set out. This for reasons of the complexity of this research and for getting a good overview. This summary is divided into a part about the existing literature and a part about the method section.

1 Existing literature part:

Firstly, the real estate and apartment market is described. Apartment price determinants and the formation of prices is explained. This to give the reader a good insight on how the apartment transaction prices are realized.

Then, the urban apartment market is handled. In this urban market, social status and redlining play an important role. Social status divides neighborhoods into 'good' and 'bad' standing, which will be thoroughly elaborated. The for this thesis investigated neighborhood of 'bad standing' is suspicious of redlining during certain periods and therefore this phenomenon is thoroughly discussed.

Because for this thesis the apartment price development is linked to the development of real GDP, the business cycle and especially its various phases are deeply discussed. The same counts for the existing literature about the apartment price development during these distinct phases.

Further, an index to measure the apartment price development over time can be constructed in multiple ways, and therefore these indexes with their pro's and con's are discussed.

2 Method section part:

In this section, the difference between the database of the NVM and the Dutch Land Registry Office (DLRO) is handled. For this thesis, there is chosen to use the database of the DLRO. This because this database contains the whole housing sales market to private persons, auction sales (forced by for example banks) included. Also this database is the most reliable in my view, as the data comes straight from notaries.

The suspicious periods of Redlining for Rotterdam are as exactly as possible appointed. This because in most neighborhoods of 'bad standing', every now and then this phenomenon is present. Redlining is performed by banks, and whole postal code areas are excluded for mortgage supply. Therefore, the expectation is that Redlining has a negative impact on the development of apartment prices.

Hereafter, the business cycle for the Netherlands is investigated by looking at real GDP over time. Peaks and troughs in the Dutch real GDP sequence are determined, these points of change form the beginning points of recessions and economic upturns in the business cycle (the general economy). Next to the whole business cycle, these distinct phases are important for this research. The aim is to investigate the development of apartment prices during the whole business cycle and also apart during the periods of recession and economic upturn. This to get a good picture of the price development in these distinct underlying periods of the overall development.

The development of apartment prices in a 'good' and a 'bad standing' Rotterdam neighborhood during former mentioned periods are compared. In the neighborhood selection process, all following issues play a role: - the distance from the city center, - scores on social status indicators, - the relative presence of transactions under special conditions, and - the presence of certain types of apartments of a certain construction period. In the end, representative streets in both neighborhoods are selected. The 6 digit postal codes of these streets are used to do the request for data at the DLRO.

The acquired data is explored, and because DLRO data contains little data of the apartments itself a weighted repeated sales index is constructed for each neighborhood. Transactions with very high relative price changes are removed, the same counts for transactions with very low price levels. For apartments with changes in between the transactions, the deviating transactions are removed. Sales transaction pairs are formed, and an apartment with more than 2 transactions during 1995-2011 is divided in multiple sales pairs.

The periods of the indexes that are constructed, are as good as possible aligned to the turning points in the Dutch real GDP sequence. In this way, the apartment price development can be investigated over the individual periods of recession/upturn. The constructed indexes have periods of 1 year, while a more detailed index would become too thin. The transaction dates of the DLRO data is brought forward with one quarter, because of a lag of the moment of actual sales to the moment of transaction at the notary (which is noted in the DLRO database).

In the weighted repeated sales index, the holding period between the transactions is taken into account. With the construction of such an index, 3 steps are involved. In the first step, the original repeated sales index is constructed, in SPSS. In the second step, the residuals of the sales pairs from the first regression are squared and regressed against the holding and the squared holding period. Performing this regression gives in the dataset the predicted values of each sales pair. In the third step, the reciprocals of the square roots of these predicted values are using as weights while performing the first step regression again. The third step regression outcomes are exponentiated, in order to get the proper indexes for both neighborhoods.

Visual inspection of the constructed indexes showed that the apartment prices lag about one year to Dutch real GDP. Therefore, for the hypotheses and testing, this lag of one year is taken into account. Two-sample t significance tests are performed to test the hypotheses with regard to the apartment price indexes. Even though the used datasets for both neighborhoods have a non normal distribution, both sample sizes are large enough for performing such a test. The tests are performed unpooled tests, while the two samples (the datasets of the two neighborhoods) are quite different in size.

Further, the constructed apartment price indexes are aligned to the two periods suspicious of redlining for Rotterdam (in combination with the alignment to real GDP turning points). However, only one of the suspicious periods can be investigated with the apartment price indexes while the other suspicious period is too short in length.

To solve this problem, a counting table of number of transactions is made for each neighborhood. Only transactions of apartments suspicious of fraudulent acting or being of non-arms length are removed. This counting table has half yearly periods and is aligned to the two suspicious periods of redlining. For each neighborhood, next to the actual number of transactions, the total number of apartments that are present in the used dataset is divided by the number of transactions per period. This to get the turnover

ratio for each neighborhood. Then the turnover ratio of the ‘bad’ standing neighborhood is divided by the turnover ratio of the ‘good’ standing neighborhood, to see more clearly whether and when the situation deteriorates for the ‘bad’ standing neighborhood that is suspicious of redlining. Also periods suspicious of less strict redlining and a probable catch up period are investigated.

For this thesis, redlining is expected to have immediate impact on the number of transactions, which is used for the hypotheses and testing. The hypothesis regarding the counting table of number of transactions is visually tested. No statistical test can be performed, while no standard deviation or standard error is available.

The outcome of the research is that apartment prices in ‘bad’ standing neighborhoods develop the same as in ‘good’ standing neighborhoods, even in the distinct phases of recession and economic upturn. The suspicious of redlining is not supported by the data used for this thesis.

Preface

During and already before my study at the Erasmus University, I am very interested in real estate and the pricing mechanism at this market. This mechanism has highly interwoven and sideway factors. For my bachelor thesis the subject was the manner how to decide whether or not to invest in certain real estate projects, and commercial and non-commercial real estate companies were compared.
The work of Suchomel (2009) gave direct rise to the subject of this thesis. This because in combination with the work of Aalbers (2003) former outcome, that housing in various types of neighborhood showed the same price development, seemed somewhat hard to understand.
As nowadays the recession has struck hard in the Netherlands, it seemed interesting to me to link the investigation of the development of apartment prices to the general economical circumstances with its various phases. Therefore, the business cycle and its phases are used to determine the periods of investigation. This to see in which type of neighborhood the apartment prices change relatively the most during the various economical circumstances.

Acknowledgements

This thesis is not only realized by working hard myself, but also for a main part with the help of others.

Firstly, I want to thank Dr. Alexander Otgaar for his supervision. He kept me up track and showed patience by letting me work according my own timeframe. This was somewhat wide, mainly caused by my fulltime job and the relocation of my family to another home.

The input of Jeroen van Haaren was important to me, while he gave a fresh sight on the readers view. This helped me to improve the understandability of this thesis to the imaginable reader.

Then Piet Burger of the COS played an important role. I was more than once welcome at his office and the variables needed for selecting the neighborhoods are acquired largely with his help.

Rob de Vries of the Dutch Land Registry Office made it possible to do 'trial catches' at their databank. Further, he gave me good tips how to get my request at the Dutch Land Registry Office fulfilled.

My nephew, Simon Gouweloos, offered a part of his vacation in order of helping me cleansing the dataset. I think this is remarkable for a boy of 14 years old, and I am very grateful for this.

Special thanks to my wife Odette, who showed great patience and understanding. She let me fulfill my study, and went to birthday parties etc. on her own. She always kept going on motivating me, sometimes by using some pep talk.

Further Rik, my son, mostly played as quit as possible while I was working on this thesis for not disrupting me. I think he is glad this thesis is finished, and his father has more time to play Lego with him. I am looking forward to it, Rik.

Lastly, I want to thank all my further friends and family who motivated me to fulfill this last challenge on the way to the degree of Master of Science. Especially my parents and parents-in-law, my sister and my sister-in-law played a supportive role.

Over the total length of my study at the University, my direct family and friends played an major role from the early beginning till this very end. Thanks for all the understanding and sympathy throughout my whole study period.

Table of Contents:

1) Introduction

1.1) Background

For many years, real estate has been booming business. The Real Estate sector has a very important influence on the society at large, and nowadays can be seen to have an important influence on modern economies (e.g. Peng 2010, and Qin Xiao 2010). Over the total period 2000 till 2008, the price of an average house, apartments included, in the Netherlands increased with about 48,8 %[1]. An investment in houses and apartments was seen as a safe investment, and a mortgage by a bank was quite easy to obtain. However, this prosperous situation changed since the start of the financial crises in 2007, which was the cause of the recent recession in the western world (a recession is also known as an economic downturn or downswing). This recession has a strong negative influence on the Real Estate sector, for a significant part because banks are more reserved (than before) to supply mortgages[2]. Also, the national rules for mortgages are more tight since the first of august 2011[3] . Since the beginning of 2009, the price of an average house in The Netherlands is decreasing, and so is the sales volume[4].

Another important aspect of the human society is urban life. Over the years, urban life is becoming more and more important. Worldwide, relatively more people than ever before nowadays live in an urban surrounding. Furthermore, this number is expected to increase in the future (Breuste et al. 2011). All in all, cities are very important in modern economies (think of network theories, governmental policies aimed at cities, etc), and their importance is expected to increase.
In some city neighborhoods (mostly 'bad' standing neighborhoods) it can be hard or impossible to get a mortgage. This phenomenon, which is called 'redlining', combines Real Estate and urban life. There are suspicions that redlining takes place nowadays in The Netherlands.

After a period of economic downturn, a period of upturn will follow. Then, it is likely that the economical less insecure situation will persuade banks to loosen the reins with respect to the supply of mortgages. This because they have to make money and the supply of mortgages is one of their core businesses. Also, probably the practice of redlining will be abandoned by banks. All in all, the expectation is that the prices of real estate will increase during this period.

1.2) Objective

Suchomel (2009) has investigated the house price (apartments are included in the housing market, and on its turn the housing market is a part of the Real Estate market, as will be explained in § 2.1) development, from 1990 until 2009, of problem and non-problem areas in the Netherlands. The outcome of his investigation is, that the price development is about the same in these different types of area. Housing prices even increase by a slightly higher rate in problem areas.

[1] Source: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=71533ned&D1=0-5,7&D2=0&D3=0&D4=16,101,186,237-240,242-244,246-248,250-252,254-257,259-261,263-265,267-269,272-274,%20276-278&HD=110421-0939&HDR=G1,T&STB=G2,G3
[2] Source: http://www.elsevier.nl/web/Nieuws/Economie/205932/Banken-strenger-met-verstrekken-hypotheek.htm?rss=true
[3] Source: http://nos.nl/artikel/260788-strengere-hypotheekregels-gaan-in.html
[4] Source: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=71533ned&D1=0-5,7&D2=0&D3=0&D4=16,101,186,237-240,242-244,246-248,250-252,254-257,259-261,263-265,267-269,272-274,%20276-278&HD=110421-0939&HDR=G1,T&STB=G2,G3

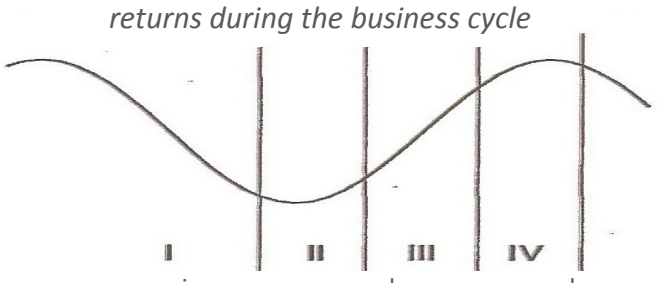
This seems strange, because Albers (2003) mentions that housing prices in 'bad'standing neighborhoods increase at a lower rate. Peng end Thibodeau (2010) have found that housing prices in different neighborhoods develop different during economic bust periods. Suchomel (2009) has made a price index for problem and non-problem area's in Amsterdam, Utrecht , Den Haag and Eindhoven. The research of Peng and Thibodeau (2010) is about Denver, USA.

It seems interesting to see whether of the former outcomes hold for Rotterdam. For Rotterdam, no price index is made in the investigation of Suchomel (2009), and for this thesis just Rotterdam is the investigated city. This also because the author of this thesis is most familiar with Rotterdam (which can be considered as a pre while investigating a city). This investigation will be focused on a specific type of housing, namely on apartments. This because of lack of other types of housing in certain Rotterdam neighborhoods. Further, for this thesis, the emphasis will be on the separate periods of up- and downturn in the general economy. Summarizing the foregoing, this research will combine the mentioned investigations with different outcomes, and will probably give better insight in the development of the prices of apartments in various types of Dutch neighborhoods during different economic circumstances. For better contrast, two diverge type of Rotterdam neighborhoods will be investigated, namely a 'good' and a 'bad' standing neighborhood. Each neighborhood will be represented in the investigation by streets that are dispersed in the neighborhood area.

Another reason to choose for the city of Rotterdam is that for the period 1990-2009 (the time period Suchomel has investigated), there a 2 suspected periods of redlining for this city. When these suspicions are true, apartment prices in a 'bad' standing neighborhood most likely have a different development than apartment prices in other neighborhoods. While for this thesis a 'good' standing neighborhood is selected as comparison, the likely difference will be made as clear as possible. The selected neighborhoods should be of constant quality over this whole period, which is explained in §4.5.1. This to be able to draw the right conclusion in the end.

All in all, one of the main goals of this research is to examine whether apartment prices in 'bad standing' neighborhoods have the same relationship with the general economy as apartment prices in 'good standing' neighborhoods. The outcome will be interesting for real estate investors and banks, which, as will be shown further on in this thesis, in some periods are suspected of practicing redlining for some Rotterdam neighborhoods.

Further,Wetten (1992) mentions a lag in reaction time of Real Estate returns to general economic circumstances, which can be seen in figure 1. As these returns for a part determine the price of Real Estate (Ross and Mc Lean, 2005), the real estate prices will also tend to lag behind the general state of the economy. This is confirmed by Quigly (1999), who has found that the real estate prices are cyclical with a lag to general economy. Literature will be reviewed whether these general real estate findings also hold for apartments, and if the outcome is the same for both the 'good' and the 'bad' city neighborhoods.



Stock	– –	+	+ +	–
Bonds	+ +	+	– –	–
Real Estate	– –	–	+	+ +

Figure 1 (source: Wetten, 1992)

Probable causes for eventual different development across different types of neighborhoods will also be investigated. This is done by examining the existing literature. As already said, redlining probably plays an important role in the price development in city areas of 'bad standing'. Determinants of apartment prices in general and neighborhood circumstances will be discussed, since they can form probable causes for a different price development.

Then for last, in this thesis it will be investigated if the collected data supports the suspicions of Aalbers (2003 and 2010) about redlining in Rotterdam. There is little evidence about exact periods, and the major author who has written about is only Aalbers (in several papers about different periods). Because of his publications, the Commission of Equal Treatment (CGB, 2006) has done some investigation. This commission has noted that some banks in more or less degree practice redlining. Two suspicious periods of redlining in Rotterdam are quite exactly mentioned by interviewees in the work of Aalbers (2003 and 2010), one period over the whole length and of the other period the beginning (no ending, since this probably is still going on). In §4.3, more can be read about these suspicious periods.

1.3) Research Questions

1.3.1) Main Research Question

Real estate is a non homogeneous good, as will be further explained in §2.2. As already said, this thesis is aimed at apartments, and the city selected for this thesis is Rotterdam. Two neighborhoods, one per type ('good' and 'bad' standing), will be investigated.

In general, the main theme of this thesis is to give an answer to the following research question:

> *- Is there a relationship between the social status of city neighborhoods and the development of apartment prices, while considering the state of the economy?*

For this thesis, the periods of investigation will be determined by the general Dutch economical circumstances. In order to answer the main research question, several sub research questions are formulated. These sub questions will be discussed below.

1.3.2) Sub Research Questions

The sub research questions are both of theoretical and practical kind. The theoretical sub questions will be answered (in order to have a sound basis for the investigation) by reviewing existing literature, while the practical sub questions will be answered by research specially performed for this thesis. As can be seen in §3.2, recessions and stages of economic upturn are stages that general economic circumstances go through. Therefore, some sub research questions are aimed at these distinct stages.

The theoretical sub research questions, needed to answer the practical sub questions, are the following:

1) *Which factors determine demand and supply of apartments?*
2) *What is the relationship between the number of transactions and the price of apartments*?
3) *Which indicators are appropriate to determine the social status of a neighborhood?*
4) *How to define a recession?*
5) *Which are the stages of an economic upturn, and how to define these stages?*
6) *What is, in which situation of available data, the most appropriate index for investigating the development of apartment prices?*

The answers of the former theoretical sub questions are used for answering the following practical sub questions:

7) *In general, do apartment prices in 'good' and 'bad standing' neighborhoods develop the same?*
8) *Is the development of apartment prices in 'good' and 'bad standing' neighborhoods the same during recessions?*
9) *Is the development of apartment prices in 'good' and 'bad standing' neighborhoods the same during economic upturns?*

As will be shown in §4.3, redlining probably plays an important role in the de development of the apartment prices in the Rotterdam neighborhood of 'bad standing' that is investigated. The presence of the practice of redlining by banks can most likely be seen in both apartment price development as in the number of transactions. Therefore, the last practical sub research questions are:

10) i*s redlining a plausible cause for possible differences in development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad standing' while looking at the apartment prices?*
11) Is redlining a plausible cause for possible differences in development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad standing' while looking at the number of transactions?

While investigating the answer to these last two sub research questions, probably the outcome gives an indication to the probability of the self-fulfilling prophecy with regard to redlining and the greater depreciation risk of apartment prices.

As will be seen in §4.9 and §4.10, hypothesis will be formulated for the practical sub research question 7 till 10. For the practical sub research question 11 no hypothesis is formulated, this for reasons given in §4.10.

1.4) Relevancy

The research exercised is stated to be both socially and scientifically relevant, for reasons given below.

1. Social relevance:

On the one hand, the answer to the development of apartment prices during economic recessions of each type of city quarters will be very useful to banks, the outcome can help them to make a right taxation of their risk during downturns. There are suspicions that banks are restrained in financing property in certain postal code area's in some cities (Aalbers, 2010). As already mentioned, this phenomenon is called 'redlining', and can take place both during recessions and economic upswings. These for finance restrained postal codes are mostly situated in quarters of 'bad' standing. Therefore, it is relevant to compare 'good standing' to 'bad standing' neighborhoods. This because, by the suspicious of this redlining behavior, apartment prices can be expected to develop differently in these two types of neighborhood. It is imaginable that during a recession banks fear of a loss when an apartment has to be sold on an auction. Real estate objects are mostly for a high share financed with mortgages. When borrowing clients are not able to pay their monthly redemption, the real estate property is forced to be sold in favor of the bank. However, if the value of the property at execution is less than the amount of the mortgage, the bank has a loss. If this happens at a large scale, the bank has a problem and the

possibility of bankruptcy is a real option. But is it true that during a recession the risk of a loss after execution of a property is larger in 'bad' standing city quarters than in 'good' standing city quarters? Also the answer to the development (of the price of apartments) during an economic upturn of each type of city quarters can show banks where the risk is declining at the fastest rate.
For reasons of general trust in the banking system, individual banks mostly will be saved by national government. However, in the end, the society (the people of the country) will pay the bill in the form of higher taxes. Therefore, the objective of this research is socially relevant.

On the other hand, the answer to the development of apartment prices during economic up- and downturns will be very useful to investors of all types because the outcome can make them to better decide at what time to do or undo a certain investment in a certain type of city quarter. An example of a real estate investors is a pension funds, and it strikes their members if a bad investment is made (looking at the indirect return on the investment) . As most people of our society are obligated to participate in a pension fund, the objective of this research is socially relevant.

2. Scientific relevance:

First aim of this research is to investigate if apartment prices in 'bad' standing neighborhoods develops different during a recession than apartment prices in 'good' parts of the city. Also the development in the different quarters during economic upswing and the general development will be investigated. In science, the outcome of existing research is not in harmony. According to the investigation of Denver (with data from 2002-2007) by Peng and Thibodeau (2010), "neighborhoods with higher house price levels experienced higher average appreciation rates but lower volatility and less sensitivity" (p. 5). This would support redlining behavior of banks during recessions. However, according to Suchomel (2009) house prices in problem areas appreciate at a slightly higher rate, compared to non-problem areas (in Amsterdam/Den Haag/ Utrecht/ Eindhoven from 1990-2009). This is contra dictionary, and would give no reason for redlining. A point of critic on the research of Suchomel (2009) is that NVM (the Dutch association of Realtors) data is used. This data contains not the whole house transaction market, includes movable goods in the sales, and auction transactions are not included in these data. Most likely this causes a bias, because probably most auctions (forced sales by the bank) happen in the problem areas during recessions (when the reasoning behind redlining is followed). This can be a very important detail of significance. Therefore, more research has to be done, and data from the Dutch Land Registry Office (further called DLRO) should be used for The Netherlands. This data covers the whole sales transaction market to private persons, auctions included (Rabobank 2009).

With regards to redlining, not the person (who wants to have a mortgage) matters for bank, but the neighborhood where the mortgage has to be supplied in is the most important. But practicing redlining on loose grounds is illegal (Aalbers 2010 and CGB 2006). Therefore it is scientifically relevant to investigate if there are legitimated grounds, to see if apartments in different types of neighborhoods show different price developments over time and during specific periods.

1.5) Structure

The remainder of this thesis will be structured as follows:

Chapter 2 is a literature review and gives theoretical background about the determinants of apartment prices, the way apartment transaction prices are realized, and the importance of demand and the

number of transactions. Also urban circumstances, indicators of social status and redlining are discussed. In the summary, answers are given to sub research questions 1, 2 and 3.

In chapter 3, literature about economical cycles and apartment price development in relation to these cycles and literature about economic up- and downturns is reviewed and discussed. Answers to sub research questions 4, 5 and 6 are given in the summary of this chapter.

Chapter 4 is about the methods used: differences between NVM and DLRO data is handled, suspicious periods of redlining for Rotterdam are discussed, recession and economic upturn periods for The Netherlands are determined, the selection procedure of the neighborhoods and the streets they are represented by is explained, the data from the DLRO is checked and explored. With this data, for each neighborhood an apartment price index and a counting table of number of transactions is constructed. Further, in this chapter the method for answering the practical sub research questions 7 till 11 and the hypotheses for the practical sub research questions 7 till 10 are being discussed.

In Chapter 5, the empirical part, the results of the investigation are given and the hypotheses regarding the practical sub research questions 7 till 11 are answered.

Chapter 6 contains the overall conclusion. The main research question is answered, and also given are the limitations of the research and recommendations for further research.

2) Formation of apartment prices: determinants and urban situation

2.1) Introduction

For answering the research questions, it is important to have a clear understanding of housing, apartments and the formation of apartment prices. Further, the research is all about urban life, the urban apartment market and city neighborhoods, in some of which redlining is probably practiced by banks. The existing literature about all these concepts will be discussed in this chapter.

2.2) Housing and apartments versus Real Estate in general

In this paragraph, the terms *Real Estate*, *Housing*, and *Apartment* will be described.

1. *Real estate*:

Is a common name for immobile matters related to land. According to Ling and Archer (2008), it is used "to identify the tangible assets of land and buildings" (p. 2). A common, and for this thesis applicable, way to define Real Estate is: *"Real Estate is the physical land and appurtenant affixed to the land, e.g. structures"* (Danner, 1997, p. 136). Buildings are also affixed to the land, and various types of buildings fall within the term Real Estate. Van Gool et al. (2007) among others for example mention farms, houses, apartments, shops, offices, hotels, buildings used for healthcare, industrial buildings etcetera.

2. *Housing:*

Housing is part of real estate. Buildings of this category have the function and destination to accommodate inhabitants. Housing is a core human basic need, next to food, clothing and safe drinking water (among others, Streeten and Burki, 1978). Around the world, governments set policies in order to keep accommodation affordable (among others Balchin (1996) and Schwartz (2010)). Housing can appear in various versions, like for example a detached single family house, farm, skyscraper etc.

3. *Apartment:*

On its turn, apartments are yet a part of housing. So, they also have the function and destination to settle inhabitants. However, a clear definition of an apartment is hard to find in literature. The terms apartment and multifamily house are strongly interwoven. A multifamily house is a dwelling that is stacked, and is a part of a building block in which not all residential units are landless (Amsterdam municipality, 2012). Some say that an apartment is a just one of the types of dwelling in multifamily houses[5], while in a less detailed sense an apartment is seen as a part of a larger building[6].

For this thesis, the less detailed view is followed and the definition adapted is: *An apartment is a residence in a larger building* [7]. So all multifamily houses are regarded as apartments. This view is also used by for example the Dutch Association of Realtors[8].

[5] Source: http://www.cbs.nl/NR/rdonlyres/8F3ED39F-7D82-48FF-B6DD-9C610EBF9512/0/2010hetwonenoverwogen2009.pdf
[6] Source: www.vandale.nl
[7] Source: www.vandale.nl

The adapted definition for apartment allows the building to take various forms, and the apartment to have multiple floors. Following this view, apartment buildings can be divided in two segments (Hulsebosch et al., 2008): 'Middle-high' and 'High'. The segment 'Middle-High' consists of buildings with 2 to 4 storeys, while the segment 'High' consists of buildings with more than 4 storeys. There are 5 types of apartments[9], namely: Maisonettes (2 or more storey multifamily house), Gallery flat, Porch apartment (1 storey multifamily house), Upper/downstairs apartment (1 storey multifamily house), and other multifamily houses.

2.3) The formation of apartment prices

2.3.1) Real Estate and apartment market

The apartment market is just a part of the real estate market. In this paragraph firstly the real estate market in general will be handled, prior to the discussion of the apartment market.

DiPasquale and Wheaton (1992) have developed a scheme which gives a good insight how the real estate market actually works. They mention that the real estate market can be divided into two markets: the market for real estate space and the market for real estate assets. These are different markets for usage of the property on the one hand and the possession of the property on the other hand. These two markets are inter-related. The notion of two separate markets is only applicable whenever the space (building or part of the building) is not owned by it's occupant. In this case, the tenant is renting the space from the owner, and the owner can be seen as an investor in assets. The mechanism (see figure 2) works as follows: Rent is determined on the property market by the level of stock of space and the demand for space (NE quadrant). In the NW quadrant, on the asset market, we see the ratio of rent to the price of real estate. Investors demand a certain yield in order to hold real estate assets, so in this quadrant the price of real estate assets is determined. On its turn, the real estate asset price determines the construction of new assets (SW quadrant). In the SE quadrant, the combination of new construction and depreciation (removal) of real estate determines the adjustment of the real estate stock. Then we come again in the NE quadrant, where the rent is determined. As mentioned before, the difference is "most clear when buildings are not occupied by their owners" (DiPasquale and Wheaton 1992, p. 181).

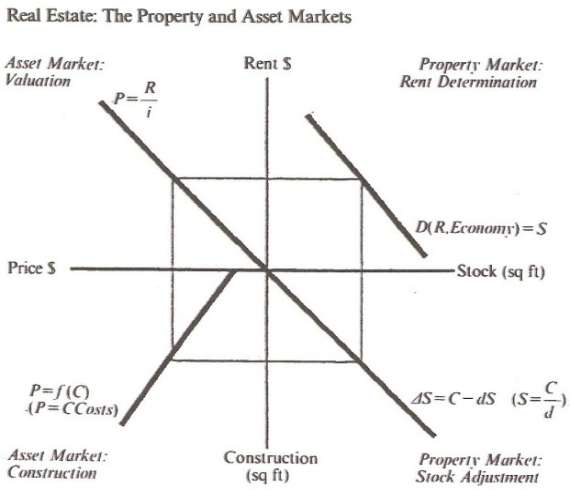


Figure 2 (source: DiPasquale and Wheaton, 1992)

As the apartment market is part of the real estate market, it follows the general rules for real estate as described above, though it has some specific characteristics. Among others, Sack and Kachadurian (1995) have found that, in comparison with other types of commercial real estate ("commercial real estate is defined as all real estate excluding single family homes and multifamily buildings up to four units, raw land, farms and ranches and government owned properties"(Lasser, 2002, p. 4)) apartments

[8] Source: http://www.funda.nl/koop/uitgebreid-zoeken/

[9] Source:http://www.agentschapnl.nl/sites/default/files/bijlagen/5.%20Voorbeeldwoningen%202011%20Onderzoeksverantwoording.pdf

have superior returns and a better capability to hedge inflation. Georgiev et al. (2003) have even found higher risk adjusted returns, for the apartment sector and they mention that this can be partially declared by the low correlation with inflation. It should be mentioned that Georgiev et al (2003) only compares office, retail and industrial real estate to apartments. Such types of real estate are more vulnerable to inflation. So most likely higher returns also counts for housing in general, because people always need accommodation to live in. However, it can be stated that institutional investors have a high interest in apartments (among others Shilton et al. (1996), Louargand and Murdy (2002)), and no evidence in literature can be found that apartments have lower returns than other types of real estate. In §2.3.2, it can be read why this high interest gives the prices of apartments an additional boost.

2.3.2) Demand, number of transactions, and apartment prices

The general economical law states that the price of a good is determined by demand and supply in the market. According to Pol (2009) and others, in principle this also counts for real estate. However, the market for real estate has some characteristic features.

One of the main things mentioned is that the supply of real estate, and therefore also housing and apartments, is rigid (Hilbers et al., 2001). This rigidity has to do with both the constraint in the supply of land (no infinite amount of land) and the fact that it may take several years for new construction to be completed. He also states that the real estate market has the following characteristics: the pricing process is one of negotiation, trades are infrequent and transaction costs are high. Another thing that makes the real estate market far from perfect is the availability of resources for financing properties.

The things mentioned above will distort the price adjustment toward an equilibrium. Carey (1990) states that in markets suffering from a fixed supply, investors willing to pay a price above the replacement costs of existing property determine the market price. Elsinga et al.(2011) states the price of existing properties to be normative for the pricing of new properties. The former would imply that the prices of real state are mainly demand driven. This can also be seen nowadays: little to no demand for dwellings makes prices falling. The stock of houses keeps the roughly same, but a decrease in demand (due to various causes) makes housing prices to diminish. It is interesting to see that nowadays, also the number of transactions has decreased[10]. A probable reason for this is the loss aversion of sellers (for example Genesove and Mayer (2001) and Einio et al (2008)), see also §3.4.4. This leads us to the correlation between the number of transactions and apartment prices. In literature, there is convincing evidence of a positive correlation between the number of transactions and apartment prices (Stein (1995), Berkovec and Goodman (1996) and Leung et al. (2002), among others). This implies that higher transaction figures go hand in hand with higher apartment prices, and the opposite for lower transaction figures.

All in all, for this thesis it is reasonable to presume that real estate prices, and therefore also apartment prices, are demand driven. At least for the short run. This opinion is confirmed by Suchomel (2009), among others. In literature, a positive relationship between the number of transactions and apartment prices is found. This is of main importance with regard to the investigation to the suspicious periods of redlining, which will be further explained in §4.3. Redlining will be discussed in §2.4.3.

2.3.3) Determinants of apartment prices in general

Among others Pol (2009) states that prices of housing, and therefore also of apartments, are determined by factors on -1) macro, and -2) meso and micro level. Now these levels will be described.

[10] Source: http://www.cbs.nl/nl-nl/menu/themas/prijzen/publicaties/artikelen/archief/2011/2011-10-21-ah-tk16.htm

2.3.3.1) Macro level determinants

These are economic factors that influence the apartment prices on a national level. In the work of Boelhouwer et al. (1996), the macro economic factors are classified in five main categories given below.

1) Governmental and institutional policy:

Governments and institutions influence the mechanism of demand and supply of apartments. This by means of subsidy policy (for example subsidies for starters on the purchase of certain dwellings[11]), fiscal treatment of house owners (the mode/possibilities of deduction of mortgage interest on taxable income), the mortgage guarantee norms and criteria (in The Netherlands, there is the National Mortgage Guarantee, of which the upper border for the dwelling price is recently raised to 350.000 euro), and monetary policy (institutions like the Central Banks play a role, for example by means of the rigidity of monetary controls on commercial banks: a looser monetary control would enable banks to expand their mortgage portfolios which will increase demand).

2) Demographical factors:

The reasoning behind this category is that, the more households there are in a certain area, the more houses needed, and vice versa. The number of households can grow through an increasing number of inhabitants or a decreasing number of persons per household. As can be read in §2.3.2, an increase of demand makes the prices of apartments go up, a decrease in demand causes the opposite.

3) Developments in supply of owner occupied housing:

This category refers to the number new owner-occupied apartments. The number of supply of new apartments influences the apartment price through the law of demand and supply.

4) Development of main economical variables that are important for apartment ownership:

Variables involved are mortgage interest rate, disposable income, inflation, rents, and construction costs. Over a broader field, these variables influences the demand to, and supply of apartments.

5) Dynamics of market forces:

These dynamics are all about behavior of potential owners and the demand for apartments. On the one hand, in order to profit in capital gain, potential owners want to acquire an apartment as soon as possible during periods of upswing of apartment prices. On the other hand, to avoid a capital loss, they want to postpone the acquisition of an apartment during periods of downswing. According to Pol (2009), these dynamics "tend to lag behind economic developments" (p. 17), further discussed in §3.4.

2.3.3.2) Meso and micro level determinants

In my view, factors on meso level influence the apartment prices on a regional and broader local level, while factors on micro level are unique specifications of each individual apartment. However, these

[11] Source: http://www.rtl.nl/(/actueel/rtlnieuws/)/components/actueel/rtlnieuws/2009/03_maart/11/verrijkingsonderdelen/0311_1045_Thermometer_koopwoningen.xml

factors are mostly interwoven, and are therefore combined. For this thesis, six categories are distinguished: four about the apartment itself and its environment, one about financial constraints towards certain local areas and one about the proprietor.

The four categories on meso/micro level about the apartment itself and its environment, come from the work of Visser et al. (2008):

1) Physical characteristics of the apartment environment:

Among others, Luttik (2000) has found evidence that presence of water and green in the residential area has a positive influence on the housing price. Other environmental characteristics mentioned by Pol (2009) are for example the density of buildings in the area, quality of public area, etc.

2) Social characteristics of the apartment environment:

These are local characteristics like composition of the population, average income, proportion of houses owned by housing corporations, unemployment rate etc. Characteristics of this category are at the core of this thesis. This because in cities, the broader local level is neighborhood level, and the social characteristics contribute to the division of neighborhoods into 'good' or 'bad' standing.

3) functional characteristics of the apartment environment:

This is all about the accessibility of the apartment to places of daily activity. Characteristics concerned are the distance of the apartment to services, public transport, motorways, recreational facilities, employment opportunities, and the city center. Further Visser et al. (2008) specially mention that accessibility to places of daily activity is a functional amenity, but a close proximity is a physical amenity. This because of accompanying negative externalities, like parking problems, noise etc. Therefore, functional characteristics have some overlap with physical apartment characteristics, described below.

4) physical characteristics of the apartment:

This category is about the characteristics of the apartment itself, for example number of rooms, volume, year of construction, energetic performance, type of apartment etc. As already said, noise, etc are also physical characteristics. They arise from functional matters. In §4.5.3, apartments of a specific segment, type, and construction year are selected for the dataset. Types of apartments are already discussed. The year of construction is important for the maximum amount of rent, in case the energetic performance label is not available[12]. From 1975 on, the energetic performance started to improve significantly[13].

Further, the category about the financial constraints towards certain areas.

5) Financial constraints towards certain areas:

Such financial constraints are like an institutional policy described at the macro level. However the policy meant in this category operates at the meso and micro level, because this category is about the

[12] Source: http://www.omniawonen.nl/uploads/_media/_897_huurverhoging.pdf
[13]Source:http://www.agentschapnl.nl/sites/default/files/bijlagen/5.%20Voorbeeldwoningen%202011%20Onderzoeksverantwoording.pdf

policy of banks in general with regard to the supply of mortgages in certain city neighborhoods. In some neighborhoods it is very difficult or impossible to acquire a mortgage. This phenomenon is known as redlining, further discussed in §2.4.3. Banks presume a higher financial risk in these neighborhoods, and therefore practice redlining. According to Holmes et al. (1994), in this context one should think of risk as greater default risk (for example that the monthly mortgage amount cannot be paid by the borrower) and greater depreciation risk (of the dwelling itself). When it is impossible for potential homebuyers to acquire a mortgage for a dwelling in a certain neighborhood, it is well imaginable that this puts a negative pressure on housing prices in these areas. This because mortgage limitations for potential homeowners makes selling a house in such a neighborhood very difficult for homeowners, and to attract potential homebuyers they will have to lower the price. The probable higher depreciation risk of apartment prices in financial constraint areas will be investigated for this thesis. Also investigated is the answer to whether redlining is caused by a probable higher depreciation risk or that the causality is the other way round (and there is question of a self-fulfilling prophecy).

Then, finally, the category involving the proprietor.

6) personal situation of the owner:

In a normal financial healthy situation of the owner, the home owner has a loss aversion with regard to the original purchase price (Genovese and Mayer, 2001), and has a relatively high reservation price to sell the property. However, the personal situation of an owner can cause a property to become a 'distressed property'. According to Brueggeman and Fisher (2008), distressed properties may be acquired below current market prices. They state that financial and/or legal problems of the owner can make a property distressed. Think of inability to make mortgage payments, divorce, personal debts, etc. Such situations make it possible for the lender to acquire title directly from the owner if the situation is not solved. The personal situation of the owner lies at the basis of the default risk, already mentioned at point e above. It can be stated that the default risk and the depreciation risk are highly connected. These are all matters that are involved in redlining (see §2.4.3).

All in all, for this thesis the focus is on the social characteristics of the apartment environment, and also on the financial constraints towards certain areas. Further, the macro economical factors are important, because the general state of the Dutch economy is used for the investigation. The macro economical factors are the same across the investigated neighborhoods, but the specific interest is on apartment price reaction during various economical stages. From the physical characteristics of the apartment, the segment and type of apartment and also year of construction are important because of the dataset composition (see §4.5.3). Then lastly, the personal situation of the owner is relevant, because DLRO data contains forced auction apartment sales (see §4.2). Other meso and micro level factors are tried to be neutralized by using a repeated sales index and exclude certain apartments from the index (see §4.7.1).

2.4) Urban apartment market features

2.4.1) Social status and neighborhoods

The broader local level within cities means neighborhood level. A city consists of various neighborhoods. Park (1915) took an empirical approach to urban sub-areas. He delineated 'natural areas' in cities, by plotting indices of physical features and correlated behavior as delinquency, mental disorder and racial composition. In general, a neighborhood is traditionally seen as a city area with "roughly 5000 to 10.000

inhabitants with largely similar levels of education, income and ethnicity, and with a neighborhood elementary school at its core" (Sawicki and Flynn, 1996, p. 166)). A neighborhood generally implies "an area smaller than a municipality but more than a few city blocks" (p.169). For research, it is common to use 4 digit postal codes to define a neighborhood (among many others, for example Hoek et al., 2002). Usually the 4 digit postal code is the most detailed level on which data is available.

The price of an apartment is influenced by the social status of the neighborhood it is located in. According Wilterdink (2007) the term 'social' refers to the way people live together, it is about the position of people in society. This position has a social cultural and a social economical side. The social cultural elements have to do with the norms and values, of which behavior is the expression. The social economical elements have to do with the availability of resources to people, which determines their position in society[14]. People of lower socio-economic status are supposed to be of lower social class and vice versa (among others Marmot et al., 1987).

In literature, a lot is written about useful indicators to determine the socio-economic status of a neighborhood. These indicators can be traced back to the delineation of 'natural areas', as Park did in 1915. Widely used as indicator are figures (on neighborhood level) related to education, unemployment, income, criminality records, ethnical composition of the population, proportion of small houses (less than 3 rooms), proportion of housing owned by housing association, nuisance and removals. Bad performing neighborhoods on the total package of scores are known as 'bad standing' neighborhoods (or just 'bad' neighborhoods), while good performing neighborhoods are known as 'good standing' neighborhoods (or 'good' neighborhoods).

For the Netherlands, several of these indicators (on 4 digit postal code level) are used to determine the 40 most deprived neighborhoods in the country. These neighborhoods are called 'Vogelaarwijken', named to a Dutch minister who's portfolio consisted of the policy aimed at cities.
Indicators used to determine a 'Vogelaarwijk' are classified into 4 categories (see appendix 1, in Dutch) : socio-economical arrears, physical arrears (with regard to the stock of housing), social problems, and physical problems (with regard to nuisance and housing/surrounding satisfaction). The individual indicators are about income, employment, education, characteristics of the houses, vandalism, resident satisfaction, insecurity, and social and physical nuisance. Remarkably, ethnical composition of the population is not included as indicator. Most likely, this is done not to stigmatize certain communities (like for example muslims, blacks, etc). The term 'Vogelaarwijk' is given extra attention because it is an element associated with this research, seen throughout the thesis. As can be seen in §2.4.4, yet minorities and ethnical proportions play an important role in models of neighborhood change.

2.4.2) Urban apartment market

In urban areas, apartments are an important type of dwelling. This is because the cost of land in cities is high (de Groot et al., 2010), and dwellings are often constructed in a stacked way. Cities can be regarded from three sides:

- the city as a whole
- geographical distance within the city
- sub-areas of the city

The urban apartment market will be discussed according these three dimensions.

[14] Source: http://www.nationaalkompas.nl/bevolking/segv/wat-is-sociaaleconomische-status/

1. *The city as a whole:*

Firstly, a look at the city as a whole, starting with the differences between urban and rural areas. Among others, Linn (1982) has found that urban housing is more expensive than rural housing. In general, cities attract people. These people need infrastructure and services (like hospital etc.), which comes at a cost. Factors that positively influence the attractiveness of the city are access to jobs, and services like shops, culture and catering (de Groot et al. 2010). On its turn, the access to jobs for example is influenced by the relative competitiveness of the city in question. This because it is known that cities compete each other on international, national and regional level (Begg, 1999). A factor of negative influence given by de Groot et al. (2010) is for example nuisance. All such matters have an impact on the demand for dwellings in a certain city, which influences the price of housing (and therefore apartments).

2. *Geographical distance within the city:*

Secondly, the geographical distance within a city plays a role in the apartment market. According to Thissen et al. (2010), the price of housing increases as the city grows. The reasoning behind this is as follows: The price of housing equals the price of the land needed, plus the costs of construction. Assumed is that people work in the Central Business District (CBD), and that this is more fruitful than working on the countryside. This is the view of the monocentric city. According to de Groot et al. (2010), the price of urban land at the borders of the city is the same as the price of land in rural areas (with zoning plan indication housing). Then, housing closer to the CBD is more expensive, because travelling costs (time and real costs for transportation) are saved. In a spatial equilibrium, traveling costs have to be discounted in the price of housing, otherwise people would have the incentive to move towards the CBD. In this setting, the traveling costs at the borders of the city equal the difference in wage between the CDB and countryside. Therefore, housing prices in the CBD are the highest. This is depicted in figure 3. Also, as the city grows, traveling costs will increase and then the price of housing in the CBD will increase as well. Because apartments are part of housing and apartments are a common type of housing in cities, the reasoning given also counts for apartments.

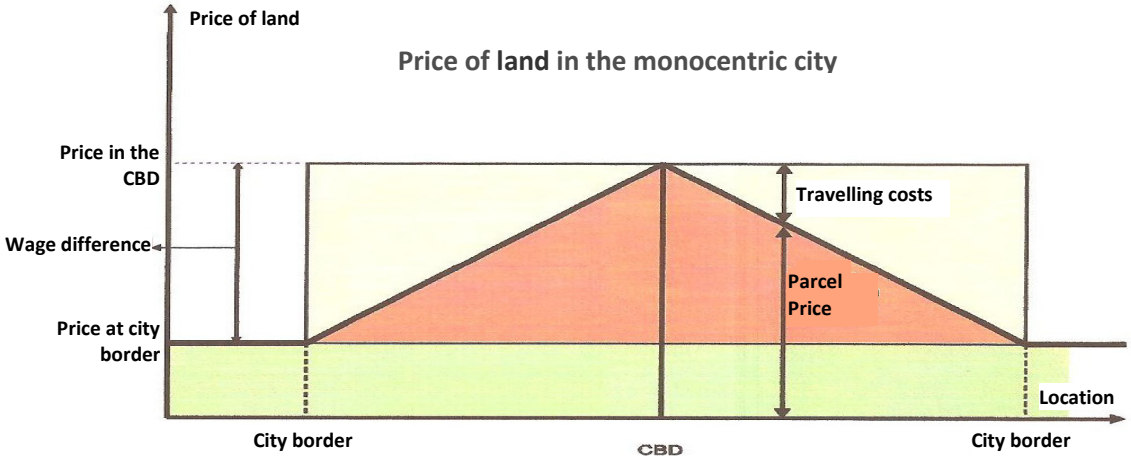


Figure 3 (source: de Groot et al., 2010)

3. *Sub-areas of the city:*

Thirdly, a city is comprised of various neighborhoods. A neighborhood forms the environment of a particular apartment, and has specific characteristics. According Cheshire and Sheppard (1998) among

others, neighborhood amenities play an important role in the demand for housing. As already seen in §2.3.3, these characteristics can be of physical, functional, and social form.
The physical characteristics are the tangible features of a neighborhood like the density of buildings, the stock of apartments (can for example be obsolete), and the street width. These physical characteristics are supposed to influence the price of, and demand for apartments. For example Abelson (1978) has developed a housing price model in which the road width is included.
The functional characteristics can be described as the operational characteristics of a neighborhood, such as the presence of subway stations, services, etc.

The foregoing physical and functional characteristics are at the source of the social characteristics, which now will be further explained. Functional characteristics are translated to a physical level. For example no subway station means every day more travelling time or walking distance for residents. On the other hand, a subway station can be supposed to increase nuisance (for example crime (Loukaitou-Sideris et al., 2002), and noise (Zimmerman, 1992)). This forms a total package of physical advantages and disadvantages that is at the base of the general neighborhood price of housing through the social characteristics. In neighborhoods where the outcome of the total package is at the good side, demand for housing is high. This influences the housing price, so neighborhoods with a good total package (of physical advantages and disadvantages) have a relative high housing price and vice versa. On its turn, the relative housing price attracts people of a certain social class. People of a lower social-economical status are generally attracted to a general low neighborhood price level and vice versa (among others Chuang et al., 2004). Finally, the social characteristics of the neighborhood are formed by their residents. These social characteristics play a role in the determination of the apartment price, because they give the neighborhood a certain social status. And that is exactly what this thesis is all about.

In the foregoing, it has been explained how functional and physical characteristics influence demand for apartments, which in turn influence neighborhood apartment prices, which in turn attracts people of a certain social class, which in turn determines the social status of a neighborhood, which on its turn also has an influence on apartment prices. The following paragraphs will discuss matters that influence various of these building blocks. It is like a causal train, and literature will also be investigated to see if this causal chain can be broken and how to redirect it (think of Urban renewal, which will be discussed in §2.4.4). Further, it might be the case that neighborhoods generally fluctuate frequently from good to bad social status and vice versa. This theme (neighborhood life cycles) will also be discussed in §2.4.4.

2.4.3) Redlining

The roots of redlining are laying in Boston, USA (Aalbers 2003). In the 1930's, city maps with red lined neighborhoods were discovered. For these red lined neighborhoods, no mortgages were supplied by the banks. This is where the concept 'redlining' originally comes from.

Nowadays, redlining has a broader meaning, which is the following: *The identification of a specific neighborhood in which no loan can be obtained or in which it is more difficult to get a loan* (Wurtzebach & Miles 1980). This is also known as 'credit blacklisting'. The outcome is discrimination based on geographical location. The former is all because banks pretend to be financially at a higher risk in neighborhoods of 'bad standing' (Aalbers, 2003). Whether this is true according literature, can be seen in §3.4. There is also the possibility of a self-fulfilling prophecy (Aalbers, 2003).

A more hidden element of redlining discussed is the discriminating element of redlining on persons. In existing literature, findings are not uniform. According to Jacobs (1961), redlining is non personal, and

makes no difference between low and high income households. It is all about neighborhoods, and not about the people living in. Another important thing she mentions is that no distinction is made between the different types of dwellings in a certain area. The work of Holmes et al. (1994) has the same outcome; no evidence was found of redlining caused by racial motives. On the other hand, Hutchinson et al. (1977) have found support for their hypothesis that the racial composition plays a role in the phenomenon redlining. Aalbers (2003) states that redlining is a form of social exclusion and possibly of discrimination. In numerous countries, like for example the Netherlands, practicing redlining is forbidden by the government (Aalbers (2010) and CGB (2006) e.g.).

For this thesis, redlining is seen as geographical discrimination, not as discrimination of individual persons. This because people that normally are not the subject of discrimination but happen to live in the redlined neighborhood, are subject to exclusion. They individually don't necessarily have to belong to an ethnic discriminated group (blacks, muslims, etc), they belong to a discriminated area. If they manage to move to another neighborhood, they are no longer excluded for mortgage. In my view, discrimination on a person cannot be wiped out by that same person only by moving to a different neighborhood in the same city (dealing with the same bank). After all, in that case the mortgage will be granted to the same person (assuming that the other requirements of the bank are met, as also assumed before the removal).

From the work of Aalbers (2003), it is reasonable to assume that the introduction of redlining by banks has an immediate impact on the number of apartment transactions and the apartment price, without a lag. Exclusion of financial facilities of a certain neighborhoods makes it immediately difficult to get a mortgage, so the financial aspect of the conditional sales contract cannot be fulfilled by the aspirant buyer, and therefore the sales will be cancelled. Seen from a sellers aspect, homeowners that need money immediately or are forced to sell by the bank, have to reduce their selling price. This will influence the price immediately. Homeowners with a longer breath will postpone the house selling, and homeowner that not want to lower the price will (because for example of sellers loss aversion, see §3.4.4) not attract buyers. This will both have an immediate influence on the number of transactions.

From an aspirant buyers aspect seen, less can be paid for a home in a redlined neighborhood as no mortgage can be obtained (only buyers with cash money can buy). Also, the blocked access to financial means for aspirant buyers makes them to continue their search for a home in other (not redlined) neighborhoods, so the number of potential buyers will decrease immediately. This will have, from a aspirant buyers aspect, have an immediate impact on the number of transactions and sales price.

All in all, for this thesis it is assumed that the practice of redlining by banks has immediate impact on the number of sales of apartments and apartment price.

2.4.4) Neighborhood change, life cycles and Urban Renewal

In literature, a lot of research has been done to the process of neighborhood change. However, most research had been done from a single perspective. For example Henderson (1985) uses the economical side, while concentrating on the amount of stock embedded in a housing unit over time The sociological side is used for example by Berry and Kasarda (1977) while focusing on the neighborhood role within the larger urban area. Bailey (1959) and Deskin (1981) for example use the geographical side and focus on the spatial process of neighborhood change.

Temkin and Rohe (1996) mention that the process of neighborhood change should be analyzed from a multi disciplinary perspective, using as well the economical, as the sociological, as the geographical point of view. They state that, over a given period in time, a neighborhood is in a stable, declining or upgrading stage. A synthetic model of neighborhood change is developed by them, which schematically sets out the interactive forces that effect a neighborhood and its residents. Below, in figure 4, the model and will be further explained:

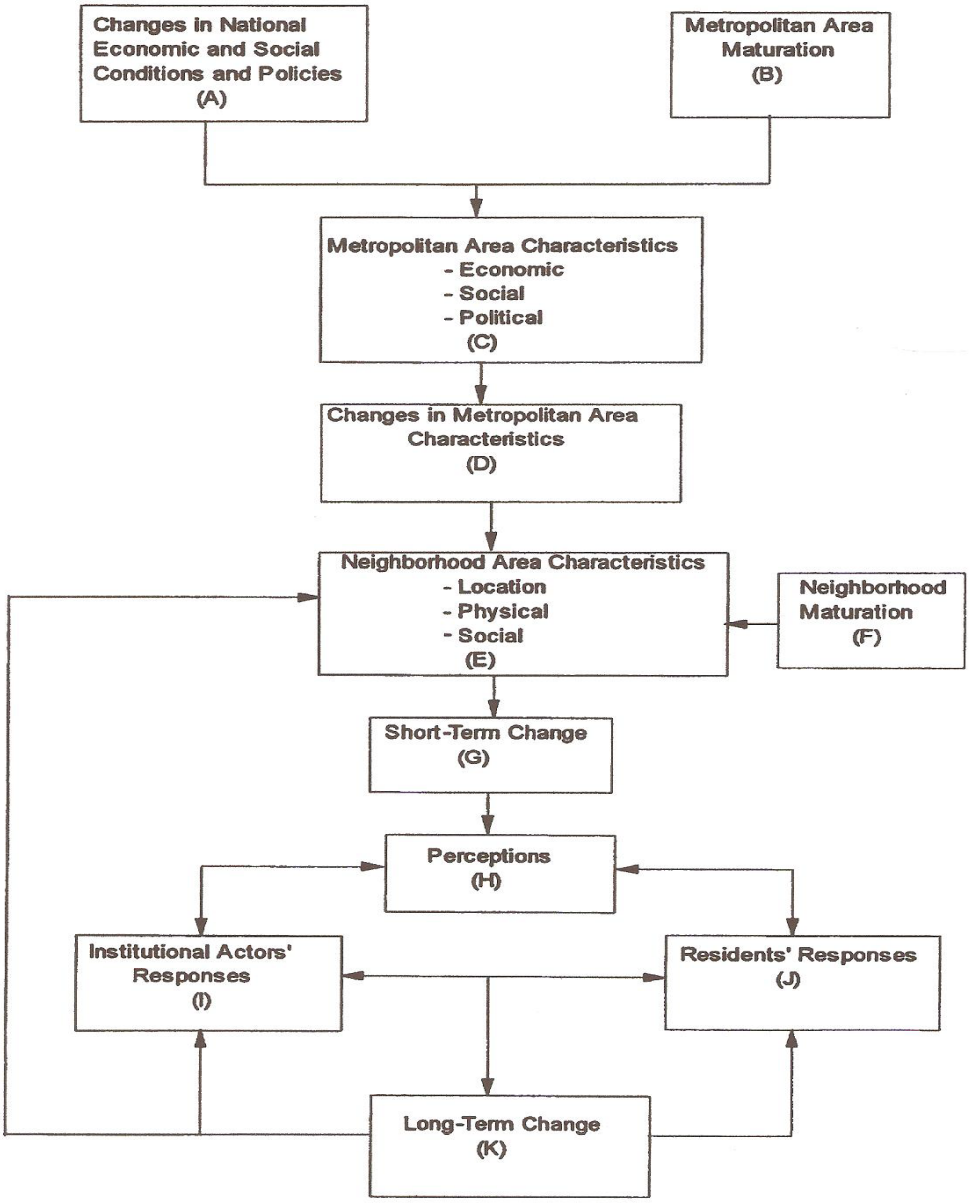


Figure 4: The model of neighborhood change (source: Temkin and Rohe, 1996)

The changes on a countrywide level (A) and metropolitan area maturation (B) are at the source of the forces of neighborhood change. Migration of ethnic groups within a country and the shift from manufacturing jobs to services in the labor market are examples of national level changes. Then, the metropolitan area itself has internal sources of change. Their physical infrastructure and population undergoes maturation. For example the city population "moves through the life cycle and this affects their decisions on commuting, housing consumption and residential location" (Temkin and Rohe, 1996, p. 166)). Together, the impact of these changes in national conditions/policies and metropolitan maturation depends on the city's economical, social, and political characteristics (C). For example cities with a high content of manufacturing industries have suffered a lot from the transition to a service

economy, while other cities just flourished. So, the existing characteristics of a city determines "the nature and the extent of changes in the characteristics of metropolitan areas" (D) (Temkin and Rohe, 1996, p. 166)). Some cities can become old, isolated and grey, while others become young and vibrant. Within a city, different reactions will be seen across various neighborhoods. Every neighborhood will be affected in its own way, depending on its location (within the city) and social and physical characteristics (E). For example, different neighborhoods suffer differently from an invasion of ethnical minorities to a certain city. Also the maturation of neighborhoods will show a different development across neighborhoods (F). For example in some neighborhoods people will move away while getting older, while in other neighborhoods people choose to stay and modify their property or search for a suitable house within the same neighborhood. On the short term, relatively small changes (in social and physical characteristics) are the outcome of changes in the metropolitan area characteristics and maturation (G). These changes cause a perception (H), and institutions (I) and local residents (J) may respond. These responses can aggravate or mitigate the neighborhood changes. Institutions can for example aggravate deterioration of a neighborhood by the practice of redlining, while increasing public investments may stop deterioration. These reactions will cause perceptions, which again causes reactions, etc. Altogether, the interplay of the institutional and resident responses will determine the neighborhood changes on the longer term.

So, a neighborhood can be in a stable, declining or upgrading stage. These stages together form the neighborhood life cycle. When a neighborhood is of 'good standing', it has a stable desirable state in which people enjoy to live in. Changes (of whatever level, countrywide or citywide) can cause a neighborhood to enter a declining stage. According to Schwirian (1983), the two most important models of neighborhood change to the deteriorating side are developed by scientists of the Chicago School and Hoover and Vernon (1959). Also other models are developed, like for example by the U.S. Department of Housing and Urban Development (1975). Former three models use different angles, and will be briefly discussed. Firstly the transition from a stable 'good' position to a stable 'bad position will be handled, secondly the upgrading stage (Urban Renewal) is discussed.

1. *Transition from stable 'good' to stable 'bad':*

Sociologists of the Chicago School, like Duncan and Duncan (1957) and Taeuber and Taeuber (1965), have developed the Invasion-Succession model. This model uses the racial composition of the neighborhood residents as a point of view. Four stages are distinguished in the declining phase by Duncan and Duncan (1957), namely penetration, invasion, consolidation and piling up. The decline is all about the entrance of ethnic minorities and the exodus of the indigenous population when a certain tipping point (in the form of ethnic minority proportion of total residents) is reached.

Hoover and Vernon (1959) distinguish 4 stages from 'good stable' to the decline towards 'bad stable' (from new construction to deprived state, see appendix 2). They use the angle of population density in neighborhoods. The first stage, they assume single family houses to be developed and constructed. In the following stage, the neighborhood is suffering from an increase of residents, and apartments are constructed. In the third stage, accommodations are downgraded through conversion and overcrowding of existing structures, and ethnic minorities spread over the neighborhood. The fourth and last stage of decline is a phase of 'shrinkage', characterized by a loss of population and decline of housing units. A little note about Hoover and Vernon: Their interpretation of the second stage is remarkable. At first glance, it seems they mean apartments to usher in deterioration of the neighborhood. However, most likely they only do not think much of earlier apartment buildings. This because at their description of the

up going phase (their fifth stage, which is about Urban Renewal), new multifamily apartments seem to be highly appreciated. It is the density of the population in combination with the obsolescence of apartments they worry about.

In 1975, the U.S. Department of Housing and Urban Development distinguish five stages (see appendix 2). The light is shed on a broader perspective. They mark the first phase as 'healthy', with homogeneous housing, upper income families, and good insurance and financing opportunities. The following phase is the stage of incipient decline, in which the houses are aging, neighborhood income and education level declines, middle-income minorities appear, and fear of racial transition occurs. The third stage is called the 'clearly declining' stage. In this stage, population density increases, increasing percentage minorities, mostly rental housing, and problems to acquire insurance and mortgage. In the fourth stage, the vacancy rate of housing increases, low-income/minorities/elderly ethnics predominate the population. There is high unemployment, a general fear of crime, no insurance or mortgage is possible, public services are declining, and apartments are absentee-owned. Then, at last in the fifth stage, decay at large scale, poverty and squatters prevail, high crime rate, and properties yield a negative cash flow

Result of the foregoing three models and their stages of decline is a deprived state of neighborhood, a neighborhood of 'bad standing'. According literature, urban renewal seems to be the key to come out of this state and attain an up going trend. Below, this last phase of the neighborhood life cycle is described.

2. Urban Renewal:

Among others according to Hoover and Vernon (1959), the recovering phase should be provoked by public intervention, this to start Urban Renewal. An appropriate definition of Urban Renewal is found in the work of Priemus (2004):

"Urban Renewal stands for the creation of conditions for the quality improvement of the housing, work, production and residential environment in and around the cities through taking measures which are primarily geared to the nature and the management of the spatial residential environment" (p. 233).

Priemus (2004) describes the shift of old to new urban renewal for the Netherlands, of which the general lines are comparable for other western countries. Firstly (until 1997), the focus of Urban renewal policies was on the stock of housing in the neighborhoods. Dwellings of inferior quality were at first mainly demolished. After an evaluation of the Urban Renewal policy, renovation (enhance the quality of the dwelling to the prevailing standards at the moment of rebuilding) became the standard. Formerly commercial rented housing became social rented housing, and social rented houses were updated. The shortcomings of this old style Urban Renewal policy was that the annual subsidies needed for the renewal were very high, and also the focus was too much on physical improvement. The residential composition of the deprived neighborhood would be the same after the renewal, and therefore no structural improvement had been made.

Then (since 1997), new style Urban Renewal was developed, and nowadays social rented housing is seen as part of the causes of neighborhood deprivation. In neighborhoods with high proportions of social rented housing, usually low income groups are concentrated, mobility and crime rates are high, and there is a strong feeling of insecurity among residents. The new style approach is to decrease social housing in favor of dwellings in ownership. The idea is that in this way, the quality of dwellings will increase and middle- and higher income households are attracted. Local authorities are not supposed to

finance all necessary investments themselves, however just play an initiating and directive role. This would have a multiplying effect on private parties like housing associations, real estate investors, businesses and owner occupiers. These private parties have to make the bulk of the investment needed.

All in all, in the end the physical, economical and social structure of the neighborhood is supposed to be altered. This by means of the earlier described interaction of institutional and residential responses, at the model of Tenkin and Rohe (1996). This is supposed to be the key to neighborhood improvement. Note that the word 'supposed' is deliberately chosen, this because whether or not the way up will be deployed is surrounded by a lot uncertainty (see for example Hulsbergen et al., 2001).

With this way up the neighborhood life cycle is completed, and after a stable desirable state of the neighborhood, the whole process will be at a new beginning. The process is comparable to business cycles with its ups and downs, like described in §3.2.

2.5) Summary and theoretical sub research questions answered

In this chapter it is seen that Real Estate is physical land and anything attached to it. Housing is part of Real Estate, apartments are part of housing. Apartments can be of Middle-Height or High segment, and there are various types of apartments.
As costs of land are higher in cities, apartments are an important type of dwelling. Because cities attract people, demand for dwellings is higher than in rural areas, which influences their price. The closer to the city center, the higher the relative price of an apartment. However, within cities the prices can highly vary because of the social status of neighborhoods.
The general Real Estate market can be divided into the market for real estate space and the market for real estate assets. These two interrelated markets together determine the price of Real Estate and apartments. The level of stock of apartment space determines the rent. This rent determines the price of apartments, and the price of apartments determines new construction. New construction in combination with depreciation (removal) determines the change of stock of apartment space, which can be read to influence the rents, etc, etc.
Institutional investors are highly interested in apartments, because apartments have higher returns than other commercial real estate and have a low correlation with inflation. This has an enhancing influence on the demand to apartments. The number of transactions and apartment prices are positively correlated, and because supply of apartments is rigid, price is mainly demand driven.
Factors on macro and meso/micro level determine demand and supply. Factors on macro level are: -governmental/institutional policy, -demographics, -development in supply of newly constructed apartments, -development of main economic variables, and –dynamics of market forces. Factors on meso/micro level are environmental characteristics on the physical/social/functional level, next to the physical apartment characteristics, the financial constraints towards certain areas (redlining), and the personal situation of the owner.

Therefore, the answer to the first Sub Research Question -*Which factors determine demand and supply of apartments?*- is: The supply of new constructed apartments is determined by the apartment price. Further supply and demand is determined by governmental/institutional policy, demographics, development in supply of newly constructed apartments, development of main economic variables, dynamics of market forces, physical/social/functional environmental characteristics, physical apartment characteristics, financial constraints towards certain areas, and the personal situation of apartment owners.

For this thesis, the number of transactions is of importance for investigating the suspicious of redlining. The answer to the second Sub Research Question -*What is the relationship between the number of transactions and the price of apartments?*- is concise: There is a positive relationship between the number of transactions and apartment prices.

The focus for this research is on the social environmental characteristics and the financial constraints towards certain areas, in combination with macro economical factors. Cities are composed of various neighborhoods, which generally have roughly between 5000 to 10000 inhabitants of largely similar education, income, and ethnicity. For research, it is common use to use 4 digit postal codes to define a neighborhood. Apartment prices are influenced by the social status of the neighborhood it is located in. This social status has to do with the norms and values of its residents, next to their availability to resources.

The answer to the third Sub Research Question -*Which indicators are appropriate to determine the social status of a neighborhood?*- is the following: Indicators of social status of a neighborhood are -education, -income, -unemployment, -criminality, -ethnical population composition, -proportion of small houses and houses owned by housing associations, and –nuisance and removals. Neighborhoods that score good on the former package of indicators are known as 'good' standing neighborhoods, while bad scoring neighborhoods are known as 'bad' standing neighborhoods.

In the Netherlands, neighborhoods of 'bad' standing are called 'Vogelaarwijken'. Redlining can be a cause of apartment price variety across city neighborhoods, while it means that in a certain neighborhood it is very difficult or impossible to get a mortgage. This because Banks state to be financially at a higher risk in such areas, however this can also be a self-fulfilling prophecy. In literature, there is no consensus whether redlining has to be seen as geographical or personal discrimination. For this thesis, redlining is seen as geographical discrimination.
Neighborhood change should be analyzed from a combined economical, sociological and geographical perspective. Over time, a neighborhood is in a stable, declining, or upgrading stage, which together forms the neighborhood life-cycle. The impact of countrywide changes and metropolitan maturation depends on the cities economical, social, and political characteristics. Neighborhoods will be each affected in their own way, depending on its location within the city, and its social and physical characteristics. Maturation will show a different development across cities. Small changes on the short term determine changes on the longer term, by a chain of perceptions and reactions of residents and institutes. Models of neighborhood change distinguish various phases during the declining stage, that eventually lead to a nadir of deterioration. The up going stage is called Urban Renewal, which is enabled by authorities.

3) Economical cycles and apartment price reaction

3.1) Introduction

For this thesis, economical circumstances for The Netherlands are used, because no (quarterly) data is available for the economical circumstances of Rotterdam. Economic up- and downturns will be further explained, since there is no single view to these phenomena. Existing literature to the development of apartment prices during the various economical circumstances will be reviewed, including the time period between changing apartment prices and a changing economical situation. Also research will be done to the development of apartment prices in 'good' and 'bad standing' neighborhoods during the afore mentioned economical circumstances.
All in all, a good understanding of the issues mentioned above is preferred for comprehending this thesis. Therefore, the literature review will handle these things in the following paragraphs of this chapter.

3.2) Economic up- and downturns

Generally, national economies grow in a cyclical way, known as business cycles. These business cycles have both a period of upswing and downswing which are divided by turning points, called peaks and troughs (Burda & Wyplosz, 2005). A full Business cycle is the period from peak to peak or from trough to trough. In figure 5, the business cycle is depicted.

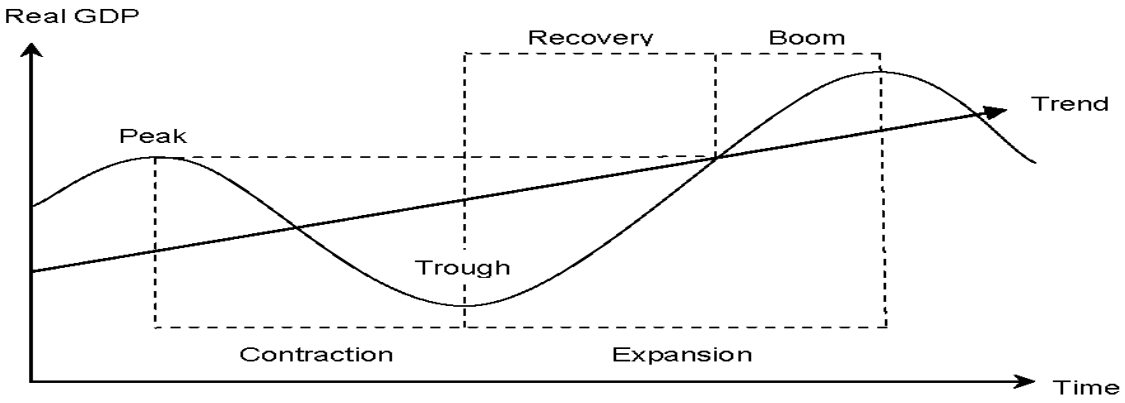


Figure 5: The business cycle [15]

As can be seen in the figure above, the state of an economy can be measured by the Gross Domestic Product (GDP) of a country, which is a *"location based measure of a country's productive activity"* (Burda & Wyplosz, 2005, p. 548). To investigate the GDP of a country over time, the GDP sequence has to be corrected for inflation in order to obtain the Real GDP.

Two authorities investigating business cycles are the National Bureau of Economic Research (NBER) and European Centre for Economic Policy Research (CEPR). The CEPR mostly "analyses euro area aggregate

[15] Source: http://www.google.nl/imgres?q=business+cycle&start=145&hl=nl&sa=X&biw=1249&bih=588&tbm=isch&prmd=imvnsb&tbnid=NrR09D0S7cSTlM:&imgrefurl=http://www.mrmikeseconsite.co.cc/APMACRO/&docid=tT3yCiA_owLFCM&imgurl=http://www.mrmikeseconsite.co.cc/APMACRO/Business_Cycle_Graph.png&w=951&h=551&ei=U-bcT4SBGsfZ0QXhu9nfCg&zoom=1&iact=hc&vpx=912&vpy=50&dur=115&hovh=171&hovw=295&tx=242&ty=96&sig=106699804396307221561&page=7&tbnh=107&tbnw=184&ndsp=26&ved=1t:429,r:5,s:145,i:192

statistics"[16] (p. 2), an area with heterogeneous institutions and policies. The NBER is regarded as the official arbiter of business cycles in the US (Filardo 2004).

According Eckstein and Sinai (1986), there is a general agreement among scientists with regard to the stages of the business cycle (see Burns and Mitchell (1946) and Mitchell (1927)), however the terms used to indicate the stages are little confusing. Eckstein and Sinai (1986) mention that the NBER has chronicled the following five stages within the full business cycle:

- peak or upper point,
- contraction or downturn
- through or lower turning point
- recovery
- expansion

It should be noticed that Eckstein and Sinai (1986) also mention that an occasional business cycle may not contain all of the previous stages.

The stage of downturn is also called recession (for example Weber, 1997, among others). So, In my view and further used for this thesis, the whole stage of downswing can be regarded as a recession.

The phase of upswing, on the other hand, is divided into two stages: the recovery phase, followed by the expansion stage. Many scientist, among many others Weber (1997) use the term 'expansion' to indicate the whole phase of business cycle upswing. The term recovery is used to indicate the first stage of expansion, which ranges from the trough till the period in which the previous peak in real GDP is reached. In case this previous peak is not reached, the range is till another recession begins. The stage of the period when real GDP is above the previous peak, till the new upcoming peak is called 'Boom' or 'prosperity'. The terms used by Weber (1997) are also used for this thesis.

The peaks and troughs are important points in the business cycle, this in order to determine the beginning of the periods of up- and downswing in the business cycle. According to Burda & Wyplosz (2005), "the quarter that immediately precedes two consecutive quarters of decline in GDP" (p.333) can be regarded as a peak, and the quarter that precedes two consecutive quarters of increase in GDP can be regarded as a trough. This method to determine the peaks and troughs is used by the NBER. In case real GDP does not have well defined peaks or troughs, other macroeconomic variables (industrial production, unemployment rate, private final consumption) can help to determine peaks and troughs (NBER)[17]. The CEPR uses a different and more complex procedure to determine a trough: during a recession which should consist of four or more quarters in a row with GDP levels below trend and a minimum of 2 quarters of negative growth during or preceding the period, the trough is the quarters with the lowest GDP level below trend (CEPR[18] and Burda & Wyplosz (2005)). The CEPR does not define a peak, but we may assume that this is the quarter with the highest real GDP level in the expansion period.

In literature there is much debate about what really is a recession. The view of the CEPR is stated above. The classical definition (Burns and Mitchell, 1946) states that a recession is the phase of the business cycle in which contraction occurs at about the same time in many economic activities. The CBS (Centraal Bureau Statistiek) mentions that the media often defined a recession as 'The state in which the

[16] Source: http://cepr.eu/press/dating.pdf , p.2
[17] Source: http://www.nber.org/cycles/recessions.html
[18] Source: http://cepr.eu/press/dating.pdf

economy is at the time when the volume of the Gross Domestic Product (GDP) , after seasonal adjustments, shrinks for two quarters in a row'. However, this definition (often used as a rule of thumb) is controversial[19].
According to the CBS, a better definition for a recession is: 'The cyclical phase in which the growth of the economical activities declines. This is measured by the declining growth of volume of the GDP, or a growth which is below the long standing average'[20].
Burda & Wyplosz (2005) mention that "a recession does not necessarily mean negative growth" (p.332). Among others, for example the NBER[21], CEPR[22], and also Hong et al.(2009) define a recession as "the period immediately after a peak to the following trough" (p.266).

Logically, it follows that the recovery period is the time immediately after the trough (CEPR[23]). As already noticed, this stage lasts till the previous peak in real GDP is reached or till another recession begins (then there had been no 'boom' in the business cycle). The stage of 'boom' is the period that ranges from the moment the previous peak in real GDP is firstly outperformed till the following peak.

To summarize the above, there is no harmony among scientist about recessions and recoveries. For reasons of simplicity, the NBER method is preferred and used for this thesis. The NBER method is relatively easy to use, and does not necessarily mean negative growth in each quarter during the recession (when the business cycle goes from a peak to a trough). For example Artis et al. (1997) mentions that this NBER method is "widely accepted and frequently used as a standard of comparison" (p. 251). Therefore firstly, for this thesis, a recession is regarded as the period that starts with two consecutive quarters of decline in real GDP. Or in case real GDP is pending and gives no clear outcome, the period in which also other macro economic variables show negative development or negative forecasts. The stage of recession ends in the quarter of the trough (this quarter is included in the recession). Secondly, a recovery is regarded as the period that starts with two quarters of consecutive incline in real GDP. Or in case real GDP is pending and gives no clear outcome, the period in which also other macro economical variables show positive development or positive forecasts. The stage of recovery ends in the quarter when the amount of real GDP of the previous peak is reached (this quarter is included in the recovery), or when another recession begins. The stage of 'boom' is the last stage in the upswing of the economy. It is the period that follows on the recovery stage and lasts till the following peak. Note that an occasional business cycle probably will not contain all stages described. For this thesis, both periods in the upswing phase (recovery and 'boom') are combined for investigation. This for reasons given in §4.4.

3.3) Apartment price indexes

"Index numbers of the prices of real properties are difficult to construct" (Bailey et al., 1963, p.933)

This appeared to be the case while reviewing the existing literature about housing price indexes. There are many thoughts about the manner of construction. However, in basis there appeared to be

[19] Source: http://www.cbs.nl/nl-NL/menu/methoden/begrippen/default.htm?ConceptID=586
[20] translated from http://www.cbs.nl/nl-NL/menu/methoden/begrippen/default.htm?ConceptID=586
[21] Source: http://www.nber.org/cycles/cyclesmain.html
[22] Source: http://cepr.eu/press/dating.pdf , p.1
[23] Source: http://cepr.eu/press/dating.pdf , p.1

four general types of indexes (the same counts for apartment price indexes, because apartments are part of housing), namely:

- Simple average price indexes
- Hedonic price indexes
- Repeated sales indexes
- Sale Price Appraisal Ratio.

Here a description of these four indexes will be given, and the advantages and disadvantages will be discussed. In the end, the appearance of hybrid forms will also be slightly handled. In figure 7, at the end of this paragraph, the pro's and con's of the discussed indexes are visualized.

1. Simple average price indexes:

These are indexes based on the mean or median of properties sold during a certain period. So to speak all properties sold are kind of put in a basket and a mean or median sales price of all these properties is computed. Because they are easy to compute, these indexes are widely used. However, these simple average price indexes have serious drawbacks.

Among many others, Wal and Tamminga (2008) mention that the differences of all these different houses in the basket are not taken into account, and index fluctuations can be caused not only by sales prices but also by a changing distribution of cheap and expensive housing over the various periods. Another disturbance is caused by the fact that the quantity and quality of housing over time is likely to increase, because of rising of real income over time (e.g. Case and Shiller, 1987). This rising income causes new built homes over time to be bigger and more luxurious. Then such indexes will rise over time, because new built homes eventually become existing homes that are included in the index.

The only advantage is of such simple average price indexes is their relatively easiness of construction. Also, because every transaction is used, there is no question of a sample selection bias. In the contrary, everything is used resulting in the comparison of apples to oranges over the periods.

2. *Hedonic price indexes:*

The hedonic price index was originally developed for the automobile market by Court (1939). This theory had been further elaborated by Rosen (1974), and it became commonly applied in the Real Estate Market. According to Rosen (1974), observed prices of heterogeneous products are the result of a set of implicit or 'hedonic' prices belonging to the "specific amounts of characteristics associated with each good" (p. 34). The hedonic method is well suited to coop with the heterogeneous nature of housing as a good, since various characteristics of dwellings are used to construct the index. Bourassa et al. (2005) mentions that this method "recognizes that properties are composite products" (p.82), and that each structural and local attribute yields its marginal contribution in the total value of the property. In basis, there are two ways of constructing an hedonic price index (among others Bourassa, 2005).

The first manner is to perform a separate regression for each time period. This regression is composed of a certain set of housing attributes (e.g. number of rooms, m2 of living space, type of dwelling etc) and a constant term (Meese and Wallace, 1997). Meese and Wallace (1997) state the constant terms to "account for any trend in housing prices over the sample period" (p.52), because the housing attributes

are a control for the quality of dwellings sold over the sample period. Then the hedonic price index is constructed “by applying the estimated implicit prices to a standardized bundle of attributes” (Bourassa et al., 2005, p.82). The outcome of this first manner of constructing is known as the multiple hedonic price index.

The second manner to construct an hedonic price index is to perform one overall hedonic regression in which time dummy variables are incorporated. The estimated coefficients of these time dummy variables then yield the hedonic price index (Bourassa et al., 2005). This second manner is of constructing is known as the single hedonic price index.

Advantages of these indexes are that they control for the quality of the dwellings. The multiple hedonic price model also has the advantage that it is not susceptible to revision when data about new periods becomes available.

The disadvantages are that a lot of characteristics of dwellings are needed to construct the hedonic price indexes, and the final result depends on the used variables (characteristics) (Bussel et al. 1996). According to Bourassa et al. (2005), other disadvantages are that hedonic price indexes are difficult to construct and suffer from sample selection bias. The latter is because to make a usable model, a selection has to be made out of all variables that can be expected to influence the property price. Also not all data of all influencing variables will be available. This is also stated by Bailey et al. (1963) who mentions that “quality characteristics are numerous and difficult to measure” (p. 933).

3. Repeated sales indexes:

Bailey et al (1963) can be considered as the founders of this type of index. The index consists of various dwellings that have been sold twice or more. The price change of each certain dwelling is measured in two subsequent periods, and the quality is presumed to stayed the same.

Meese and Wallace (1997) mention that “researchers control for hedonic characteristics by examining only those properties that have sold more than once during the sample, without any change in house characteristics between sales” (p.52). The log of the second sales price of a property is reduced by the log of the first sales price (Case and Shiller 1987). At this base, a regression of all properties is made estimated on time dummy variables. These time variables have the number -1 for the year of the first sale, 1 for the year of the second sale, and 0 otherwise. By means of the estimated regression coefficients, the repeated sales index can be constructed.

Case and Shiller (1987) have further developed the former original index, by means of adding an extra step in order to construct weights that correct for heteroskedasticity. This heteroskedasticity is partly caused by the fact that, over time, the price of dwellings will generally increase (Bourassa et al., 2005, see also the part of the simple average price indexes in this paragraph). Of major importance is that some apartments are well maintained by their owners, while others are not. This all causes the variance of the residuals to be influenced by the holding period. The extra added step makes the WRS method of Case and Shiller (1987) to have three stages. The first step is the same as practiced by Bailey et al. (1963). In the extra added second step, the squared residual errors of the first step are used to run a weighted regression “with a constant term and the time interval between sales on the right hand side”(Case and Shiller, 1987, p. 15).

According to Dreiman and Pennington-Cross (2004), this second step allows "asymmetry and price tier effects to interact with the time between the transaction" (p. 314). So, in this way, the time between the transaction is taken into account. Over time, various modified versions of this second step of the WRS method are developed (for example by Abraham and Schauman, 1991). This in order to optimize the performance of the index.
Then thirdly, each observation used for the first step regression is divided by the square root of the fitted value of the second step regression, and a generalized least square regression is made of the quotients. Such a regression is used because it cannot be assumed that the variance of the residual errors are constant (Dreiman and Pennington-Cross, 2004).
The Weighted Repeated Sales index is seen as a major index with regard to housing prices (Dreiman and Pennington-Cross, 2004). It is used by many authorities in many countries, for example by Standard and Poor's (2008), while mentioning that the Weighted Repeated Sales index "is recognized as the most reliable means to measure housing price movements" (p. 4).

An advantage of the repeated sales index is that the same dwellings are compared over time, so the index does not suffer from a bias caused by for example the proportion of cheap and expensive dwellings (so there is control for quality in the sense of the type and accompanying value of the sold houses). Another advantage is that "the most basic forms of repeat sales indexes are relatively easy to administer"(Bourassa et al., 2005, p. 81)

A major disadvantage of this index is the difficulty to control for constant quality within the same dwelling. Between the sales, for example modifications can have been made to the dwelling. Such changes in quality will bias the repeat sales indexes (Bourassa et al., 2005). Assessing the values at the time of the first and second sale can give some outcome, since in this way, of modification suspected houses (for example houses with an unrealistic increase in price) can be filtered out of the dataset. However, on its turn this reduces data, and not all modifications will lead to an unrealistic price development. Another weakness is that the repeated sales index is prone to sample selection bias and should be "revised when data for new time periods are added" (Bourassa et al., 2005, p. 81). Also the number of observations per period can be thin, because only dwellings at minimum sold twice can be used (Grimes and Young, 2010).

At the end of this paragraph, in figure 7, also for this method the former advantages and disadvantages can be seen. Here, the weighted repeat sales method of Case and Shiller (1987) is simply called 'All repeats´. As already said, a simple way to control for quality is the removal of suspicious dwellings from the dataset. In figure 7, such a method that "excludes the repeat sales on properties whose quality changed between the first and the second transaction", is called 'Constant quality repeats' (Bourassa, 2005, p. 87).

4. Sale Price Appraisal Ratio:

Bourassa et al. (2005) give an extensive description of this method, also called the SPAR method. They state the SPAR index to be an arithmetic repeat index, which has been used in New Zealand since the early 60's. The appraisal of a property by the government or tax authorities are used as quality control mechanism. Two values of a property are used to construct the index, which works in the following way: The first value used is the transaction price, the actual sales price at a certain date. The second value used is the appraisal of the property by the government or the tax authorities (valid on the moment of transaction). These appraisals are made for example for property tax purposes. In the Netherlands, from

1995 to 2003 the appraisals have been determined every four years. Since 2003 these intervals are decreased (Wal, 2008), and nowadays the appraisals are determined every year. Every time the base appraisal changes, "the new appraisals become the base for calculation of the index" (Bourassa et al., 2005, p. 85). Wal (2008) mentions that the appraisal will be adjusted when the property is modified. Such quality control is also stated by Bourassa et al. (2005), who mention that "the base appraisal is adjusted for subsequent improvements to the property that require a building permit, thereby controlling for major quality changes" (p. 85). The sales prices are divided by the appraisals to get the sales price appraisal ratio. Below an example of the calculation of the sales price appraisal ratio's and the SPAR index.

Calculation of equal-weighted and value-weighted SPAR indexes

Property	1	2	3	4	5	Average	Sum
Current period sales							
Sale price	120,000	125,000	85,000	80,000	110,000		520,000
Appraisal	90,000	118,000	85,000	85,000	125,000		503,000
SPA ratio	1.333	1.059	1.000	0.941	0.880	1.043	1.034
Previous period sales							
Sale price	110,000	120,000	75,000	95,000			400,000
Appraisal	130,000	125,000	65,000	90,000			410,000
SPA ratio	0.846	0.960	1.154	1.056		1.004	0.976

Index numbers	Equal-weighted	Value-weighted
Previous	100	100
Current	104	106

Figure 6 (source: Bourassa et al., 2005)

As can be seen in Figure 6 above, there are two versions of the SPAR index: the Equal weighted and a Value weighted version. In the Equal weighted version, each dwelling gets the same weight. No matter the height of its value. For every dwelling, the sales price is divided by the appraisal. In this way sales price appraisal ratios are calculated for each dwelling, and these numbers are counted up. Then the aggregated sum of all sales appraisal ratios is divided by the number of dwellings to get the average sum. In the Value weighted version, dwellings with a higher value have a bigger weight. All sales prices and appraisals are counted up. In the end, the total sum of sales prices is divided by the total sum of the appraisals.

According to Shiller (1991), with regard to repeated sales indexes, a value weighted index is more useful for portfolio valuation. Bourassa et al. (2005) state this also to be valid for the SPAR index, and from his work can be reasoned that the equal weighted version is best used "to understand average or typical growth rates" (p. 86). So which one to choose depend on the purposes.

Bourassa et al. (2005) among others mention that the SPAR method produces an index that is "very much like those produced by repeated sales method, particularly the 'constant quality' repeated sales method" (p. 82). Therefore, the SPAR index can be seen as an index of high quality. The main advantages of this SPAR index is that it is still easy to construct, it "relies on all transactions that have occurred in a given housing market" (p. 81), it is not susceptible for revisions when data for new periods are added, and it controls for the quality of housing (Bourassa et al., 2005). Grimes and Young (2010, p.3) mention another important advantage, namely that the SPAR index is "not restricted to properties that have sold at least twice". In this way, with the same dataset more data can be used compared to repeated sales indexes.

However, also the SPAR index has disadvantages. Such indexes are susceptible for sample selection bias, though to a lesser extent than repeated sales indexes (because, as already said, for repeated sales indexes not all the data but only these dwellings sold at least twice can be used). A potential drawback is that the initial appraisal have to be accurate and of good quality (Grimes and Young, 2010). This appears to be a significant handicap for useful application for this thesis.

Official authorities have also discovered the combination of relative easiness of construction and high reliability from the SPAR index. Nowadays, many authorities use the SPAR index, or an index which is based on it. For example in the Netherlands, the Dutch Land Registry Office uses a SPAR method based index.

5. Hybrid forms:

Further there are various hybrid forms, which are various combinations of the hedonic and the repeated sales methods (Bourassa et al., 2005). These methods for example combine hedonic characteristics in a repeated sales model. Shiller (1991, 1993) for example, includes some housing characteristics in the weighted repeat sales model. The reason why hedonic and repeat sales approaches are combined, is to diminish the bias and efficiency problems that are present in both separate approaches.

To summarize, in the table below, the different housing price indexes are compared (except for the simple average price index, which has too many shortcomings) and the discussed strengths and weaknesses are visualized. For constructing an hedonic price index, detailed characteristic of the dwelling are needed. According to Song et al. (2010, p. 40), repeated sales indexes are in favor when the researcher "has limited access to hedonic characteristics", and Weighted Repeated Sales Indexes are recognized as the most reliable (Standard and Poor's, 2008). The SPAR index has a similar outcome compared to Weighted Repeated Sales Indexes, spills less data and is not susceptible for revision. However, for constructing a SPAR index, the appraisals (valid at the moment of the transaction) of each dwelling need to be accurate.

Comparison of alternative methods

Criteria	Multiple hedonic	Single hedonic	All repeats	Constant quality repeats	Hybrid	Sale price appraisal ratio
Constant quality	++	++	–	++	++	++
No sample selection bias	–	–	––	––	–	–
Consistent when updated	++	–	––	––	–	++
Easy to administer	–	–	++	+	––	+

Note: ++ indicates that the criterion is satisfied; + indicates that the criterion is partly satisfied; – indicates that the criterion is not satisfied; and –– indicates that the criterion is not satisfied and the problem is more severe than is the case for criteria rated –.

Figure 7 (source: Bourassa et al., 2005)

3.4) Apartment price development during various economical circumstances

3.4.1) Apartment price development and economical circumstances in general

In this paragraph, the relationship between apartment prices and the general economic circumstances will be discussed. In this context, also literature about apartment price development in 'good' and 'bad' standing types of neighborhood will be reviewed. Points of interest are if apartment prices develop in a cyclical way (just like national economies), if this development is pro or counter cyclical with regard to the economical business cycle, and if apartment prices in 'good' and 'bad' standing neighborhoods develop is the same way. Whether there is a lead or a lag with regard to the economical business cycle will be discussed in §3.4.4.
Firstly the apartment price development of apartment prices in general, secondly the development in 'good' and 'bad standing' neighborhoods will be handled. This approach will be repeated in the following sub-paragraphs.

1. *General apartment price development:*

In literature, there is done a lot of research to real estate price cycles and cyclical development of apartment prices. Wheaton (1999) mentions that "different types of real estate can have very different cycle properties" (p. 209). He found that apartment prices follow a cyclical path, which is confirmed by many others. All results point in the same direction. Ling and Archer (2008), among many others, explain the occurrence of these cycles. They mention that for builders and developers, it is profitable to build when the market value of apartments is above the total construction costs (acquisition of land included). The result is an increase in supply, and levels of occupancy will decline. This causes a decline in the rental rate, which lowers the market value of apartments and less apartments will be built. In case this former process was instantaneous of correction, no apartment price cycles would occur. However, apartment development takes a lot of time from the first plans to the moment of completion (among others Barras, 1994), and Ling and Archer (2008) mention a lead time of 2 years or more. The presence of business cycles in the general economy causes fluctuations in demand for apartments, which influences the apartment price. This in turn influences newly constructed supply of apartments, which on its turn again influences the apartment price. Therefore, the development of apartment prices is pro cyclical with regard to the business cycle. This is also stated by Davis and Heathcote (2005) and Leamer (2007) for example, who found a positive sign for the correlation between housing prices and GDP.

However, there is no consensus in existing literature about the strength of this correlation. For example Kan et al. (2004) has found a significant correlation between housing prices and GDP of less than 15%, while Davis and Heathcote (2005) have found it to be about 65%. Former can also be presumed to account approximately for apartment prices. However, the absolute figures can somewhat differ, because apartments seem to have some special behavioral characteristics compared to housing in general with regard to volatility and recovery path. This can be read in §3.4.2 and §3.4.3.

2. *Apartment price development in neighborhoods of 'good' and 'bad standing':*

There is neither consensus among scientists about the development of apartment prices across different types of neighborhoods with regard to general economical circumstances. By reasoning the determinants of apartment prices and social status of neighborhoods, for this thesis it is assumed that

relatively low end priced apartments are overrepresented in neighborhoods of 'bad standing', while relatively high end priced apartments are overrepresented in 'good standing' neighborhoods.

On the one hand, according to Mayer (1993) for example, higher end housing prices are more volatile than lower end housing prices. An explanation is found in the work of Smith and Tesarek (1991), who state that changes in city structure of employment can be a cause for this finding, while for high end priced housing less entrepreneurial and professional income led to steeper declines. Poterba (1991) found another cause in the combination of governmental policy and development of inflation. The reasoning is that when an economy is doing well, inflation rises. When mortgage interest payments are deductible on taxable income, this "can result in negative real after-tax borrowing rates" (p. 182), which will lower the real costs for the homeowner. When the economy is in a bad state, inflation will decrease and the opposite will occur. In bad standing neighborhoods, the former tax argument can be presumed to have less influence, since apartments are cheaper (and therefore the amount of mortgage is lower) and homeowners are in a lower taxation bracket (while most likely earning less income).
The former findings would imply that apartment prices in 'bad standing' neighborhoods are less risky for banks during downturns, only looking at the value of dwellings, which gives banks no reason for redlining.

On the other hand, for example Belsky and Duda (2002) found the opposite, namely that apartment prices in 'bad' standing neighborhoods have a higher volatility than apartment prices in 'good' standing neighborhoods. In my view, a probable explanation can be financial constraints for 'bad' standing neighborhoods (introduced by for example banks) that are tightened during bad general economic circumstances and loosened during good general economic situations. Then prices will fall harder in 'bad' neighborhoods during economical bad times, while raising harder during economical good times. When this is the case, banks are causing a self-fulfilling prophecy while practicing redlining. However, a point of interest is that banks also practice redlining during general economic good times (Aalbers, 2003), which would have to lower the volatility to the upper side of apartment prices in 'bad' standing neighborhoods (at least for the time period redlining is practiced by banks). This is what Aalbers (2003) has found, namely that apartment prices in 'bad' standing neighborhoods increase at a lower rate than apartment prices in 'good' standing neighborhoods.

It will be interesting to see whether there will be a catching up of the apartment prices during economical good times after the redlining practices are abolished, because of all contra dictionary findings.

Then thirdly, according to Case and Maryenchenko (2001) for example, there is not much to say about general difference of housing price patterns between 'good' and 'bad' neighborhoods, while these patterns highly differ over time and across cities. Suchomel (2009, p. 40) states that general apartment price development over time is "roughly at the same level" across 'good' and 'bad' neighborhoods.

All in all, in literature there are contra dictionary findings about the general apartment price development over time across neighborhoods of 'good' and 'bad' standing.

3.4.2) Apartment price development during economic downturns

1. General apartment price development:

There is conformity among scientists that housing prices are more volatile than GDP (Leung (2004) and Ortalo-Magne (1998) among others). The development of apartment prices is pro cyclical to the business cycle. So, in an economic downturn, housing prices will show a relative steeper decline (apart from a leading or lagging period, see §3.4.4) than the decline in GDP. A main cause is the long lead time, which on its turn causes that the "the property market is characterized by a persistent disequilibrium and a cycle of oversupply and undersupply" (D'Arcy and Keogh, 1999, p. 918). This over- and undersupply causes major deflections in price, because the price is determined by demand.

Other things of major influence are the financial situation within banks and the outlook towards the apartment price development. This will influence banks in their mortgage policy. This can also be seen nowadays in the Netherlands: the banking sector is under pressure (they shall more easily provide a mortgage while being in a financially stable than in an unstable position) and the outlook of the housing price development is negative, which causes banks to tighten up credit constraints (Elsinga et al., 2011). This in turn causes a decrease in demand of housing, which causes prices of dwellings to decrease. The former has further consequences. Namely, people that cannot pay their monthly mortgage liability, for example because of job loss during the recession, are forced by the bank to sell their dwelling. This is because the bank reclaims the mortgage, and is entitled to sell the house in order to realize this. With little demand, probably the sales price is lower than the mortgage amount, and this can cause the bank to have a loss (in case the former home owners cannot bear this loss and are personally bankrupt, except for example in cases of a mortgage guarantee by the government). The general lower revenues of the forced sales transactions put a negative pressure on the rest of the housing market. In such a situation that aspirant home owners can choose between a cheaper forced sales home or a normally sold home, they would prefer the first. Therefore, to stay in the running, also owners of houses that are normally sold should lower their prices. Because of the foregoing losses on forced sales, the financial position of banks can deteriorate further, which on its turn influences the available resources for aspirant buyers. In this way, apartment prices are found to be in a downward spiral that goes beyond the general negative economic situation.

Housing prices are more volatile than GDP. However, apartments play a special role. Louargand and Murdy (2002) mention that apartments are a defensive asset in economic downturns, while compared to other types of housing, they are less volatile and less sensitive to a broader market downturn. A probable cause, which is confirmed by real estate agents[24], can be the fact that owners of apartments generally own the apartment for a shorter time than owners of single family houses. They have not, or barely, benefitted from former increases in price. Because of sellers loss aversion (see §3.4.4), apartment owners are less willing to water the wine. This causes apartment prices to decrease less during economical downturns than prices of other types of housing.

All in all, in literature apartment prices are found to decrease during a recession. Apartment prices are more volatile than GDP, but diminish least compared to all other types of housing during recessions.

[24] Source: http://www.opbodmakelaar.nl/nl/makelaarsnieuws/66/verkooptijd_appartementen_harder_opgelopen.php

2. *Apartment price development in neighborhoods of 'good' and 'bad standing':*

In the previous paragraph, we have seen contra dictionary findings about the general apartment price development over time across different types of neighborhood. This means nothing sensible can be said about a difference in development of apartment prices during recessions, between 'good' and 'bad' standing neighborhoods. By reasoning Mayer (1993) apartment prices in 'bad' neighborhoods would show a minor deterioration (compared to 'good' standing neighborhoods), by reasoning Belsky and Duda (2002) just the opposite would happen, while by reasoning Case and Maryenchenko (2001) every of the former outcomes can be true.

All in all, evidence in literature points out all directions, and no consensus is reached.

3.4.3) Apartment price development during economic upturns

1. *General apartment price development:*

Because of the pro cyclical behavior with regard to the business cycle, apartment prices can be presumed to increase during an economic upswing (apart from a leading or lagging period). This is confirmed by for example Genesove and Mayer(2001). The higher volatility of apartment prices with regard to GDP would presume apartment prices to increase relatively faster than GDP. Existing literature shows uniformity on this point. For example Otrok and Terrones (2005) mention that the relative growth rate of housing prices can be up to 4 times as high as the relative growth rate of GDP.

Again, apartments play a special role compared to other types of housing. According Louargand and Murdy (2002, p. 203), apartments "are the first product type to recover from a downturn".

So, all in all, housing prices will increase at a faster rate than GDP during economic upturns, and apartments prices are in the leading position with regard to the moment in time of starting the way up .

2. *Apartment price development in neighborhoods of 'good' and 'bad standing':*

Poterba (1991) and Mayer (1993) have found that apartment prices in 'good' standing neighborhoods appreciate faster than apartment prices in 'bad' standing neighborhoods. The same is stated by Aalbers (2003) and Peng and Thibodeau (2010). Belsky and Duda (2002) on the contrary have just found apartment prices in 'bad' standing neighborhoods to appreciate faster during economic upswings, while reasoning the work of Case and Maryenchenko (2001) , again every of the former outcomes can be true.

All in all, again evidence points out all directions, and no consensus is reached in existing literature.

3.4.4) Apartment prices: leading or lagging GDP?

The following point of interest is whether the apartment price cycle is leading or lagging the business cycle. Wetten (1992) and Quigly (1999) stated Real Estate to lag behind general economy. However, Real Estate in general consists of Residential and Non-Residential Real estate, and the question is if this statement holds for housing and in particular apartments.

1. *General apartment price development:*

After reviewing the existing literature, not a single conclusion can be drawn. Surprisingly, it seems that slightly more results point just in the direction of GDP lagged to apartment prices.

On the one hand, for example Chui and Chau (2005), Davis and Heathcote (2005) and Leamer (2007) among others, have found that GDP is lagged to apartment prices. Leamer (2007) states housing to be a good indicator of oncoming recessions.

On the other hand, others like for example Chau and Lam (2001) have found the inverse, namely that apartment prices are lagged to GDP. Pol (2009, p. 17) states that apartment prices "tend to lag behind economic developments". This because of the dynamics of market forces, given in §2.3.3. The same can be reasoned out of the work of Genesove and Mayer (2001). House sellers pursue a higher sales price than the former purchase price, and have an aversion to a loss. Therefore sellers are found to have a lagged adjustment to changing market conditions with regard to the sales price of their apartment. As seen in §3.4.2, this point just especially counts for apartments. In my view, this would probably cause apartment prices to be lagged to GDP, at least in case of economic downturns.

The former shows contradicting findings. Even though there is slightly more evidence for a leading role of apartment prices with regard to GDP, the lagging role stated by Pol (2009) seems most interesting for this thesis. This because he has investigated the Netherlands, and specific circumstances in other countries can cause a different outcome.

Because of the former contra dictionary findings, in §4.7.6 the outcomes of the data used for this thesis will visually be inspected. This in order to formulate the hypotheses in a proper manner. In §3.4.5, the time frame of changing apartment prices and GDP will be discussed.

2. *Apartment price development in neighborhoods of 'good' and 'bad standing':*

About a probable difference between types of neighborhood, with regard to a leading versus lagging position in relation to GDP, nothing can be found in existing literature. Therefore, for this thesis the leading or lagging role for both types of neighborhood is assumed to be the same.

3.4.5) Changing apartment prices and economical circumstances, reaction time

About the exact time period between changing apartment prices and changing economical circumstances, little can be found in existing literature. Pol (2009), who states a lagging role for apartment prices and is used as guideline for this thesis, gives no indication of this lagging period. However, some scientists that state a somewhat 'exact' time period see apartment prices in the leading role. For example Leamer (2007) has found that housing prices lead to GDP with 5 quarters when heading a recession. There are no reasons to presume that this leading time differs much for apartment prices. For heading a recovery, no leading time is mentioned in the work of Leamer. Shiller (2007) gives a more rough indication of a reaction time. He has found that GDP lags house prices with a period varying from months to years, in case GDP is heading towards a recession. While heading towards a recovery, he mentions that GDP lags to house prices with a period of months. Davis and Heathcote (2005) have used yearly data for their research, and found that the correlation between the residential investments at time t-1 and GDP at time t have a higher correlation than the contemporaneous correlation. Because residential investment and housing prices are positively correlated, housing prices (and therefore also

apartment prices) can be presumed to be leading GDP with one year or more. This while heading recessions and recoveries.

All in all, there is little evidence available in existing literature to give a clear answer about any exact leading or lagging time of apartment prices to GDP. About a probable difference between types of neighborhood, with regard to the time period between changing apartment prices and changes in GDP, nothing can be found in existing literature either.

In §4.7.6, the for this thesis used reaction time of apartments with regard to GDP will be further elaborated.

3.5) Summary and theoretical sub research questions answered

In this chapter it is seen that generally, national economies grow in a cyclical way, called business cycles. These cycles have periods of up- and downturns, with turning points called peaks and troughs. A full business cycle is from peak till peak or from trough till trough. About the beginning of economic down- and upturns, also called recessions and recoveries, there is no consensus among scientists in existing literature. Detecting peaks and troughs in the business cycles is of major importance in order to determine the beginning of the recessions and recoveries. The best way to detect the peaks and troughs, is to use the NBER method.

Following this method, the answer to fourth Sub Research Question –*How to define a recession?*- is: a recession is the period that starts with two consecutive quarters of decline in real GDP. Or, in case real GDP is pending and gives no clear outcome, the period in which also other macro economic variables (like industrial production, unemployment rate and private final consumption) show negative development or forecasts. The recession lasts till the quarter of the trough, this quarter included.

Following the same method, the answer to the fifth Sub Research Question -*Which are the stages of an economic upturn, and how to define these stages?*- is: the stages of an economic upturn are the stage of recession and the stage of 'boom'. A recovery is the period that starts with two consecutive quarters of incline in real GDP. Or, in case real GDP is pending and gives no clear outcome, the period in which also other macro economic variables (like industrial production, unemployment rate and private final consumption) show positive development or forecasts. The recovery lasts till the former peak in real GDP is matched, this quarter included. The 'boom' is the period that starts at the moment the previous peak in real GDP is outperformed, and lasts till the new following peak.

For investigating apartment prices over time, in base there are 3 useful methods to construct an index: -multiple hedonic method, -weighted repeated sales method, and SPAR method. The one best to use for a research depends on the available data. The answer to the sixth Sub Research Question -*What is, in which situation of available data, the most appropriate index for investigating the development of apartment prices?*- is: When having data about many specific characteristics of apartments (like number of rooms, m2 of living space, state of maintenance, etc) at the disposal, the Multiple Hedonic Price Index is most appropriate for using for investigation. When having little or no data about the characteristics of an apartment, the weighted repeated sales method and the SPAR method are best suited. The SPAR index is best to use when appraisals of good accuracy and quality are at the disposal. When such appraisals are not available, the Weighted Repeated Sales Index is the best one to use.

Each index has advantages and disadvantages. The Multiple Hedonic Price Index controls for the quality of apartments and is not susceptible to revision over time. However, a lot of characteristics of apartments are needed to construct such an index. Also, the final result depends on the variables chosen, so it suffers from a selection bias. The SPAR Index is relatively easy to construct, relies on all transactions occurred in a given housing market, controls for the quality of housing and is not susceptible for revisions. Disadvantages of the SPAR Index are that appraisals of the apartments in the index need to be available and also these appraisals need to be accurate and of good quality. The Weighted Repeated Sales Index are also relatively easy to construct, and controls for quality in the sense of type and accompanying value of apartments. On the other hand, only apartments that at least sold twice can be used, it is difficult to control for constant quality within the same apartment over time, and it is susceptible to sample selection bias and revision.

Apartment price develop pro-cyclical to the business cycle. In literature, there is no harmony whether apartment prices in 'good' and 'bad' standing neighborhoods generally develop in a different way (with regard to GDP), and in which neighborhoods apartment prices are more volatile.

Apartment prices have found to be relatively decrease more than GDP during recessions. However, during recessions, apartments lose relatively least of their value compared to other types of housing. There are contradicting findings about the apartment prices development during recessions across different types of neighborhood. Evidence is going all directions, and nothing sensible can be concluded. During recoveries, apartment prices increase at a higher rate than GDP. Compared to other types of housing, apartment prices are in the leading role with regard to the moment in time of starting the way up. Again, contradicting findings with regard to the apartment price development during recessions across different types of neighborhood.

There is found slightly more evidence in favor of leading apartment prices to GDP, than the other way round. For the Netherlands, Pol (2009) has found a lagging role of apartment prices with regard to GDP. Because of the former contra dictionary findings, the for this research constructed apartment price indexes are visually inspected. The reaction time to a change in real GDP is assumed to be the same across neighborhoods of 'good' and 'bad' standing, since no evidence is found of differences between these types of neighborhood.

4) Method

4.1) Introduction

In this fourth chapter, the used methods and techniques will be discussed. Firstly, the differences between the data from the NVM and the DLRO will be handled, and the choice to use the DLRO data for this research will be explained. Secondly, the suspicious periods of redlining for Rotterdam will be described. Then following are the economical peaks and troughs of the Dutch economy, for the period 1995-2011. Hereafter, the method for preselecting 'good' and 'bad' Rotterdam neighborhoods will be explained, and after this, the further steps to come to a definite selection of the two contrasting neighborhoods will be set out. Then, the handling of the acquired data from the DLRO will be explained. This includes the manner of exploration of the acquired data, and the requirements for excluding apartments from the definite dataset. At last, the construction of both the apartment price index of the neighborhoods and the counting table of the number of transactions (further just called counting table) will be discussed, next to the final hypotheses.

4.2) NVM versus Dutch Land Registry Office data

According to Francke et al. (2009), there are 2 databases with information about the transactions of housing for The Netherlands: the NVM and the DLRO. The NVM is a Dutch association for real estate agents, which has over 4000 members nowadays (source: NVM). The DLRO is a former governmental institution, involved in the registration and provision of information about the location of Dutch Real Estate and the rights belonging to this, like ownership and mortgage (source: DLRO). The similarities and differences of these two databases will now be discussed.

The NVM records the date of the sales in the database, while the DLRO records the date of the actual transfer of the ownership of the property. The difference between these 2 point in time are on average one quarter of a year (Francke et al. 2009 for example mentions 2 months , while Rabobank 2009 mention 3 months). They both publicize nominal prices. The Rabobank (2009) mentions that in the NVM data, on the one hand movable goods are included in the sales and on the other hand auction transactions are not included. In the data of the DLRO, these auction transactions are included, as well as transactions of investors and housing associations to private persons. All in all, the data of the NVM contains about 70-75% of the transaction market, while the databank of the DLRO contains the whole sales transaction market to private persons.

The databank of the NVM includes, besides the transaction price, various characteristics of the property sold (like number of rooms, maintenance etc). For the DLRO databank, the information comes from notarial acts. The most important information here is the transaction price of the property besides the square meters of land. Also the type of dwelling (detached house, apartment etc) is defined (de Vries et al 2009). However, the NVM databank is far more detailed, with extensive specific characteristics of the building itself.

Since DLRO data comes straight from notaries, it is highly reliable. The data of the NVM is more susceptible for flaws, because each real estate agent types in the data in the NVM databank himself.

To summarize the above, the data of the DLRO is highly reliable, contains the whole housing sales market to private persons, but is less detailed about the building itself than the data of the NVM. For this thesis, a weighted repeated sales index is used (see §4.7.3), where no detailed information about the building is required. Therefore, DLRO data is preferred and used.

4.3) Suspicious periods of redlining for Rotterdam

In the work of Aalbers (2003), interviewees give a quite exact suspicious period of redlining in 'bad standing' Rotterdam neighborhoods. These neighborhoods are indicated with a red line on a map of Rotterdam. Also the 'bad standing' neighborhood selected for this thesis is indicated on this map, so the suspicious can be investigated on support from our collected data. Not only a probably negative influence of redlining on the housing price index can be investigated, but also a probable negative influence on the number of sales. This is because when it is harder or impossible to get a mortgage, the selling of a house will be very difficult. The beginning of the first suspected redlining period indicated by interviewees is May 1999, and the ending is the 1st of January 2000. The interviewees also mention, that from the course of 1998, obtaining a mortgage was slightly started to become more difficult. However, from May 1999 on till 1st of January 2000 it seemed quite impossible at any bank. Therefore, this period is chosen as the first suspicious period.

The second suspicious period again is found in work of Aalbers (2010). Redlining is suspected to be present in 'Vogelaarwijken' in Rotterdam. The 'bad standing' neighborhood selected for this thesis is also a 'Vogelaarwijk', so again these suspicious can be investigated on support from our collected data. Only the beginning of the of redlining suspected period is given by interviewees, not the ending. According the interviewees, the beginning of this second suspected period equals the beginning of the credit crisis. Though there is no uniformity in literature about the exact beginning of the credit crisis (for example OECD(2008) mentions June 2007, DNB[25] August 2007, Hollanders and Verbon (2012) and the Dutch Government[26] just the year 2008, while Hazeu mentions autumn 2008), in my view caused by different points of view (for example a USA point of view or a worldwide point of view, when the world got influenced). In the work of Aalbers (2010), a real estate agent mentions that since autumn 2008 the obtaining of mortgages is getting hard in certain neighborhoods. Former indications point in the direction of a suspicious period of redlining starting in 2008Q4. In the same article (Aalbers, 2010), a direction is given to another point in time where there are still suspicious of redlining: 'De Volkskrant' (Eerenbeemt et al., 2009) states on 24 June 2009 that no mortgages are provided in 'Volgelaarwijken'. So, in my view it justifiable to state that the suspicious period lasts certainly till 2009Q2. Further, a probable ending of the 2nd suspicious period is not given. This means that from 2009Q3, there is uncertainty whether the suspicious period of redlining continues or not. Probably the suspicious of practice redlining by bank continues, but it is also possible that it ends and a catch up phase sets in in the Redlined neighborhoods.

The collected data of the 'bad standing' Rotterdam neighborhood selected for this thesis will be, whenever possible, investigated for the periods during the suspected periods of redlining. The data of the 'good standing' Rotterdam neighborhood will be used as control group. In case there are changes only in the neighborhood of 'bad' standing (in the apartment prices and/or the number of apartment sales), these are probably caused by this practicing of redlining by banks.

[25] Source: http://www.dnb.nl/binaries/De%20kredietcrisis%20en%20de%20reele%20economie_tcm46-211167.pdf
[26] Source: http://www.rijksoverheid.nl/onderwerpen/kredietcrisis

All in all, the two certain suspicious periods of redlining for Rotterdam are:

- 1999Q3-1999Q4
- 2008Q4-2009Q2

The less strict period of redlining is:

- 1998Q4-1999Q2

A possible catch up phase following on the first suspicious phase can be in the year 2000 for the 1st suspicious period and from 2009Q3 for the 2nd suspicious period. However, the period from 2009Q3 can also be the continuance of the suspicious period, that is uncertain. Therefore, the possible catch up phase to investigate is set at:

- 2000Q1+2000Q2

It should be noted that the quarters to investigate the apartment price development should fit and match the constructed indexes as much as possible. Therefore, as can be seen in §4.7.2 and §4.9, not all quarters and suspicious periods given in this paragraph can be used for the investigation of the apartment prices. This is the reason that also a half yearly counting table is made. This in order to see if the number of transactions deviate significantly negative during the periods that are suspicious for redlining. In this way, reasoning through the positive correlation of the number of transactions and apartment prices, an indication can be given towards the first suspicious period.

As the introduction of redlining is expected to have immediate effect on the number of transactions and the apartment prices, it seems reasonable to assume that the abolishment of redlining has also immediate effect.

4.4) Recessions, phases of upswing and full business cycles in The Netherlands

According to Jeffrey et al. (1969) city economies are for a large part influenced by national and subnational factors. Quarterly data about Real GDP is needed for determining recessions and recoveries. Because quarterly economical data for Rotterdam is not available for the period 1995-2011, the best option is to use data for the Netherlands (see appendix 3 for the used data). The periods of recession, economic upturn, and full business cycles for the Netherlands from 1995-2011 now will be discussed.

1. *Recessions in the Netherlands from 1995-2011:*

Smant[27] uses the classical US definition (see §2.7) when he states that from 1995 till 2010, 2 recessions have occurred in the Netherlands. The whole timeframe 1995-2011 will be checked according the NBER method. In figure 8 can be seen that from 1995 till 2001Q2, growth in real GDP is positive. The economy is an a phase of upswing. After 2001Q2, till 2002Q2, real GDP growth starts pending.
This means that there is no clear peak according the first phase of the NBER method (the search is for a peak, as from 1995 on the economy comes from an upturn). The quarter before the pending in real GDP growth starts, 2001Q2, is a possible peak (this quarter is marked in green). Therefore, additionally the unemployment rate, industrial production volume growth and private final consumption are investigated. This following the reasoning of the second phase of the NBER method. These indicators does not point unanimously in one direction during the period 2001Q2 till 2002Q2, though

[27] Source: http://people.few.eur.nl/smant/m-economics/dutchdata/dutchrecession.htm

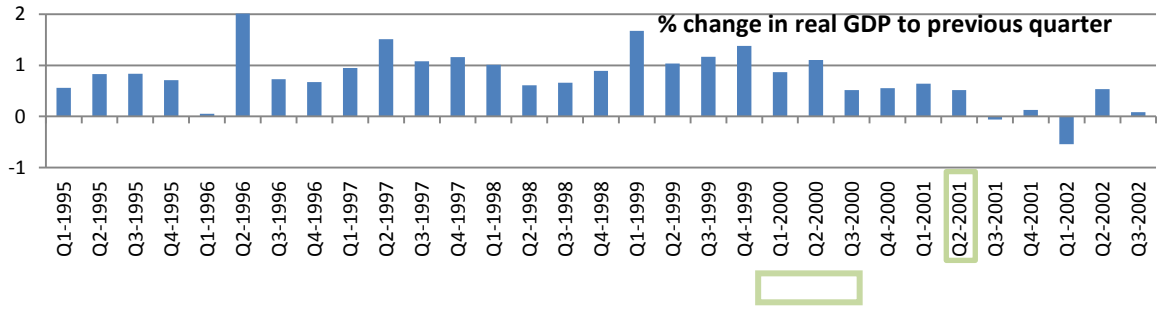


Figure 8 (source OECD)

developments and forecasts are slightly more positive than negative. Unemployment rate decreases even after 2001Q2, though from 2001Q3 it slightly increases. Industrial production growth is also pending during this period, and except for one single quarter, private final consumption growth stays on the positive side. See Appendix 4 for the figures of these indicators. It can be stated that till 2002Q2 no peak in the Dutch economy occurred. Therefore, as 2002Q3 again (just as 2002Q2) shows positive real GDP growth, from 1995Q1 till 2002Q3 the Dutch economy is stated to be in an economic upturn.

Figure 9 depicts the growth in real GDP of the Dutch economy since this period (with some overlap in the beginning for reasons of clarity).

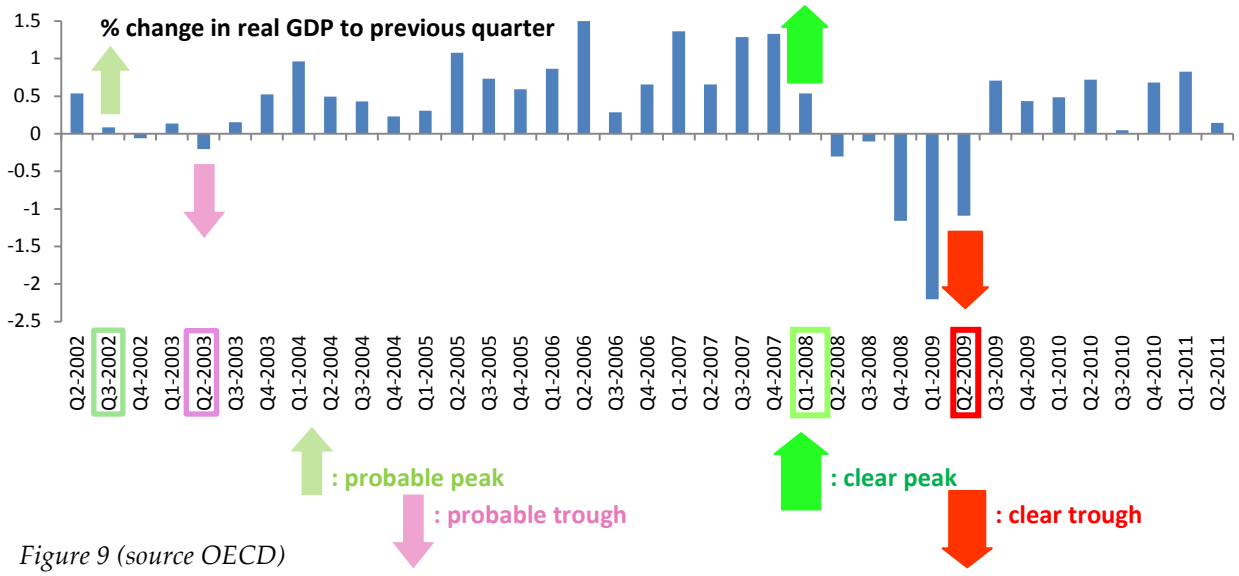


Figure 9 (source OECD)

The larger, bright colored arrows indicate a clear peak and trough that can be detected looking only at the % change in real GDP, the first phase of the NBER method. Remember that a recession does not necessarily means negative growth in all quarters during the period.

Between the smaller, faded colored arrows, real GDP growth is pending from positive to negative. So, there is not a clear peak and trough according the first phase of the NBER method. Again, according the second phase of the NBER method, additionally the unemployment rate, industrial production volume growth and private final consumption are investigated. See appendix 5, for the figures of these three indicators during the period 2002/2003. In general, these additional indicators show a deterioration or negative forecast around 2002/2003 (an exact explanation is also given in the appendix), and therefore the smaller, faded colored arrows in figure 9 are regarded as peaks and troughs. The research to the development of apartment prices during economic downturns will be focused on the periods that range from the quarter after the peak till the trough, with the likely notice of a reaction lag (see §3.4.3).

According the latest GDP quarterly growth figures, the last two (most recent calculated) quarters of 2011 again show negative growth of real GDP for The Netherlands[28]. Therefore, the second quarter of 2011 can also be regarded as a peak, and from the 3rd quarter on the Netherlands are regarded to be in a recession period.

All in all, the three periods of recession for the Dutch economy in the period 1995-2011 are:

- 2002Q4-2003Q2
- 2008Q2-2009Q2
- 2011Q3-2011Q4

2. *Economic upturns in the Netherlands from 1995-2011:*

The stages of economic upturn are the stages of recovery and 'boom'. For this investigation, these both stages are seen as one. The reasons for this will explained further on in this paragraph, and now both these stages in the Dutch economy for the period 1995-2011 will be described.

The recovery periods are the first stage of the upturn phase and start in the quarter after the troughs, which can be seen in figure 10 below.

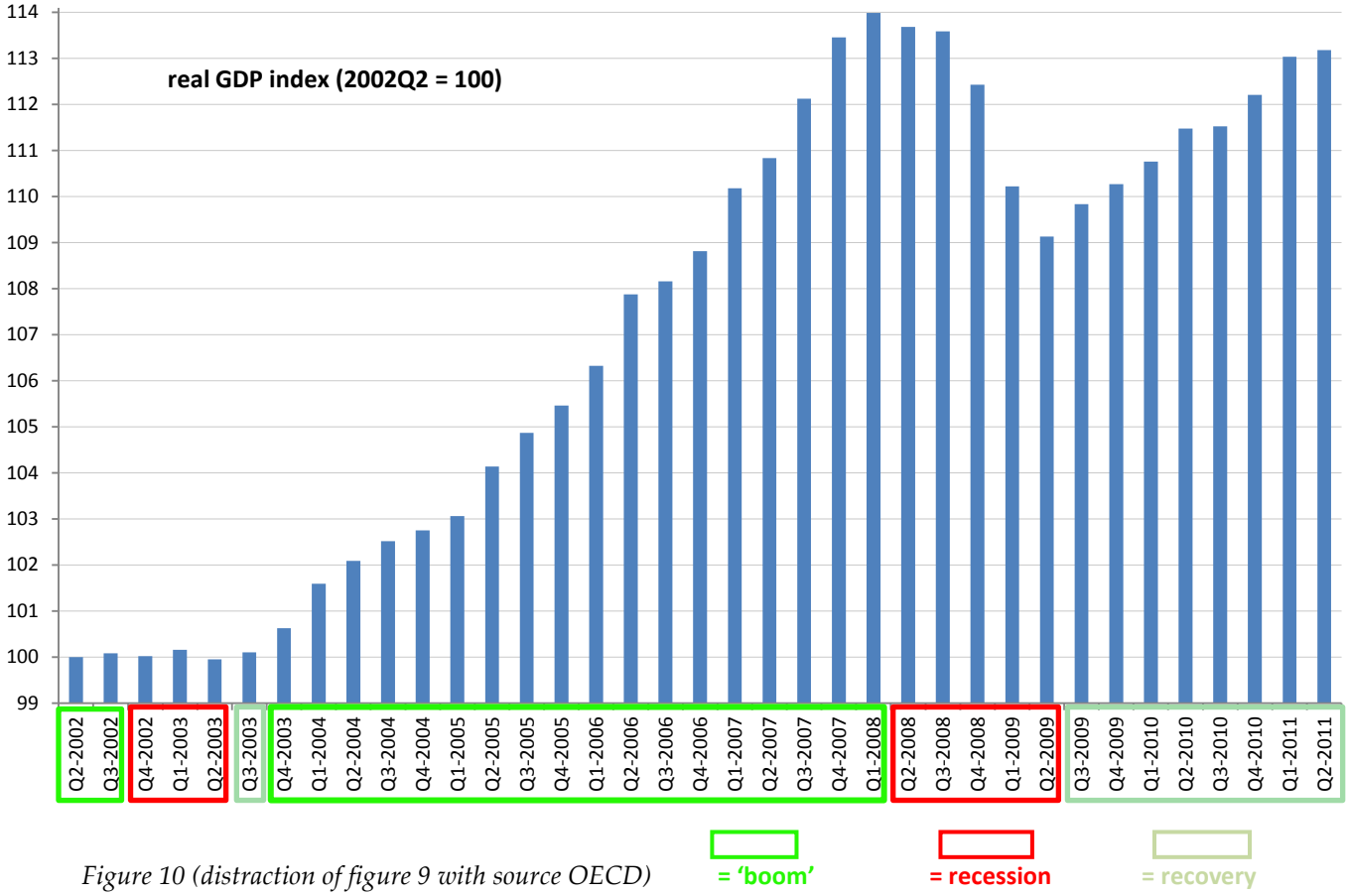


Figure 10 (distraction of figure 9 with source OECD)

Recoveries are the periods from a trough till the amount of real GDP of the previous is reached, or (in case of no 'boom' in the business cycle) till another recession begins. In figure 10, it is depicted if and

[28] Source: http://www.oecd-ilibrary.org/economics/quarterly-gross-domestic-product-change-over-previous-quarter_2074384x-table13

when former peaks in amount of real GDP are reached during the upturn phases in the period 2002-2011 for the Netherlands.

The first period of economic upswing in the period 1995-2011 was already in the booming stage in 1995, and lasted till the peak in Q3-2002. Then 3 months of recession follow, marked in red. The period of recovery lasted only one Quarter (2003Q3), marked in faded green. From then on the economy was in the stage of 'boom', which lasted till 2008Q1 (marked in bright green). The next 5 quarters of recession are followed by a period of recovery that lasted from 2009Q3 till 2011Q2 (again marked in faded green). For economic upturns, the faded and bright green marked periods have to be combined.

So, the three periods of upturn for the Dutch economy in the period 1995-2011 are:

- 1995Q1-2002Q3
- 2003Q3-2008Q1
- 2009Q3-2011Q2

The reasons to combine the 2 stages of the economic upturn are mainly because in this way, in theory 3 periods of general economic upturn can be investigated. The main goal of this thesis is to investigate differences in the development of apartment prices between neighborhoods of 'good' and 'bad' standing. While choosing investigating only or recoveries or 'booms', data of apartment prices of the period before 2002Q3 (when choosing for investigating recoveries) or the period after 2009Q2 (when choosing for investigating 'booms') would be useless. This would not be preferable for this research. Also, with the apartment price index that is developed, it would be impossible to investigate the recovery containing only one quarter in 2003Q3. This because of the too limited time frame of this recovery. While choosing only for investigating apartment price development during 'booms', price development after the trough would not be taken into account.

Therefore the choice is made for investigating the total upturn phase. In this way theoretically 3 periods can be investigated, and hopefully a general statement can be made about the apartment price development in neighborhoods of 'good' and 'bad' standing during an economic upturn.

3. *Full Business Cycle in the Netherlands from 1995-2011:*

The general development of apartment prices over time can, in my view, be investigated by measuring the price development over a full business cycle. While taking a full business cycle from peak to peak, for the period 1995-2011 for the Dutch economy, in theory 2 full business cycles can be investigated. This can be seen in the former figure 9.

The periods of these 2 full business cycles are:

- 2002Q3-2008Q1
- 2008Q1-2011Q2

The quarters to investigate for this thesis should fit and match the constructed indexes (see §4.7.4) as much as possible. Therefore, as can be seen in §4.7.2 and §4.8.8, not all quarters given in this paragraph can be used for investigation.

4.5) Areas and apartments of investigation

4.5.1) Pre-selection of ‘good’ and ‘bad’ standing Rotterdam neighborhoods

Two types of Rotterdam neighborhoods have to be investigated, and therefore a selection out of the various neighborhoods is made. For this thesis, a neighborhood is regarded to be a city area consisting of a 4 digit postal code, which is the most detailed scale available of indicating scores about status. Now, the steps of the selection process will be described.

The first part of the selection process had to do with distance from the city center. Neighborhoods that for their largest part lie more than 8,5 km remoted from the city center (the midpoint of the city triangle ‘Stadsdriehoek’, at the middle of the Coolsingel) are removed. This distance is chosen because then mostly industrialized area’s (with little inhabitants) fall out. Also, neighborhoods that are far from the city center can be presumed to be less connected to the city, and form a society of their own (like for example ‘Hoek of Holland’, which is a Rotterdam neighborhood located at the North Sea and has its own facilities). As can be seen in figure 11, it is visually a good balance for the city of Rotterdam.

Figure 11 (Source: Aalbers, 2003)

The next step was the removal of neighborhoods with less than 150 inhabitants. These are highly industrialized zones, with little housing. Most likely the number of repeated sales of houses in these neighborhoods will be too low for proper analyses. Also this number is chosen because these neighborhoods are at clear distance of the rest (with regard to the number of inhabitants), because the population of the first neighborhood closest to this group was more than 2,5 times as high.

After these steps, ‘good’ and ‘bad’ standing neighborhoods had to be selected from the remaining neighborhoods. Therefore, these neighborhoods are compared on various types of scores that indicate the level of social status (see §2.4.2 for these indicators). For Rotterdam, scores are available that are composed from several of these individual indicators. The databanks to use are from the COS (“Centrum voor Onderzoek en Statistiek”), and the SCP (“Social and Cultureel Planbureau”). To be able to cover the whole period of 1995-2011, the following scores for Rotterdam are available and are investigated: - Scores on social deprivation (source COS), - Status scores (source SCP), - Social Index (source COS), and – Safety Index (source COS). The outcome of these composed scores are given (for each type of score one

figure which is roughly representative for its whole released period) in figures 12 till 15. Note that for the 'Status scores', the higher the score the worse the status. See Appendix 6 for all figures of Scores on social deprivation/Status scores/Social Index/Safety Index.

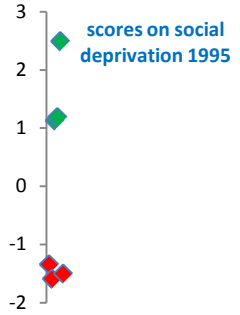


Figure 12

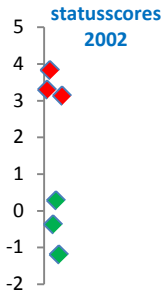


Figure 13

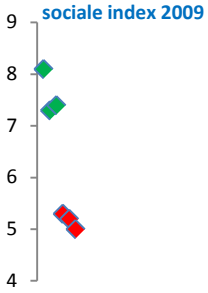


Figure 14

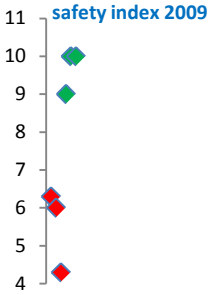


Figure 15

Three relatively constant good scoring neighborhoods over the whole period 1995-2011 are marked in green (with emphasis on 'relatively constant': other neighborhoods can perform better for a few periods, but are not constantly performing well over the whole investigated time. The reverse counts for relatively bad scoring neighborhoods), while three relatively constant bad scoring neighborhoods are marked in red. Even till 1980, the selected neighborhoods relatively remain of constant socio-economical status.

The 3 relatively constant good scoring neighborhoods over the period 1995-2011 are (4 digit postal codes included): 'Molenlaankwartier' (3055), 'Hillegersberg-N' (3054), and 'Blijdorp' (3039).

The 3 relatively constant bad scoring neighborhoods are: 'Hillesluis' (3074), 'Spangen' (3027), and 'Bospolder' (3025).

4.5.2) First impression, exclusion by apartment sales price versus actual value

Because a request for data at the DLRO can be at maximum up to 1500 dwellings, a selection in apartments had to be made. By looking at the two main Dutch websites for selling and buying housing[29], a first impression of the selected neighborhoods was obtained about apartment sales prices and actual value. Noticeably, especially in the neighborhood 'Spangen' relatively a lot of apartments are sold under special conditions. Such apartments are mostly formerly owned by a housing corporation (apartments until recently owned by housing corporations are useless for this research, because of its limited price history), and the special conditions are meant to persuade probable aspirant home buyers to buy the apartment. However, these special conditions put a negative bonus on the actual value of the apartment, which makes the price not representative. These apartments therefore are not suitable for this research. These practices are mostly done in 'bad standing' neighborhoods, but at first glance this problem was less present in the other two selected 'bad standing' neighborhoods. Because of the foregoing, 'Spangen' is not preferred for definite selection.

4.5.3) Types of apartments represented in selected areas and further exclusion

Data of the COS showed that, of the remaining neighborhoods, the absolute number of houses owned by dwellers or private investors was the lowest in 'Hillesluis' and 'Bospolder'. Therefore, these neighborhoods were used as starting point for looking at the types of apartment best represented. Apartments of older construction were preferred, because these apartments could be optimally traced back in time. A good starting point with regard to the year of construction appeared to be 1975.

[29] www.funda.nl and www.jaap.nl

Apartments with a year of construction before 1975 are relatively high available in the two remaining 'bad standing' neighborhoods. Apartments constructed after this year appeared to have characteristic features that are expressed in better energy labels and subsequent maximum rental prices, which also influences sales price. Therefore, apartments built before 1975 were preferred (then no disturbance in price will occur caused by energetic performance of the apartment while comparing apartments).

The apartment types best represented within this period of construction appeared to be apartments in the 'Middle Height' segment. They are mostly of the type with 6 or 8 apartments sharing one central street porch (Porch apartment), upper/downstairs apartment with both their own door to the street (Upper/downstairs apartment), and Maisonettes. All in all, these types of apartments from the same segment ('middle height') and construction epoch (before 1975) seem very suitable for comparison on price over time.

Therefore, for this thesis, apartments of the 'Middle-high' segment with construction year before 1975 are selected for investigation. The types selected are Maisonette, Porch apartment, and Upper-downstairs apartment.

After the neighborhoods of 'bad standing', the neighborhoods of 'good standing' are looked at. It appeared to be that in 'Molenlaankwartier', apartments in the preferred 'Middle Height' segment and the preferred construction period are available, but in only a biased way. Mostly porch apartments, however the upper/downstairs apartments and Maisonettes are very scarcely present. Therefore, 'Molenlaankwartier' is not preferred for definite selection.

4.5.4) Definite selected neighborhoods and representing streets

Because of the foregoing selection, four preselected neighborhoods remain. To be able to construct a thorough repeated sales index (with enough repeated sales per year), the decision is made to select one neighborhood per high and low socio-economical status.

As 'Hillesluis' is ranking worse than 'Bospolder' on every socio-economical score, 'Hillesluis' preferred to represent the neighborhoods of 'bad' standing.

On almost every socio-economical score (except the safety-index), 'Blijdorp' ranks better than 'Hillegersberg-N'. Also, the number of removals and relative percentage of houses in ownership by private owners is higher in 'Blijdorp'. This increases the chance of a good catch for repeated sales at the DLRO databank. Because of the foregoing, 'Blijdorp' is preferred to represent the neighborhoods of 'good' standing. In figure 16 below, both definite selected neighborhoods are depicted.

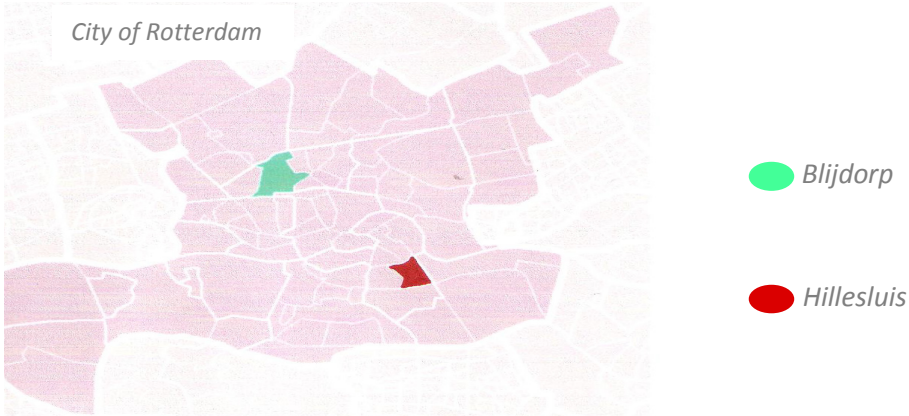


Figure 16 (source: Wikipedia)

The total number of apartments (in the 'Middle Height' segment, before 1975) in the definite selected neighborhoods 'Hillesluis' and 'Blijdorp' is altogether far over 1500, so a further reduction is required. Once again the 2 main websites for Dutch real estate[30] as also an auction site[31] are consulted to see in which streets it is relatively most likely to find apartments owned by dwellers or private investors. Streets with relatively a lot apartments for sale under special conditions are avoided. Such apartments mostly are previously rented by housing corporations (these apartments are not found in the DLRO data), and probably the housing corporation owns more apartment blocks in the same street. The streets where it is most likely to find apartments owned by dwellers or private investors are selected, and further investigated. Parts of these streets, sections with new apartments, have to be avoided. Beneath the former mentioned used main websites, also the function streetview of Google Maps is used (to see by eye). From the usable sections of the selected streets, the 6 digit postal code is looked upon[32]. The cadastral division of the house numbers is checked[33], and in this way the number of apartments of each 6 digit postal code is found. So, each 6 digit postal code has a certain number of porch and upper/downstairs apartments.

Such a combination of 6 digit postal codes per definite selected neighborhood is made, that data of about 650 apartments per neighborhood is presumed to be acquired from the DLRO. This to make sure to stay well below the total border of 1500 dwellings (otherwise the request for data will be rejected by the DLRO). Also, an equal distribution in these 650 apartments, between porch apartments, upper/downstairs apartments and maisonettes over the neighborhoods, is aimed at. A trial catch at the DLRO on some 6 digit postal codes, showed that the number of retrieved dwellings for 'Blijdorp' was 1 ⅓ times as high as for 'Hillesluis'. Therefore, the actual request at the DLRO contained more postal codes for 'Hillesluis'. This in order to try to keep a balance (in the number of apartments of the definite catch) between 'Hillesluis' and 'Blijdorp'. However, how many DLRO data per neighborhood would be useful could only be seen by exploring the obtained data from the DLRO, so only after the request to the DLRO had been made. Also, the selected 6 digit postal codes could still contain apartments owned by housing corporations, which would probably change the distribution of porch, upper/downstairs apartments and maisonettes over neighborhoods and also the number of apartments per neighborhood in the dataset. This cannot be foreseen.

4.6) Exploration of the acquired Dutch Land Registry Office data

The actual catch with regard to the number of apartments in the acquired data appeared to be 904 in total, 299 apartments for 'Hillesluis' and 605 apartments for 'Blijdorp. The acquired DLRO data (available on request) contains both usable and redundant information for constructing an apartment price index. Some figures need a closer look.

Redundant information are figures as the number of the notary act and the geographic coordinates. The size of the apartment is cannot be used, because it is set at the value of zero for all apartments. Lastly, the state of the purchaser of the apartment is of no use for this thesis. This is information whether the purchaser is a private person or a company. The state of the purchaser can be presumed not to influence the transaction price.

[30] www.funda.nl and www.jaap.nl
[31] www.notarishuis.com
[32] www.postcode.nl
[33] www.prijsvaneenhuis.nl

Useful information is the postal code (to classify the property into 'good' or 'bad' neighborhood), exact address, the date of the transaction and the transaction price. Information about whether there is more property involved in the transaction is useful since it gives an indication if the total property package sold has probably changed. When for example a garage is included in the first sale, while in the second sales it is not, this has naturally consequences for the price. Also useful is the information about whether or not the apartment is rented. A change in this status will influence the transaction price. In case no indication about the rental state for an apartment in a certain year is given, for this thesis it is assumed that the rental state between two transactions has not changed.

The land registry number of the apartment is useful to double check if it is actually the same apartment during the repeated sales, or that something has changed (for example a splitting up a large apartment into two apartments). The so called 'culture code' and 'culture text' are related to the also given information about the type of dwelling. This information is only used to check if it is absolutely apartments that are used for this investigation.

Figures that are looked closer, are the 'impediments' and 'objective right'. The objective right gives information about the rights involved in the transaction. This can be, next to the right on the apartment itself, for example the right of the long lease of the ground on which the building is located. The impediments give information about the restrictions involved in the apartment, for example whether a property is classified as a monument. Changes in the objective right or impediments may influence the apartment price, and therefore both figures are useful in the preparatory stage of constructing the indexes. For the list of impediments belonging and objective rights that are present in the data, see appendix 7 (in Dutch).

For the actual construction of the apartment price index, only information about the transaction date and the apartment transaction price can be used from the acquired DLRO data. More about the actual construction and the index chosen for this thesis can be read in §4.7.3.
The former of this paragraph is of interest for the construction of the apartment price index. Also, in §4.8.3, a counting table is constructed. This table is used only for investigating the suspicious periods of redlining for Rotterdam. For this table, only the number of sales per period are of interest.

4.7) Method of constructing the neighborhood apartment price indexes

4.7.1) Excluding transactions for apartment price indexes

As this thesis is investigating apartments, stray properties of another type will be removed from the acquired dataset. Further all changes that influence the apartment price should be filtered out. For transactions where the total package of the property changes, only the deviating transaction will be removed and not the apartment itself. Whenever possible two separate sequences of the apartment will be made, one with the former characteristics and one with the later characteristics. In this way, the same package is compared to each other while the dataset is kept as large as possible. For changes in the rental position of the apartments, only the deviating transactions during the repeated sales sequence are removed or used for a separate sequence. The same counts for possible splitting up or merging of apartments, a change in the objective rights, and a change in the impediments. Each time, the deviating transaction in the sequence per apartment is removed. In case only 2 transactions are involved in a certain apartment and these transactions have changes in one of the former things, this apartment will be removed from the dataset.

Further, like Wal (2008) and Visser and Van Dam (2006), transaction prices of less than 10.000 euro are removed. This for eliminating the biggest downward outliers. Transactions of over 4.000.000 euro (the upper range border mentioned by Visser and Van Dam, 2006) are not present in the acquired dataset from the DLRO.

In case an apartment is sold 2 times in one year, the first transaction is considered to be the final transaction of a former sequence. The reason is that there is a high chance that the transaction price of the second transaction is extra boosted caused by a renovation (the first purchaser has bought the apartment for making quick profit with renovating and reselling the apartment). The second transaction of the year in question is regarded to be the first in a new series of transactions. When there is no former sequence of transactions (so, before the year in question), the first transaction is removed, while when there is no later sequence of transactions (so, after the year in question), the second transaction is removed. In case there are only two transactions of an apartment in one year, the apartment is removed.

Transactions with an average price increase of 80% per year are removed for the same reasoning of changes in housing quality, which is also done by Mahieu and Van Bussel (1996) for example. Then, transactions of apartments sold more than one time per day are removed, the same as transactions with an average price decrease of more than 80% per year. This because in my view, in such cases there is a high chance of fraudulent acting[34] or of non arms length transactions (between friends or family etc.). The upward boundary for filtering out such transactions is already caught by the excluding average price increases of over 80% per year, and the downward boundary is for this thesis set at the same percentage on the negative side.

With the remaining apartments, after cleansing the original acquired dataset in the former way, the two neighborhood apartment price indexes are constructed. All in all, for 'Hillesluis' 97 apartments could be used for constructing a weighted repeated sales index (so, were at least sold twice), for 'Blijdorp' 324. The apartments used for 'Hillesluis' were involved in 224 actual usable transactions, for 'Blijdorp' the number is 813 (dataset available on request).

4.7.2) Aligning apartment price indexes to periods of up/downturn and redlining

The constructed apartment price indexes will be yearly indexes, because a more detailed index (for example quarterly or half yearly) with the used dataset would be too thin. All in all, the aim of aligning the apartment price indexes that are developed to the real GDP sequence, is that the turning points in real GDP and the suspicious periods of redlining both together should fit as best as possible to apartment price index portions of one year. The division of the real GDP sequence into portions of one year, while using the turning points as guidance, will first be discussed.

1. *Aligning apartment price index to periods of up/downturn:*

There is little found in literature about the reaction time with regard to apartment prices and GDP. Scientist that give a somewhat exact reaction period state apartment prices to lead GDP. However, Pol (2009) has investigated housing prices in the Netherlands and states housing prices to lag GDP. Unfortunately, he gives no reaction time in his work.

[34] Source: http://www.novatv.nl/page/detail/uitzendingen/6582/Justitie+gaat+frauderende+taxateurs+aanpakken

Because Pol (2009) investigated the Netherlands, while others who gave a quite exact reaction period investigated other countries, the work of Pol is used as base for the reasoning of this investigation. So, a reaction period of apartment prices that is lagged to GDP is expected for the used dataset.

Since no lagging period is given by Pol, for this thesis is chosen to start the periods of the constructed indexes most as possible around the turning points in the Real GDP sequence. In combination, they should also about fit as most as possible the periods suspicious of redlining. The actual constructed indexes will be viewed to see whether a reaction time is present in the used dataset (see §4.7.6).

The periods of up and downturn for the Netherlands are again given in figure 16 below.

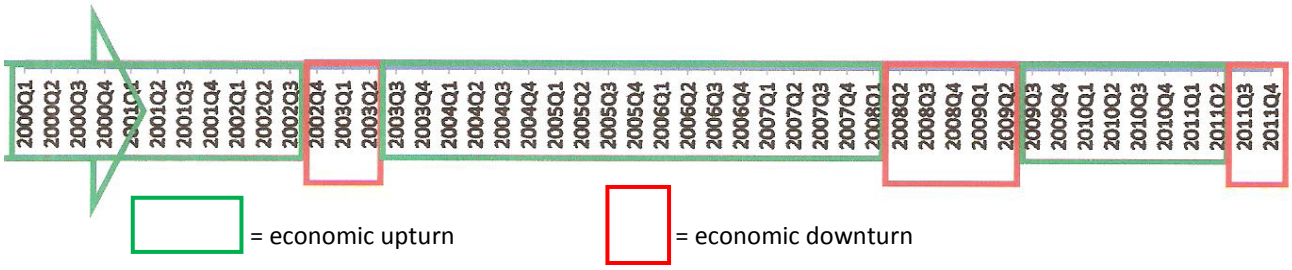


Figure 16: periods of Dutch economic up- and downturn

For aligning a yearly apartment price index to the Dutch economic up- and downturns, the third quarter of the year is the best starting point for the index periods. This because the changes from economic up- to downturns and vice versa mostly happen between the 2nd and 3rd quarter of the whole years. The only two points of dissonance are the transition point at 2002Q3/2002Q4 and 2008Q1/2008Q2.

With regard to the transition point at 2002Q3/2002Q4, the choice is made to classify 2002Q3 among the recession period of 2002Q4-2003Q2. In this way, for the index the recession period of 2002Q3-2003Q2 can be included in the investigation (and is totally regarded as a period of recession), and then in total two full recession periods and one ongoing recession period can be investigated. Otherwise, one full recession period would be lost for investigation. In my view, The reasons that it is defendable to include 2002Q3 in the recession period are the following: the quarter 2002Q3 just shows very little growth in real GDP (as can be seen in figure 10 of §4.4) and is outnumbered by the 3 subsequent quarters of the recession period. So for this investigation, the whole period from 1995 till 2002Q2 is regarded as an economic upturn.

For the transition point 2008Q1/2008Q2, a similar solution is chosen. In my view, classifying 2008Q2 among the former period of upturn (2007Q3/2007Q4/2008Q1) is a defendable choice. This because in 2008Q2, though the growth of real GDP was negative, it was not quite severe (see §4.4, figure 10). Therefore, the choice made for this thesis is to classify the period 2008Q2 among the period of economic upturn of 2007Q3-2008Q1. Therefore, the total period of 2007Q3-2008Q2 is seen as a period of economic upturn.

2. Aligning apartment price index to periods suspicious of redlining:

Then the aligning of the apartment price index to construct to the suspicious period of redlining, which are depicted in figure 17 on the following page.

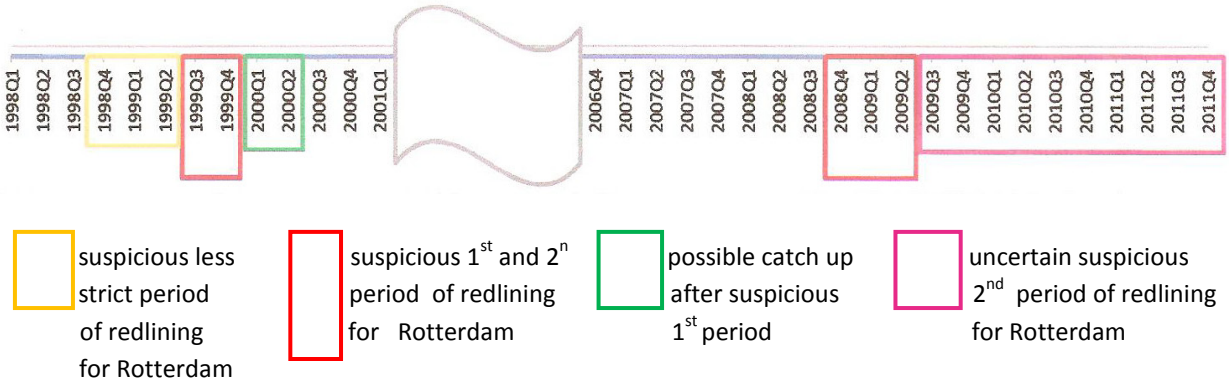


Figure 17: suspicious periods of redlining for Rotterdam

It is assumed that implementing redlining has immediate effect, which also counts for the abolishment of redlining. So, a probable lag does not have to be taken into account.

The 1st suspicious period of redlining seems difficult to investigate on a yearly apartment price index. A yearly index that begins in the third quarter of each year will combine the suspicious period (199Q3+1999Q4) with the probable catch up period, (2000Q1+2000Q2) which will most likely neutralize the effects. A yearly index that begins in the first quarter combines a suspicious less strict period of redlining (1999Q1+1999Q2) with a suspicious strict one (1999Q3+1999Q4), while missing a part of the less strict period of redlining (1998Q4) and is an outlier in the rest of the former outcomes of best alignment (for economic up/downturns and the second suspicious period of redlining). So, the first suspicious period cannot be investigated using a yearly apartment price index, no matter the alignment.

For the 2nd suspicious period, beginning of the yearly apartment price indexes in the third quarter of each year is a reasonable fit. This suspicious period starts in 2008Q4 and ends in 2009Q2, so the end will match with a yearly index that starts in the 3rd quarter. The beginning of this suspicious period does not match, but as with the economic up- and downturns, it seems best to classify 2008Q3 among the 2nd suspicious period of redlining.

3. Overall conclusion according alignment:

In my view, the overall conclusion with regard to the alignment of the apartment price indexes to the periods of economic up/downturn and suspicious periods of redlining, it is best to divide the yearly apartment price index in periods that start in the third quarter of each year.

4.7.3) Price Index chosen for this research

The acquired DLRO data contains little information about the specific characteristics of each individual apartment. In this situation, the weighted repeat sales index and the SPAR index are the best applicable. For constructing a SPAR index, the appraisals of each individual apartment from the dataset are needed. For the Netherlands, the accuracy of these appraisals can be doubted for the investigated period. Till 2009, definite appraisals are only available for the year 1999, 2003, 2007, and 2009 (Wal, 2008). Only since then, appraisals are available for each year and will be accurate. Non accurate appraisals will be useless for constructing a proper index, and therefore the for this research constructed indexes for each neighborhood are Weighted Repeated Sales Indexes. Such Indexes are highly reliable, and are also used

for recognized house price indexes (as for example by Standard and Poor's, the Official of Federal Housing Entreprise Oversight –OFHEO-, and until recently in the Netherlands by the DLRO).

4.7.4) Method elaborated and actual apartment price index construction

In this paragraph, the successive steps of constructing the apartment price indexes for the two contrasting neighborhoods will be handled. The SPSS (version 20) software program is used for this, together with the book of Field (2005). Also the Statistical books of Moore et al. (2003) and Aczel (2002) are consulted.

The constructed apartment price indexes are yearly indexes. The used transaction prices of apartments are acquired from the DLRO databank. Apartments that not fulfill the prescribed standards, see §4.6.2, are removed from the dataset. Information that is not given at a certain transaction (for example if the apartment is rented or not), is presumed not to have changed during the transactions. An important note is that the data of the DLRO lag actual sales with approximately one quarter. This deficiency is tackled by classifying the data from the DLRO of a certain point in time one quarter earlier.

Because the development of apartment prices is compared to real GDP, the nominal apartment prices are corrected for inflation. For this purpose, monthly inflation figures of the CBS[35] (see appendix 8) are used and the amount is averaged over the yearly periods that are used for the indexes. This method is necessary since the beginning of a yearly period in the constructed apartment price indexes starts in the third quarter of an actual year. Then, the natural logarithms of the real apartment transaction prices are used, like in Bailey et al. (1963) and Case and Shiller (1987) for example.

In basis, the three step WRS method of Case and Shiller (1987) is followed. Case and Shiller argued that the variance in house price appreciation is influenced by the holding period between the repeated sales, this because prices of dwellings have the tendency to increase over time and increasing differences in the maintenance over time of individual houses by their owners.

For this research, the choice is made to use the modified WRS version of Abraham and Schauman (1991). Their modification is about the relationship of the variance of house prices and the holding period between the sales. This modified version is also used for example by Calhoun (1996) for the OFHEO index and by Jansen et al. (2007) for the Woningwaarde Index Kadaster for the Netherlands. In the work of Calhoun (1996) and Jansen (2007) this thesis modified WRS version is clearly explained, and mainly their reasoning is followed for this research.

Further, for this thesis the equal weighted version of the Weighted Repeated Sales index is used (so only the time span between two repeated sale transactions is taken into account, not the price level of each individual apartment). This is because just the average growth rate of one neighborhood per index is investigated, and each index is not a portfolio of different neighborhoods/geographical areas. For this purpose, reasoned from the work of Bourassa (2005), the equal weighted version is best suited (see §3.3). For constructing the weighted repeated sales index according the modified method of Abraham and Schaumann (1991), the following three steps have to be made:

[35] Source: http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=70936NED&D1=0&D2=0-11,13-24,26-37,39-50,52-63,65-76,78-89,91-102,104-115,117-128,130-141,143-154,156-167,169-180,182-193,195-206,208-219,221-232,234-245,247-258,260-271,273-284,286-297,299-310,312-323,325-336,338-349,351-362,364-375,377-388,390-401,403-414,416-427,429-440,442-453,455-466,468-479,481-492,494-505,507-518,520-531,533-544,546-557,559-570,572-583,585-596,598-641&HDR=T&STB=G1&VW=T

• 1) performing the procedure of Bailey et al. (1963), and calculate a vector of regression residuals.
• 2) performing a regression analysis on the squared residuals of the first step (they become the dependent variable) on the left side and the holding period, the holding period squared and a constant term on the right side of the equation (Jansen et al. 2007).
• 3) again performing the regression proposed by Bailey et al. (1963), however this time with weights extracted from the former second step.

These steps will be thoroughly explained below.

1. *The first step*

This step is running the regression proposed by Bailey et al.(1963). This standard repeated sales model has the following form (source Calhoun, 1996):

$$\Delta V_i = \ln(P_{it}) - \ln(P_{is}) = \sum_{t=0}^{T} \beta_t D_{it} + \varepsilon_i$$

In the model above, i means each sales pair (so the sell and the next following resell of an individual apartment) used in the dataset for a neighborhood. The sample period is t = 0,…, T. The initial sales of an apartment is in period s, the period of resell is t ($0 \leq s < t \leq T$). The prices P are real transaction prices, because the dataset is corrected for inflation. Further, ε_i is the random error term, and D_{it} (with t = 0,…,T) is a time dummy variable with value 1 in the period of the resale and -1 in the period of the previous sale of each sales pair. There is no time dummy for the first period, "if the first sale was in the first period there is no dummy variable corresponding to the first sale" (Case and Shiller, 1987, p.13). Then, lastly, β_t is the regression coefficient at time t.

For this research, this section is implemented as follows:
Firstly, a matrix X of dummy variables is made. This matrix has N rows and T-1 columns. N is the number of sales pairs, in the sense of two subsequent transactions per row. In case an apartment had more transactions during the investigated period, this was divided in multiple sales pairs and spread over multiple rows. For Hillesluis, the number of sales pairs is 127, for Blijdorp 469. Columns that not contain a transaction on a row (so, the periods in which no transaction occurred for a certain apartment) are set at zero. So for Hillesluis, matrix X has 127 rows, for Blijdorp 469 rows. The matrix X has T -1 columns, T is the number of periods for which data is available. These columns are time dummy variables in the regression (Ordinary Least Square multiple regression), and a time dummy is used for all periods except the first period. For this research, data of the DLRO is available from 1st January 1995 till the first quarter of 2012. Taking into account the lag of the actual sales in comparison to the DLRO data, the time span of actual sales ranges from 1994Q4-2011Q4. Dividing this time span into pieces of 1 year, each year beginning at the 3rd quarter of a year, makes T = 18 (note that the first and last period do not contain a whole year). Therefore, for matrix X, the number of columns is 17 for both neighborhoods (labeled DummyPeriod1,…, DummyPeriod17 in SPSS).

Secondly, an N-row vector of dependent variables is made. This vector is called Y, and on each row it contains the ln price of the second sale of the transactions in a sales pair minus the ln price of the previous first sale (labeled lnp2minlnp1 in SPSS).

Then in SPSS a multiple regression is made. For getting per sales pair the standard error of mean predictions and the residuals, these options have to be selected in SPSS (under the button 'save') while performing the regression. The in this way obtained unstandardized residuals (labeled RES_1) are the ones needed for the following second step. See appendix 9 for the SPSS outcomes.

It should be noted that heteroskedasticity seems to be slightly present in the standard errors of the former regression (with regard to the holding period) for Hillesluis, see appendix 10. Therefore in my view, the weighted version of the repeated sales index is confirmed to be the right choice. Another thing is that this version is never stated to be worse performing than the original repeated sales index of Bailey et al. (1963), always at minimum equal or better. Therefore, this thesis will be continued with the second step

2. *The second step*

This step is running the regression (Ordinary Least Squares) as is proposed by Abraham and Schauman (1991). For the variance of the error term (which refers to the holding period, the time between the repeated sales pair), they proposed the following model (source Calhoun, 1996):

$$E[d_i^2] = A(t - s) + B(t - s)^2 + 2C$$

In the model above, d_i^2 are the squared residuals from the regression of the first step, 2C is a constant term that gives an indication of twice the house-specific random error, A is an estimate of the increase in variance for each additional period (in this research, one period is one year), and B is an estimate of the increase in variance for each additional period squared.
So three row vectors are used: the squared residuals are calculated from the unstandardized residuals of the first step (RES_1 multiplied by RES_1), (t - s) is the holding period within each sales pair, and $(t - s)^2$ is the square of the former value. As already said, 2C is a constant that is included in the regression (select the option 'include constant in equation' under the button 'Options')
For performing the regression, the regressand for the second step are the squared residuals of each sales pair from the first step regression. A constant term is included in the second step regression. (Jansen et al. 2007). The unstandardized predicted values are saved (select the option 'unstandardized predicted values' under the button 'Save'), and these predicted values (labeled RES_1 in SPSS) are needed for the third step. See appendix 9 for the SPSS outcomes.

3. the third step

Here, a weighted least squares regression analysis (Generalized Least Squares Regression) is made. For constructing the weights for this regression, the square roots from the predicted values (of each sales pair) of the former step are taken, and their reciprocals are used as weights. Then, the form of the model will be as follows (Calhoun, 1996):

$$\frac{\Delta V_i}{\sqrt{\hat{d}_i^2}} = \sum_{t=0}^{T} \beta_t \frac{D_{it}}{\sqrt{\hat{d}_i^2}} + \frac{\varepsilon_i}{\sqrt{\hat{d}_i^2}}$$

In the model above, $\hat{d}_i^2$ means the predicted values of d_i^2. As can be seen, this is the model of the first step, modified by means of multiplying each variable with the reciprocal of the square roots of the predicted values computed in the second step.

This third section is implemented as follows:
In SPSS, the X-matrix and the N-row vector Y from the first step are used again for performing this regression. This time, a Weighted Least Squares Regression (Generalized Least Square Regression) is made. In SPSS, the option 'Analyze' is chosen in the toolbar, then 'Regression', and then 'Linear'. This is the same procedure as during the first step. However, for this step, insert the weight variable (labeled PRE_1squarerootreciprocal in SPSS) at 'WLS Weight'. The outcome of the Weighted Least Squares Regression for each neighborhood can be seen in Appendix 11. The 17 coefficients of the third step dummy periods are exponentiated, in order to get the proper indexes for both neighborhoods. The base period (value of 100) of the indexes is 1994Q4-1995Q2.

The in the former manner calculated indexes of both neighborhoods can be seen in §5.3 figure 18, where it is used for further analysis. The absolute exact numbers of the constructed indexes are given in appendix 13.

4.7.5) Reliability of the constructed indexes

Calhoun (1996) mentions that at least 10 sales per period are needed to construct a reliable index. He uses large databases of a minimum of 1000 houses sold in a certain region. However, the regions (for this thesis: neighborhoods) and therefore the databases used for constructing the apartment price indexes (left after filtering out the impropriate transactions) are much smaller. For Hillesluis the database consists of 97 apartments involved with repeated sales, for Blijdorp 324. For Blijdorp, 10 sales per period is mostly not a problem, only period 2011Q3+2011 gives just 6 sales. For Hillesluis, the reliability of the constructed index is more at stake. Till 2009Q2, the number of sales per period is mostly above 10 (exceptions are 1997Q3-1998Q2 and 2002Q3-2003Q2 with 7 sales). However for 2009Q3-2010Q2 the number of sales is 3, while only 1 apartment is available in the dataset for 2011Q3+2011Q4. In my view, 7 sales per period is sufficient for Hillesluis for constructing a reliable index given the available usable total number of apartments involved with the repeated sales.

Therefore for this thesis, till 2009Q2 the constructed index for Hillesluis is supposed to be reliable, while from 2009Q3 on it cannot be used for investigation. This is also supported by the large deflection of this index from 2009Q3 on. So this limits the time span for comparing both neighborhoods, and the investigation therefore contains the period 1995Q3-2009Q2.

4.7.6) Leading or lagging period and the used dataset

For a probable leading or lagging role of apartment prices with regard to GDP, the constructed apartment price indexes (see figure 18 in §5.3) are visually inspected.

In both indexes, the apartment prices seem to have a lagging role of 1 year with regard to GDP both for the period of economic upturn till 2002Q3 and the period of downturn of 2002Q4 till 2003Q2. Also the beginning of the following upturn (from 2003Q3 on) seems to support the lagging role of apartment prices. However, the ending of this period is somewhat troublesome. For 'Blijdorp' the lagging role seems to be present, but for 'Hillesluis' there seems to be no lag at all (in 2008Q3-2009Q2 already a minus in apartment price development). But the true reasons for the absence of a lag can lie in the

possible practice of redlining by banks, which could be the cause for this minus in price development. This possible redlining influencing problem continues for the index for 'Hillesluis' till the end of the investigated period. For 'Blijdorp' the lag of apartment prices seem roughly to hold for the following periods.

The choice is made not to make a correlation coefficient table (of Real GDP and the constructed indexes lead/lagged/matching in time), as the economic circumstances are mostly in an upswing phase during the investigated period. However, the interest for this thesis is on these points in time where signs (of Real GDP and the constructed indexes) change from positive to negative and vice versa. This won't be the outcome of a correlation coefficient.

Overseeing the forgoing, in my view it is justified to follow PoI (2009) with his the statement of a lagged role of apartment prices with regard to GDP. For this thesis, in my view it is appropriate to take a lag of 1 year into account while formulating the hypotheses in §4.9.

4.8) Method of constructing counting table of number of transactions

4.8.1) Requirements for excluding transactions for counting table

For the construction of this table, most of the acquired DLRO data can be used. There is no restriction to the use of only repeated sales and also changes in quality or rental state etc do not matter. So, all transactions can be used, except these transactions with the scent of fraudulent acting or being of non-arms length. These are transactions of apartments sold twice or more the same day. The boundary of a yearly 80% price deviation is chosen not to use for the counting table, since this is also a control for quality (which is irrelevant for the counting table). Therefore, only these transactions that are related to the sale of twice or more per day of the same apartment are excluded from the counting table.

4.8.2) Aligning counting table to suspicious periods of redlining

The counting table is constructed in order detect notable dips for 'Hillesluis' during the suspicious periods of redlining that do not occur for 'Blijdorp'.

For the first suspicious period of redlining (1999Q3-1999Q4), the counting table the only usable method for investigation while for the second suspicious period (2008Q4-2009Q2) it operates next to the constructed apartment price index. A counting table constructed on a lower level than a half year (per quarter) would provide very low numbers for some quarters for Hillesluis (for example 2002Q4 has only 1 transaction). Therefore, in my view, it is best to use a minimum scale of a half a year or more. Then, the minimum number of transactions is 5 (for 2002Q3+2002Q4).

For aligning the yearly apartment price indexes to the 2nd suspicious period of redlining, it is seen that it is best to classify 2008Q3 among the 2nd suspicious period. Here, for the counting table of number of transactions, the same holds. In this way the two suspicious periods will be as follows: 1999Q3+1999Q4 (1st suspicious period) and 2008Q3+2008Q4+2009Q1+2009Q2 (2nd suspicious period).

Altogether, these two suspicious periods will align best to a counting table that is made on a half yearly basis, the first two quarters of each certain year combined, as well as the last two quarters.

4.8.3) Actual construction of counting table

For constructing the counting table, firstly the number of transactions are counted and combined per half year for each neighborhood. A total number of 441 apartments for Hillesluis and 1176 for Blijdorp are used for the counting table (dataset available on request). The absolute number of transactions each period are divided by the total number of apartments used for the counting table, to obtain the 'turnover ratio's on total population in %' for each neighborhood. Also the relative changes per period are calculated ('% change in turnover ratio on previous period'). Per period, the ratio on total population of Hillesluis is divided by the ration on total population of Blijdorp, and then the relative with respect to previous period is calculated (' Hillesluis turnover ratio/Blijdorp turnover ratio, change on previous period in %'). In §5.4.2, former numbers are visualized in figure 20 till 22. In this paragraph, these figures are used for visual analyses over time within each neighborhood and across the two neighborhoods. The actual constructed counting table can be seen in appendix 18.

4.8.4) Suspicious and uncertain suspicious periods of redlining and used dataset

About the exactness of the first suspicious period of redlining for Rotterdam, 1999Q3+1999Q4, there is none uncertainty. The second suspicious period is certain for the period 2008Q4-2009Q2, which is set at 2008Q3-2009Q2 for this research for reasons of alignment with the indexes/counting tables.

After this second suspicious period, there is uncertainty about the further continuation. The period 2009Q3-2011Q4 can be either a continuance of the 2nd suspicious period or a catch up phase because the foregoing 2nd suspicious period of redlining has ended. Also a visual inspection of figures 20 till 22 in §5.4.2 gives no clear outcome. Because of these contra dictionary possible outcomes, the uncertain period from 2009Q3 will not be taken into account while formulating the hypothesis in §4.9.

4.9) Hypotheses for practical sub research questions involving the price indexes

For this thesis overall, by development of apartment prices is meant the relative growth to the previous period taken as comparison. The especially for this thesis constructed yearly apartment price index of each neighborhood (with base period 1994Q4-1995Q2) is used as base for investigation. The Practical Sub research Questions are related to economic circumstances or suspicious of redlining. In this paragraph, the practical Sub Research Questions regarding economic circumstances are handled.

1. Firstly, the seventh Sub Research Question –*In general, do apartment prices in 'good' and 'bad standing' neighborhoods develop the same?*- is handled.

As there is contradicting evidence about differences in general apartment price development over time across neighborhoods of 'good' and 'bad standing'. The starting point for this hypotheses is that the general apartment price development over time across neighborhoods of 'good' and 'bad standing' is the same. The hypothesis regarding the seventh Sub Research Question is:

(H1): In general, the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad standing'.

Additional to H1:

- Neighborhoods of 'good standing' are operationalized by the Rotterdam neighborhood 'Blijdorp, neighborhoods of 'bad standing' are operationalized by 'Hillesluis'. Both neighborhoods have a stable social status for 1995-2011, even since 1980.
- Apartment prices are represented by the especially for this thesis constructed weighted repeated sales indexes, one for each neighborhood. This index is yearly based, and because of alignment matters, the time periods range from 1995Q3-1996Q2, 1996Q3-1997Q2, etc.
- The relative growth of apartment prices is operationalized by comparing the level of the apartment price index of each neighborhood of a certain year, with the level of the apartment price index of the same neighborhood of the other year of interest. The relative growth figures are calculated, and the growth can be both positive as negative.
- The term 'in general' is operationalized by investigating the longest representative period possible from 1995-2011. With representative is meant that the periods of measurement (the starting and ending point of the investigated period) should not suffer from shortcomings. The shortcoming involved in this matter is the suspicious of redlining. The longest period from 1995-2011 in which the starting nor ending points are influenced by probable redlining practices, is 1995-2008Q2. Investigating also the development over a full business cycle is considered, however there appeared to the some serious drawbacks. These have to do with the inability of aligning the apartment price index to the exact 2 full business cycles (2002Q3-2008Q1 and 2008Q1-2011Q2) in the period 1995-2011. Another thing about the last full business cycle is that it cannot be investigated in a proper way, since it possibly is influenced by redlining at the measure point of ending of this business cycle.

Because of the aligning of the apartment price indexes to the general economic circumstances and suspicious periods of redlining, the research starts in 1995Q3. All in all, the time period investigated for hypothesis H1 is: 1995Q3-2008Q2. The two periods of measurement from the apartment price indexes for 'Hillesluis' and 'Blijdorp' are the base period 1994Q4-1995Q2 and 2007Q3-2008Q2.

2. Secondly, the eighth Sub Research Question –*Is the development of apartment prices in 'good' and 'bad standing' neighborhoods the same during recessions?*- is discussed.

As there is no consensus in literature about differences in development during recessions of apartment prices between neighborhoods of 'good' and 'bad standing', for this thesis the development during recessions is supposed to be the same across the investigated neighborhoods.
The hypothesis regarding the eight Sub Research Question is:

(H2): During a recession, the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad standing'.

Additional to H2:

- For the operationalization of the relative growth, apartment prices, neighborhoods of 'good standing, and neighborhoods of 'bad standing' see the part additional to H1.

- With regard to the operationalization of a recession, for this thesis apartment prices are assumed to lag real GDP with 1 year. During the period 1995-2011, there are 2 completed periods of recession in the Netherlands. The actual first one is extended for this thesis (with one

quarter in advance of the actual occurring recession period) because of the alignment with the constructed apartment price index (see §4.7.2), and therefore lasts from 2002Q3-2003Q2 for the investigation of this Research Question. The second investigated recession period is missing the first quarter of the actual occurring recession, again for reasons of aligning the index. So the investigated periods in real GDP, are for this thesis ranged at 2002Q3-2003Q2 and 2008Q3-2009Q2. Because a lagging time of 1 year of apartment prices to real GDP is assumed, the periods of interest of the apartment price indexes theoretically are 2003Q3-2004Q2 and 2009Q3-2010Q2. However the last of the former periods lies fully in a period of uncertainty about suspicious of redlining, and therefore probably gives no representative outcome at the measuring points. Also, after 2009Q2, the constructed apartment price indexes cannot be supposed to be reliable. Therefore, this period is excluded for investigation with regard to Hypothesis H2 and the period investigated is 2003Q3-2004Q2. The previous period, 2002Q3-2003Q2, is used as comparison, for determining the relative growth.

So, The two periods of measurement from the apartment price indexes for 'Hillesluis' and 'Blijdorp' are 2002Q3-2003Q2 and 2003Q3-2004Q2.

3. Then thirdly discussed is the ninth Sub Research Question –*Is the development of apartment prices in 'good' and 'bad standing' neighborhoods the same during economic upturns?*-.

About differences in developments during recessions of apartment prices between neighborhoods of 'good' and 'bad standing', no consensus is found in existing literature. Therefore, for this thesis the development during recessions is supposed to be the same across the investigated neighborhoods. The hypothesis regarding the ninth Sub Research Question is:

(H3): During an economic upturn, the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad standing'.

Additional to H3:

- As before, see the part additional to H1 for the operationalization of the relative growth, apartment prices, and 'good and 'bad standing' neighborhoods.
- With regard to the operationalization of an economic upturn, during the period 1995-2011, there are 3 periods of economic upturn in the Netherlands: 1995Q1-2002Q3, 2003Q3-2008Q1, and 2009Q3-2011Q2. The last two periods are complete periods (starting right after the trough), the first upturn period was already ongoing in 1995Q1. So, the periods of interest theoretically are 1995Q1-2002Q3, 2003Q3-2008Q1 and 2009Q3-2011Q2. The last period is suspicious of redlining, which is an argument for not using this period for investigation. Also, from 2009Q3 on, the constructed apartment price indexes cannot supposed to be reliable. Again for reasons of aligning the index, the first period 1995Q1-2002Q3 will range from 1995Q3-2002Q2.
  The second period is supposed to be from 2003Q3 till 2008Q2 for this thesis, also for reasons of alignment.
  Because of the lag of 1 year of apartment prices to real GDP, both periods have to be adapted for investigation. However, for the second period the lag of 1 year will make this period end in 2009Q2. Then the ending and measure point is in a period suspicious of redlining (suspicious period of redlining starts in 2008Q3 for this thesis). Therefore, the ending measure point of the second period will be 2008Q2 for this research.

So, the periods investigated for Hypothesis H3 are both 1995Q3-2003Q2 as 2004Q3-2008Q2. The points of measurement are the base period 1994Q4-1995Q2, 2002Q3-2003Q2, 2003Q3-2004Q2 and 2007Q3-2008Q2.

4.10) Handling practical sub research questions about suspicious of redlining

For collecting evidence from different angles with regard to the suspicious periods of redlining, two Sub Research Questions should be answered. One question concerning the number of transactions, and one about the apartment prices. For this thesis it is assumed that redlining has an immediate negative impact on the number of transactions and apartment prices. So, without a lag.

1. Here, the tenth Sub Research Question - *is redlining a plausible cause for possible differences in development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad standing' while looking at the apartment prices?*- is discussed.

The hypothesis concerning the apartment prices during the suspicious periods of redlining is:

(H4): During periods suspicious of redlining, the relative growth in the number of apartment prices in 'bad standing' neighborhoods is less positive or stronger negative than in 'good standing' Neighborhoods.

Additional to H4:

- As before, see the additional part of H1 for the operationalization of 'good' and 'bad standing' neighborhoods. In this part, also the operationalization of the apartment prices and the relative growth of these apartment prices is given.
- Aligning the constructed yearly apartment price indexes to the first suspicious period of redlining (1999Q3+1999Q4) is impossible. Also the probable following catch up period will neutralize eventual redlining effects. Therefore, only the second suspicious period (2008Q3-2009Q2) can be used while investigating the periods suspicious of redlining by means of the constructed apartment price indexes. This second suspicious period is compared on probable differences on price development between 'Hillesluis' and 'Blijdorp' while comparing this period just to the previous period 200073-2008Q2.

So, for Hypothesis H4, 2008Q3-2009Q2 is the period investigated. The points of measurement from the apartment price indexes for 'Hillesluis' and 'Blijdorp' are 2007Q3-2008Q2 and 2008Q3-2009Q2. A probable catch up period with regard to apartment price for Hillesluis cannot be investigated, since there is uncertainty about the continuance of the 2nd suspicious period of redlining after 2009Q2 and the constructed apartment price indexes cannot be supposed to be reliable from 2009Q3-2011Q4.

2. Lastly the eleventh Sub Research Question – *Is redlining a plausible cause for possible differences in development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad standing' while looking at the number of transactions?*- is handled.

For answering this Sub Research Question, the figures derived from the counting table are used. It is not possible to formulate an hypothesis for this question, as it would be impossible to perform a decent test

for such an hypothesis. This because the lack of a standard error, which is needed for a t-test. Therefore, the counting table will be visually evaluated in order to come to an answer. The following path of operation is followed:

- For the operationalization of 'good and 'bad standing' neighborhoods, see the part additional to H1.
- For operationalizing the number of transactions, the transactions per half year and per neighborhood are counted. Then, the total number of apartments used to construct the counting tables for each neighborhood is divided by the number of transactions per half year (first two and last two quarters of each year combined). The outcome is a 'turnover ratio on total population in %' for each neighborhood. Further, for each neighborhood also the '% change in turnover ratio on previous period' is calculated. This is the relative change in the number of sales (related to total population) with regard to the previous period. To get a good view on how the development in both neighborhoods compare, for each period the Hillesluis sales ratio on total population is divided by the Blijdorp sales ratio on total population. The relative change of this outcome on the previous period is calculated and these outcomes form the '% change on previous period of Hillesluis turnover ratio/Blijdorp turnover ratio' (see §5.4.2). Former three variables are used for answering the Sub Research Question.
- With regard to the operationalization of the suspicious periods of redlining, from 1995-2011 there are two periods suspicious of redlining for Rotterdam: 1999Q3-1999Q4 and 2008Q3-2009Q2. These are periods of strict redlining. The period of less strict redlining, 1998Q4 + 1999Q1/Q2, is also taken into account. While visually inspecting 1998Q4, the previous period cannot be separated, which causes some inconvenience. The possible catching up phase is expected in 2000Q1/Q2. The choice is for the period right after the first suspicious period of redlining, because in my view the eventual abolition of redlining will have immediate effect. Each period is compared to its previous period. Also the periods of the second suspicious period (2008Q3/Q4 + 2009Q1/Q2) will both be compared to their previous periods.

So, the periods investigated for the eleventh Sub Research Question are 1998Q3/Q4 (compared to 1998Q1/Q2), 1999Q1/Q2 (is compared to 1998Q3/Q4), 1999Q3/Q4 (is compared to 1999Q1/Q2), 2000Q1/Q2 (compared to 1999Q3/Q4), 2008Q3/Q4 (is compared to 2008Q1/Q2) and lastly 2009Q1/Q2 (is compared to 2008Q3/Q4).

4.11) Summary

In chapter 4, it is seen that the use of DLRO data is chosen for this research since this data is highly reliable and contains the whole housing sales market to private persons.
In general, the stages of economic upturn are 'recovery' and 'boom' in real GDP. Both stages are combined for this research. The 3 periods of upturn for the Dutch economy for the period 1995-2011 are: 1995Q1-2002Q3, 2003Q3-2008Q1, and 2009Q3-2011Q2.
In the same period, there are also 3 economic downturns for the Netherlands: 2002Q4-2003Q2, 2008Q2-2009Q2, and 2011Q3-2011Q4.
A full business cycle is the period from peak to peak or through to through in real GDP. For the period 1995-2011, there are 2 full business cycles for the Netherlands: 2002Q3-2008Q1 and 2008Q1-2011Q2.
Two Rotterdam neighborhoods are selected for this thesis, one representing the neighborhoods of 'good standing' and one representing the neighborhoods of 'bad standing'. Neighborhood selection is done by means of scores on social deprivation, status, the social index, and the safety index.

Since 1980, 'Hillesluis' is a constantly bad performing neighborhood, and is the definite selected neighborhood to represent the neighborhoods of 'bad standing'.'Blijdorp' is constantly good performing and is the one representing the 'good neighborhoods'.
Also the relative share of apartments with special buyers conditions and the sort/type of apartments available in the neighborhood played a role in the definite selection process.
Streets with a relative high share apartments constructed before 1975 that belong to the 'middle height segment' (porch, upper/downstairs apartments and maisonettes) are selected. This is because in the preselected 'bad standing' neighborhoods, this is the most common type. 'Bad standing' neighborhoods were leading for choosing the type of apartment, while the number of privately owned apartments is much lower here than in neighborhoods of 'good standing'.
Of the data acquired from the DLRO, the transaction date and transaction price are used to construct an apartment price index for each definite selected neighborhood. Sales pairs are formed, and a Weighted Repeated Sales index is made. Only apartment that have been sold at least 2 times during the investigated period can be used. Apartments that has been physically changed between the subsequent transactions have been excluded or has been divided into different sales pairs. Deviating transactions (for example during a certain transaction the apartment is rented while during other transactions not) are removed, as also is done with transactions with price de- and incline of more than 80% a year. Also transactions of less than 10.000 euro are removed.
The constructed apartment indexes per neighborhood are yearly indexes, aligned to the Dutch periods of economical up/downturns and to the periods suspicious of redlining for Rotterdam. Some quarters are reclassified (for example the last period of upturn among the following downturn period) in order to get a good alignment. Starting the yearly index in the 3rd quarter of each year fits best.
Real apartment prices are used so the prices are corrected for inflation. Quarterly inflation figures from the CBS are used to construct yearly inflation figures that also start in the 3rd quarter each year.
The choice in made to construct a Weighted Repeated Sales index, since this most suits the acquired DLRO data. Such an index is recognized as highly reliable and are used by many official authorities in many countries. A modified version of the WRS method (introduced by Abraham and Schauman (1991) is used for this thesis, which handles the relation between the holding period and the change in apartment price in the right way.
Visual inspection of the constructed indexes point in the direction of a lag of apartment prices to real GDP, and a lag of 1 year is used to form the hypothesis.
Suspicious periods of redlining for Rotterdam are 1999Q3+1999Q4 and 2008Q4-2009Q2. 'Hillesluis' is supposed to suffer from redlining during the suspicious periods. Redlining is expected to have immediate effect on both the number of transactions as on the apartment prices.
The second suspicious period of redlining can be investigated using the constructed apartment price indexes, and a hypothesis is formulated for the investigation of the apartment price index with regard to this suspicious period of redlining.
However, the first suspicious period cannot be investigated using the apartment price indexes. The number of transactions therefore form a useful completion. For this purpose, counting tables are made. Both the first as the second suspicious period are investigated using these counting tables.
Various ratios are contracted from the original number of transactions. The total number of apartments used for constructing these tables of counts are for each neighborhood divided by the number of transactions. This in order to acquire a sales turnover ratio. To get a clear picture across the two neighborhoods, the ratio for Hillesluis is divided by the ratio for Blijdorp and the relative change per period is calculated. For reasons of alignment to the suspicious periods, the counting table of number of transactions is made on a half yearly basis. This counting table of number of transactions will be visually examined, and therefore no hypothesis is formulated.

5) Empirical Results and applied analyses

5.1) Introduction

In this chapter, the hypotheses formulated in §4.9 will be tested. The way of testing will be elaborated and probable differences between neighborhoods of 'good' and 'bad standing' will be discussed. The next paragraph gives general applications for the performed tests, and the then following two paragraphs are each separately aimed at economical circumstances and suspicious of redlining. These three paragraphs lean heavily on the work of Field (2005), Moore et al. (2003), and Aczel (2002). The sub-paragraphs of §5.3 and §5.4 are each aimed at a certain hypothesis, and in each sub-paragraph the outcome of the test of the subsequent hypothesis will be given. Also the hypotheses will be clearly answered. Paragraph 5.5 contains a summary of all results and answers on the hypotheses, the answers on the subsequent sub-research questions of the hypotheses are given and conclusions are drawn.

5.2) General applications for hypotheses

The data used for this thesis is unpaired data. So, unpaired tests on means are aimed at for this thesis. However, there are other things to consider which will be discussed below. A division is made on behalf of the constructed apartment price indexes and counting tables.

1. *general applications for the tests with regard to the constructed price indexes:*

The base of the investigation of the constructed apartment price indexes forms the original SPSS output with the ln values of the coefficients. This output for Blijdorp and Hillesluis is given in appendix 11.

General applications for all hypotheses in which the constructed apartment price indexes are involved are that investigation of the sales pairs showed that nor for Hillesluis nor for Blijdorp, the data (the variable labeled lnp2minlnp1, used to construct the apartment price indexes for both neighborhoods) have a normal distribution. See appendix 12 for the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests and histograms.

There is no good reason to remove the outliers, since the dataset has been cleansed in advance. So, the first thought is to use nonparametric tests. However, the constructed indexes contain values for each year which are the best fit of all different vectors (these vectors have been drawn from total population n, and each individual sales pair has different transaction periods, different starting points, different ending points, with different periods between the repeated sales). Therefore unpaired nonparametric tests (like the Wilcoxon rang sum test for example), in my view cannot be used to compare the two neighborhood index values for a certain year.

The weighted regressions that have been made to construct the apartment price indexes for both neighborhoods, give as outcome for each year the coefficient (which is transformed to the index value by exponentiation) and also for each year the standard error. Whenever Normality of the data can be assumed, a two-sample t significance test would perfectly match with this information. This is because two means (in this research the index values), each coming from a different population, are compared.

Though normality tests showed a significant outcome, in my view the two-sample t significance test is applicable for this research, as the population sizes are large enough to perform a robust t-test. Moore et al. (2003) states that when n1+n2>40, it is allowed to perform a two sample t-test. In our case, the population size for Hillesluis is 127 and for Blijdorp it is 469, and therefore this requirement is fulfilled by far. The only thing of concern is that the two samples are not of equal size, but Moore et al. (2003, p. 469) mention that the 'former guidelines are rather conservative, especially when the two samples are of equal size'. Though the two samples are not of equal size, in my view the statement of Moore et al. (2003)can be interpreted as that even then the former guidelines are rather conservative. That the sample sizes are much larger than in the guidelines, in my view makes it even more justifiable to use the two-sample t significance test for this thesis.

So, in my view, two-sample t significance tests (also called independent t-test) are applicable for this thesis with regard to the hypotheses in which the constructed apartment price indexes are involved.

Another question involved is whether the variances of both neighborhoods are the same in both neighborhoods and probably can be pooled. However, Moore et al. (2003, p. 479) mentions that "when the samples are quite different in size, the pooled t procedures become sensitive to unequal standard deviations and should be used with caution". Because the one sample in this research is about 3,7 times as big as the other, in my view it is better not to use the pooled two-sample t procedures. The original outcomes (in ln values) of the constructed indexes are used (both for the coefficient as the standard error) for the t-tests.

All in all, the unpooled independent t-tests are in my view appropriate for investigating the constructed apartment price indexes. The test have been done manually, and the following formulas from the work of Moore et al. (2003) have been used:

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}} \qquad \text{and} \qquad t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

In the formulas above, $SE_{\bar{x}}$ is the standard error of the sample mean (so, of the statistic), s is the standard deviation, n is the population size, n_1 and n_2 are the sample sizes of population 1 and 2, $\bar{x}_1$ and $\bar{x}_2$ are the sample means of population 1 and 2, lastly μ_1 and μ_2 are the means of population 1 and 2. The degrees of freedom is the number of the smallest population minus one. In the case of this thesis, this is Hillesluis with n = 127. Therefore, the number of degrees of freedom is 126.

The significance level of the performed tests is set at 5%.

2. general applications with regard to the counting table of number of transactions:

For the visual testing of the suspicious periods of redlining by means of the number of transactions, the original number of transactions per half year are used as a basis. See §5.4.2 figure 20 till 22.

The sales counts (transactions) are regarded within each neighborhood over a longer period, the 'Hillesluis change in turnover ratio' is regarded over its previous periods. The 'change in Hillesluis

turnover ratio/Blijdorp turnover ratio' is a comparison across neighborhoods, and also in this case the values are regarded over its previous periods.

5.3) Apartment price reaction to economical circumstances

Firstly, the constructed apartment price indexes and the relative changes of the index values on former period can be seen in figure 18 and 19 below. The absolute exact numbers are given in appendix 13.

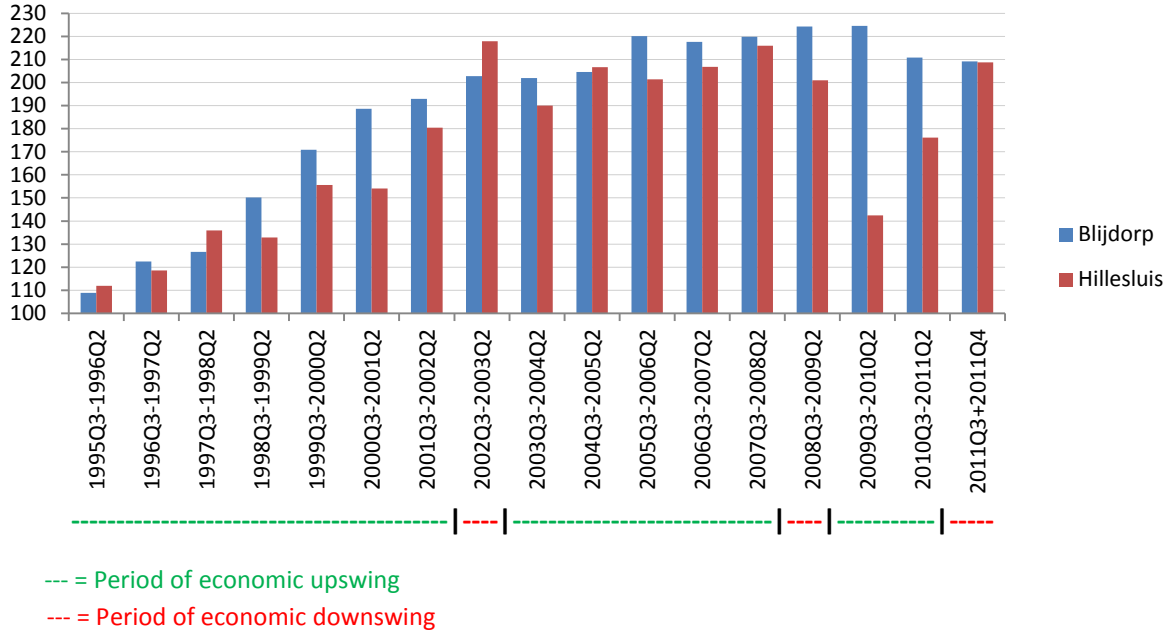


Figure 18: Apartment Price Indexes Blijdorp and Hillesluis

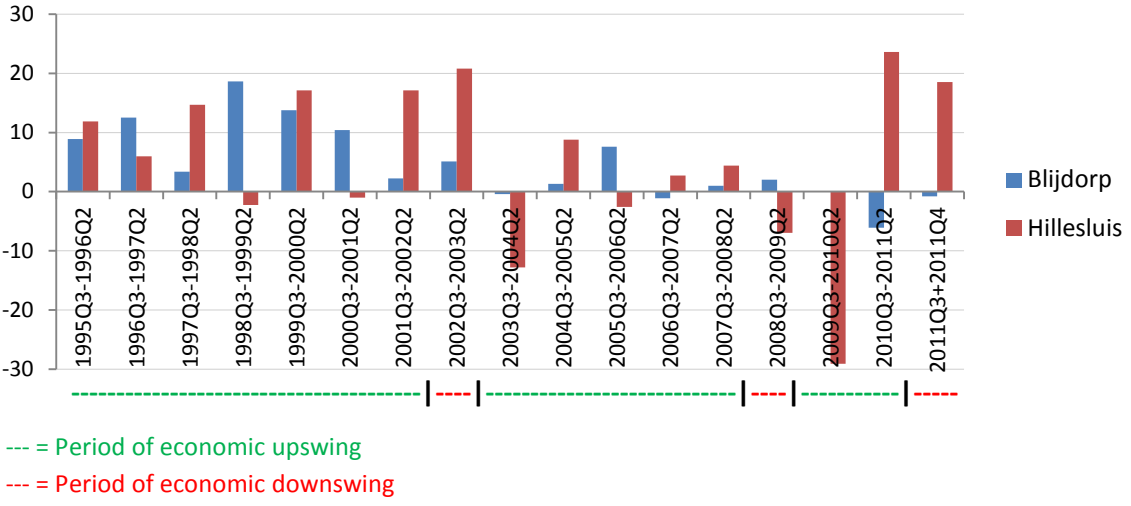


Figure 19: % change on previous period of Apartment Price Indexes Blijdorp and Hillesluis

At first glance, in figure 18 and 19 of § 4.7.4, it seems like the apartment prices in Hillesluis are more volatile than the apartment prices in Blijdorp. However, for this thesis, the emphasis is on the apartment price development with regard to the business cycle and its various stages. The volatility is linked to the former stages, and the turning points in real GDP determine the measuring points for investigation.

Because of the foregoing, the price volatility from just index period on subsequent index period is not investigated for this thesis.

In the next sub sections, the results of the investigation will be discussed.

5.3.1) General price development in the two types of neighborhoods

The independent t-test, done to check Hypothesis H1 "*In general, the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad standing'* ", is performed two sided.

The two means of the 'good standing' neighborhood Blijdorp and the 'bad standing' neighborhood Hillesluis are compared, and the outcome of this test is that the null hypothesis ($\mu_1 = \mu_2$) is not rejected. The means of Blijdorp and Hillesluis do not differ significantly (t = -0,16). Therefore, Hypothesis H1 is accepted. See appendix 14 for the calculations.

This is what is expected on forehand, while only looking at the values of the constructed indexes in figure 18. The values of Blijdorp and Hillesluis are very close to each other for the period 2007Q3-2008Q2 (219,90 index points for Blijdorp against 215,98 index points for Hillesluis), and the investigated period started in the base year.

5.3.2) Reaction to economic downturns of the two types of neighborhoods

The test performed for Hypothesis H2 "*During a recession, the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad standing'* " is again two sided.

The independent t-test on means shows that the null hypothesis cannot be rejected (t = -1,38). In appendix 15, the exact calculations are given. Hypothesis H2 is thus accepted.

Although the apartment prices in Hillesluis seem worse performing than the apartment prices in Blijdorp while looking at figure 19 (for the period 2003Q3-2004Q2), the outcome of the test does not reach the critical value. Still the outcome of the test seems to slightly point in the direction of apartment prices 'bad standing' neighborhoods to perform worse during economic downturns, while a one sided t-test would be significant at the 10% level (for a one sided test, the 10% critical value is between -1,282 and -1,29).

5.3.3) Reaction to economic upturns of the two types of neighborhoods

Then third hypothesis H3 "*During an economic upturn, the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad standing'* ". Also this hypothesis is tested by a two sided independent t-test. Such a test is performed for each period of economic upturn apart.

According the calculated t-values, for both investigated periods of economic upturn (1995Q3-2003Q2 and 2004Q3-2008Q2), the means of Blijdorp and Hillesluis do not differ significantly (t = 0,59 for the first period of economic upturn, and t = 0,39 for the second period of economic upturn). So, also Hypothesis H3 is accepted. See Appendix 16 for the exact calculations.

While looking at figure 18, the outcome of the test is what could be expected. The apartment prices in Hillesluis seem to perform slightly better over the periods 1995Q3-2003Q2 and 2004Q3-2008Q2. In the

performed tests, both periods show a positive sign, however the difference between the two neighborhoods is not big enough to be significant.

5.4) Presence of empirical support for suspicions of redlining

5.4.1) Support in form of apartment price change

Lastly Hypothesis H4 "*During periods suspicious of redlining, the relative growth in the number of apartment prices in 'bad standing' neighborhoods is less positive or stronger negative than in 'good standing' neighborhoods* " is tested. The corresponding independent t-test for this hypothesis is performed one sided.

The outcome of the test is that the means of Blijdorp and Hillesluis do not differ significantly from each other during the investigated period suspicious of redlining (t = - 0,81). Therefore, hypothesis H4 has to be rejected. The calculations can be seen in appendix 17.

Former outcome of the test is not quite what was expected on forehand. When looking at figure 18 and 19, it is seen that the apartment prices in Blijdorp show an increase for the here investigated suspicious period of redlining (2008Q3-2009Q2), while Hillesluis shows a clear decrease. However, this difference is not big enough to be of significance. Literature is quite clear about the suspicious of redlining in Rotterdam, and therefore this non significant testing result comes as a kind of surprise.

5.4.2) Support in form of change in number of sales of apartments

The figures 20 till 22 are used for the analyses with regard to the number of transactions per period. These figures have their origin in the constructed counting table , which can be seen in appendix 18. The yellow shaded quarters are suspicious less strict periods of redlining, the red ones are suspicious periods, the green shaded quarters is a possible catch up period, and the grey period is uncertain whether there is a suspicious of redlining or a possible catch up phase. Former all just counts for the neighborhood Hillesluis.

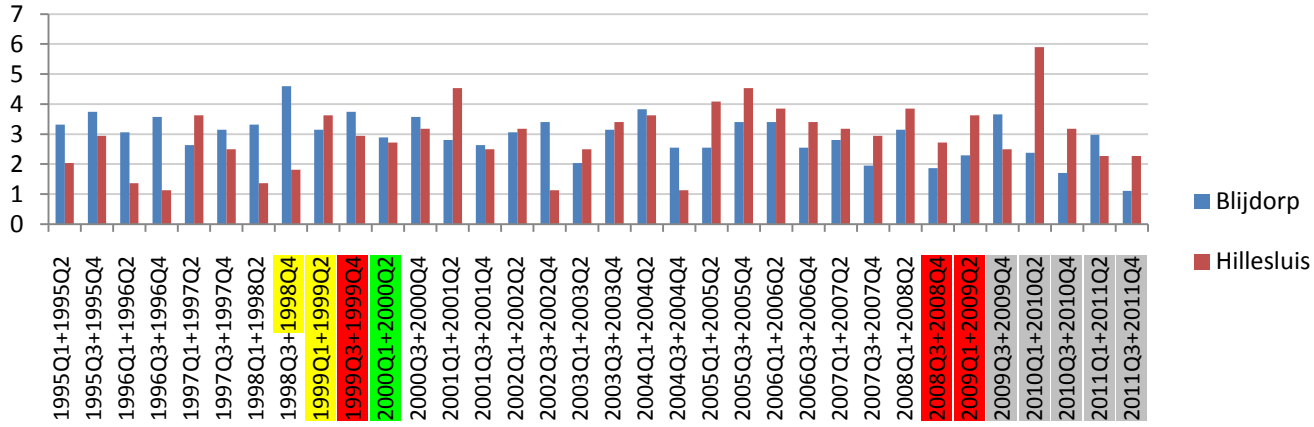


Figure 20: Turnover ratio's on total population in %

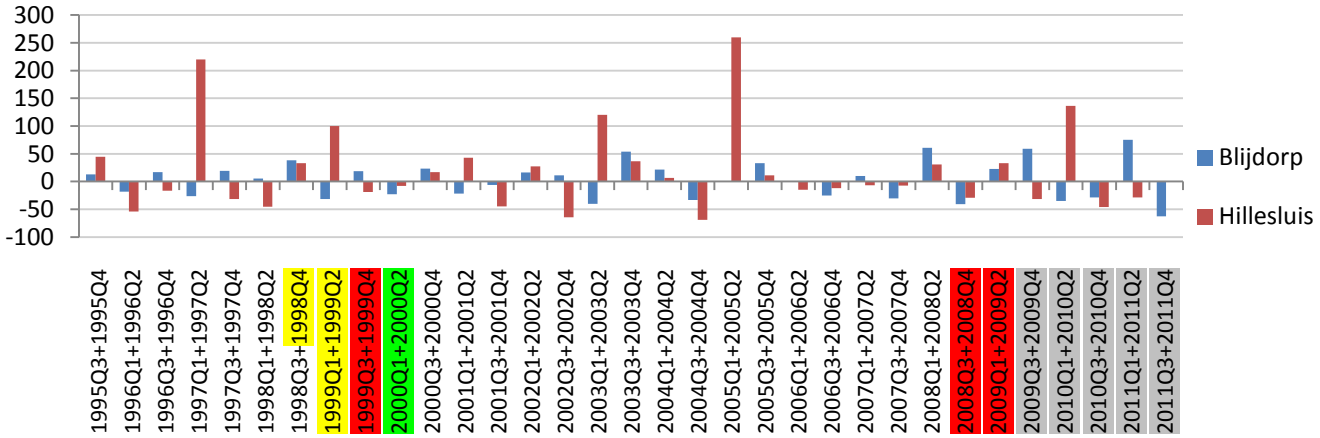


Figure 21: % change in turnover ratio on previous period

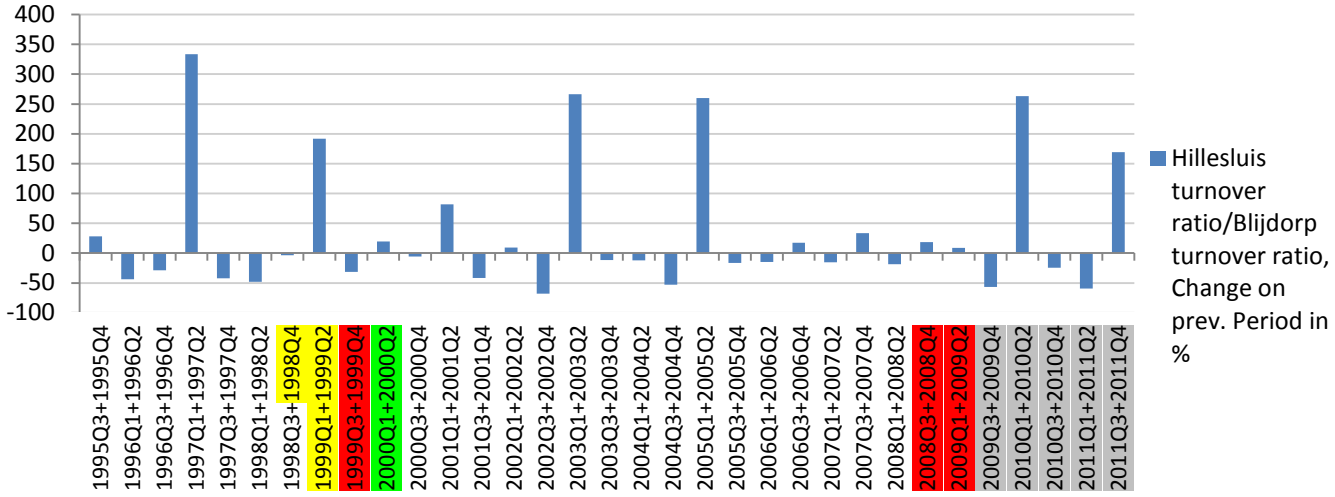


Figure 22: % change on previous period of Hillesluis turnover ratio/Blijdorp turnover ratio

Below, the two suspicious periods will be visually examined using these figures. Each part of each suspicious period of redlining will be handled separately.

-1) *First suspicious period :*

For the less strict period of redlining for Hillesluis (1998Q4+1999Q1/1999Q2), particularly the first two quarters of 1999 are expected to show negative values in figure 21 and 22. However, in contrary of these expectations, both figures show very firm positive signs. Even for 1998Q3+1998Q4, in which the Hillesluis numbers should be influenced by the start up of the less strict period of redlining during this period, the turnover ratio of Hillesluis (figure 21) shows a severe plus. For these quarters only a weak minus in figure 22, but this seems to be caused by a temporarily higher than normal increase in the sales counts for Blijdorp (see 1998Q1+Q2 and 1998Q3+Q4 for Blijdorp in figure 21, but also the levels in figure 20).

For the first suspicious period of redlining for Hillesluis (1999Q3+1999Q4), both the Change in Hillesluis turnover ratio as Change in Hillesluis turnover ratio/Blijdorp turnover ratio (fig. 21 and 22) show

negative signs. This is what is expected in a period of redlining. In Hillesluis there are less sales counts than in the previous period (see fig. 20, 1999Q3+Q4 versus 1999Q1+Q2). Also compared to Blijdorp, the performance is worse. However, in my view the sales counts for Hillesluis are not abnormally low (see fig. 20), while regarding the whole sequence. Therefore, in my view, the suspicious of redlining for the period 1999Q3+1999Q4 is not supported by the data used for this research.

Then, 2000Q1 +2000Q2 is a possible catch up period for Hillesluis. So, this period is expected to show a firm plus for the Hillesluis '% change in turnover ratio on previous period' (fig 21). However, a negative sign is noted for this period. The change on previous period of the Hillesluis turnover ratio/Blijdorp turnover ratio (fig. 22) shows a good plus, but this seems to be caused by the higher decrease in sales counts for Blijdorp than for Hillesluis during this period (see fig. 20, 2000Q1+Q2 versus 1999Q3+Q4). The number of sales counts for Hillesluis has decreased, which is contra dictionary to what is expected.

-2) *The second suspicious period:*

For the period 2008Q3+2008Q4, for the Hillesluis '% change in turnover ratio' (fig. 21), a severe minus is expected. The same for 2009Q1+2009Q2. In my view, in case that for 2008Q3+2008Q4 the decrease is very firm, a value around zero or a very light plus is also acceptable for 2009Q1+2009Q2. This would imply that the fall in number of transactions has stabilized on a low level. The value for this ratio has a severe minus for 2008Q3+Q4, however notes a following severe plus for 2009Q1+Q2. When we look closer to the severe minus for 2008Q3+Q4 and combine this to the change in Hillesluis turnover ratio/Blijdorp turnover ratio (fig. 22), we see that the latter ratio notes a good plus. So, for 2008Q3+Q4 the minus in the number of sales counts for Blijdorp is larger than the minus for Hillesluis. Also the period 2009Q1+Q2 also notes a plus for this ratio. This makes that the used data for this thesis not supports the suspicious of redlining for neither 2008Q3+Q4 nor 2009Q1+Q2.

5.5) Summary and conclusions

In this chapter, the hypotheses with regard to the apartment price indexes are tested by means of independent t-tests. The counting table of number of transactions is visually examined.

It is seen that the first hypothesis is accepted. So, in general the relative growth of apartment prices is the same in neighborhoods of 'good' and 'bad' standing. Therefore, the answer to the seventh Sub Research Question - *In general, do apartment prices in 'good' and 'bad' standing neighborhoods develop the same?*- is yes. Apartment prices in both types of neighborhoods develop the same.

Also the second hypothesis is accepted This means an affirmative answer to the eight Sub Research Question - *Is the development of apartment prices in 'good' and 'bad' standing neighborhoods the same during recessions?*-. The development of apartment prices in both types of neighborhood is the same during recessions.

Though the second hypothesis is accepted, the outcome of the test provides food for thought. This while it slightly points in the direction of apartment prices in 'bad standing' neighborhoods performing worse during recessions than apartment prices in 'good standing' neighborhoods (although not significantly for this research). It should be noted that, if existing literature had given reasons to perform a one sided t-test with regard to the development of apartment prices during recessions, the outcome

of such a one sided test would be significant at a 10% significance level. This gives thoughts for further research.

The third hypothesis is again accepted, which means a positive answer to the question – *Is the development of apartment prices in 'good' and 'bad' standing neighborhoods the same during economic upturns?-* , which is the ninth Sub Research Question. The development of apartment prices in both types of neighborhood is the same during economic upturns.

With regard to the suspicious of redlining, it is seen that the fourth hypothesis is rejected. Therefore the answer on the tenth Sub Research Question - *Is redlining a plausible cause for possible differences in development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad' standing, while looking at apartment prices?-* is no. Looking at apartment prices, redlining is not a plausible cause for possible differences in development of apartment prices between both types of Rotterdam neighborhoods.

Then, visual examination of the data resulted in a negative answer on the eleventh Sub Reseach Question - *Is redlining a plausible cause for possible differences in development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad' standing, while looking at the number of transactions?-*. Redlining is not a plausible cause for possible differences in the development of apartment prices, looking at the number of transactions.

It comes as kind of surprise that no support, nor by testing the apartment prices nor by visual examination of the number of transactions, is found for the suspicious of redlining. In his work, Aalbers (2003 and 2010) is quite explicit about the occurrence of redlining during the suspicious periods. The Commision of Equal Treatment (CGB, 2006), state that some banks in more or less degree practice redlining. Probably it is in the scope mentioned by this commission that no support is found in the data, while redlining is stated to be practiced by only some banks, and only in more or less degree.

As no support is found for the suspicious of redlining (not by testing the apartment price indexes nor by visually examining the counting tables of number of transactions), no indication can be given to the probability of a self-fulfilling prophecy with regard to redlining and the greater depreciation risk of apartment prices.

Lastly, as apartment prices in different types of neighborhood have the same development during various economic circumstances, no legitimate grounds have been found for the practice of redlining.

Perhaps further research can provide legitimate grounds for the practice of redlining during recessions, whenever house price development during recessions in 'good' and 'bad standing' neighborhoods will be further investigated in other neighborhoods or in other cities. The neighborhoods of 'bad standing' to be investigated than should not be suspicious of redlining, or should have periods suspicious of redlining that not equal the recession periods.

6) Conclusion

6.1) conclusions

The test outcomes in chapter 5 result in the statement that there are no differences in price development between 'good' and 'bad' standing neighborhoods. Not in general price development, and neither in price development during economic upturns nor economic downturns.

The answer further below to the Main Research Question is concluded from the positive answers on either of the following practical sub research questions 7 till 9:

- In general, do apartment prices in 'good' and 'bad standing' neighborhoods develop the same?
- Is the development of apartment prices in 'good' and 'bad standing' neighborhoods the same during recessions?
- Is the development of apartment prices in 'good' and 'bad standing' neighborhoods the same during economic upturns?

All in all, the **answer to the Main Research Question**:
- Is there a relationship between the social status of city neighborhoods and the development of apartment prices, while considering the state of the economy?- is: **there is no relationship between the social status of city neighborhoods and the development of apartment prices, while considering the state of the economy.**

It should be said that, if the test concerning the price development during recessions had been performed one sided, the outcome would have been significant at a 10% level. So, at this significance level and at a one sided test, the outcome would have been that apartment prices in 'bad standing' neighborhoods perform worse during recessions, than apartment prices in 'good standing' neighborhoods. Although for this thesis there have been no reasons to perform this test one sided after reviewing the existing literature, in the future, the outcome of this research gives a reason to do so.

About the suspicious of redlining for Rotterdam, no support of this suspicious is found in the for this thesis used data. Therefore, the outcomes are negative on both of the following practical sub research questions 10 and 11:

- Is redlining a probable cause for possible differences in the development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad standing' while looking at apartment prices?
- Is redlining a probable cause for possible differences in the development of apartment prices between Rotterdam neighborhoods of 'good' and 'bad standing' while looking at the number of transactions?

That no support is found in the data for the suspicious of redlining is probably caused by reasons given by the Commission of Equal Treatment, while they state that redlining is only practiced by some banks, and only in a more or less degree.

Since no support for the suspicious of redlining is found, no indication can be given to the probability of a self-fulfilling prophecy of the practice of redlining.

All in all, this thesis gives no legitimate grounds for banks to practice redlining. This since apartment prices in neighborhoods of 'good' and 'bad' standing develop the same. Investors run the same risk in both investing in real estate in 'good' as in 'bad' standing neighborhoods.

The only one thing of slight concern is the performance of apartment prices in the investigated 'bad standing' neighborhood during recessions. Though the for this research performed test has a non significant outcome, further future research towards apartment prices during recessions might possibly point in the direction of a worse performance of apartment prices in 'bad standing' neighborhoods, which may provides banks legitimate grounds to practice redlining during recessions.

6.2) limitations and recommendations for further research

- Limitations of this research:

For some years for Hillesluis, the dataset is slightly thin. Also, because of limitations for the request at the Dutch Land Registry Office, it was only possible to investigate two Rotterdam neighborhoods. Adding more neighborhoods to the investigation would cause the construction of more apartment price indexes, which would be too thin to use for research.

The outcome of this thesis therefore can be based on a coincidence, and perhaps the outcome for other 'good' or 'bad' neighborhoods will be different. Another thing is that only apartments of the 'middle height segment' with year of construction before 1975 are included in this thesis. Other types of apartments can show other outcomes, however this is not expected. Also, for other types of housing than apartments or other cities or other countries, the outcomes possibly differ.

- Recommendations for further research:

The review of existing literature gave no reason for this research to perform a one sided test concerning the apartment price development during recessions. As the outcome of a one sided test would have been significant at a 10% level, this gives reason for future research to start at the point that the house price development during recessions is worse in 'bad standing' neighborhoods than in 'good standing' neighborhoods. Further research to the probable differences in price development in 'good' and 'bad standing' neighborhoods is recommended, and it should be expected that the house price development in 'bad standing' neighborhoods is worse than in 'good standing' neighborhoods.

The used dataset was limited by the done request to the Dutch Land Registry Office. Whenever the use of a wider/larger dataset is possible, more detailed (in periods) apartment price indexes can be constructed. Then further research to an exact and detailed (in time period) leading/lagging period of apartment prices with regard to real GDP is recommended.

Also probably then it is possible to make a distinct in the two periods of economic upturn: 'recovery' and 'boom'. Possibly, an in periods more detailed apartment price index makes differences in developments of apartment prices between 'good' and 'bad' standing neighborhoods touchable during various stages

of economic state. More detailed apartment price indexes will also makes it possible to investigate both suspicious periods of redlining on apartment price development.

Whenever it is not possible to construct a more detailed apartment price index, then for the Netherlands then a longer time range than 1995-2011 should be investigated. This in order to include a better researchable recovery period than the period 2003Q3, or catch the whole period of 'boom' before 1995. An alternative can then also be to perform this kind of research for another country, where probably other business cycles occur, with better comparable separate stages of upswing in the investigated period.

A wider use of data will also make it possible to engage more Rotterdam neighborhoods in the research. Further, investigation of apartment price development in both types of neighborhood with regard to economical circumstances can be expanded to other Dutch cities or cities in other countries. The same counts for further investigation of redlining.

When adequate appraisals are available over longer period in the future, Spar indexes can be constructed. Such indexes will be 'fatter', because not only repeated sales can be used, but all sales. This means a 'fatter' index with the same dataset.
Another way of widening the investigating, whenever the use of a wider the dataset is possible, is extending the types of apartment (and their years of construction) used for the future research.

At the time that the current economic recession is over, this period is recommended to include in further researches. This is because this period of economic downswing is longer lasting than normal, is steep and incomparable with previous recessions.

Also interesting for further research is to investigate if there is a 'cycle of pauperism' for the neighborhoods in the city of Rotterdam. For such a research, just neighborhoods have to be selected which are not of constant quality over time.

The last recommendation has to do only with redlining and is recommended further research to whether the same type of neighborhood has the same housing price development, suspicious redlining neighborhoods versus non redlining neighborhoods both of the same type (so, 'bad' type neighborhoods). For this thesis for Rotterdam, all selected 'bad' neighborhoods (that are constantly 'bad' over the period 1980-2011) are suspicions of redlining (fully, or in a bit less strict manner), so this investigation was impossible to do during this research.

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Appendices

Appendix 1: The four categories of indicators to determine 'Vogelaarwijk'

Indicators for selection of the neighborhoods (in Dutch):

Thema **Achterstanden**	Bron	Peiljaar	
Sociaal-economisch			
1. Inkomen	RIO, CBS	2002	gemiddeld besteedbaar particulier huishoudinkomen
2. Werk	RIO, CBS	2002	aandeel werkenden
3. Opleiding	Wegener/Geo-marktprofiel	2002	aandeel huishoudens met lage opleiding
			vraagstelling : aantal mensen met een lage opleiding in uw straat?
			9 antwoordklassen van extreem weinig via gemiddeld naar extreem veel
			berekening : aandeel bovengemiddeld op het totaal
Fysiek			
Woningvoorraad	CBS/Syswov/	2002,2006	aandeel woningen klein , oud en goedkoop
4. Kleine woningen	/CFV		# klein : eengezinsw 4 en minder kamers; meergezinsw 3 en minder kamers
5. Oude woningen			# oud : bouwjaar 1970 en eerder
6. Goedkope woningen			# goedkoop : sociale huurwoningen
Problemen			
Sociaal /leefbaarheid	WBO/WoON	2002,2006	
sociale overlast, vandalisme en onveiligheid			Oordeel bewoner vervelende voorvallen en misdrijven in de buurt
7 vandalisme			# bekladding van muren en/of gebouwen, komt dit in uw buurt voor?
8 vandalisme			# vernieling van telefooncellen, bus- of tramhokjes, komt dit in uw buurt voor?
9. sociale overlast			# ondervindt u overlast door directe buren?
10 sociale overlast			# ondervindt u overlast door omwonenden?
11. onveiligheid			# bent u bang om in de woonbuurt lastig gevallen of beroofd te worden?
Fysiek	WBO/WoON	2002,2006	
12. tevredenheid woning			Hoe tevreden bent u met uw huidige woning?
13. tevredenheid woonomgeving			Hoe tevreden bent u met uw huidige woonomgeving?
14. verhuisgeneigdheid			Aandeel verhuisgeneigde hh en hh die al andere woning gevonden hebben op het totaal
fysieke overlast			Oordeel bewoner over vervelende voorvallen in de buurt
15. geluidsoverlast			# in welke mate ondervindt u in uw buurt vormen van geluidsoverlast?
16. vervuiling			# idem overlast door stank, stof, vuil?
17. verkeer			# idem overlast door het verkeer?
18. veiligheid			# oordeel bewoner m.b.t. de veiligheid qua verkeerssituatie

Source: http://www.rijksoverheid.nl/onderwerpen/aandachtswijken/documenten-en-publicaties/brochures/2010/09/24/lijst-indicatoren-wijken.html

Appendix 2 : The stages of neighborhood transition

Edgar M. Hoover and Raymond Vernon *Anatomy of a Metropolis: The Changing Distribution of People and Jobs within the New York Metropolitan Region* (Regional Plan Association of New York, 1959)	Real Estate Research Corporation *The Dynamics of Neighborhood Change* (U.S. Department of Housing and Urban Development, 1975)
Stage 1 Single-family residential development	*Stage 1: Healthy* Homogeneous housing and moderate to upper income, insurance and conventional financing available
Stage 2 Transition to higher density, apartment construction	*Stage 2: Incipient Decline* Aging housing, decline in income and education level, influx of middle-income minorities, fear of racial transition
Stage 3 Downgrading to accommodate higher density through conversion and overcrowding of existing structures, spread of ethnic and minority districts	*Stage 3: Clearly Declining* Higher density, visible deterioration, decrease in white in-movers, more minority children in schools, mostly rental housing, problems in securing insurance and financing
Stage 4 Thinning-out or "shrinkage" characterized by population loss and decline in housing units	*Stage 4: Accelerating Decline* Increasing vacancies, predominantly low-income and minority tenants or elderly ethnics, high unemployment, fear of crime, no insurance or institutional financing available, declining public services, absentee-owned properties
Stage 5 Renewal through public intervention, redevelopment and replacement of obsolete housing with new multifamily apartments	*Stage 5: Abandoned* Severe dilapidation, poverty and squatters, high crime and arson, negative cash flow from buildings

Source: Metzger (2000)

Appendix 3 : Dutch quarterly real GDP

Dataset: Quarterly National Accounts	
Subject	B1_GE: Gross domestic product - expenditure approach
Measure	GPSA: Growth rate compared to previous quarter, seasonally adjusted
Frequency	Quarterly
Country	Netherlands
Period	
Q1-1995	0,556858
Q2-1995	0,8298725
Q3-1995	0,8338767
Q4-1995	0,7100961
Q1-1996	0,0538114
Q2-1996	2,0113571
Q3-1996	0,7289523
Q4-1996	0,6704709
Q1-1997	0,9453049
Q2-1997	1,5072162
Q3-1997	1,0778205
Q4-1997	1,1607478
Q1-1998	1,0129857
Q2-1998	0,6125636
Q3-1998	0,6611577
Q4-1998	0,8896097
Q1-1999	1,6713038

Q2-1999		1,0343364
Q3-1999		1,1638254
Q4-1999		1,3794948
Q1-2000		0,8637396
Q2-2000		1,1039396
Q3-2000		0,5188647
Q4-2000		0,5547506
Q1-2001		0,6406262
Q2-2001		0,5144438
Q3-2001		-0,0619512
Q4-2001		0,1294198
Q1-2002		-0,5403264
Q2-2002		0,5355932
Q3-2002		0,0838814
Q4-2002		-0,0606647
Q1-2003		0,1356025
Q2-2003		-0,2057087
Q3-2003		0,1544695
Q4-2003		0,5229347
Q1-2004		0,9630578
Q2-2004		0,4953378
Q3-2004		0,4314514
Q4-2004		0,2319798
Q1-2005		0,3087659
Q2-2005		1,0782762
Q3-2005		0,7337303
Q4-2005		0,5911367
Q1-2006		0,8651319
Q2-2006		1,5471445
Q3-2006		0,2851287
Q4-2006		0,6547312
Q1-2007		1,3634838
Q2-2007		0,6565056
Q3-2007		1,2874303
Q4-2007		1,3298576
Q1-2008		0,536138
Q2-2008		-0,3025839
Q3-2008		-0,1020746
Q4-2008		-1,1583091
Q1-2009		-2,2036871
Q2-2009		-1,0921507
Q3-2009		0,7057325
Q4-2009		0,4348407
Q1-2010		0,4880777
Q2-2010		0,7202001
Q3-2010		0,0462426
Q4-2010		0,6801181
Q1-2011		0,8281556
Q2-2011		0,1433226

Source: OECD

Appendix 4 : Unemployment rate/Industrial production/private final consumption during period 2001/2002

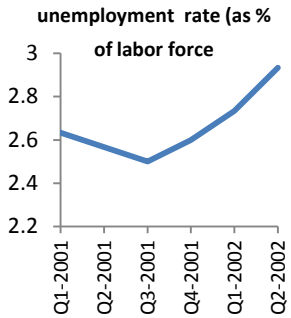


Figure 1 (source OECD)

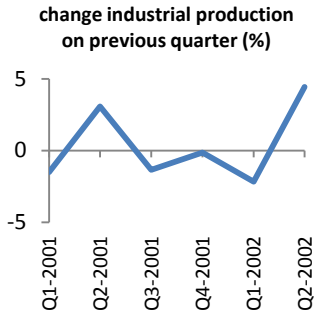


Figure 2 (source OECD)

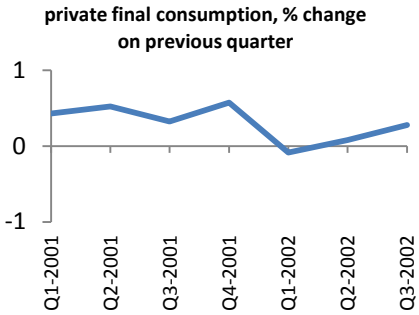


Figure 3 (source OECD)

Appendix 5 : Unemployment rate/Industrial production/private final consumption during period 2002/2003

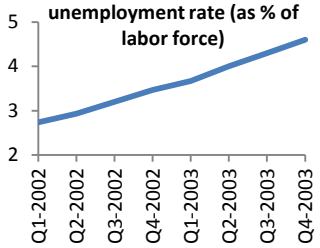


Figure 1 (source OECD)

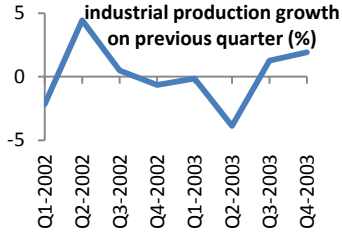


Figure 2 (source OECD)

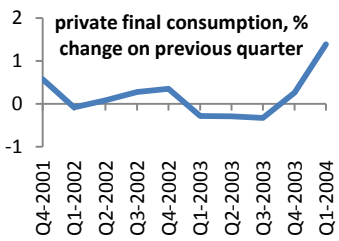


Figure 3 (source OECD)

Explanation of the figures with regard to the further investigation of a probable peak in GDP in 2002Q3, and a probable trough in GDP in 2003Q2:
During the intermediate period, a deterioration of the unemployment can be seen in figure 1.
In figure 2, the deterioration in the industrial production is lagged with a quarter, which can be explained for example by the finishing of outstanding orders. In figure 3, the deterioration of private final consumption is lagged with 2 quarters. This can be explained because it takes a while for consumers to take full notion of, and feel the recession in their purse (and during this time, their spending on goods continues). Therefore, 2002Q3 is regarded as a peak in GDP, and 2003Q2 is regarded as a through.

Appendix 6: Neighborhood Scores on social deprivation/Status scores/Social Index and Safety Index

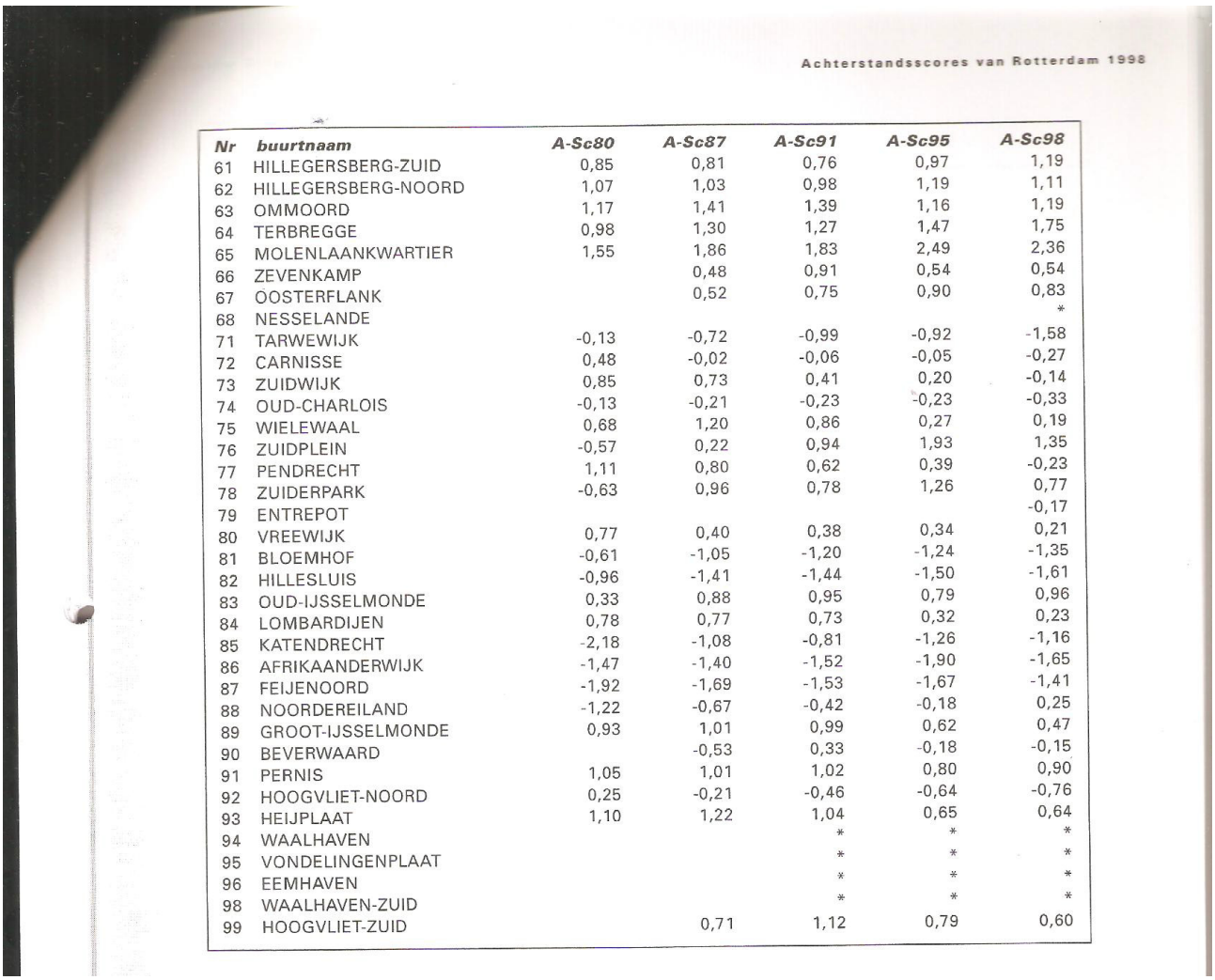
Scores on social deprivation (in Dutch)

Bijlage 2: **Achterstandsscores per buurt en deelgemeente vanaf 1980.**

Tabellen 2.1 en 2.2 geven het verloop van de scores per buurt en deelgemeente sinds 1980. Bij buurten met minder dan 500 inwoners is een sterretje (*) afgedrukt, aangezien in deze buurten de achterstandsscore niet voldoende nauwkeurig is.

Tabel 2.1: **Het verloop van de scores per buurt, sinds 1980**

Nr	buurtnaam	A-Sc80	A-Sc87	A-Sc91	A-Sc95	A-Sc98
01	STRAND EN DUIN		1,17	1,19	2,08	1,55
02	DORP		1,18	1,08	1,12	1,41
03	RIJNPOORT		*	*	*	*
06	BOTLEK			*	*	*
07	EUROPOORT			*	*	*
08	MAASVLAKTE				-2,04	
10	STADSDRIEHOEK	-0,13	0,21	0,56	1,22	1,26
11	OUDE WESTEN	-2,51	-1,68	-1,23	-1,37	-1,33
12	COOL	-1,57	-0,49	-0,36	0,37	0,24
13	C.S. KWARTIER	-1,43	0,24	0,60	1,77	1,69
14	RUBROEK	-0,26	0,08	0,11	0,00	0,00
15	AGNIESEBUURT	-1,66			-0,57	-0,70
16	PROVENIERSWIJK	-0,99	-0,97	-1,02	-0,47	-0,38
17	KOP VAN ZUID					*
18	NIEUWE WERK	-1,26	-0,61	-0,22	0,74	0,71
19	DIJKZIGT	*	*	*	*	*
20	DELFSHAVEN	-0,83	-0,81	-0,62	-0,78	-0,87
21	BOSPOLDER	-1,25	-1,30	-1,67	-1,34	-1,45
22	TUSSENDIJKEN	-0,77	-1,15	-1,19	-0,94	-1,10
23	SPANGEN	-0,93	-1,37	-1,71	-1,59	-1,77
24	NIEUWE WESTEN	-0,97	-1,19	-1,54	-1,21	-1,24
25	MIDDELLAND	-1,43	-1,38	-1,37	-0,80	-0,74
26	NIEUW-MATHENESSE			*	*	*
27	OUD-MATHENESSE	0,39	0,19	-0,07	-0,11	-0,19
28	WITTE DORP	-0,99	-1,12	-1,89	-0,97	-1,16
29	SCHIEMOND		-1,23	-0,39	-1,82	-1,20
31	BERGPOLDER	0,07	-0,28	-0,48	-0,14	-0,02
32	BLIJDORP	0,94	0,74	0,63	1,13	1,22
34	LISKWARTIER	-0,45	-0,52	-0,52	-0,10	-0,06
35	OUDE NOORDEN	-1,31	-1,40	-1,23	-0,94	-0,80
36	NIEUW-CROOSWIJK	-0,51	-1,17	-1,47	-1,17	-1,08
37	OUD-CROOSWIJK	-2,25	-1,45	-0,82	-1,19	-0,93
40	RIVIUM					
41	KRALINGEN-WEST	0,33	-0,52	-0,40	-0,28	-0,21
42	KRALINGEN-OOST	0,26	0,45	0,50	1,75	1,88
43	KRALINGSE BOS	*	*	*	*	*
44	'S-GRAVENLAND	-0,60	1,42	0,53	1,76	1,84
45	DE ESCH	-2,86	-0,26	0,13	0,58	1,05
46	KRALINGSEVEER	0,57	1,06	0,83	0,38	0,99
47	STRUISENBURG	-0,16	0,15	0,08	0,56	0,90
48	PRINSENLAND	0,80	0,40	0,57	0,42	1,05
49	HET LAGE LAND	0,85	1,16	1,05	1,29	1,16
51	KLEINPOLDER	0,84	0,21	0,07	-0,17	-0,15
52	NOORD-KETHEL	*	*	*	*	*
53	SPAANSE POLDER	*	*	*		
54	SCHIEVEEN	*	*	*	*	*
55	ZESTIENHOVEN	0,35	-0,10	0,34	0,22	-0,24
56	OVERSCHIE	0,84	0,91	0,89	0,99	0,98
57	LANDZICHT	*	*	*	*	*
58	BLIJDORPSE POLDER	*	*	*	*	*
59	OOST-ABTSPOLDER					*
60	SCHIEBROEK	1,23	1,10	0,98	0,93	0,78



Achterstandsscores van Rotterdam 1998

Nr	buurtnaam	A-Sc80	A-Sc87	A-Sc91	A-Sc95	A-Sc98
61	HILLEGERSBERG-ZUID	0,85	0,81	0,76	0,97	1,19
62	HILLEGERSBERG-NOORD	1,07	1,03	0,98	1,19	1,11
63	OMMOORD	1,17	1,41	1,39	1,16	1,19
64	TERBREGGE	0,98	1,30	1,27	1,47	1,75
65	MOLENLAANKWARTIER	1,55	1,86	1,83	2,49	2,36
66	ZEVENKAMP		0,48	0,91	0,54	0,54
67	OOSTERFLANK		0,52	0,75	0,90	0,83
68	NESSELANDE					*
71	TARWEWIJK	-0,13	-0,72	-0,99	-0,92	-1,58
72	CARNISSE	0,48	-0,02	-0,06	-0,05	-0,27
73	ZUIDWIJK	0,85	0,73	0,41	0,20	-0,14
74	OUD-CHARLOIS	-0,13	-0,21	-0,23	-0,23	-0,33
75	WIELEWAAL	0,68	1,20	0,86	0,27	0,19
76	ZUIDPLEIN	-0,57	0,22	0,94	1,93	1,35
77	PENDRECHT	1,11	0,80	0,62	0,39	-0,23
78	ZUIDERPARK	-0,63	0,96	0,78	1,26	0,77
79	ENTREPOT					-0,17
80	VREEWIJK	0,77	0,40	0,38	0,34	0,21
81	BLOEMHOF	-0,61	-1,05	-1,20	-1,24	-1,35
82	HILLESLUIS	-0,96	-1,41	-1,44	-1,50	-1,61
83	OUD-IJSSELMONDE	0,33	0,88	0,95	0,79	0,96
84	LOMBARDIJEN	0,78	0,77	0,73	0,32	0,23
85	KATENDRECHT	-2,18	-1,08	-0,81	-1,26	-1,16
86	AFRIKAANDERWIJK	-1,47	-1,40	-1,52	-1,90	-1,65
87	FEIJENOORD	-1,92	-1,69	-1,53	-1,67	-1,41
88	NOORDEREILAND	-1,22	-0,67	-0,42	-0,18	0,25
89	GROOT-IJSSELMONDE	0,93	1,01	0,99	0,62	0,47
90	BEVERWAARD		-0,53	0,33	-0,18	-0,15
91	PERNIS	1,05	1,01	1,02	0,80	0,90
92	HOOGVLIET-NOORD	0,25	-0,21	-0,46	-0,64	-0,76
93	HEIJPLAAT	1,10	1,22	1,04	0,65	0,64
94	WAALHAVEN			*	*	*
95	VONDELINGENPLAAT			*	*	*
96	EEMHAVEN			*	*	*
98	WAALHAVEN-ZUID			*	*	*
99	HOOGVLIET-ZUID		0,71	1,12	0,79	0,60

Source: COS

Status scores

pcnr	pcname06	score06	score02	score98	score94	rank 06	rank 02	rank 98	rank 94	%rank 06	%rank 02	%rank 98	%rank 94
3.011	STADSDRIEHOEK	-0,62610	-0,52018	0,28822	-0,18	51	50	43	52	0,107	0,125	0,25	0,072
3.012	COOL	0,73643	0,78887	1,29403	0,69	36	35	29	35	0,375	0,392	0,5	0,381
3.013	C.S. KWARTIER	-2,23594	-1,69428	-2,12871	-2,63	56	56	56	56	0,017	0,017	0,017	0
3.014	OUDE WESTEN	3,76141	3,81117	3,97600	3,74	1	3	2	2	1	0,964	0,982	0,981
3.015	DIJKZIGT	0,73320	1,31329	0,60574	-0,09	37	31	38	49	0,357	0,464	0,339	0,127
3.016	NIEUWE WERK	-0,45750	-1,42596	0,08116	0,28	49	53	44	42	0,142	0,071	0,232	0,254
3.021	MIDDELLAND	1,77327	2,10595	2,28559	1,80	26	18	17	19	0,553	0,696	0,714	0,672
3.022	NIEUWE WESTEN	2,26547	2,73299	2,45923	2,19	14	12	15	15	0,767	0,803	0,75	0,745
3.023	NIEUWE WESTEN	2,02009	2,37431	2,90548	2,83	21	15	11	9	0,642	0,75	0,821	0,854
3.024	DELFSHAVEN	2,46480	2,86165	2,78983	2,44	13	11	12	13	0,785	0,821	0,803	0,781
3.025	BOSPOLDER	2,52480	3,30256	3,34495	3,21	12	7	7	5	0,803	0,892	0,892	0,927
3.026	TUSSENDIJKEN	2,85717	2,91197	2,74672	2,70	8	10	13	10	0,875	0,839	0,785	0,836
3.027	SPANGEN	3,13867	3,83736	4,28409	3,75	4	2	1	1	0,946	0,982	1	1
3.028	OUD-MATHENESSE	1,97232	1,65584	1,52560	1,54	22	27	24	25	0,625	0,535	0,589	0,563
3.031	RUBROEK	2,03645	2,37938	1,80988	1,94	20	14	19	17	0,66	0,767	0,678	0,709
3.032	AGNIESEBUURT	1,23846	1,89934	1,36127	1,59	31	23	28	23	0,464	0,607	0,517	0,6
3.033	PROVENIERSWIJK	0,97848	1,14991	1,21950	1,50	33	32	30	26	0,428	0,446	0,482	0,545
3.034	NIEUWCROOSWIJK	3,27889	3,34088	3,67048	3,18	2	6	4	6	0,982	0,91	0,946	0,909
3.035	OUDE NOORDEN	2,74315	3,08504	3,01357	2,30	9	9	9	14	0,857	0,857	0,857	0,763
3.036	OUDE NOORDEN	3,00798	3,45146	3,59838	3,26	5	5	5	4	0,928	0,928	0,928	0,945
3.037	LISKWARTIER	0,90661	0,44040	0,95732	1,22	34	41	35	30	0,41	0,285	0,392	0,472
3.038	BERGPOLDER	1,40915	1,78219	1,46620	1,72	29	25	26	21	0,5	0,571	0,553	0,636
3.039	BLIJDORP	-0,52466	-0,36973	-0,16303	-0,01	50	48	49	45	0,125	0,16	0,142	0,2
3.042	KLEINPOLDER	2,16315	2,26829	1,67922	1,59	16	16	21	24	0,732	0,732	0,642	0,581
3.043	ZESTIENHOVEN	0,02489	0,09066	0,60419	0,38	47	45	39	39	0,178	0,214	0,321	0,309
3.045	ZESTIENHOVEN	0,50747	0,54345	1,50598	1,39	40	37	25	27	0,303	0,357	0,571	0,527
3.046	SCHIEVEEN	-1,13956	-1,02713	-0,54312	-0,11	54	51	52	50	0,053	0,107	0,089	0,109
3.051	H'BERG-Z	0,00924	-0,39472	-0,13848	-0,11	48	49	48	51	0,16	0,142	0,16	0,09
3.052	SCHIEBROEK	1,85955	0,94541	1,01717	0,34	24	34	32	40	0,589	0,41	0,446	0,29
3.053	SCHIEBROEK	0,71562	0,50554	0,47026	0,42	38	39	42	38	0,339	0,321	0,267	0,327
3.054	H'BERG-N	0,35732	0,28678	0,03793	0,21	42	44	45	44	0,267	0,232	0,214	0,218
3.055	MOLENLAANKW	-0,82427	-1,18623	-1,85332	-1,91	52	52	55	55	0,089	0,089	0,035	0,018
3.056	TERBREGGE ROTTERDAM	-1,03892	-1,47743	-1,01651	-0,63	53	54	53	53	0,071	0,053	0,071	0,054
3.059	ZEVENHUIZEN	-2,68241	-2,53565	-2,36698		57	57	57		0	0	0	
3.061	KRALINGEN-WEST	1,68918	1,83038	1,74478	1,94	27	24	20	16	0,535	0,589	0,66	0,727
3.063	DE ESCH	0,52208	0,49271	0,93046	0,30	39	40	36	41	0,321	0,303	0,375	0,272
3.064	KRALINGSE VEER	0,09228	0,53544	0,48729	0,63	46	38	41	37	0,196	0,339	0,285	0,345
3.065	'S-GRAVENLAND	-1,54219	-1,52159	-1,48418	-1,64	55	55	54	54	0,035	0,035	0,053	0,036
3.066	PRINSENLAND	0,36688	-0,05364	-0,17779	0,24	41	46	50	43	0,285	0,196	0,125	0,236
3.067	HET LAGE LAND	0,33083	0,63998	-0,10305	-0,03	43	36	47	46	0,25	0,375	0,178	0,181
3.068	OMMOORD	0,16017	0,40658	-0,03090	-0,07	45	42	46	48	0,214	0,267	0,196	0,145
3.069	OMMOORD	0,16710	-0,15280	-0,28616	-0,07	44	47	51	47	0,232	0,178	0,107	0,163
3.071	FEIJENOORD	1,34132	1,97385	2,95050	3,04	30	19	10	8	0,482	0,678	0,839	0,872
3.072	AFRIKAANDERW	2,94506	3,84429	3,53677	3,37	6	1	6	3	0,91	1	0,91	0,963
3.073	BLOEMHOF	2,61577	2,71756	2,73536	2,49	11	13	14	11	0,821	0,785	0,767	0,818
3.074	HILLESLUIS	2,92765	3,13309	3,87187	3,12	7	8	3	7	0,892	0,875	0,964	0,89
3.075	VREEWIJK	2,20223	1,93025	1,20122	1,18	15	22	31	31	0,75	0,625	0,464	0,454
3.076	LOMBARDIJEN	1,91279	1,77463	0,98166	1,05	23	26	33	33	0,607	0,553	0,428	0,418
3.077	BEVERWAARD	0,79997	0,33999	0,68873	0,64	35	43	37	36	0,392	0,25	0,357	0,363
3.078	GROOT-IJSSELM	1,84013	1,94891	1,39952	1,31	25	20	27	29	0,571	0,66	0,535	0,49
3.079	GROOT-IJSSELM	1,18664	1,06890	0,55972	0,76	32	33	40	34	0,446	0,428	0,303	0,4
3.081	TARWEWIJK	3,16905	3,53076	3,17926	2,44	3	4	8	12	0,964	0,946	0,875	0,8
3.082	OUD-CHARLOIS	2,07924	1,93695	1,85635	1,77	18	21	18	20	0,696	0,642	0,696	0,654
3.083	CARNISSE	2,05816	1,40724	0,97919	1,15	19	29	34	32	0,678	0,5	0,41	0,436
3.084	ZUIDERPARK	1,64175	1,40014	2,32513	1,85	28	30	16	18	0,517	0,482	0,732	0,69
3.085	ZUIDWIJK	2,13577	1,55725	1,62817	1,71	17	28	22	22	0,714	0,517	0,625	0,618
3.086	PENDRECHT	2,62732	2,10634	1,58938	1,36	10	17	23	28	0,839	0,714	0,607	0,509

Source: SCP

Social index	score 2010	score 2009	score 2008	perc. rank 2010	perc. rank 2009	perc. rank 2008
Neighborhood name						
s Graveland	8	7,9	7,7	0,983	0,983	0,95
Terbregge	8	7,8	7,8	0,983	0,95	0,966
Molenlaankwartier	7,9	8,1	8	0,967	1	1
Nesselande	7,7	7,7	7,8	0,95	0,933	0,966
Kralingseveer	7,6	7,8	7,5	0,934	0,95	0,883
Hillegergsberg-Z	7,4	7,5	7,5	0,868	0,883	0,883
Hillegergsberg-N	7,4	7,3	7,2	0,868	0,85	0,85
Kralingen Oost/Kralingse Bos	7,4	7,6	7,5	0,868	0,916	0,883
Pernis	7,4	7,5	7,2	0,868	0,883	0,85
Oud Ijsselmonde	7,1	6,9	7	0,836	0,75	0,8
Overschie e.o.	6,9	7,1	6,7	0,786	0,8	0,733
Blijdorp	7,2	7,4	7,5	0,852	0,866	0,883
Het Lage Land	6,4	6,9	6,8	0,688	0,75	0,766
Prinsenland	7	7,2	7	0,819	0,833	0,8
Schiebroek	6	6,8	6,8	0,54	0,7	0,766
Ommoord	6,9	7,1	7,1	0,786	0,8	0,833
Noordereiland	6,4	6,1	6,2	0,688	0,483	0,6
De Esch	6	6,4	6,4	0,54	0,583	0,633
Struisenburg	6,7	6,8	6,7	0,754	0,7	0,733
Wielewaal	6,1	6,5	5,8	0,59	0,65	0,433
Heijplaat	5,8	6,2	6	0,442	0,516	0,533
Schiemond	5,6	5,6	5,5	0,344	0,333	0,316
Liskwartier	6,3	6,4	6,4	0,655	0,583	0,633
Kop van Zuid-Entrepot	6,2	6,4	5,8	0,622	0,583	0,433
Zevenkamp	6	7	6,6	0,54	0,783	0,716
Kleinpolder	5,5	5,5	5,8	0,311	0,266	0,433
Bergpolder	6,2	6,2	5,9	0,622	0,516	0,5
Katendrecht	5,9	5,6	5,3	0,475	0,333	0,2
Provenierswijk	5,9	6	6,1	0,475	0,433	0,566
Oosterflank	6,3	6,5	6,4	0,655	0,65	0,633
Oud/Nieuw Mathenesse/Witte dorp	5,2	5,2	5,3	0,163	0,166	0,2
Lombardijen	5,6	5,8	5,5	0,344	0,416	0,316
Beverwaard	5,2	5,7	5,9	0,163	0,366	0,5
Groot IJsselmonde-Noord	5,9	6,4	6	0,475	0,583	0,533
Zuidwijk	5,4	5,7	5,5	0,278	0,366	0,316
Vreewijk	5,8	6,1	6,3	0,442	0,483	0,616
Kralingen-West	5,7	6	5,6	0,377	0,433	0,383
Rubroek	5,7	6	5,7	0,377	0,433	0,4
Delfshaven	5,7	5,4	5,3	0,377	0,25	0,2
Oud-Charlois	5,4	5,1	5,3	0,278	0,1	0,2
Spangen	5,1	5,3	5,3	0,114	0,2	0,2
Tussendijken	5,1	5,1	5	0,114	0,1	0,116
Bospolder	5	5,2	5,2	0,098	0,166	0,166
Agniesebuurt	5,5	5,5	5,5	0,311	0,266	0,316
Oud Crooswijk	5,2	5,1	5,2	0,163	0,1	0,166
Carnisse	4,9	5,1	4,9	0,065	0,1	0,083
Oude Noorden	5,3	5,3	5,1	0,213	0,2	0,15
Stadsdriehoek/C.S. Kwartier	6,6	6,8	6,5	0,737	0,7	0,683
Feijenoord	4,9	4,8	4,9	0,065	0	0,083
Pendrecht	5,1	4,9	4,6	0,114	0,05	0,016
Nieuwe Westen	5,3	5,5	5,4	0,213	0,266	0,3
Afrikaanderwijk	4,7	4,9	4,7	0,016	0,05	0,05
Nieuw Crooswijk	5,3	5,3	5	0,213	0,2	0,116
Middelland	5,7	5,7	5,7	0,377	0,366	0,4
Bloemhof	4,7	4,8	4,6	0,016	0	0,016
Cool/Nieuwe Werk/Dijkzigt	6,4	6,5	6,5	0,688	0,65	0,683
Zuiderpark/Zuidplein	6,1	6,2	6,1	0,59	0,516	0,566
Hillesluis	4,8	5	4,7	0,049	0,083	0,05
Oude Westen	5,3	5,5	5,3	0,213	0,266	0,2
Tarwewijk	4,6	4,8	4,5	0	0	0
Kop van Zuid	6,8			0,77		
Groot IJsselmonde-Zuid	5,9	6,3	5,8	0,475	0,566	0,433

Source: COS

Safety Index	score	score	score	score	score	score	score	score	score	perc. Rang	perc. Rang	perc. Rang	perc. Rang	perc. Rang	perc. Rang	perc. Rang	perc. Rang	perc. Rang
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2001	2002	2003	2004	2005	2006	2007	2008	2009
Neighborhood name																		
Oude Westen	1,5	1,8	2,2	2,7	3,5	4,5	4	3,5	4,1	0	0,017	0	0	0	0,05	0	0	0,016
Cool/Nieuwe Werk/Dijkzigt	1,8	1,5	2,7	4	4,2	4	5,4	5,2	4,7	0,017	0	0,017	0,017	0,016	0	0,118	0,101	0,067
Stadsdriehoek/C.S. Kwartier	2,8	3,1	3,9	4,2	4,5	5,1	5,1	5,1	5,5	0,051	0,086	0,086	0,051	0,05	0,101	0,067	0,067	0,203
Spangen	2,5	2,7	4	4,5	4,6	7	7	6,3	6,3	0,034	0,034	0,103	0,068	0,084	0,423	0,44	0,372	0,322
Middelland	4,7	3,7	4,2	5	5,2	4,8	5,3	5,2	5	0,327	0,12	0,137	0,206	0,186	0,084	0,101	0,101	0,101
Bospolder	3,8	4,5	4,9	5,3	5,7	6,3	6,5	6,4	6	0,137	0,258	0,258	0,241	0,271	0,322	0,322	0,423	0,288
Nieuwe Westen	4,1	4,4	4,6	5,5	5,1	5,4	6,2	4,8	5,3	0,224	0,206	0,224	0,275	0,169	0,152	0,237	0,05	0,152
Delfshaven	3,9	4,6	5,5	5,6	6,2	5,9	6,4	5,6	6,7	0,189	0,275	0,362	0,31	0,338	0,271	0,305	0,22	0,355
Tussendijken	3,3	4,4	5	5,8	6,6	6	6,9	6,2	6,2	0,086	0,206	0,275	0,344	0,474	0,288	0,423	0,322	0,305
Schiemond	4,1	4,9	6,3	6	6,5	7,2	7,6	8	8	0,224	0,344	0,5	0,431	0,44	0,491	0,559	0,61	0,644
Oud-Nieuw Mathen./Witte Dorp	5,5	5,6	6,1	6,5	7,4	7,3	7,9	7,4	7,3	0,482	0,5	0,465	0,482	0,559	0,508	0,627	0,525	0,474
Pendrecht	4	3,9	4,3	4,8	4,9	4,7	5,4	5,5	5,4	0,206	0,137	0,172	0,137	0,135	0,067	0,118	0,186	0,169
Tarwewijk	3,6	3,5	3,5	4,8	4,5	5,3	4,6	4,6	3,9	0,103	0,103	0,034	0,137	0,05	0,118	0,016	0,016	0
Zuidplein	2,9	2,7	3,7	4,9	4,9	4,4	4,7	5,1	4,4	0,068	0,034	0,051	0,172	0,135	0,033	0,033	0,067	0,05
Oud-Charlois	5	5,4	5	5,1	4,6	5,7	6,3	5,9	6,4	0,379	0,431	0,275	0,224	0,084	0,22	0,271	0,288	0,338
Carnisse	5	4,4	5,6	5,9	5,8	5,8	5,7	6,2	5,6	0,379	0,206	0,413	0,396	0,288	0,254	0,152	0,322	0,22
Zuidwijk	5,4	5,4	6,3	6,2	6,7	6,8	6,7	6,2	7	0,465	0,431	0,5	0,465	0,508	0,406	0,355	0,322	0,423
Heijplaat	7,5	8,2	7,6	8,5	7,5	8,4	9,4	9,1	8,2	0,793	0,879	0,741	0,81	0,576	0,711	0,83	0,779	0,661
Wielewaal	8	7,9	8,2	9,4	8,5	9,2	10	9,9	8,2	0,879	0,844	0,81	0,931	0,745	0,813	0,864	0,864	0,661
Bloemhof	4,1	3,9	4,2	4,5	4,3	5,5	5,1	5,3	4,8	0,224	0,137	0,137	0,068	0,033	0,169	0,067	0,152	0,084
Hillesluis	3,7	4,2	3,8	4,5	5,5	5,6	4,9	4,6	4,3	0,12	0,189	0,068	0,068	0,237	0,186	0,05	0,016	0,033
Afrikaanderwijk	4,4	4,1	4,6	4,6	5,4	5,6	5,7	5,5	5,1	0,293	0,172	0,224	0,12	0,22	0,186	0,152	0,186	0,135
Feijenoord	5,9	5,6	5,5	5,8	6,2	7	6,3	5,7	5,4	0,534	0,5	0,362	0,344	0,338	0,423	0,271	0,237	0,169
Vreewijk	5,5	5,6	5,8	5,9	6,2	6,5	7	7,6	6,8	0,482	0,5	0,431	0,396	0,338	0,355	0,44	0,559	0,372
Katendrecht	3,8	4,9	5,5	6	6,3	5,7	7,1	7,1	7,6	0,137	0,344	0,362	0,431	0,389	0,22	0,525	0,474	0,542
Kop van Zuid entrepot	5,9	5,9	6,8	7,6	8,1	8	7,9	7,7	7,9	0,534	0,586	0,62	0,655	0,694	0,644	0,627	0,576	0,61
Noordereiland	6,4	7	7,9	8,3	8,7	8,6	8,9	8,3	8,5	0,655	0,741	0,758	0,758	0,796	0,779	0,762	0,711	0,728
Oude Noorden	3,8	3	4,1	4	5,2	4,1	6	5,2	5,6	0,137	0,068	0,12	0,017	0,186	0,016	0,186	0,101	0,22
Agniesebuurt	4,9	5	5,3	4,9	5,8	5,3	6	6	5,7	0,344	0,379	0,327	0,172	0,288	0,118	0,186	0,305	0,254
Bergpolder	5,6	5,3	5,9	6,7	6,6	7,7	7,4	7,3	7,7	0,517	0,413	0,448	0,517	0,474	0,576	0,542	0,491	0,559
Liskwartier	6	5,8	6,7	6,9	7,7	7,5	7,7	8,1	7,9	0,586	0,551	0,586	0,551	0,61	0,542	0,593	0,644	0,61
Provenierswijk	5,1	5,5	6,6	7	7	7,3	7,6	7,3	7,5	0,431	0,465	0,568	0,568	0,542	0,508	0,559	0,491	0,525
Blijdorp	7	6,9	7,9	7,7	8	8,3	8,8	9	9	0,724	0,706	0,758	0,672	0,677	0,661	0,728	0,762	0,796
Kralingen West	4,4	4,6	4,4	5,4	6,1	6,5	7	6,3	6,8	0,293	0,275	0,189	0,258	0,322	0,355	0,44	0,372	0,372
Nieuw Crooswijk	4,9	4,8	4,5	5,5	4,7	6,3	6,1	5,8	5	0,344	0,327	0,206	0,275	0,118	0,322	0,22	0,271	0,101
Oud Crooswijk	5	4,6	5,1	5,7	5,5	6	7	5,4	5,7	0,379	0,275	0,31	0,327	0,237	0,288	0,44	0,169	0,254
Rubroek	4,3	5,1	5,4	5,8	6,5	6,6	6,2	5,7	6,8	0,275	0,396	0,344	0,344	0,44	0,389	0,237	0,237	0,372
Struisenburg	5,3	6	6,7	7	7,7	8,4	8,9	7,9	8,3	0,448	0,603	0,586	0,568	0,61	0,711	0,762	0,593	0,694
Kralingen Oost/Kralingse Bos	5,9	6,5	6,9	7,4	8,8	9,6	10	9,9	10	0,534	0,655	0,637	0,603	0,83	0,881	0,864	0,864	0,864
De Esch	6,7	6,6	7,4	7,9	8,2	8,4	7,8	8,2	8,3	0,689	0,689	0,706	0,689	0,728	0,711	0,61	0,677	0,694
Beverwaard	6,2	5,8	6,5	6,6	6,3	7,1	6,5	6,3	7,2	0,637	0,551	0,534	0,5	0,389	0,474	0,322	0,372	0,457
Groot Ijsselmonde	6	6,3	6,5	6,7	6,8	7	7	6,6	7,1	0,586	0,62	0,534	0,517	0,525	0,423	0,44	0,44	0,44
Lombardijen	6,1	5,5	6,1	7,4	6,3	7,9	6,8	7	7,3	0,62	0,465	0,465	0,603	0,389	0,61	0,372	0,457	0,474

Oud Ijsselmonde	8,2	8,4	8,8	9,2	10	9,7	8,9	9,6	9,4	0,896	0,913	0,913	0,879	0,915	0,898	0,762	0,847	0,847
Zevenkamp (t/m 2004 incl Nesselande)	6,9	6,9	7,5	7,5	7,5	7,8	6,8	8	7,8	0,706	0,706	0,724	0,637	0,576	0,593	0,372	0,61	0,593
Oosterflank	7	6,4	7,3	8	8,1	7,5	6,8	7,5	7,4	0,724	0,637	0,689	0,724	0,694	0,542	0,372	0,542	0,508
Ommoord	7,5	7,3	7,9	8,3	8,6	7,9	8,1	8,1	8,6	0,793	0,775	0,758	0,758	0,779	0,61	0,661	0,644	0,745
Het Lage Land	8,3	7,8	8,5	8,5	8,5	8,3	8,3	8,9	9	0,913	0,827	0,844	0,81	0,745	0,661	0,694	0,745	0,796
Prinsenland	8,3	8,4	9,1	8,9	8,9	8,9	8,8	9,3	8,8	0,913	0,913	0,931	0,862	0,847	0,796	0,728	0,813	0,762
s Graveland	8,6	8,7	9,6	9,9	10	10	10	10	10	0,948	0,948	0,948	0,948	0,915	0,915	0,864	0,898	0,864
Kralingseveer	9,3	9,6	9,8	10	10	10	10	10	10	1	0,982	0,965	0,982	0,915	0,915	0,864	0,898	0,864
Nesselande					10	10	10	10	10					0,915	0,915	0,864	0,898	0,864
Kleinpolder	6,4	6,5	7,1	7,9	7,8	8,5	8,1	8,2	7,7	0,655	0,655	0,655	0,689	0,644	0,762	0,661	0,677	0,559
Overschie e.o.	7,3	7,4	8,6	9,2	8,7	9,4	9,3	9,2	9	0,775	0,793	0,862	0,879	0,796	0,847	0,813	0,796	0,796
Schiebroek	7	7	7,2	8,2	7,9	8,3	8,7	8,7	8,8	0,724	0,741	0,672	0,741	0,661	0,661	0,711	0,728	0,762
Hillegersberg Z	7,6	8	8,3	8,3	9,3	9,3	10	10	10	0,827	0,862	0,827	0,758	0,881	0,83	0,864	0,898	0,864
Hillegersberg N	7,7	7,7	8,6	8,7	9,4	10	10	10	10	0,844	0,81	0,862	0,844	0,898	0,915	0,864	0,898	0,864
Molenlaankwartier	8,7	9,2	10	9,9	10	10	10	10	10	0,965	0,965	1	0,948	0,915	0,915	0,864	0,898	0,864
Terbregge	9,1	9,6	9,9	10	10	10	10	10	10	0,982	0,982	0,982	0,982	0,915	0,915	0,864	0,898	0,864
Pernis	7,9	8,3	8,7	9,2	9,2	9,5	9,5	9,4	10	0,862	0,896	0,896	0,879	0,864	0,864	0,847	0,83	0,864

Source: COS

Appendix 7 : Impediments and Objective rights

Impediments (in Dutch):

Code	**omschrijving**
AL	Aanwijzing van luchtvaartterrein ex. art.18 Luchtvaartwet
AM	Beschermd Archeologisch monument als bedoeld in de Monumenten Wet 1988
AMD	Beschermd Archeologisch monument als bedoeld in de Monumenten Wet 1988 op een ged. van het perceel
AP	Aanschrijving of bouwverbod krachtens provinciale wegenverordening
AS	Tevens appartementsrecht in eigendom na belasting met erfpacht
AV	Regeling artikel 18 van de Reconstr. Wet M-Delfland
AW	Aanschrijving woningwet
AWD	Aanschrijving woningwet gedeeltelijk
BB	Bouwgrond- en/of baatbelasting; inl. bij de Gemeente
BBD	Bouwgrond- en/of baatbelasting gedeeltelijk; inlichtingen bij de Gemeente
BG	BP-gedoogplicht
BGD	BP-gedeeltelijk gedoogplicht
BH	Beklemhuur
BL	Belemmeringenwet landsverdediging
BLD	Belemmeringenwet landsverdediging ged.
BO	Bevel buitengewone omstandigheden
BOD	Bevel buitengewone omstandigheden ged.
BP BP	(zak. recht/ged. pl.)
BPD BP	gedeeltelijk (zak. recht/ged. pl.)
BS	Beschermd stads- of dorpsgezicht, zie monumentenwet 1988; inl. bij de gemeente
BSD	Gedeeltelijk gelegen in beschermd stads-dorpsgezicht, zie monumentenwet 1988; inl. bij de Gemeente
BV	Vonnis van boedelverzegeling

BVD	Vonnis van boedelverzegeling ged.
BW	Verplichting tot bijdragen in het onderhoud, zie Waterstaatswet 1900
BZ	Zakelijk recht als bedoeld in art.5,lid 3,onder b,van de Belemmeringenwet Privaatrecht
BZD	Zakelijk recht als bedoeld in art.5,lid 3,onder b, van de Belemm. wet Privaatr op ged. van perceel
DW	Deltawet
DWD	Deltawet gedeeltelijk
FA	Fictief appartementsrecht
GG	Gezamenlijke grootte
GH	Gedoogverplichting Wet geluidhinder
GHD	Gedoogverplichting Wet geluidhinder ged.
GL	Gedoogverplichting Wet luchtverontreiniging
GLD	Gedoogverplichting Wet luchtverontr. ged.
GM	Gemeentelijk monument; inlichtingen bij de Gemeente
GMD	Gemeentelijk monument gedeeltelijk; inlichtingen bij de Gemeente
GP	Gedoogplicht ex. art.31 of 32 Grondwaterwet
GS	Gebouwd met subsidie
GSD	Gebouwd met subsidie ged.
GT	Gedoogplicht ex. hoofdstuk 5 Telecommunicatiewet
GW	Gedoogplicht ex. art10, lid 2, 12 of 12a Waterstaatswet 1900
GZ	Geluidszone ex. art.41 Wet geluidhinder
IR	Instelling rechtsmiddel
IRD	Instelling rechtsmiddel ged.
IV	Instelling rechtsvordering
IVD	Instelling rechtsvordering ged.
KB	Kapverbod ex. art.13 Boswet
KV	Kwalitatieve verbintenis
KVD	Kwalitatieve verbintenis ged.
LB	Lening wet bezitvormingsfonds
LBD	Lening wet bezitvormingsfonds ged.
LIV	Landinrichtingsprojekt in voorbereiding
LW	Verbod artikel 38 Luchtvaartwet
LWD	Verbod art.38 Luchtvaartwet ged.
MA	Bestemming tot gemeensch. nut i.v.m. Mandeligheid
MC	Meetconsort
MD	Met aandeel in mandelig perceel
MDD	Bestemming tot gemeenschappelijk nut i.v.m. mandeligheid v.w.b. een gedeelte van een perceel
MN	Nog te meten
MW	Beschermd monument als bedoeld in de Monumenten Wet 1988
MWD	Monumentenwet gedeeltelijk
MY	Machtiging ex. art.10 Mijnwet 1810
NM	Natuurmonument
NMD	Natuurmonument op een gedeelte van het perceel
NS	Appartementsrecht in eigendom na belasting met erpacht
NW	Natuurschoonwet
NWO	Natuurschoonwet in onderzoek
NWP	Natuurschoonwet opengesteld voor publiek
OB	Ondergronds bouwwerk
OBD	Ondergronds bouwwerk inzake een gedeelte van een perceel
OG	Opstal olie/gas
OGD	Opstal olie/gas gedeeltelijk
OL	Opstalrecht Nutsvoorzieningen
OLD	Opstalrecht Nutsvoorzieningen op gedeelte van perceel

ON	Besluit inzake onteigening; inlichtingen bij de Gemeente
OND	Raadsbesluit tot onteigening gedeeltelijk; inlichtingen bij de Gemeente
OT	Ondergrondse olietank, inlichtingen bij de gemeente
OW	Onderhoudsplicht of verplichting tot bijdragen onderhoud, zie Wegenwet
PM	Provinciaal monument; inl. bij Provincie
PMD	Provinciaal monument gedeeltelijk; inlichtingen bij de Provincie
PO	Plicht tot onderhoud of verbodsbepaling krachtens waterschapskeur
PP	Bouwverbod krachtens provinciale plassenverordening
RB	Raadpleeg brondokument
RO	Met betrekking tot het perceel is een ruilverkavelingsovereenkomst ingeschreven
ROD	Met betrekking tot een gedeelte van het perceel is een ruilverkavelingsovereenkomst ingeschreven
RR	RVK-rente te verwachten
SD	Schuldplichtigheid Deltawet
SDD	Schuldplichtigheid Deltawet ged.
SV	Vergunning nodig voor splitsing in app.rechten; inlichtingen bij de Gemeente
TB	Toestemming om boom, enz. binnen verboden afstand te hebben
TBD	Toestemming om boom, enz. binnen verboden afstand te hebben ged.
TC	Eigendom Telecommunicatienetwerk
TCD	Eigendom Telecommunicatienetwerk gedeeltelijk
TE	Erfpachtrecht Telecommunicatienetwerk
TED	Erfpachtrecht Telecommunicatienetwerk gedeeltelijk
TV	Vruchtgebruik Telecommunicatienetwerk
TVD	Vruchtgebruik Telecommunicatienetwerk gedeeltelijk
VB	Verbodsbepalingen waterkeringen; inlichtingen bij het Waterschap
VBD	Verbodsbepalingen waterkeringen gedeeltelijk; inlichtingen bij het Waterschap
VG	Voorkeursrecht gemeenten
VGD	Voorkeursrecht gemeenten gedeeltelijk
VM	Verlaten Mijnbouwwerk; Inlichtingen: Staatstoezicht op de mijnen Rijswijk tel. 070-3956500
VN	Voornemen vernieuwing
VR	Vrijwillige ruilverkaveling
VS	Verbouwd met subsidie
VSD	Verbouwd met subsidie ged.
VW	Afwijkende regeling artikel 59, boek 5 van het Burgerlijk Wetboek
VWD	Afwijkende regeling art.59 boek 5 BW ged.
WB	Inzake dit perceel bestaat een een besluit als bedoeld in art.55 Wet Bodembescherming
WBD	Inzake een gedeelte van dit perceel bestaat een besluit als bedoeld in art.55 Wet Bodembescherming
WR	Wettelijke herverkaveling
WR0	Wettelijke ruilverkaveling (DUMMY)

Source: Dutch land registry office

Objective rights (in Dutch):

Omschrijving zakelijk recht codes

Code, omschrijving

EP Recht van erfpacht
VE Eigendom

Source: Dutch land registry office

Appendix 8: Monthly Inflation in the Netherlands

Consumer prices: inflation

periods	%		
1994 July	2,7		
1994 August	2,6		
1994 September	2,7		
1994 October	2,8		
1994 November	2,5		
1994 December	2,6		
1995 January	2,4		
1995 February	2,4		
1995 March	2,3		
1995 April	2,3		
1995 May	2,1	average over	
1995 June	2,1	1994Q3-1995Q2	2,458333333
1995 July	1,8		
1995 August	1,5		
1995 September	1,5		
1995 October	1,3		
1995 November	1,6		
1995 December	1,7		
1996 January	1,9		
1996 February	1,8		
1996 March	2		
1996 April	2		
1996 May	2	average over	
1996 June	1,8	1995Q3-1996Q2	1,741666667
1996 July	2,2		
1996 August	1,9		
1996 September	2		
1996 October	2,4		
1996 November	2,3		
1996 December	2,5		
1997 January	2,3		
1997 February	2,2		
1997 March	2		
1997 April	1,8		
1997 May	2,2	average over	
1997 June	2,2	1996Q3-1997Q2	2,166666667

1997 July	2,3		
1997 August	2,6		
1997 September	2,6		
1997 October	2,3		
1997 November	2,5		
1997 December	2,3		
1998 January	1,8		
1998 February	2,2		
1998 March	2,3		
1998 April	2,4		
1998 May	2	**average over**	
1998 June	2,2	**1997Q3-1998Q2**	**2,291666667**
1998 July	2		
1998 August	1,7		
1998 September	1,7		
1998 October	1,9		
1998 November	1,7		
1998 December	1,7		
1999 January	2,2		
1999 February	2,1		
1999 March	2,2		
1999 April	2,2		
1999 May	2,3	**average over**	
1999 June	2,3	**1998Q3-1999Q2**	**2**
1999 July	2,1		
1999 August	2,6		
1999 September	2,2		
1999 October	2,1		
1999 November	2,2		
1999 December	2,2		
2000 January	2		
2000 February	2		
2000 March	1,9		
2000 April	2,1		
2000 May	2,4	**average over**	
2000 June	2,7	**1999Q3-2000Q2**	**2,208333333**
2000 July	2,8		
2000 August	2,5		
2000 September	2,9		
2000 October	3,1		
2000 November	3		
2000 December	2,9		
2001 January	4,2		
2001 February	4,5		
2001 March	4,6		
2001 April	4,9		
2001 May	4,9	**average over**	
2001 June	4,5	**2000Q3-2001Q2**	**3,733333333**
2001 July	4,6		
2001 August	4,7		
2001 September	4,7		
2001 October	4,3		
2001 November	4,2		
2001 December	4,4		
2002 January	4		
2002 February	3,8		
2002 March	3,6		
2002 April	3,6		
2002 May	3,3	**average over**	
2002 June	3,4	**2001Q3-2002Q2**	**4,05**

2002 July	3,4		
2002 August	3,3		
2002 September	3,3		
2002 October	3,2		
2002 November	3,1		
2002 December	3,1		
2003 January	2,4		
2003 February	2,4		
2003 March	2,4		
2003 April	2,1		
2003 May	2	**average over**	
2003 June	2	**2002Q3-2003Q2**	**2,725**
2003 July	2,1		
2003 August	2,1		
2003 September	2		
2003 October	2		
2003 November	2		
2003 December	1,7		
2004 January	1,3		
2004 February	1,2		
2004 March	1,1		
2004 April	1,4		
2004 May	1,5	**average over**	
2004 June	1,4	**2003Q3-2004Q2**	**1,65**
2004 July	1,1		
2004 August	1,1		
2004 September	1		
2004 October	1,4		
2004 November	1,3		
2004 December	1,2		
2005 January	1,5		
2005 February	1,6		
2005 March	1,8		
2005 April	1,5		
2005 May	1,3	**average over**	
2005 June	1,6	**2004Q3-2005Q2**	**1,366667**
2005 July	1,6		
2005 August	1,8		
2005 September	1,8		
2005 October	1,6		
2005 November	1,8		
2005 December	2		
2006 January	1,3		
2006 February	1,1		
2006 March	1		
2006 April	1,2		
2006 May	1,2	**average over**	
2006 June	1,3	**2005Q3-2006Q2**	**1,475**
2006 July	1,3		
2006 August	1,4		
2006 September	1,1		
2006 October	0,9		
2006 November	1		
2006 December	1,1		
2007 January	1,4		
2007 February	1,5		
2007 March	1,8		
2007 April	1,8		
2007 May	1,8	**average over**	
2007 June	1,7	**2006Q3-2007Q2**	**1,4**

2007 July	1,5		
2007 August	1,1		
2007 September	1,3		
2007 October	1,6		
2007 November	1,9		
2007 December	1,9		
2008 January	2		
2008 February	2,2		
2008 March	2,2		
2008 April	2		
2008 May	2,3	**average over**	
2008 June	2,6	**2007Q3-2008Q2**	**1,883333333**
2008 July	3,2		
2008 August	3,2		
2008 September	3,1		
2008 October	2,8		
2008 November	2,3		
2008 December	1,9		
2009 January	1,9		
2009 February	2		
2009 March	2		
2009 April	1,8		
2009 May	1,6	**average over**	
2009 June	1,4	**2008Q3-2009Q2**	**2,266667**
2009 July	0,2		
2009 August	0,3		
2009 September	0,4		
2009 October	0,7		
2009 November	1		
2009 December	1,1		
2010 January	0,8		
2010 February	0,8		
2010 March	1		
2010 April	1,1		
2010 May	1	**average over**	
2010 June	0,8	**2009Q3-2010Q2**	**0,766667**
2010 July	1,6		
2010 August	1,5		
2010 September	1,6		
2010 October	1,6		
2010 November	1,6		
2010 December	1,9		
2011 January	2		
2011 February	1,9		
2011 March	2		
2011 April	2,1		
2011 May	2,3	**average over**	
2011 June	2,3	**2010Q3-2011Q2**	**1,866667**
2011 July	2,6		
2011 August	2,6		
2011 September	2,7		
2011 October	2,6		
2011 November	2,6	**average over**	
2011 December	2,4	**2011Q3+2011Q4**	**2,583333**
2012 January	2,5		
2012 February	2,5		
2012 March	2,5		
2012 April	2,4		

Source: CBS

Appendix 9 : First and second step regression outcomes for Blijdorp and Hillesluis

Blijdorp:

ADRESS	lnp2minlnp1 Blijdorp	RES_1	TminS	TminS squared	Squared Residuals	PRE_1	PRE_1 squareroot	PRE_1squareroot reciprocal
Cleyburchstraat 47A	0,962097584	0,341	8	64	0,116301	0,031	0,176347823	5,670611554
Cleyburchstraat 47A	0,16492051	0,0592	6	36	0,003508	0,026	0,16257114	6,151153272
Cleyburchstraat 47B	0,057290547	0,0078	2	4	6,04E-05	0,018	0,133933709	7,466380238
Cleyburchstraat 49A	0,419348176	-0,0307	4	16	0,00094	0,022	0,148467517	6,735480064
Cleyburchstraat 49A	0,508251453	0,2315	10	100	0,053595	0,036	0,189868745	5,266796278
Cleyburchstraat 49B	0,532132261	0,1128	4	16	0,012729	0,022	0,148467517	6,735480064
Cleyburchstraat 49B	0,198821893	0,1506	1	1	0,022688	0,016	0,126459316	7,907681569
Cleyburchstraat 49C	0,267910017	0,1298	6	36	0,016847	0,026	0,16257114	6,151153272
Cleyburchstraat 51C	0,636426822	0,1363	7	49	0,018586	0,029	0,169495322	5,899867844
Cleyburchstraat 53A 1st serie	0,389638002	0,153	3	9	0,023422	0,02	0,141262593	7,0790149
Cleyburchstraat 53A 2nd serie	0,312574192	0,064	3	9	0,0041	0,02	0,141262593	7,0790149
Cleyburchstraat 53C	0,39670857	0,0928	6	36	0,008605	0,026	0,16257114	6,151153272
Cleyburchstraat 53C	0,106273705	0,0096	4	16	9,31E-05	0,022	0,148467517	6,735480064
Cleyburchstraat 55A	0,082027135	0,0266	3	9	0,000709	0,02	0,141262593	7,0790149
Cleyburchstraat 55B	0,789710191	0,3397	4	16	0,115395	0,022	0,148467517	6,735480064
Cleyburchstraat 55B	0,112314448	-0,0587	4	16	0,003451	0,022	0,148467517	6,735480064
Cleyburchstraat 55B	0,083617018	0,0092	4	16	8,55E-05	0,022	0,148467517	6,735480064
Cleyburchstraat 55C	0,866534597	0,295	6	36	0,087015	0,026	0,16257114	6,151153272
Cleyburchstraat 55C	-0,000651201	-0,0561	3	9	0,003143	0,02	0,141262593	7,0790149
Cleyburchstraat 55C	0,169280562	0,1091	2	4	0,011892	0,018	0,133933709	7,466380238
Cleyburchstraat 57A	0,434470939	0,3129	2	4	0,097925	0,018	0,133933709	7,466380238
Cleyburchstraat 57A	-0,006994675	-0,1348	4	16	0,018177	0,022	0,148467517	6,735480064
Cleyburchstraat 57B	0,012690053	-0,157	3	9	0,024664	0,02	0,141262593	7,0790149
Cleyburchstraat 57C	0,03834378	-0,1637	11	121	0,026801	0,039	0,196549831	5,087768314
Cleyburchstraat 59A	0,493758124	0,2917	2	4	0,0851	0,018	0,133933709	7,466380238
Cleyburchstraat 59A	0,261180194	-0,0428	6	36	0,001829	0,026	0,16257114	6,151153272
Cleyburchstraat 59A	0,130383656	0,0619	3	9	0,003833	0,02	0,141262593	7,0790149
Cleyburchstraat 59B	0,410529626	-0,0088	4	16	7,71E-05	0,022	0,148467517	6,735480064
Cleyburchstraat 59C 1st serie	0,410529626	0,0875	3	9	0,007659	0,02	0,141262593	7,0790149
Cleyburchstraat 59 C 2nd serie	0,287594498	-0,0415	12	144	0,001719	0,041	0,203184973	4,921623812
Cleyburchstraat 61B	0,632048901	-0,0239	7	49	0,000569	0,029	0,169495322	5,899867844
Cleyburchstraat 61C	0,723376281	0,1023	8	64	0,010467	0,031	0,176347823	5,670611554
Dresselhuysstraat 3B	0,108542537	0,0302	2	4	0,000914	0,018	0,133933709	7,466380238
Dresselhuysstraat 3C 1st serie	0,294359563	-0,0287	3	9	0,000821	0,02	0,141262593	7,0790149
Dresselhuysstraat 3c 2nd serie	-0,093413559	-0,342	3	9	0,116932	0,02	0,141262593	7,0790149
Dresselhuysstraat 3c 2nd serie	-0,037584945	-0,0871	2	4	0,007587	0,018	0,133933709	7,466380238
Dresselhuysstraat 3c 2nd serie	0,427634538	0,3251	5	25	0,1057	0,024	0,155565705	6,428151997
Dresselhuysstraat 5B	0,396740574	-0,0538	5	25	0,002899	0,024	0,155565705	6,428151997
Dresselhuysstraat 5B	0,109539637	-0,0183	4	16	0,000334	0,022	0,148467517	6,735480064
Dresselhuysstraat 5B	-0,034868084	0,0338	6	36	0,00114	0,026	0,16257114	6,151153272
Dresselhuysstraat 5C	0,22736976	0,155	1	1	0,02401	0,016	0,126459316	7,907681569
Dresselhuysstraat 5C	0,006527534	0,0538	5	25	0,002899	0,024	0,155565705	6,428151997
Dresselhuysstraat 9C	0,096310786	-0,0003	4	16	9,99E-08	0,022	0,148467517	6,735480064
Dresselhuysstraat 11A	0,669618896	0,0137	7	49	0,000188	0,029	0,169495322	5,899867844
Dresselhuysstraat 11A	0,141047491	0,0929	1	1	0,008621	0,016	0,126459316	7,907681569
Dresselhuysstraat 11A	0,060305989	-0,0154	5	25	0,000237	0,024	0,155565705	6,428151997
Dresselhuysstraat 13B	0,002119827	-0,064	3	9	0,004096	0,02	0,141262593	7,0790149
Dresselhuysstraat 15B	0,088480883	0,02	3	9	0,0004	0,02	0,141262593	7,0790149
Dresselhuysstraat 17B	0,055165209	-0,0231	2	4	0,000536	0,018	0,133933709	7,466380238
Dresselhuysstraat 17B	-0,041885988	0,0054	5	25	2,94E-05	0,024	0,155565705	6,428151997
Dresselhuysstraat 17C	0,015975538	-0,0525	3	9	0,002756	0,02	0,141262593	7,0790149
Dresselhuysstraat 19A	0,35817523	0,2825	5	25	0,079799	0,024	0,155565705	6,428151997
Dresselhuysstraat 19B	0,465668141	-0,1059	6	36	0,011211	0,026	0,16257114	6,151153272
Sonoystraat 23B	0,137118196	0,2058	6	36	0,042333	0,026	0,16257114	6,151153272
Sonoystraat 23C	0,159323853	0,1944	4	16	0,03781	0,022	0,148467517	6,735480064
Doezastraat 2B	0,377256288	-0,1718	5	25	0,029523	0,024	0,155565705	6,428151997
Doezastraat 2B	0,088913409	-0,0141	10	100	0,000198	0,036	0,189868745	5,266796278
Doezastraat 4A	0,55599929	-0,1494	9	81	0,022327	0,034	0,183136688	5,460402335

Doezastraat 4A	0,094385922	0,0161	2	4	0,000258	0,018	0,133933709	7,466380238
Doezastraat 4B	-0,4690275	-0,4217	5	25	0,177844	0,024	0,155565705	6,428151997
Doezastraat 6B	0,693996516	0,0606	6	36	0,003668	0,026	0,16257114	6,151153272
Doezastraat 8A	0,378724128	-0,0219	10	100	0,000477	0,036	0,189868745	5,266796278
Doezastraat 10B	0,352886974	0,2251	4	16	0,050652	0,022	0,148467517	6,735480064
Doezastraat 10B	-0,006947589	-0,0312	3	9	0,000971	0,02	0,141262593	7,0790149
Doezastraat 14A 1st serie	0,05598236	-0,0904	7	49	0,008168	0,029	0,169495322	5,899867844
Doezastraat 14A 2nd serie	-0,108264849	-0,0649	3	9	0,004211	0,02	0,141262593	7,0790149
Doezastraat 18A	0,192165675	0,0541	6	36	0,002922	0,026	0,16257114	6,151153272
Doezastraat 18B	0,55435253	-0,2294	11	121	0,052614	0,039	0,196549831	5,087768314
Doezastraat 22	0,143201117	0,1109	8	64	0,012295	0,031	0,176347823	5,670611554
Paetsstraat 21A	0,120970498	-0,0501	4	16	0,002509	0,022	0,148467517	6,735480064
Paetsstraat 23A	0,240918391	0,064	5	25	0,004092	0,024	0,155565705	6,428151997
Paetsstraat 23A	-0,009180961	-0,0343	6	36	0,001176	0,026	0,16257114	6,151153272
Paetsstraat 29A	0,301436938	0,1776	6	36	0,031525	0,026	0,16257114	6,151153272
Paetsstraat 29B	1,005468524	0,372	6	36	0,138412	0,026	0,16257114	6,151153272
Paetsstraat 29B	0,072886721	0,0009	3	9	8,05E-07	0,02	0,141262593	7,0790149
Paetsstraat 29C	0,105424656	0,1094	2	4	0,011961	0,018	0,133933709	7,466380238
Paetsstraat 31A	0,111837436	0,034	4	16	0,001153	0,022	0,148467517	6,735480064
Paetsstraat 31B	0,421207528	0,0922	3	9	0,008495	0,02	0,141262593	7,0790149
Paetsstraat 31B	0,108144635	-0,1412	6	36	0,019944	0,026	0,16257114	6,151153272
Hogerbeetsstraat 13A	0,836591675	0,3866	4	16	0,149444	0,022	0,148467517	6,735480064
Hogerbeetsstraat 17B	0,356358177	-0,1111	5	25	0,012354	0,024	0,155565705	6,428151997
Hogerbeetsstraat 17B	0,154049528	0,047	7	49	0,002213	0,029	0,169495322	5,899867844
Hogerbeetsstraat 17C	0,556980077	0,0882	6	36	0,007771	0,026	0,16257114	6,151153272
Hogerbeetsstraat 21A	0,159549541	0,0876	3	9	0,007667	0,02	0,141262593	7,0790149
Hogerbeetsstraat 21A	0,119148842	0,053	3	9	0,002812	0,02	0,141262593	7,0790149
Hogerbeetsstraat 21A	0,036528234	0,0283	1	1	0,0008	0,016	0,126459316	7,907681569
Hogerbeetsstraat 21B	0,2570977	0,0205	3	9	0,00042	0,02	0,141262593	7,0790149
Hogerbeetsstraat 21B	0,384708451	-0,0346	4	16	0,001197	0,022	0,148467517	6,735480064
Hogerbeetsstraat 23A	0,40967547	-0,1247	5	25	0,015547	0,024	0,155565705	6,428151997
Hogerbeetsstraat 23B	0,333713251	-0,2007	5	25	0,040261	0,024	0,155565705	6,428151997
Hogerbeetsstraat 23B	0,331288714	0,1602	4	16	0,025674	0,022	0,148467517	6,735480064
Bickerstraat 2C	0,538499097	0,1621	7	49	0,026287	0,029	0,169495322	5,899867844
Bickerstraat 10B	0,465397654	-0,0837	5	25	0,007002	0,024	0,155565705	6,428151997
Bickerstraat 10B	-0,02807902	-0,1662	6	36	0,02762	0,026	0,16257114	6,151153272
Bickerstraat 10C	0,243627814	0,0383	2	4	0,001467	0,018	0,133933709	7,466380238
Bickerstraat 10C	0,58758269	-0,015	12	144	0,000226	0,041	0,203184973	4,921623812
Bickerstraat 14A	0,242169448	-0,1547	3	9	0,023921	0,02	0,141262593	7,0790149
Bickerstraat 14A	0,101818583	-0,0363	6	36	0,001317	0,026	0,16257114	6,151153272
Bickerstraat 14A	0,141674178	0,1768	4	16	0,031258	0,022	0,148467517	6,735480064
Bickerstraat 14B	0,489618282	-0,0819	6	36	0,006713	0,026	0,16257114	6,151153272
Bickerstraat 14B	0,012319257	-0,1033	5	25	0,010675	0,024	0,155565705	6,428151997
Bickerstraat 16B	0,445126483	-0,0049	4	16	2,39E-05	0,022	0,148467517	6,735480064
Bickerstraat 16C	0,641978459	0,0222	7	49	0,000494	0,029	0,169495322	5,899867844
Bylwerffstraat 4A 1st serie	0,427498783	-0,0006	4	16	3,68E-07	0,022	0,148467517	6,735480064
Bylwerffstraat 4A 2nd serie	0,026972181	-0,0225	2	4	0,000508	0,018	0,133933709	7,466380238
Bylwerffstraat 4A 2nd serie	-0,005226882	-0,0835	2	4	0,006978	0,018	0,133933709	7,466380238
Bylwerffstraat 4A 2nd serie	-0,077879588	-0,1053	4	16	0,011079	0,022	0,148467517	6,735480064
Bylwerffstraat 4B	0,863360117	0,2607	12	144	0,067989	0,041	0,203184973	4,921623812
Bylwerffstraat 6A	0,530820677	0,2078	3	9	0,043184	0,02	0,141262593	7,0790149
Bylwerffstraat 6B	0,49320407	0,1965	4	16	0,0386	0,022	0,148467517	6,735480064
Bylwerffstraat 16 BI	0,307802322	0,3825	1	1	0,146301	0,016	0,126459316	7,907681569
Bylwerffstraat 20A	0,171988804	-0,3027	7	49	0,091644	0,029	0,169495322	5,899867844
Bylwerffstraat 20B	0,309760138	-0,1408	5	25	0,01983	0,024	0,155565705	6,428151997
Bylwerffstraat 20B	0,198726159	0,0435	8	64	0,001894	0,031	0,176347823	5,670611554
Bylwerffstraat 28B	0,171674364	0,0165	8	64	0,000271	0,031	0,176347823	5,670611554
Bylwerffstraat 28C	0,422335012	0,1738	3	9	0,030205	0,02	0,141262593	7,0790149
Bylwerffstraat 30A	0,728504723	0,1814	8	64	0,032895	0,031	0,176347823	5,670611554
Bylwerffstraat 32C	-0,022610992	-0,1937	4	16	0,037507	0,022	0,148467517	6,735480064
Bylwerffstraat 32C	0,151441766	0,0489	5	25	0,002393	0,024	0,155565705	6,428151997
Bylwerffstraat 34C	0,41492902	0,0144	10	100	0,000206	0,036	0,189868745	5,266796278
Bylwerffstraat 36A	0,519227255	0,0191	7	49	0,000366	0,029	0,169495322	5,899867844
Bylwerffstraat 36C	0,410697244	-0,0393	4	16	0,001546	0,022	0,148467517	6,735480064

Bylwerffstraat 38B	0,400940172	-0,0496	5	25	0,002464	0,024	0,155565705	6,428151997
Bylwerffstraat 38B	0,061242593	-0,0666	4	16	0,004433	0,022	0,148467517	6,735480064
Bylwerffstraat 38C	0,567678534	0,0186	5	25	0,000346	0,024	0,155565705	6,428151997
Bylwerffstraat 38C	0,203205903	0,0568	7	49	0,003232	0,029	0,169495322	5,899867844
Bylwerffstraat 42A	-0,066935265	-0,2221	8	64	0,049347	0,031	0,176347823	5,670611554
Bylwerffstraat 42B	0,400908689	0,1042	4	16	0,010852	0,022	0,148467517	6,735480064
Bylwerffstraat 42B	0,073092748	0,0659	2	4	0,00434	0,018	0,133933709	7,466380238
Bylwerffstraat 42B	0,003326095	-0,0965	5	25	0,009307	0,024	0,155565705	6,428151997
Nobelstraat 73B 1st serie	-0,058623495	-0,1577	1	1	0,024866	0,016	0,126459316	7,907681569
Nobelstraat 73B 1st serie	0,092210334	0,0427	2	4	0,001823	0,018	0,133933709	7,466380238
Nobelstraat 73B 2nd serie	-0,21917175	-0,2853	3	9	0,081393	0,02	0,141262593	7,0790149
Nobelstraat 73B 3rd serie	-0,154516414	-0,1909	2	4	0,036448	0,018	0,133933709	7,466380238
Nobelstraat 75A 1st serie	0,464287626	0,045	4	16	0,002023	0,022	0,148467517	6,735480064
Nobelstraat 75A 2nd serie	-0,380580705	-0,4129	8	64	0,170485	0,031	0,176347823	5,670611554
Nobelstraat 75B	1,432540177	0,7271	9	81	0,528703	0,034	0,183136688	5,460402335
Nobelstraat 77B	0,41754017	0,0885	3	9	0,007833	0,02	0,141262593	7,0790149
Nobelstraat 77B	0,216051913	-0,0333	6	36	0,00111	0,026	0,16257114	6,151153272
Nobelstraat 77B	-0,00004626	-0,0274	4	16	0,000752	0,022	0,148467517	6,735480064
Nobelstraat 79A	0,136416134	-0,1121	3	9	0,012572	0,02	0,141262593	7,0790149
Nobelstraat 79A	0,361261439	0,2092	7	49	0,043776	0,029	0,169495322	5,899867844
Nobelstraat 79B	0,658236314	0,1233	9	81	0,0152	0,034	0,183136688	5,460402335
Nobelstraat 83A	0,200014597	0,1446	3	9	0,020911	0,02	0,141262593	7,0790149
Nobelstraat 83A	-0,029185989	-0,129	5	25	0,016637	0,024	0,155565705	6,428151997
Nobelstraat 83B 1st serie	0,698358792	0,0786	7	49	0,00618	0,029	0,169495322	5,899867844
Nobelstraat 83B 2nd serie	0,176044267	0,1086	4	16	0,011794	0,022	0,148467517	6,735480064
Nobelstraat 83B 2nd serie	-0,253187108	-0,2614	1	1	0,068347	0,016	0,126459316	7,907681569
Bylwerffstraat 9B	0,115814012	0,0663	2	4	0,004395	0,018	0,133933709	7,466380238
Bylwerffstraat 15A	0,061411301	-0,0352	4	16	0,00124	0,022	0,148467517	6,735480064
Bylwerffstraat 35B	0,310106638	0,2547	3	9	0,064871	0,02	0,141262593	7,0790149
Bylwerffstraat 35B	0,022441183	-0,0742	4	16	0,005504	0,022	0,148467517	6,735480064
Bylwerfffstraat 37A	0,143429847	-0,0118	8	64	0,000139	0,031	0,176347823	5,670611554
Bylwerffstraat 45	0,143471585	0,0278	5	25	0,000775	0,024	0,155565705	6,428151997
Bisschopstraat 40	-0,200881469	-0,3472	7	49	0,120575	0,029	0,169495322	5,899867844
VD Meydestraat 16 1st serie	0,243202288	0,0412	2	4	0,001694	0,018	0,133933709	7,466380238
VD Meydestraat 16 1st serie	0,305724117	0,0797	2	4	0,006345	0,018	0,133933709	7,466380238
VD Meydestraat 16 2nd serie	-0,069863387	-0,1756	6	36	0,030819	0,026	0,16257114	6,151153272
VD Meydestraat 18C	0,093064598	0,0187	4	16	0,00035	0,022	0,148467517	6,735480064
VD Meydestraat 18D	0,413216416	-0,0374	5	25	0,001396	0,024	0,155565705	6,428151997
VD Meydestraat 20C	0,001591528	-0,038	3	9	0,001442	0,02	0,141262593	7,0790149
Nobelstraat 9B	-0,034150489	-0,0896	3	9	0,008021	0,02	0,141262593	7,0790149
Nobelstraat 9B	-0,244665759	-0,3413	4	16	0,116481	0,022	0,148467517	6,735480064
Nobelstraat 9C	-0,062164967	-0,186	6	36	0,034614	0,026	0,16257114	6,151153272
Nobelstraat 11A	0,378148929	0,0491	3	9	0,002412	0,02	0,141262593	7,0790149
Nobelstraat 11B	0,592190185	0,1641	4	16	0,026924	0,022	0,148467517	6,735480064
Nobelstraat 11B	0,096275352	0,0243	3	9	0,00059	0,02	0,141262593	7,0790149
Nobelstraat 11C	0,197066846	0,0448	2	4	0,002009	0,018	0,133933709	7,466380238
Nobelstraat 11C	0,610538336	0,1107	13	169	0,012258	0,044	0,209778531	4,766932034
Nobelstraat 17B	0,269527461	-0,1273	3	9	0,016207	0,02	0,141262593	7,0790149
Nobelstraat 17B	0,108981238	-0,0291	6	36	0,000849	0,026	0,16257114	6,151153272
Nobelstraat 17C	0,049064449	-0,4198	6	36	0,176198	0,026	0,16257114	6,151153272
Nobelstraat 19A	0,149475718	0,2181	6	36	0,047571	0,026	0,16257114	6,151153272
Nobelstraat 19C	0,176013464	-0,026	2	4	0,000677	0,018	0,133933709	7,466380238
Nobelstraat 65B	0,2573888	0,1051	2	4	0,011055	0,018	0,133933709	7,466380238
Nobelstraat 103A	0,160763082	0,0451	5	25	0,002036	0,024	0,155565705	6,428151997
Noorderhavenkade 55A	0,532834741	-0,0941	9	81	0,00886	0,034	0,183136688	5,460402335
Noorderhavenkade 57A	0,751434131	0,3009	5	25	0,090514	0,024	0,155565705	6,428151997
Noorderhavenkade 57B	0,400680319	0,1641	3	9	0,026924	0,02	0,141262593	7,0790149
Noorderhavenkade 57B	0,707876214	0,1647	10	100	0,027121	0,036	0,189868745	5,266796278
Noorderhavenkade 57C	0,802950262	0,0975	9	81	0,009512	0,034	0,183136688	5,460402335
Noorderhavenkade 57C	0,173040595	0,0987	4	16	0,009736	0,022	0,148467517	6,735480064
Noorderhavenkade 59A	0,615120322	0,0808	5	25	0,006522	0,024	0,155565705	6,428151997
Noorderhavenkade 59A	0,150226251	0,0512	1	1	0,002617	0,016	0,126459316	7,907681569
Noorderhavenkade 59A	0,150206097	0,0795	2	4	0,006326	0,018	0,133933709	7,466380238
Noorderhavenkade 59A	0,062390365	-0,0172	3	9	0,000297	0,02	0,141262593	7,0790149

Noorderhavenkade 59A	-0,064052375	0,0046	6	16	2,1E-05	0,026	0,160385031	6,234995821
Noorderhavenkade 59B	0,545015569	0,0107	5	25	0,000113	0,024	0,155565705	6,428151997
Noorderhavenkade 59B	0,473335448	0,3036	3	9	0,092172	0,02	0,141262593	7,0790149
Noorderhavenkade 59C	0,346176408	0,0171	3	9	0,000294	0,02	0,141262593	7,0790149
Noorderhavenkade 59C	0,107084272	-0,0627	3	9	0,003925	0,02	0,141262593	7,0790149
Noorderhavenkade 61B	0,569423304	0,1621	4	16	0,026263	0,022	0,148467517	6,735480064
Noorderhavenkade 61B	0,264495304	0,016	3	9	0,000255	0,02	0,141262593	7,0790149
Nolensstraat 79B	0,082991798	-0,0673	5	25	0,00453	0,024	0,155565705	6,428151997
Nolensstraat 79C	0,328746204	-0,2203	5	25	0,048546	0,024	0,155565705	6,428151997
Nolensstraat 79C	0,23713948	0,0868	5	25	0,007541	0,024	0,155565705	6,428151997
Nolensstraat 81B	0,468847614	0,0495	4	16	0,002454	0,022	0,148467517	6,735480064
Nolensstraat 81C	0,324302443	-0,0831	4	16	0,006899	0,022	0,148467517	6,735480064
Nolensstraat 81C	0,434307582	0,1376	4	16	0,018926	0,022	0,148467517	6,735480064
Nolensstraat 81D	0,465136187	0,0151	4	16	0,000229	0,022	0,148467517	6,735480064
Nolensstraat 81D	0,157528079	-0,0122	3	9	0,000149	0,02	0,141262593	7,0790149
Nolensstraat 83B	0,201560029	0,0305	4	16	0,00093	0,022	0,148467517	6,735480064
Nolensstraat 83B	0,07212987	-0,0304	5	25	0,000923	0,024	0,155565705	6,428151997
Nolensstraat 85A	0,402181666	-0,0653	5	25	0,004267	0,024	0,155565705	6,428151997
Nolensstraat 85D	0,610657442	-0,1609	12	144	0,025884	0,041	0,203184973	4,921623812
Loeffstraat 4B	0,20247936	0,0561	7	49	0,00315	0,029	0,169495322	5,899867844
Loeffstraat 6A	0,245070246	-0,0317	10	100	0,001003	0,036	0,189868745	5,266796278
Loeffstraat 8A	0,416769919	0,2647	7	49	0,070085	0,029	0,169495322	5,899867844
Loeffstraat 8BII	0,025646589	0,0198	1	1	0,00039	0,016	0,126459316	7,907681569
Loeffstraat 11A	0,153041163	0,122	7	49	0,014894	0,029	0,169495322	5,899867844
Loeffstraat 11B	0,336892384	0,2091	4	16	0,043709	0,022	0,148467517	6,735480064
Loeffstraat 11C	0,274200674	-0,1022	7	49	0,010438	0,029	0,169495322	5,899867844
Schepenstraat 4B	0,314193769	-0,0864	10	100	0,007462	0,036	0,189868745	5,266796278
Schepenstraat 4C	0,268544449	-0,0295	5	25	0,000871	0,024	0,155565705	6,428151997
Schepenstraat 6A	0,40049896	-0,0742	7	49	0,005508	0,029	0,169495322	5,899867844
Schepenstraat 10B	0,32708013	0,2875	3	9	0,082664	0,02	0,141262593	7,0790149
Schepenstraat 3A	0,387189929	-0,3169	8	64	0,100433	0,031	0,176347823	5,670611554
Schepenstraat 3B	0,273238052	0,0366	3	9	0,001343	0,02	0,141262593	7,0790149
Schepenstraat 3B	0,272251317	-0,0255	2	4	0,000651	0,018	0,133933709	7,466380238
Schepenstraat 3B	0,123818652	-0,0531	5	25	0,002823	0,024	0,155565705	6,428151997
Schepenstraat 3C	0,075987389	-0,0937	3	9	0,008789	0,02	0,141262593	7,0790149
Schepenstraat 3C	0,31402343	0,3068	2	4	0,094133	0,018	0,133933709	7,466380238
Schepenstraat 3C	-0,02030927	-0,0454	6	36	0,002063	0,026	0,16257114	6,151153272
Schepenstraat 3D	0,141592939	0,0425	1	1	0,001808	0,016	0,126459316	7,907681569
Schepenstraat 3D	0,036546382	-0,0413	4	16	0,001709	0,022	0,148467517	6,735480064
Schepenstraat 3D	0,110983937	0,0386	1	1	0,001487	0,016	0,126459316	7,907681569
Schepenstraat 5A	0,385739621	-0,0818	5	25	0,006685	0,024	0,155565705	6,428151997
Schepenstraat 5B	0,607977809	0,073	9	81	0,005334	0,034	0,183136688	5,460402335
Schepenstraat 5C	0,433123106	0,005	4	16	2,52E-05	0,022	0,148467517	6,735480064
Schepenstraat 5C	0,131700842	0,0538	4	16	0,002896	0,022	0,148467517	6,735480064
Schepenstraat 5C	0,107849978	0,0827	6	36	0,006847	0,026	0,16257114	6,151153272
Schepenstraat 5D	0,651203158	0,0797	6	36	0,006344	0,026	0,16257114	6,151153272
Schepenstraat 5D	0,058722454	0,0105	1	1	0,000111	0,016	0,126459316	7,907681569
Schepenstraat 7C	0,591015524	0,141	4	16	0,019882	0,022	0,148467517	6,735480064
Schepenstraat 7D	0,406208113	-0,1429	5	25	0,020412	0,024	0,155565705	6,428151997
Schepenstraat 7D	0,030171857	-0,0418	3	9	0,001749	0,02	0,141262593	7,0790149
Schepenstraat 27A	0,428225999	0,2575	1	1	0,066284	0,016	0,126459316	7,907681569
Schepenstraat 27A	0,201011586	-0,0251	2	4	0,000628	0,018	0,133933709	7,466380238
Schepenstraat 27B	0,250486903	0,0797	1	1	0,006355	0,016	0,126459316	7,907681569
Schepenstraat 31B	0,22487745	-0,1825	4	16	0,033302	0,022	0,148467517	6,735480064
Schepenstraat 31B	0,346017867	-0,0577	11	121	0,003332	0,039	0,196549831	5,087768314
Schepenstraat 35	0,100200877	0,0011	1	1	1,29E-06	0,016	0,126459316	7,907681569
Schepenstraat 75A	0,475473255	-0,1766	15	225	0,031185	0,05	0,222855638	4,487209792
Schepenstraat 77A	0,560703298	0,0932	5	25	0,008686	0,024	0,155565705	6,428151997
Schepenstraat 77A	0,191985823	0,1163	5	25	0,013525	0,024	0,155565705	6,428151997
Schepenstraat 77C	0,43426339	0,1971	7	49	0,038842	0,029	0,169495322	5,899867844
Schepenstraat 79A	0,275127869	0,0982	5	25	0,009639	0,024	0,155565705	6,428151997
Schepenstraat 79A	0,00229824	-0,0975	5	25	0,009506	0,024	0,155565705	6,428151997
Schepenstraat 81A	0,85481918	0,2351	7	49	0,055258	0,029	0,169495322	5,899867844
Schepenstraat 81A	0,05419979	-0,0254	3	9	0,000647	0,02	0,141262593	7,0790149

Schepenstraat 81B	0,87948927	0,0684	15	225	0,004676	0,05	0,222855638	4,487209792
Statensingel 59B	0,477209125	0,0272	4	16	0,00074	0,022	0,148467517	6,735480064
Statensingel 59C	0,756740104	0,1905	10	100	0,036299	0,036	0,189868745	5,266796278
Statensingel 61B	-0,001169589	-0,1227	2	4	0,015058	0,018	0,133933709	7,466380238
Statensingel 61B	0,162068804	0,0382	6	36	0,001458	0,026	0,16257114	6,151153272
Statensingel 61C	0,118518492	0,0478	2	4	0,002289	0,018	0,133933709	7,466380238
Statensingel 61C	0,00556721	-0,0016	2	4	2,71E-06	0,018	0,133933709	7,466380238
Statensingel 63A	0,79126171	0,0115	13	169	0,000132	0,044	0,209778531	4,766932034
Statensingel 63C	0,660909892	0,0825	9	81	0,006807	0,034	0,183136688	5,460402335
Statensingel 65C	0,576370649	0,1075	6	36	0,011566	0,026	0,16257114	6,151153272
Statensingel 67A	0,218982717	0,1794	3	9	0,03219	0,02	0,141262593	7,0790149
Statensingel 69C	0,442255002	0,0349	4	16	0,001217	0,022	0,148467517	6,735480064
Bentincklaan 53C	0,356389847	-0,339	12	144	0,114953	0,041	0,203184973	4,921623812
Bentincklaan 53D	0,549649296	0,1733	7	49	0,030027	0,029	0,169495322	5,899867844
Bentincklaan 55C	0,139122357	-0,3297	6	36	0,108703	0,026	0,16257114	6,151153272
Bentincklaan 55C	0,27022346	0,1959	4	16	0,038359	0,022	0,148467517	6,735480064
Bentincklaan 55D	0,492877523	-0,2307	13	169	0,053227	0,044	0,209778531	4,766932034
Bentincklaan 57A	0,510359812	-0,1107	8	64	0,012256	0,031	0,176347823	5,670611554
Bentincklaan 57B	0,180688649	-0,0214	2	4	0,000456	0,018	0,133933709	7,466380238
Bentincklaan 57D	0,38589646	0,0569	3	9	0,003233	0,02	0,141262593	7,0790149
Bentincklaan 57D	0,115951095	-0,0056	2	4	3,12E-05	0,018	0,133933709	7,466380238
Bentincklaan 59A	0,45215705	-0,1194	6	36	0,014255	0,026	0,16257114	6,151153272
Bentincklaan 59D	0,623632659	0,0039	7	49	1,51E-05	0,029	0,169495322	5,899867844
Bentincklaan 59D	-0,075479894	-0,1825	7	49	0,033302	0,029	0,169495322	5,899867844
Gordelweg 234A	0,177138543	0,0249	2	4	0,00062	0,018	0,133933709	7,466380238
Gordelweg 234A	0,369517787	-0,0273	3	9	0,000746	0,02	0,141262593	7,0790149
Gordelweg 234A	0,153921924	0,076	4	16	0,005782	0,022	0,148467517	6,735480064
Gordelweg 234B	0,391282764	0,0945	4	16	0,008939	0,022	0,148467517	6,735480064
Gordelweg 234C	0,297202826	0,0606	3	9	0,003673	0,02	0,141262593	7,0790149
Gordelweg 234C	0,248783139	-0,2944	10	100	0,086677	0,036	0,189868745	5,266796278
Gordelweg 235B	-0,031627321	-0,0558	3	9	0,003118	0,02	0,141262593	7,0790149
Gordelweg 235C	0,086376509	-0,0847	4	16	0,007171	0,022	0,148467517	6,735480064
Gordelweg 235C	0,216433357	0,1381	2	4	0,019078	0,018	0,133933709	7,466380238
Gordelweg 238A	0,439517651	0,0202	4	16	0,000408	0,022	0,148467517	6,735480064
Gordelweg 238A	0,128594126	0,0047	6	36	2,22E-05	0,026	0,16257114	6,151153272
Gordelweg 239A	0,638910918	0,0192	7	49	0,000367	0,029	0,169495322	5,899867844
Gordelweg 239C	0,422382278	0,1246	2	4	0,015529	0,018	0,133933709	7,466380238
Gordelweg 239C	0,279261287	0,0338	8	64	0,001145	0,031	0,176347823	5,670611554
Gordelweg 239C	-0,049358289	0,0153	4	16	0,000235	0,022	0,148467517	6,735480064
Gordelweg 240A	0,560916178	-0,0175	9	81	0,000306	0,034	0,183136688	5,460402335
Gordelweg 240B	0,560916178	0,1416	4	16	0,020053	0,022	0,148467517	6,735480064
Gordelweg 240B	-0,029446168	-0,1815	7	49	0,032935	0,029	0,169495322	5,899867844
Gordelweg 241A	0,343173085	-0,0642	4	16	0,004121	0,022	0,148467517	6,735480064
Gordelweg 241A	0,617103816	0,2165	10	100	0,046885	0,036	0,189868745	5,266796278
Gordelweg 241C	0,179374525	0,1735	1	1	0,030096	0,016	0,126459316	7,907681569
Gordelweg 241C	-0,021741682	-0,1215	5	25	0,014772	0,024	0,155565705	6,428151997
Statenweg 44B	0,193451891	-0,1033	4	16	0,010668	0,022	0,148467517	6,735480064
Statenweg 44B	0,151115811	0,0754	5	25	0,005689	0,024	0,155565705	6,428151997
Statenweg 44D	0,600678932	0,0535	8	64	0,002867	0,031	0,176347823	5,670611554
Statenweg 46B	0,623237762	0,2264	3	9	0,051258	0,02	0,141262593	7,0790149
Statenweg 46C	0,326969815	0,004	3	9	1,57E-05	0,02	0,141262593	7,0790149
Statenweg 46C	0,341204501	0,0431	5	25	0,001862	0,024	0,155565705	6,428151997
Statenweg 48B	-0,058596649	-0,5086	4	16	0,258682	0,022	0,148467517	6,735480064
Statenweg 50A	0,098929233	-0,4071	8	64	0,165696	0,031	0,176347823	5,670611554
Statenweg 50B	0,066053278	-0,257	3	9	0,066028	0,02	0,141262593	7,0790149
Statenweg 52C	-0,122225577	-0,6282	8	64	0,394651	0,031	0,176347823	5,670611554
Statenweg 86B	0,14702371	-0,3036	5	25	0,092146	0,024	0,155565705	6,428151997
Statenweg 88A	0,471215559	0,0519	4	16	0,002694	0,022	0,148467517	6,735480064
Statenweg 88A	0,195734145	0,1152	9	81	0,013276	0,034	0,183136688	5,460402335
Statenweg 88B	0,788767382	0,062	14	196	0,003845	0,047	0,216334308	4,622475321
Statenweg 90B	0,262225074	-0,0345	4	16	0,001191	0,022	0,148467517	6,735480064
Statenweg 90B	0,172583023	0,0656	7	49	0,0043	0,029	0,169495322	5,899867844
Statenweg 94A	0,943682441	0,2383	9	81	0,056769	0,034	0,183136688	5,460402335
Statenweg 114B	0,270410747	0,1861	1	1	0,034618	0,016	0,126459316	7,907681569

Statenweg 114B	0,380348882	-0,0697	4	16	0,004853	0,022	0,148467517	6,735480064
Statenweg 114C	0,385162918	0,0561	3	9	0,00315	0,02	0,141262593	7,0790149
Statenweg 120A	0,155676386	0,05	6	36	0,002499	0,026	0,16257114	6,151153272
Statenweg 120B	0,14600071	0,0703	5	25	0,004944	0,024	0,155565705	6,428151997
Statenweg 120D	0,698587609	0,1495	5	25	0,022353	0,024	0,155565705	6,428151997
Statenweg 122A	0,084533718	-0,0121	4	16	0,000146	0,022	0,148467517	6,735480064
Statenweg 122B	0,81696026	0,2679	5	25	0,071761	0,024	0,155565705	6,428151997
Statenweg 156C	0,208865553	0,0537	8	64	0,002879	0,031	0,176347823	5,670611554
Statenweg 160B	0,484975154	0,1869	5	25	0,034939	0,024	0,155565705	6,428151997
Statenweg 162A	0,340295977	0,0363	6	36	0,001321	0,026	0,16257114	6,151153272
Statenweg 162C	0,188183173	-0,0604	3	9	0,003643	0,02	0,141262593	7,0790149
Statenweg 166B	0,140940716	-0,0611	2	4	0,003733	0,018	0,133933709	7,466380238
Statenweg 166B	0,1006061	-0,2758	7	49	0,076043	0,029	0,169495322	5,899867844
Statenweg 168A	0,328104052	0,0915	3	9	0,008374	0,02	0,141262593	7,0790149
Statenweg 168A	0,201988218	-0,2655	5	25	0,070499	0,024	0,155565705	6,428151997
Statenweg 168A	0,128849439	0,0614	4	16	0,003771	0,022	0,148467517	6,735480064
Statenweg 172B	0,305485153	0,1777	4	16	0,031563	0,022	0,148467517	6,735480064
Statenweg 176A	0,462788947	0,0435	4	16	0,001891	0,022	0,148467517	6,735480064
Statenweg 176A	0,130052567	0,0746	3	9	0,005572	0,02	0,141262593	7,0790149
Statenweg 176C	0,115786289	-0,0306	7	49	0,000935	0,029	0,169495322	5,899867844
Statenweg 178B	0,179129373	-0,3871	10	100	0,149837	0,036	0,189868745	5,266796278
Sonmansstraat 3A 1st serie	0,379799454	0,0568	3	9	0,003225	0,02	0,141262593	7,0790149
Sonmansstraat 3A 2nd serie	0,309988417	-0,0664	7	49	0,004406	0,029	0,169495322	5,899867844
Sonmansstraat 3A 2nd serie	0,283591529	0,2562	4	16	0,065645	0,022	0,148467517	6,735480064
Sonmansstraat 5A	0,946012074	0,3263	7	49	0,106448	0,029	0,169495322	5,899867844
Sonmansstraat 5B	-0,127626717	-0,0803	5	25	0,00645	0,024	0,155565705	6,428151997
Sonmansstraat 7A	-0,083444082	-0,4908	4	16	0,240894	0,022	0,148467517	6,735480064
Sonmansstraat 7B	0,312570055	0,0754	7	49	0,005684	0,029	0,169495322	5,899867844
Sonmansstraat 9A 1st serie	-0,229709147	-0,4663	3	9	0,217441	0,02	0,141262593	7,0790149
Sonmansstraat 9A 2nd serie	0,282432384	0,0564	2	4	0,003177	0,018	0,133933709	7,466380238
Sonmansstraat 9A 2nd serie	0,15948105	0,0888	2	4	0,007887	0,018	0,133933709	7,466380238
Sonmansstraat 9A 2nd serie	-0,368585948	-0,3699	1	1	0,13683	0,016	0,126459316	7,907681569
Sonmansstraat 9A 2nd serie	0,384628815	0,3063	2	4	0,093831	0,018	0,133933709	7,466380238
Sonmansstraat 9A 2nd serie	0,002183728	-0,022	3	9	0,000485	0,02	0,141262593	7,0790149
Sonmansstraat 9A 2nd serie	-0,094648807	-0,0978	1	1	0,009569	0,016	0,126459316	7,907681569
Sonmansstraat 9B	0,784490362	0,3652	4	16	0,133358	0,022	0,148467517	6,735480064
Sonmansstraat 17B	0,105255325	0,0247	9	81	0,000612	0,034	0,183136688	5,460402335
Sonmansstraat 19B	0,620181255	0,2911	3	9	0,084764	0,02	0,141262593	7,0790149
Sonmansstraat 19B	0,150485621	0,0514	1	1	0,002644	0,016	0,126459316	7,907681569
Sonmansstraat 99B	0,32210961	-0,0069	3	9	4,8E-05	0,02	0,141262593	7,0790149
Sonmansstraat 99B	0,154814258	0,0333	2	4	0,001107	0,018	0,133933709	7,466380238
Sonmansstraat 99B	-0,11307854	-0,2651	7	49	0,070285	0,029	0,169495322	5,899867844
Sonmansstraat 111A	-0,043899231	-0,1649	1	1	0,027183	0,016	0,126459316	7,907681569
Sonmansstraat 111A	0,450153456	0,1211	3	9	0,014669	0,02	0,141262593	7,0790149
Vroesenlaan 1A 1st serie	0,281053931	-0,048	3	9	0,002303	0,02	0,141262593	7,0790149
Vroesenlaan 1A 2nd serie	0,448906382	0,1753	9	81	0,030741	0,034	0,183136688	5,460402335
Vroesenlaan 2A	0,098209144	0,1022	2	4	0,010435	0,018	0,133933709	7,466380238
Vroesenlaan 2C	0,46999859	0,1719	5	25	0,029564	0,024	0,155565705	6,428151997
Vroesenlaan 3A	0,732783862	0,1984	5	25	0,03937	0,024	0,155565705	6,428151997
Vroesenlaan 3A	0,24724591	0,1257	2	4	0,015802	0,018	0,133933709	7,466380238
Vroesenlaan 3A	0,109435933	0,0289	9	81	0,000836	0,034	0,183136688	5,460402335
Vroesenlaan 3B	0,519726684	0,0196	7	49	0,000385	0,029	0,169495322	5,899867844
Vroesenlaan 3C	0,390678404	-0,0167	4	16	0,000278	0,022	0,148467517	6,735480064
Vroesenlaan 4A	0,266091725	0,04	2	4	0,001602	0,018	0,133933709	7,466380238
Vroesenlaan 4C	0,396762273	-0,0532	4	16	0,002836	0,022	0,148467517	6,735480064
Vroesenlaan 4C	0,379613381	0,1302	6	36	0,016964	0,026	0,16257114	6,151153272
Vroesenlaan 4C	0,010855036	-0,0165	4	16	0,000273	0,022	0,148467517	6,735480064
Vroesenlaan 5C	0,62921664	0,2099	4	16	0,044061	0,022	0,148467517	6,735480064
Vroesenlaan 6A	0,342597095	-0,1074	4	16	0,011538	0,022	0,148467517	6,735480064
Vroesenlaan 6A	0,318529716	0,0692	6	36	0,004784	0,026	0,16257114	6,151153272
Vroesenlaan 6A	0,069323031	0,0451	3	9	0,002035	0,02	0,141262593	7,0790149
Vroesenlaan 7A	0,708107019	0,0027	9	81	7,22E-06	0,034	0,183136688	5,460402335
Vroesenlaan 7C	0,072748232	0,0232	2	4	0,00054	0,018	0,133933709	7,466380238
Vroesenlaan 8A	0,112375698	0,0099	5	25	9,72E-05	0,024	0,155565705	6,428151997

Vroesenlaan 8B	0,638194907	0,1882	4	16	0,035413	0,022	0,148467517	6,735480064
Vroesenlaan 8B	0,295945937	0,119	5	25	0,01416	0,024	0,155565705	6,428151997
Vroesenlaan 31D	0,414307459	0,3541	2	4	0,125371	0,018	0,133933709	7,466380238
Vroesenlaan 32B	-0,12570172	-0,2295	6	36	0,052689	0,026	0,16257114	6,151153272
Vroesenlaan 34B	0,1804379	0,0028	9	81	7,61E-06	0,034	0,183136688	5,460402335
Vroesenlaan 34D	0,177810792	-0,0242	2	4	0,000587	0,018	0,133933709	7,466380238
Vroesenlaan 35C	0,496957435	-0,0746	6	36	0,005564	0,026	0,16257114	6,151153272
Vroesenlaan 35C	-0,062554921	-0,1864	6	36	0,03476	0,026	0,16257114	6,151153272
Vroesenlaan 36D	0,290695297	-0,0383	3	9	0,00147	0,02	0,141262593	7,0790149
Vroesenlaan 36D	0,214739026	0,0932	2	4	0,008686	0,018	0,133933709	7,466380238
Vroesenlaan 36D	0,032799024	-0,095	4	16	0,00903	0,022	0,148467517	6,735480064
Vroesenlaan 36D	0,070194377	0,0428	4	16	0,001833	0,022	0,148467517	6,735480064
Vroesenlaan 37A	0,704758872	0,0778	9	81	0,006053	0,034	0,183136688	5,460402335
Vroesenlaan 37A	0,089173361	0,0641	6	36	0,004105	0,026	0,16257114	6,151153272
Vroesenlaan 37C	0,144498245	-0,1594	6	36	0,025424	0,026	0,16257114	6,151153272
Vroesenlaan 37C	0,242757724	0,1461	4	16	0,021354	0,022	0,148467517	6,735480064
Vroesenlaan 37D	0,170816509	0,0929	4	16	0,008637	0,022	0,148467517	6,735480064
Cleyburchstraat 16B	0,348121339	-0,08	4	16	0,006397	0,022	0,148467517	6,735480064
Cleyburchstraat 16B	0,045234406	-0,0929	6	36	0,008626	0,026	0,16257114	6,151153272
Cleyburchstraat 16C	0,23913654	-0,0899	3	9	0,008082	0,02	0,141262593	7,0790149
Cleyburchstraat 16C	0,265077202	0,094	4	16	0,00884	0,022	0,148467517	6,735480064
Cleyburchstraat 16C	-0,019369552	-0,1251	6	36	0,01564	0,026	0,16257114	6,151153272
Cleyburchstraat 20A	0,395647419	-0,0549	5	25	0,003017	0,024	0,155565705	6,428151997
Cleyburchstraat 20A	0,051425453	-0,004	3	9	1,59E-05	0,02	0,141262593	7,0790149
Cleyburchstraat 20A	0,090916365	0,0658	6	36	0,004331	0,026	0,16257114	6,151153272
Cleyburchstraat 20B	0,121604222	-0,1156	7	49	0,013358	0,029	0,169495322	5,899867844
Cleyburchstraat 20C	0,267475809	0,0964	4	16	0,009297	0,022	0,148467517	6,735480064
Cleyburchstraat 26B	0,601250406	-0,0198	8	64	0,000393	0,031	0,176347823	5,670611554
Cleyburchstraat 26B	0,211282467	0,133	2	4	0,017682	0,018	0,133933709	7,466380238
Cleyburchstraat 26B	0,055627453	0,0596	2	4	0,003548	0,018	0,133933709	7,466380238
Cleyburchstraat 28A	0,196125372	0,0458	5	25	0,0021	0,024	0,155565705	6,428151997
Cleyburchstraat 21C	0,343709475	0,1934	5	25	0,037407	0,024	0,155565705	6,428151997
Cleyburchstraat 21C	-0,006985005	-0,0344	4	16	0,001181	0,022	0,148467517	6,735480064
Cleyburchstraat 23A	0,456173316	0,2301	2	4	0,05295	0,018	0,133933709	7,466380238
Cleyburchstraat 23A	0,09252965	-0,0538	7	49	0,002898	0,029	0,169495322	5,899867844
Cleyburchstraat 23B	0,251782006	0,0497	2	4	0,002474	0,018	0,133933709	7,466380238
Cleyburchstraat 23C	0,439604429	0,0115	4	16	0,000132	0,022	0,148467517	6,735480064
Cleyburchstraat 29C	0,067975497	-0,004	3	9	1,61E-05	0,02	0,141262593	7,0790149
Cleyburchstraat 35A	0,108044783	-0,0423	5	25	0,001786	0,024	0,155565705	6,428151997
Cleyburchstraat 36B	0,55348817	-0,0799	6	36	0,006391	0,026	0,16257114	6,151153272
Cleyburchstraat 38B	0,191220085	-0,0454	3	9	0,002059	0,02	0,141262593	7,0790149
Cleyburchstraat 38B	0,353051227	-0,1158	6	36	0,013403	0,026	0,16257114	6,151153272
Cleyburchstraat 38B	0,254011971	0,1483	6	36	0,022	0,026	0,16257114	6,151153272
Cleyburchstraat 40B	0,291746529	-0,0122	6	36	0,000149	0,026	0,16257114	6,151153272
Cleyburchstraat 40B	0,206683638	0,1465	2	4	0,021449	0,018	0,133933709	7,466380238
Cleyburchstraat 44B	-0,01368728	-0,0844	2	4	0,007116	0,018	0,133933709	7,466380238
Cleyburchstraat 44B	0,039426006	0,0381	1	1	0,001452	0,016	0,126459316	7,907681569
Cleyburchstraat 44B	0,148314311	0,0739	4	16	0,005468	0,022	0,148467517	6,735480064
Cleyburchstraat 46A	0,210793552	0,1038	7	49	0,010771	0,029	0,169495322	5,899867844
Cleyburchstraat 48B	0,545314252	0,1485	3	9	0,022046	0,02	0,141262593	7,0790149
Cleyburchstraat 48B	0,058738334	-0,0191	4	16	0,000366	0,022	0,148467517	6,735480064
Cleyburchstraat 48B	0,145130793	0,0767	3	9	0,005876	0,02	0,141262593	7,0790149
Cleyburchstraat 50A	0,105482059	-0,0102	5	25	0,000103	0,024	0,155565705	6,428151997
Walenburgerweg 91A	0,509958415	0,206	6	36	0,04244	0,026	0,16257114	6,151153272
Walenburgerweg 91A	0,051887539	-0,0166	3	9	0,000275	0,02	0,141262593	7,0790149
Schieweg 10A	0,409873122	-0,0182	4	16	0,000332	0,022	0,148467517	6,735480064
Schieweg 16A	0,390769161	0,1887	2	4	0,035619	0,018	0,133933709	7,466380238
Schieweg 16B	0,924684711	0,4246	7	49	0,180276	0,029	0,169495322	5,899867844
Schieweg 22B	0,218196484	0,1403	4	16	0,019688	0,022	0,148467517	6,735480064
Schieweg 22C	0,207622468	-0,0296	7	49	0,000874	0,029	0,169495322	5,899867844
Schieweg 22D	0,417196299	-0,1299	8	64	0,016884	0,031	0,176347823	5,670611554
Schieweg 24A	0,430289303	-0,0685	6	36	0,00469	0,026	0,16257114	6,151153272
Schieweg 24B	0,600680226	0,0262	12	144	0,000685	0,041	0,203184973	4,921623812
Schieweg 28 B	0,372906194	-0,0946	5	25	0,008949	0,024	0,155565705	6,428151997

Schieweg 28D	0,347323211	-0,2189	10	100	0,047915	0,036	0,189868745	5,266796278
Schieweg 30C	0,08311117	-0,345	4	16	0,119021	0,022	0,148467517	6,735480064
Schieweg 32B	0,378624964	-0,0495	4	16	0,002448	0,022	0,148467517	6,735480064
Schieweg 32B	0,091439106	0,0136	4	16	0,000184	0,022	0,148467517	6,735480064
Schieweg 32D	0,519815416	-0,0999	7	49	0,009987	0,029	0,169495322	5,899867844
Schieweg 34B	0,585158627	-0,1946	13	169	0,037881	0,044	0,209778531	4,766932034
Schieweg 36C	0,086469213	-0,1629	6	36	0,026536	0,026	0,16257114	6,151153272
Schieweg 36D	0,322075755	0,0767	8	64	0,005875	0,031	0,176347823	5,670611554
Schieweg 38A	0,167063019	-0,131	5	25	0,017159	0,024	0,155565705	6,428151997
Schieweg 38A	0,03137678	0,0004	7	49	1,43E-07	0,029	0,169495322	5,899867844
Schieweg 38B	0,603963514	-0,0018	13	169	3,32E-06	0,044	0,209778531	4,766932034
Schieweg 38C	0,735957341	0,1697	10	100	0,028812	0,036	0,189868745	5,266796278
Schieweg 42A	-0,169804539	-0,4775	13	169	0,228042	0,044	0,209778531	4,766932034
Schieweg 46D	0,752534392	0,1467	13	169	0,021536	0,044	0,209778531	4,766932034
Schieweg 48A	0,654221655	-0,0452	10	100	0,002039	0,036	0,189868745	5,266796278
Schieweg 48B	0,161739589	-0,135	4	16	0,018224	0,022	0,148467517	6,735480064
Schieweg 48B	0,118871318	0,0392	3	9	0,00154	0,02	0,141262593	7,0790149
Schieweg 48D	0,165983865	0,0881	4	16	0,007762	0,022	0,148467517	6,735480064
Schieweg 50C	-0,052164688	-0,0832	7	49	0,006916	0,029	0,169495322	5,899867844
Schieweg 52B	0,406660124	-0,1717	9	81	0,029496	0,034	0,183136688	5,460402335
Schieweg 52B	0,165298524	0,1775	1	1	0,031501	0,016	0,126459316	7,907681569
Schieweg 52C	0,422118459	-0,0454	5	25	0,00206	0,024	0,155565705	6,428151997
Schieweg 52C	0,046875856	-0,0206	4	16	0,000423	0,022	0,148467517	6,735480064
Schieweg 54C	0,462421522	-0,0364	6	36	0,001322	0,026	0,16257114	6,151153272
Schieweg 56B 1st serie	0,182248321	-0,1408	3	9	0,019815	0,02	0,141262593	7,0790149
Schieweg 56B 2nd serie	0,261905891	-0,1145	7	49	0,013101	0,029	0,169495322	5,899867844
Schieweg 56B 3rd serie	0,090861287	0,0635	4	16	0,00403	0,022	0,148467517	6,735480064

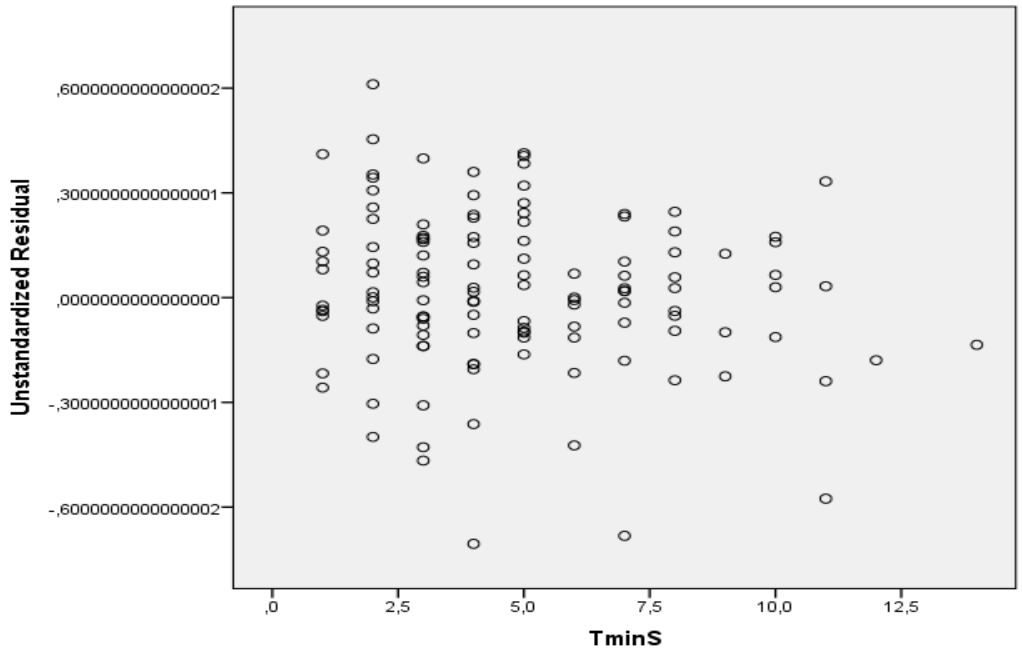
Hillesluis:

adress	lnp2minlnp1 Hillesluis	RES_1	TminS	TminS squared	Squared Residuals	PRE_1	PRE_1 squareroot	PRE_1squareroot reciprocal
Randweg 7B	-0,3388753	-0,68	7	49	0,46538	0,05	0,2163608	4,62190836
Randweg 7C	0,10361202	-0,16	5	25	0,02651	0,05	0,2213329	4,518081685
Randweg 11B	0,31843879	0,04	5	25	0,00129	0,05	0,2213329	4,518081685
Randweg 11B	0,22780886	0,18	3	9	0,03134	0,05	0,2290335	4,366173601
Randweg 29B	0,60059467	0,16	5	25	0,02636	0,05	0,2213329	4,518081685
Randweg 53A	0,45781525	-0,01	7	49	0,00022	0,05	0,2163608	4,62190836
Randweg 97B	0,12035384	0,12	3	9	0,0146	0,05	0,2290335	4,366173601
Randweg 100A	0,61910099	0,03	10	100	0,00089	0,05	0,214406	4,66404797
Randweg 100B	0,69853731	0,03	7	49	0,00073	0,05	0,2163608	4,62190836
Randweg 100B	-0,4052387	0,02	7	49	0,00038	0,05	0,2163608	4,62190836
Randweg 106B	0,29297799	-0,1	8	64	0,00906	0,05	0,2149613	4,652000364
Randweg 116B	0,35158472	-0,09	5	25	0,00751	0,05	0,2213329	4,518081685
Randweg 118B	0,18779563	0,1	1	1	0,01075	0,06	0,2391993	4,180613734
Randweg 148A	0,2020433	0,06	5	25	0,00409	0,05	0,2213329	4,518081685
Randweg 150B	-0,2943473	-0,22	1	1	0,04708	0,06	0,2391993	4,180613734
Randweg 152A	1,02742309	0,33	11	121	0,11074	0,05	0,2152561	4,645628886
Randweg 154B	0,3656747	-0,11	6	36	0,01311	0,05	0,2184917	4,576831909
Randweg 154B	0,38045827	0,24	5	25	0,05875	0,05	0,2213329	4,518081685
Randweg 154B	-0,0285976	0	2	4	6,49E-07	0,05	0,2338265	4,276674686
Beyerlandselaan 136A	-0,2461216	-0,3	2	4	0,09247	0,05	0,2338265	4,276674686
Breeweg 65A	0,0874768	-0,21	4	16	0,04205	0,05	0,2248573	4,447264936
Breeweg 67A	-0,2673022	-0,4	2	4	0,15924	0,05	0,2338265	4,276674686
Breeweg 67A	0,27825748	-0,06	3	9	0,00365	0,05	0,2290335	4,366173601
West-Varkenoordseweg 105B	0,21513369	-0,07	5	25	0,00454	0,05	0,2213329	4,518081685
West-Varkenoordseweg 181A	0,10501827	-0,05	1	1	0,00273	0,06	0,2391993	4,180613734
West-Varkenoordseweg 181B	0,30461635	0,17	10	100	0,03035	0,05	0,214406	4,66404797
West-Varkenoordseweg 185	0,40082718	-0,07	7	49	0,00514	0,05	0,2163608	4,62190836
West-Varkenoordseweg 187A	0,36814545	-0,24	11	121	0,05725	0,05	0,2152561	4,645628886
West-Varkenoordseweg 187B	0,32003144	-0,24	8	64	0,05598	0,05	0,2149613	4,652000364
West-Varkenoordseweg 243B	0,34614827	0,34	2	4	0,11788	0,05	0,2338265	4,276674686
West-Varkenoordseweg 243B	-0,5272571	-0,36	4	16	0,13126	0,05	0,2248573	4,447264936

West-Varkenoordseweg 243C	0,15432955	0,23	7	49	0,054	0,05	0,2163608	4,62190836
West-Varkenoordseweg 245A	0,15803473	0,07	3	9	0,00506	0,05	0,2290335	4,366173601
West-Varkenoordseweg 247A	0,50785542	0,23	4	16	0,05237	0,05	0,2248573	4,447264936
West-Varkenoordseweg 247C	0,25924577	-0,14	14	196	0,01829	0,05	0,2221908	4,500636469
West-Varkenoordseweg 249A	0,33516369	0,26	2	4	0,0667	0,05	0,2338265	4,276674686
West-Varkenoordseweg 251A	0,1290057	0,02	2	4	0,00023	0,05	0,2338265	4,276674686
West-Varkenoordseweg 251A	0,29513688	0,14	2	4	0,02095	0,05	0,2338265	4,276674686
West-Varkenoordseweg 251B	-0,0886472	0,13	8	64	0,01681	0,05	0,2149613	4,652000364
West-Varkenoordseweg 251C	0,58716137	0,32	5	25	0,10288	0,05	0,2213329	4,518081685
West-Varkenoordseweg 253A	0,28257007	0,17	4	16	0,03008	0,05	0,2248573	4,447264936
West-Varkenoordseweg 255A	0,1820337	0,19	1	1	0,03688	0,06	0,2391993	4,180613734
West-Varkenoordseweg 255B	0,55317829	0,27	5	25	0,07326	0,05	0,2213329	4,518081685
West-Varkenoordseweg 257B	-0,1219754	-0,43	3	9	0,18359	0,05	0,2290335	4,366173601
West-Varkenoordseweg 257B	0,16602587	0,04	3	9	0,00196	0,05	0,2290335	4,366173601
West-Varkenoordseweg 257B	0,65061196	0,38	5	25	0,14761	0,05	0,2213329	4,518081685
West-Varkenoordseweg 257B	-0,0549747	-0,05	3	9	0,00297	0,05	0,2290335	4,366173601
West-Varkenoordseweg 261A	0,49091809	0,02	7	49	0,00034	0,05	0,2163608	4,62190836
West-Varkenoordseweg 261A	-0,039706	-0,1	5	25	0,00945	0,05	0,2213329	4,518081685
West-Varkenoordseweg 261B	0,16261448	-0,18	7	49	0,03265	0,05	0,2163608	4,62190836
West-Varkenoordseweg 225B	0,38203011	0,21	3	9	0,0439	0,05	0,2290335	4,366173601
West-Varkenoordseweg 225B	0,46727489	0,16	3	9	0,02547	0,05	0,2290335	4,366173601
West-Varkenoordseweg 225C	0,51159676	0,45	2	4	0,20578	0,05	0,2338265	4,276674686
West-Varkenoordseweg 231C	0,21145581	0,1	2	4	0,00955	0,05	0,2338265	4,276674686
West-Varkenoordseweg 231C	0,20077941	-0,11	3	9	0,01143	0,05	0,2290335	4,366173601
West-Varkenoordseweg 233B	0,4074513	-0,04	8	64	0,00147	0,05	0,2149613	4,652000364
West-Varkenoordseweg 233B	-0,5099379	-0,14	3	9	0,0192	0,05	0,2290335	4,366173601
West-Varkenoordseweg 233C	0,1191928	-0,03	2	4	0,00097	0,05	0,2338265	4,276674686
West-Varkenoordseweg 233C	0,2882585	-0,01	6	36	5E-05	0,05	0,2184917	4,576831909
West-Varkenoordseweg 233C	-0,5099379	-0,14	3	9	0,0192	0,05	0,2290335	4,366173601
West-Varkenoordseweg 233C	-0,0512844	-0,26	1	1	0,0664	0,06	0,2391993	4,180613734
West-Varkenoordseweg 239C	0,38407732	0,31	2	4	0,09436	0,05	0,2338265	4,276674686
West-Varkenoordseweg 217B	0,22633952	-0,08	3	9	0,00643	0,05	0,2290335	4,366173601
Hillevliet 136B	-0,5852972	-0,42	6	36	0,17906	0,05	0,2184917	4,576831909
Hillevliet 138A	0,57002319	0,24	4	16	0,05622	0,05	0,2248573	4,447264936
Hillevliet 138B	-0,1360144	-0,31	3	9	0,09518	0,05	0,2290335	4,366173601
Hillevliet 44A	0,22715202	-0,22	6	36	0,04656	0,05	0,2184917	4,576831909
Hillevliet 44A	0,22150281	0,17	3	9	0,02915	0,05	0,2290335	4,366173601
Hillevliet 44B	0,36002032	-0,08	6	36	0,00687	0,05	0,2184917	4,576831909
Hillevliet 16A	0,26685528	0,29	4	16	0,08611	0,05	0,2248573	4,447264936
Hillevliet 20A	0,21549245	0,13	1	1	0,01727	0,06	0,2391993	4,180613734
Hillevliet 20A	-0,7317539	-0,71	4	16	0,49726	0,05	0,2248573	4,447264936
Hillevliet 24A	0,77717525	0,25	8	64	0,06043	0,05	0,2149613	4,652000364
Hillevliet 24B	0,04250042	-0,58	11	121	0,33148	0,05	0,2152561	4,645628886
Polderlaan 24B	-0,3799258	-0,47	3	9	0,21793	0,05	0,2290335	4,366173601
Polderlaan 30A	0,12999609	0,16	4	16	0,02452	0,05	0,2248573	4,447264936
Polderlaan 38A	-0,0116605	-0,18	2	4	0,0309	0,05	0,2338265	4,276674686
Slaghekstraat 204	0,13000761	0,07	2	4	0,00519	0,05	0,2338265	4,276674686
Slaghekstraat 204	0,39811847	0,4	3	9	0,15887	0,05	0,2290335	4,366173601
Slaghekstraat 97A	0,20440455	0,1	4	16	0,00908	0,05	0,2248573	4,447264936
Utrechtsestraat 13A	0,27752711	0,41	5	25	0,17102	0,05	0,2213329	4,518081685
Utrechtsestraat 15A 1st serie	0,87940373	0,16	10	100	0,02517	0,05	0,214406	4,66404797
Utrechtsestraat 15A 2nd serie	0,03648886	2,8E-15	6	36	0,00E+00	0,05	0,2184917	4,576831909
Vlasakkerstraat 17A	0,55374871	0,35	2	4	0,12432	0,05	0,2338265	4,276674686
Vlasakkerstraat 17B	0,48680641	-0,01	4	16	0,00015	0,05	0,2248573	4,447264936
Vlasakkerstraat 17B	0,08487631	0,17	3	9	0,02795	0,05	0,2290335	4,366173601
Vlasakkerstraat 25A	0,95994976	0,61	2	4	0,37361	0,05	0,2338265	4,276674686
Donkerslootstraat 107	0,33404061	0,06	3	9	0,00359	0,05	0,2290335	4,366173601
Donkerslootstraat 111A	-0,0568738	-0,11	5	25	0,01308	0,05	0,2213329	4,518081685
Donkerslootstraat 113B	0,18924463	-0,01	4	16	8,4E-05	0,05	0,2248573	4,447264936
Donkerslootstraat 115B	0,11843962	-0,05	3	9	0,00292	0,05	0,2290335	4,366173601
Donkerslootstraat 115B	0,57122714	0,41	1	1	0,16877	0,06	0,2391993	4,180613734
Donkerslootstraat 115B	0,32496163	0,07	6	36	0,0047	0,05	0,2184917	4,576831909
Donkerslootstraat 115B	-0,0079072	-0,01	3	9	5,5E-05	0,05	0,2290335	4,366173601
Donkerslootstraat 87A	0,48697569	-0,18	12	144	0,03212	0,05	0,2168488	4,61150775

Donkerslootstraat 87B	0,24319963	-0,05	4	16	0,00243	0,05	0,2248573	4,447264936
Donkerslootstraat 59B	-0,0372326	-0,09	2	4	0,00781	0,05	0,2338265	4,276674686
Donkerslootstraat 119A	0,28125586	-0,05	8	64	0,00271	0,05	0,2149613	4,652000364
Donkerslootstraat 121B	0,19605801	0,23	2	4	0,05083	0,05	0,2338265	4,276674686
Donkerslootstraat 131B	0,65539009	0,22	5	25	0,04715	0,05	0,2213329	4,518081685
Donkerslootstraat 133B	0,13995352	-0,01	2	4	0,00011	0,05	0,2338265	4,276674686
Donkerslootstraat 135A	0,34949898	0,02	4	16	0,00028	0,05	0,2248573	4,447264936
Donkerslootstraat 135A	0,34812104	0,06	7	49	0,00394	0,05	0,2163608	4,62190836
Donkerslootstraat 135B	0,74620502	0,19	8	64	0,03593	0,05	0,2149613	4,652000364
Donkerslootstraat 137B	0,30838969	-0,19	4	16	0,03637	0,05	0,2248573	4,447264936
Donkerslootstraat 139A	0,65088014	0,03	11	121	0,00106	0,05	0,2152561	4,645628886
Donkerslootstraat 139B	0,53007898	0,07	10	100	0,00423	0,05	0,214406	4,66404797
Donkerslootstraat 141A	0,42294056	-0,02	6	36	0,0004	0,05	0,2184917	4,576831909
Donkerslootstraat 141B	0,12556266	-0,03	1	1	0,00121	0,06	0,2391993	4,180613734
Donkerslootstraat 141B	0,38864688	0,1	7	49	0,01067	0,05	0,2163608	4,62190836
Donkerslootstraat 32B	0,13983639	0,08	1	1	0,00657	0,06	0,2391993	4,180613734
Donkerslootstraat 32B	0,827371	0,41	5	25	0,16482	0,05	0,2213329	4,518081685
Donkerslootstraat 32B	0,03764324	-0,1	5	25	0,01009	0,05	0,2213329	4,518081685
Donkerslootstraat 44B	0,12125943	-0,04	1	1	0,00153	0,06	0,2391993	4,180613734
Donkerslootstraat 50B	0,76230915	0,13	9	81	0,01578	0,05	0,2143074	4,666194225
Donkerslootstraat 52B 1st serie	0,41119377	-0,23	9	81	0,05084	0,05	0,2143074	4,666194225
Donkerslootstraat 52B 2nd serie	0,03340973	-0,1	4	16	0,01029	0,05	0,2248573	4,447264936
Donkerslootstraat 56A	0,58290662	0,24	7	49	0,05741	0,05	0,2163608	4,62190836
Donkerslootstraat 20A	0,29230694	0,03	4	16	0,0008	0,05	0,2248573	4,447264936
Donkerslootstraat 20A	0,13441621	-0,02	1	1	0,00052	0,06	0,2391993	4,180613734
Donkerslootstraat 20B	-0,1598798	0,06	8	64	0,00341	0,05	0,2149613	4,652000364
Donkerslootstraat 22B	0,24971564	0,11	5	25	0,01246	0,05	0,2213329	4,518081685
Donkerslootstraat 30A	0,19516047	0,36	4	16	0,12968	0,05	0,2248573	4,447264936
Donkerslootstraat 143B	0,43141319	-0,1	9	81	0,00982	0,05	0,2143074	4,666194225
Donkerslootstraat 155A	0,47305471	0,03	8	64	0,00075	0,05	0,2149613	4,652000364
Donkerslootstraat 155B	0,44633629	-0,11	10	100	0,0128	0,05	0,214406	4,66404797
Donkerslootstraat 155B	-0,3548859	-0,19	4	16	0,03607	0,05	0,2248573	4,447264936

Appendix 10 : Heteroskedasticity of errors for Hillesluis



TminS is the time between the subsequent transactions

Appendix 11 : Weighted least square regression Blijdorp and Hillesluis

Blijdorp:

Coefficients[a,b,c]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	DummyPeriod1	,085	,033	,081	2,528	,012
	DummyPeriod2	,203	,034	,196	6,066	,000
	DummyPeriod3	,236	,031	,225	7,596	,000
	DummyPeriod4	,407	,031	,432	13,241	,000
	DummyPeriod5	,536	,031	,610	17,332	,000
	DummyPeriod6	,635	,032	,697	20,105	,000
	DummyPeriod7	,657	,031	,777	21,171	,000
	DummyPeriod8	,707	,033	,710	21,476	,000
	DummyPeriod9	,703	,031	,782	22,613	,000
	DummyPeriod10	,716	,033	,745	21,536	,000
	DummyPeriod11	,789	,033	,832	23,957	,000
	DummyPeriod12	,778	,036	,626	21,328	,000
	DummyPeriod13	,788	,036	,638	21,797	,000
	DummyPeriod14	,808	,040	,560	20,190	,000
	DummyPeriod15	,809	,037	,631	21,732	,000
	DummyPeriod16	,746	,042	,470	17,708	,000
	DummyPeriod17	,738	,073	,225	10,106	,000

a. Dependent Variable: lnp2minlnp1Blijdorp
b. Linear Regression through the Origin
c. Weighted Least Squares Regression - Weighted by PRE_1squarerootreciprocal

Hillesluis:

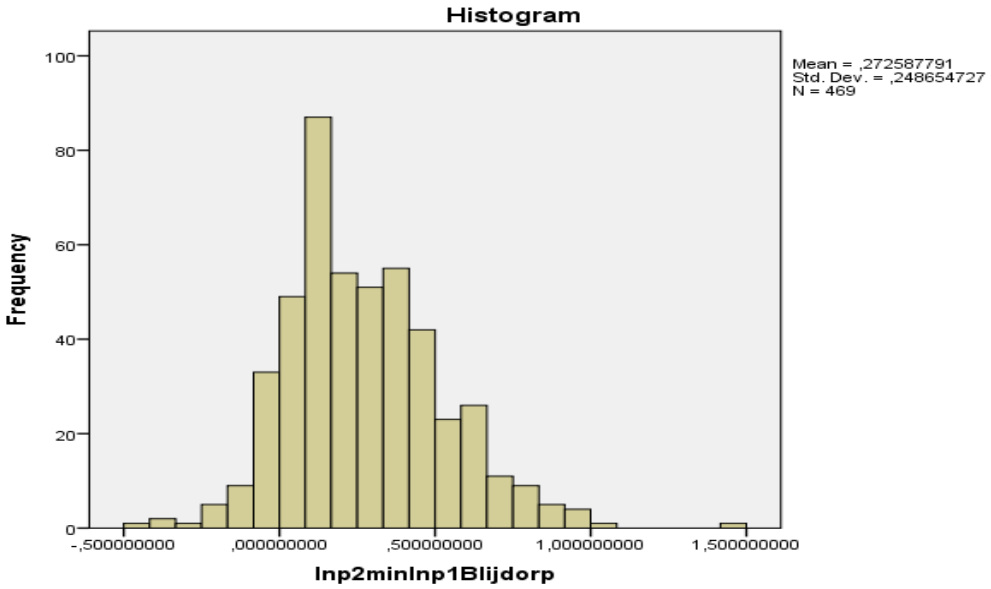
Coefficients[a,b,c]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	DummyPeriod1	,112	,102	,094	1,092	,277
	DummyPeriod2	,170	,096	,153	1,768	,080
	DummyPeriod3	,307	,106	,194	2,909	,004
	DummyPeriod4	,284	,098	,283	2,903	,004
	DummyPeriod5	,442	,087	,442	5,072	,000
	DummyPeriod6	,432	,098	,421	4,415	,000
	DummyPeriod7	,590	,104	,493	5,671	,000
	DummyPeriod8	,779	,117	,526	6,659	,000
	DummyPeriod9	,642	,091	,627	7,061	,000
	DummyPeriod10	,726	,093	,729	7,774	,000
	DummyPeriod11	,700	,093	,735	7,512	,000
	DummyPeriod12	,727	,097	,768	7,485	,000
	DummyPeriod13	,770	,103	,624	7,437	,000
	DummyPeriod14	,698	,107	,537	6,492	,000
	DummyPeriod15	,354	,153	,157	2,316	,022
	DummyPeriod16	,566	,111	,424	5,086	,000
	DummyPeriod17	,736	,256	,167	2,879	,005

a. Dependent Variable: lnp2minlnp1Hillesluis
b. Linear Regression through the Origin
c. Weighted Least Squares Regression - Weighted by PRE_1squarerootreciprocal

Appendix 12 : Histograms and Kolmogorov-Smirnov/Shapiro-Wilk tests for used dataset Blijdorp and Hillesluis

Blijdorp:

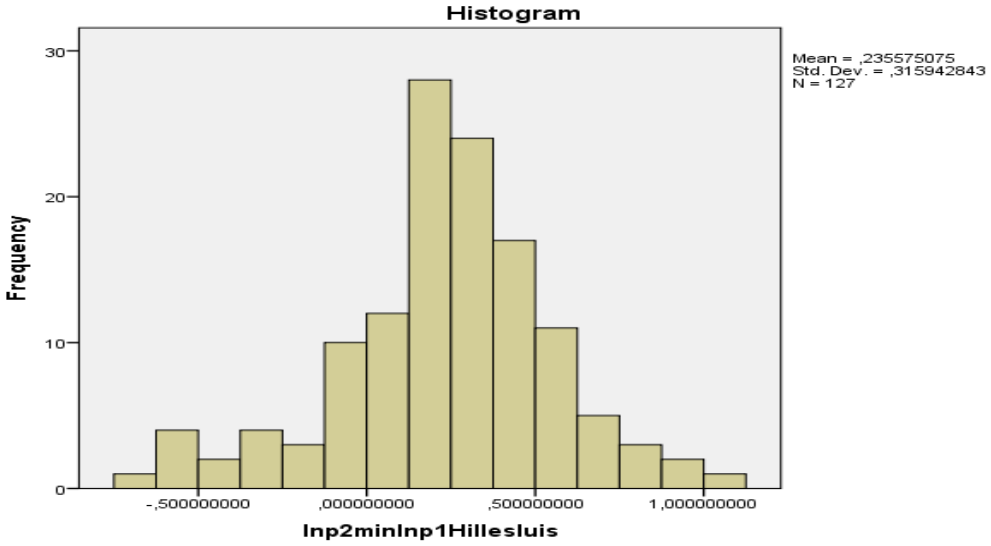


Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
lnp2minlnp1Blijdorp	,077	469	,000	,977	469	,000

a. Lilliefors Significance Correction

Hillesluis:



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
lnp2minlnp1Hillesluis	,103	127	,002	,975	127	,019

a. Lilliefors Significance Correction

Appendix 13: Apartment price index and changes of index on previous period for Blijdorp and Hillesluis

	Apartment price index Blijdorp			Apartment Price Index Hillesluis	
	Index with base year 100	relative change on former period (%)		Index with base year 100	relative change on former period (%)
1994Q4-1995Q2	**100**		1994Q4-1995Q2	**100**	
1995Q3-1996Q2	**108,87**	*8,87*	1995Q3-1996Q2	**111,85**	**11,85**
1996Q3-1997Q2	**122,51**	*12,52*	1996Q3-1997Q2	**118,53**	**5,97**
1997Q3-1998Q2	**126,62**	*3,36*	1997Q3-1998Q2	**135,93**	**14,68**
1998Q3-1999Q2	**150,23**	*18,65*	1998Q3-1999Q2	**132,84**	**-2,27**
1999Q3-2000Q2	**170,92**	*13,77*	1999Q3-2000Q2	**155,58**	**17,12**
2000Q3-2001Q2	**188,70**	*10,41*	2000Q3-2001Q2	**154,03**	**-1,00**
2001Q3-2002Q2	**192,90**	*2,22*	2001Q3-2002Q2	**180,40**	**17,12**
2002Q3-2003Q2	**202,79**	*5,13*	2002Q3-2003Q2	**217,93**	**20,80**
2003Q3-2004Q2	**201,98**	**-0,40**	2003Q3-2004Q2	**190,03**	**-12,80**
2004Q3-2005Q2	**204,62**	**1,31**	2004Q3-2005Q2	**206,68**	**8,76**
2005Q3-2006Q2	**220,12**	**7,57**	2005Q3-2006Q2	**201,38**	**-2,57**
2006Q3-2007Q2	**217,71**	**-1,09**	2006Q3-2007Q2	**206,89**	**2,74**
2007Q3-2008Q2	**219,90**	**1,01**	2007Q3-2008Q2	**215,98**	**4,39**
2008Q3-2009Q2	**224,34**	**2,02**	2008Q3-2009Q2	**200,97**	**-6,95**
2009Q3-2010Q2	**224,57**	**0,10**	2009Q3-2010Q2	**142,48**	**-29,11**
2010Q3-2011Q2	**210,85**	**-6,11**	2010Q3-2011Q2	**176,12**	**23,61**
2011Q3+2011Q4	**209,17**	**-0,80**	2011Q3+2011Q4	**208,76**	**18,53**

Period of economic upswing Period of economic downswing

Appendix 14 : Calculations hypothesis 1

Calculations for testing Hypothesis H1:
For this hypothesis, Dummyperiod 13 is investigated, while this represents the period 2007Q3-2008Q2.
Hillesluis is regarded as population 1, Blijdorp as population 2.
The used figures are as follows:

$\bar{x}_1 = 0{,}770$

$\bar{x}_2 = 0{,}788$

$SE_{\bar{x}_1} = 0{,}103$

$SE_{\bar{x}_2} = 0{,}036$

$D_f = 127 - 1 = 126$

$$\rightarrow t = \frac{0{,}770 - 0{,}788}{\sqrt{(0{,}103^2 + 0{,}036^2)}} = \frac{-0{,}018}{\sqrt{0{,}011905}} = \frac{-0{,}018}{0{,}109110036} = -0{,}164971075$$

Hypothesis H1 is two sided (Ho: $\mu_1 = \mu_2$, and Ha: $\mu_1 \neq \mu_2$). According the t-table in Moore et al. (2003), the critical value for $D_f = 126$ on a 5% significance level is between - 1,962 and - 1,984. The calculated value is below (has not reached) the critical level.

Therefore, the null hypothesis is not rejected.

Appendix 15 : Calculations hypothesis 2

Calculations for testing Hypothesis H2:
For this hypothesis, Dummyperiod 9 is investigated, while this represents period 2003Q3-2004Q2. The period 2002Q3-2003Q2 (Dummyperiod 8) becomes the base year, while it is used as comparison over time. Therefore, the coefficients of the original output are recalculated to this new base year. Herefore, the original coefficients for Dummyperiod 9 are reduced by the value of the original coefficients for Dummyperiod 8.
Hillesluis is regarded as population 1, Blijdorp as population 2.
So, the used figures are as follows:

$\bar{x}_1$ = 0,642 – 0,779 = - 0,137
$\bar{x}_2$ = 0,703 – 0,707 = - 0,004

$SE_{\bar{x}_1}$ = 0,091
$SE_{\bar{x}_2}$ = 0,031

D_f = 127 – 1 = 126

$$\rightarrow t = \frac{-0,137 + 0,004}{\sqrt{(0,091^2 + 0,031^2)}} = \frac{-0,133}{\sqrt{0,009242}} = \frac{-0,133}{0,096135321} = -1,383466541$$

Hypothesis H2 is two sided (Ho: $\mu_1 = \mu_2$, and Ha: $\mu_1 \neq \mu_2$). According the t-table in the work of Moore et al. (2003), the critical value for $D_f = 126$ on a 5% significance level is between - 1,962 and - 1,984. The calculated value is below (has not reached) the critical level.

Therefore, the null hypothesis is not rejected.

Appendix 16 : Calculations hypothesis 3

Calculations for testing Hypothesis H3:
For this hypothesis, firstly Dummyperiod 8 is investigated, while this represents period 2002Q3-2003Q2. The original base year stays the base year, as 1994Q4-1995Q2 are used as comparison over time. the base year, while it is used as comparison over time.
Hillesluis is regarded as population 1, Blijdorp as population 2.
So, the coefficients from the original output are used:

$\bar{x}_1 = 0{,}779$

$\bar{x}_2 = 0{,}707$

$SE_{\bar{x}_1} = 0{,}117$

$SE_{\bar{x}_2} = 0{,}033$

$D_f = 127 - 1 = 126$

$$\rightarrow t = \frac{0{,}779 - 0{,}707}{\sqrt{(0{,}117^2 + 0{,}033^2)}} = \frac{0{,}072}{\sqrt{0{,}014778}} = \frac{0{,}072}{0{,}121564797} = 0{,}592276726$$

Hypothesis H3 is two sided (Ho: $\mu_1 = \mu_2$, and Ha: $\mu_1 \neq \mu_2$). According the t-table in the work of Moore et al. (2003), the critical value for $D_f = 126$ on a 5% significance level on the negative side is between 1,962 and 1,984. The calculated value is below the critical level.

Secondly, Dummyperiod 13 is investigated, while this represents period 2007Q3-2008Q2. The period 2003Q3-2004Q2 (Dummyperiod 9) becomes the base year, while it is used as comparison over time. Therefore, the coefficients of the original output are recalculated to this new base year. Herefore, the original coefficients for Dummyperiod 13 are reduced by the value of the original coefficients for Dummyperiod 9. So, the used figures are as follows:

$\bar{x}_1 = 0{,}770 - 0{,}642 = 0{,}128$

$\bar{x}_2 = 0{,}788 - 0{,}703 = 0{,}085$

$SE_{\bar{x}_1} = 0{,}103$

$SE_{\bar{x}_2} = 0{,}036$

$D_f = 127 - 1 = 126$

$$\rightarrow t = \frac{0{,}128 - 0{,}085}{\sqrt{(0{,}103^2 + 0{,}036^2)}} = \frac{0{,}043}{\sqrt{0{,}011905}} = \frac{0{,}04}{0{,}109110036} = 0{,}394097569$$

Hypothesis H3 is two sided (Ho: $\mu_1 = \mu_2$, and Ha: $\mu_1 \neq \mu_2$). According the t-table in the work of Moore et al. (2003), the critical value for $D_f = 126$ on a 5% significance level is between 1,962 and 1,984. The calculated value is below the critical level.

The outcome of both foregoing tests is that the null hypothesis is not rejected.

Appendix 17 : Calculations hypothesis 4

Calculations for testing Hypothesis H4:
For this hypothesis, Dummyperiod 14 is investigated, while this represents period 2008Q3-2009Q2. The period 2007Q3-2008Q2 (Dummyperiod 13) becomes the base year, while it is used as comparison over time. Therefore, the coefficients of the original output are recalculated to this new base year. Herefore, the original coefficients for Dummyperiod 14 are reduced by the value of the original coefficients for Dummyperiod 13.
Hillesluis is regarded as population 1, Blijdorp as population 2.
So, the used figures are as follows:

$\bar{x}_1$ = 0,698 – 0,770 = - 0,072

$\bar{x}_2$ = 0,808 – 0,788 = 0,020

$SE_{\bar{x}_1}$ = 0,107

$SE_{\bar{x}_2}$ = 0,040

D_f = 127 – 1 = 126

$$\rightarrow t = \frac{-0,072 - 0,020}{\sqrt{(0,107^2 + 0,040^2)}} = \frac{-0,092}{\sqrt{0,013049}} = \frac{-0,092}{0,114232219} = -0,805376983$$

Hypothesis H4 is one sided (Ho: $\mu_1 \geq \mu_2$, and Ha: $\mu_1 < \mu_2$). According the t-table in the work of Moore et al. (2003), the critical value for D_f = 126 on a 5% significance level is between -1,66 and -1,646. The calculated value is below (has not reached) the critical level.

Therefore, the null hypothesis is not rejected.

Appendix 18 : Counting table of number of transactions

	BLIJDORP		HILLESLUIS/BLIJDORP		HILLESLUIS		
	A	B	C	D	E	F	G
	sales counts	turnover ratio in %	change in Hillesluis turnover ratio/ Blijdorp turnover ratio in %	Hillesluis turnover Ratio / Blijdorp turnover ratio	change in turnover ratio in %	turnover ratio in %	sales counts
1995Q1+1995Q2	39	3,32		0,62		2,04	9
1995Q3+1995Q4	44	3,74	28,03	0,79	44,44	2,95	13
1996Q1+1996Q2	36	3,06	- 43,59	0,44	- 53,85	1,36	6
1996Q3+1996Q4	42	3,57	- 28,57	0,32	- 16,67	1,13	5
1997Q1+1997Q2	31	2,64	333,55	1,38	220,00	3,63	16
1997Q3+1997Q4	37	3,15	- 42,40	0,79	- 31,25	2,49	11
1998Q1+1998Q2	39	3,32	- 48,25	0,41	- 45,45	1,36	6
1998Q3+**1998Q4**	54	4,59	- 3,70	0,40	33,33	1,81	8
1999Q1+1999Q2	37	3,15	**191,89**	1,15	**100,00**	3,63	16
1999Q3+1999Q4	44	3,74	**- 31,68**	0,79	**- 18,75**	2,95	13
2000Q1+2000Q2	34	2,89	**19,46**	0,94	**- 7,69**	2,72	12
2000Q3+2000Q4	42	3,57	- 5,56	0,89	16,67	3,17	14
2001Q1+2001Q2	33	2,81	81,82	1,62	42,86	4,54	20
2001Q3+2001Q4	31	2,62	- 41,45	0,95	- 45,00	2,49	11
2002Q1+2002Q2	36	3,06	9,60	1,04	27,27	3,17	14
2002Q3+2002Q4	40	3,40	- 67,86	0,33	- 64,29	1,13	5
2003Q1+2003Q2	24	2,04	266,67	1,22	120,00	2,49	11
2003Q3+2003Q4	37	3,15	- 11,55	1,08	36,36	3,40	15
2004Q1+2004Q2	45	3,83	- 12,30	0,95	6,67	3,63	16
2004Q3+2004Q4	30	2,55	- 53,13	0,44	- 68,75	1,13	5
2005Q1+2005Q2	30	2,55	260,00	1,60	260,00	4,08	18
2005Q3+2005Q4	40	3,40	- 16,67	1,33	11,11	4,54	20
2006Q1+2006Q2	40	3,40	- 15,00	1,13	- 15,00	3,85	17
2006Q3+2006Q4	30	2,55	17,65	1,33	- 11,76	3,40	15
2007Q1+2007Q2	33	2,81	- 15,15	1,13	- 6,67	3,17	14
2007Q3+2007Q4	23	1,96	33,23	1,51	- 7,14	2,95	13
2008Q1+2008Q2	37	3,15	- 18,71	1,23	30,77	3,85	17
2008Q3+2008Q4	22	1,87	**18,72**	1,45	**- 29,41**	2,72	12
2009Q1+2009Q2	27	2,30	**8,64**	1,58	**33,33**	3,63	16
2009Q3+2009Q4	43	3,66	- 56,83	0,68	- 31,25	2,49	11
2010Q1+2010Q2	28	2,38	262,99	2,48	136,36	5,90	26
2010Q3+2010Q4	20	1,70	- 24,62	1,87	- 46,15	3,17	14
2011Q1+2011Q2	35	2,98	- 59,18	0,76	- 28,57	2,27	10
2011Q3+2011Q4	13	1,11	169,23	2,05	0,00	2,27	10

Suspicious less strict period of Redlining for Hillesluis

Suspicious period of Redlining for Hillesluis

Possible catch up period for Hillesluis

Uncertain suspicious period of Redlining for Hillesluis