A Quantitative study on the Longitudinal Relation between Urban Green and Housing Prices

Student: I.M.J. Cockx
Student number: 910318159010
Supervisor: M.M. Bakker
Second supervisor: L.B. Janssen-Jansen
Date: 23-9-2015

Abstract

It is an accepted thought that urban green has many qualities and thereby positive influences on the urban area. Therefore, the influence of urban green on housing prices was researched many times. The hedonic price analysis is an often-used method for these researches. However, this analysis is cross-sectional, which has its shortcomings. The outcomes of these researches are that green could have an influence on the housing prices, but this is not always the case. In this research, from another point of view the housing prices are researched. A longitudinal study is done to test if the same results are showing up in another type of research. This study is about the longitudinal influence of urban green on the housing prices. This research is done by statistically comparing the average WOZ-values of sixteen greened urban neighbourhoods over the years 1997-2014. These WOZ-values are compared with the WOZ-values of similar control neighbourhoods from the same city. The outcome of this research was that only in four out of sixteen cases, the WOZ-values of the greened urban neighbourhood increased over those of the control neighbourhood. In these four cases, the greened area had indeed a positive influence on the housing prices. In the other twelve cases, no significant positive influence could be found. This research gave extra insight in the relationship between urban green and housing prices, which can be used during decisions in planning projects.

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1 Introduction

The world is urbanising in an ever increasing pace. In 2014, 54% of the world population lived in urban areas (WHO, 2014), and therefore it is important that these cities remain healthy and liveable. Urban green contributes to this liveability, as green supports and satisfies various needs of citizens (Bengochea Morancho, 2003; Gibbons et al., 2014; Melichar and Kaprová, 2013; Netusil et al., 2014). It is a source of relaxation and leisure: inhabitants enjoy nature by, for example, walking, biking or swimming, but it is also seen as a visual attraction or source for ecological education. Urban green also absorbs air pollution particles emitted by cars and air conditioning systems, it allows precipitation and it helps balancing temperature during hot spells. For these reasons, urban planners and policymakers are concerned with providing sufficient green space for their inhabitants. They often defend expenditures on urban green development by claiming that housing prices will increase, due to the development of urban green (Netusil et al., 2014). These expenditures can be repaid in different ways, for example by tax increment funding, indirect value capturing or by 'Red for Green'.

The idea that urban green increases the housing price is a widely accepted thought in literature (Bengochea Morancho, 2003; Biao et al., 2012; Fennema, 1995; Fennema et al., 1996; Gibbons et al., 2014; Luttik, 2000; Melichar and Kaprová, 2013; Netusil et al., 2014). Much quantitative research has been done after the effect of different types of urban green on housing prices; for example, the value of vicinity of tree canopies, water, open spaces, but also agricultural land, (national) parks and domestic gardens. The results of these examinations, however, are variable and not all of them show significant effects of urban green on housing prices. In the Netherlands, it was found that housing prices near parks can be about 2-12% higher than houses farther away from parks (Bervaes and Vreke, 2004; Fennema et al., 1996; Luttik and Zijlstra, 1997; Luttik, 2000). However, in the research of Luttik (2000) both significant and non-significant relationships were found. The relation between parks and housing prices was mostly not significant, while the relationship between water -e.g. a lake or canal- and housing prices was majorly significant. Bervaes and Vreke (2004) also researched the situation in different Dutch cities and found that results differed strongly among cities: in the case of Apeldoorn, the housing prices by a front view on a park were 6.3% higher than the houses prices without this view; while in the case of Breda, no significant difference was found between the housing prices with and without a park view. This was also the case for 'distance to park'; in Apeldoorn no significant difference was found, in Breda the distance of the park could influence the housing price with 11% (Berveas and Vreke, 2004). These differences between cities could not be explained. In other countries than the Netherlands, the same type of research was done. In different cities, a significant relation was found between distances to urban green and housing prices; the closer to urban green, the higher the housing price (Bengochea Morancho, 2003; Gibbons et al., 2014; Biao et al., 2012).

These studies have all used the hedonic pricing method to test the influence of different types of green on het housing prices. The hedonic pricing method explains the value of non-market products by explaining observed transaction prices. These transaction prices are a reflection of the people's decisions where to locate (Perman et al., 2011). This method is based on cross-sectional data that generates a value for non-tradable market elements, such as location and presence of facilities or green (Marlet, 2009). The method uses a multivariate regression analysis and is therefore useful for rational analyses.

The use of cross-sectional analyses, however, has an important shortcoming, namely confounding. The structural relationships between correlated explanatory variables may confound relationships of interest (Bervaes and Vreke, 2004; Gundimeda, 2005; Lomax and Haghs-Vaughn, 2012; Spit and Needham, 1987; Stokking, 2014). It is frequently difficult to separate the independent effect of different elements that explain the housing price when these elements are correlated. Often, high-value houses were developed close to parks in history, not only being close to a park, but also being more beautiful than houses farther away of parks. Aesthetics and architecture of a house also influences the housing prices significantly (Planbureau voor de Leefomgeving et al., 2014). This suggests a structural relationship between important price-determining characteristics. Scientists often attempt to control for confounding, by including potential confounders as explanatory variables, next to the variable of interest. However, this only partially solves the problem, because when two or more variables are structurally related, statistical analyses cannot identify the true association. At best, one can identify a range between the minimal effect of a variable and its maximal effect (Field, 2013; Gundimeda, 2005). In spite of the possibility to control for confounding variables, the effects of aesthetics of houses were often not included, because they were too difficult to identify. These confounding issues seriously hinder the use of a regression-based method such as hedonic price analysis.

To overcome this shortcoming, this research performs a longitudinal study to research the how the development of urban green affects the housing prices. Rather than looking at spatial variability of prices, we studied the development of prices during a period within which a park was created, and hence the only characteristic of the houses that changes is the distance to a park. To our best knowledge, there was no longitudinal study done on the relationships between urban green and housing prices yet. The purpose of this research was to investigate the longitudinal link between urban green and housing prices by using quantitative data and case studies in a range of cities. In total 16 case studies were examined. Each case study consists of a greened and a non-greened area. The analysis investigated whether the difference between the two groups changes significantly after greening one of the neighbourhoods, which would demonstrate the effect of green development on housing prices. The effect of urban green area development on housing prices was examined by searching for the existence of a significant difference between the price development of

both neighbourhoods in each case study. Based on previous research, the hypothesis is that greening the neighbourhood leads to a difference between the two groups in each case study, where the housing prices of the greened neighbourhood increases significantly over the non-greened neighbourhood.

This thesis is organised as follows. This section introduces the topic including a short literature review of former research. The following section includes a small theoretical foundation, which explains the elements of housing prices, the construction of the value of green and three often-used methods to examine the housing market. Section 3 elaborates on the methodology and data used in this study. Section 4 reports the results. The thesis ends with a discussion about the findings.

2 Theoretical foundation

Every house has a unique setting. They all have a different view, location or architectonical style. It is possible to distinguish housing characteristics in four categories (Visser and Dam, 2006; Bervaes and Vreke, 2004). The first category includes the physical house characteristics. This includes type (detached, semi-detached), size, number of rooms, isolation, type of architecture etcetera. The second category covers the physical characteristics of the surrounding, such as presence of open spaces, a park in the neighbourhood, or how dense the neighbourhood setting is. The third category includes the social characteristics of the surrounding. This contains social elements such as unemployment rates, demographics and the sale/rent distribution. The last category concerns the functional characteristics of the surrounding, like presence of and accessibility to facilities and infrastructures such as trains or highways.

In the introduction, the positive effects of green were already explained. It improves the liveability of an area in different ways. However, the market of nature and green is complex. It does not include direct values (Perman et al., 2011). There is no evidence how much consumers are willing to pay for nature or green, because there is no direct demand curve. Even when there is a demand curve, for example if a nature park uses admission fees, there is still no exact economic value for all economic benefits. For example, the positive effect on air quality is not taken into account in the admission fees. Green consists of use-values and non-use values. By use-values, the environmental goods are used, for example timber. It can get destroyed, while consuming the items. In non-use values, no destruction takes place (Perman et al., 2011). The non-use values exists of the satisfaction 'consumers' get by the idea and thought that elements exist, e.g. polar bears.

The use-values, in combination with housing prices, can be inferred from observed behaviour. The three often-used methods are interviews with real estate agents, research after the willingness to pay of consumers, and the hedonic price method. The first method, the interviews with real-estate agents will give an overview of the value of green on the housing market. This method is based on experience and taxations. This method is subjective, and therefore less useful for rational analysis (Visser and Dam, 2006). The second way is the use of willingness to pay. This method uses questionnaires to ask consumers what they are willing to pay for a particular situation (Leeuwen, 1997). As the situation is not real, there may be a difference between the answers of this questionnaire and the reality. A positive element of this method is that it can also be used in hypothetical situations. The third method is the hedonic price method. The evaluation of the good (in this case urban green) is assumed to be reflected into the housing prices (Perman et al., 2011). The hedonic price method uses the idea that every consumption good consist of different characteristics, with all their portion of the price (Visser and Van Dam, 2006; Bengochea Morancho, 2003). The housing choice is based on the utility maximization. It takes into account the characteristics of the house and the income of the consumers. The

hedonic price analysis is able to include many characteristics, as long as these can be captured in quantitative data. Elements such as attractiveness or quality of the view are excluded. The hedonic price method knows three types of regressions, namely a linear, a semi-logarithmic and a double logarithmic. The best option to choose differs per situation (Visser and Van Dam, 2006; Bengochea Morancho, 2003).

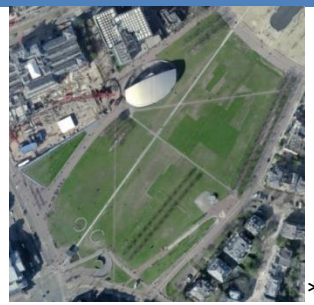
3 Methodology

In this study, none of the three often-used methods is used. To study the longitudinal relationship between urban green and housing prices, time series of housing prices around the moment the urban green was completed were collected. In order to ascribe any development in prices to the presence of urban green, there is a need to control for other economic developments. To do this, control groups were used. Control groups are similar neighbourhoods, in which no park has been developed. Both neighbourhoods are expected to be affected by economic developments in similar ways, so that the only variable that is different between the two neighbourhoods is the presence of urban green, from a certain moment onward.

3.1 Data

3.1.1 Projects

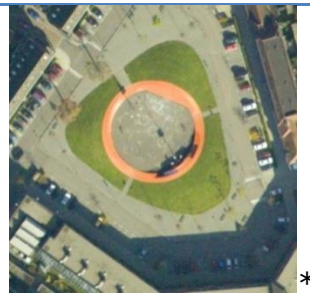
The Netherlands are known for their efficient land-use planning, which is a long-standing tradition that resulted in many green projects. Of these projects, a selection of urban greening projects was examined. They were selected from various governmental reports that listed green developments. This research focused only on urban green realised between 1997 and 2011. All projects were constructed in existing urban areas. This is because in newly built areas, the area is totally reconstructed and project developers set the selling prices, which results in distortion. Furthermore, the greened areas were chosen regardless of characteristics such as size, surroundings, or type of green area. In this research, no comparison is made between the greened areas in different cities, which makes accounting for such differences not necessary. The selected projects are elaborated in table 1.

Greened area	City	Years of realisation	Description	Overview
Museumplein	Amsterdam	1992-1999	Museumplein was a parking lot in the middle of Amsterdam. In the 1990's the area was reconstructed in a green field1. The location is surrounded by many famous museums of Amsterdam, like the Van Gogh museum and Rijksmuseum.	 *
Westergasfabriekterrein	Amsterdam	2002-2003	This spot was already a park since 1891 close to a gas fabric. In 1967, the fabric was closed. In 2002-2003, a new part has been constructed next to the fabric. The terrain and fabric is known for different cultural activities[2,3].	 *

[1] Bolhuis (2004)
[2] Ministerie van VROM (2006)
[3] Ministerie van VROM (2010)

Presikhaaf	Arnhem	2004-2007	It was already a city park since the construction of the area in 1950. However, due to the many interventions, it lost its attraction[4]. Between 2004-2007, a green edge is reconstructed around a consisting neighbourhood.	 *
Phoenixtuin	Delft	1999-2001	This small park is located between busy streets and is reconstructed into a green walking route[5].	 *
Westerpark	Den Bosch	1997-2000	This former business park is reconstructed into an urban area including a green park[6]. Major elements in this park are the many island surrounded by water. It became a location for recreation and nature.	 *

[4] Dienst Stadsbeheer (2010)
[5] SJLS (2002)
[6] Buro Lubbers (2014)

Oude Krispijn	Dordrecht	2006	During the reconstruction of the area, there was chosen to remove the elderly houses and create a green playing field instead[7].	 *
CiBoGa-terrein	Groningen	2011	The CiBoGa area was a former gas factory area. The reconstruction of the area stopped, due to the crisis. Temporary green plans were constructed instead[8]. It is also known for different cultural activities and events.	 9
Stadspark	Groningen	2003-2005	The park Stadspark was opened in 1926. In 2005, a new vision is constructed for the park, including a reconstructed of the park itself[10].	 *

[7] SJLS (2007)
[8] Ebbingekwartier (2014)
[9] Adapted from Gemeente Groningen (2014)
[10] SGLS (2007)

Afrikaanderplein	Rotterdam	1999; 2003-2005	This green field exist since 1907. Since then, different renovations have been taken place and there was need for another renovation in 2003-2005[11]. The area is known, because it is besides a market space.	 *
Proefpark de Punt	Rotterdam	2004	This area was ready for the construction of houses, which has not been started yet. This area received a temporary function, namely a park for testing the functionality of local initiatives[12].	 *
De Schat van Schoonderloo	Rotterdam	1999	The neighbourhood has reconstructed an unused area in Rotterdam into eight different park types[13].	 *

[11] Ministerie van VROM (2006)
[12] Ministerie van VROM (2006)
[13] De Schat van Schoonderloo (2014)

Griftpark	Utrecht	1998-1999	This former gas factory has been reconstructed into a park. The opening was in 1999[14]. It is now an often visited park location close to the centre of Utrecht.	 *
Waterwinpark	Zeist	2010	This water harvesting area is reconstructed into a park[15]. The water elements are still important and it received different functions for different visitors.	 16

*Table 1: all selected projects including the city, years of realisation and description. * Aerial photos adapted from Google Maps (2015).*

[14] Gemeente Utrecht (2014)
[15] OKRA (2014)
[16] OKRA (2014)

3.1.2 WOZ-trends

The Waarde Onroerende Zaken (value of property)(WOZ-value) is used as indicator for the housing prices. This value is assessed on an annual basis and forms the basis for various taxes (Rijksoverheid, 2014). It is based on housing prices of similar sold houses and other appraisals of houses. The Statistics Bureau of the Netherlands (CBS) publishes these data every year or second year since 1997, the year in which the WOZ-taxes were introduced. This data is directly online available for the years 1997; 1999; 2001 and 2003-2013, and therefore attractive as source. Moreover, the database also includes other data such as income and percentages of occupied houses, which was used to select control groups.

3.1.3 Control neighbourhood

In order to use the control group to actually control for the economic developments, ideally both groups respond to such developments in the same way. Although this is difficult, it may be achieved by selecting control groups that are inhabited by 'the same type of people' by using different proxies. The proxies are shown in table 1. Data was used from the years 1997; 1999; 2001; 2003-2013. All data, except for 'function', were published by CBS. The functions of the buildings were based on designation plans published by municipalities. The boarders of all neighbourhoods were set by the municipalities, and were included in the CBS databases.

The first proxy was income: when the average income per neighbourhood is similar between the two neighbourhoods, it is more likely that the purchasing powers of the inhabitants are equal and that changes in this purchasing powers due to economic developments affect both neighbourhoods in the same way. Density of the area is the second proxy, as it describes the urban character of the neighbourhood. Indirectly, it often explains the type of houses: a high density often includes flats in an urbanised area, while a low density often includes detached houses in a semi-urbanised area. Similar densities often indicate similar types of houses and thereby inhabitants. The third proxy is occupied houses. A higher percentage probably results in a higher safety feeling and satisfaction, but also in more social connections in the neighbourhood (Cox, 2013). When the percentages are the same, the chance that the same effects take place in both neighbourhoods is higher. The last proxy was the function of buildings: a neighbourhood contains mostly mixed, residential, or business functions. This characterizes the neighbourhood, which attracts a similar type of inhabitants. An important note here is the absence of some designation plans; since 1 January 2010 the publication of designation plans is obligatory in the Netherlands, but renewing a designation plan for a neighbourhood is only obligatory every ten years. This results in missing plans; however, this problem is solved by using Google Maps to see the main functions of the area. All data were directly online available. The procedures for selecting the control groups are described in the next section (Analysis – Control group selection).

Proxy	
Income per capita	This is based on the mean income per capita of the total population.
Density of area (omgevingsadressendichtheid)	This is based on the amount of addresses per square kilometre within a radius of one kilometre.
Occupied houses (%)	100% includes occupied, rent and owner unknown properties. This is based on the numbers of property registrations, such as WOZ, Kadaster and housing statistics.
Function of buildings	This is based on maps of governmental designation plans. Functions can be mixed, residential or business.

Table 2: four proxies were used to select a control group for each neighbourhood. When all characteristics were similar, the neighbourhood was selected as control group.

3.2 Analysis

3.2.1 Control neighbourhood selection

The control neighbourhood was selected using various tests. The first test compared the average incomes, which were tested with a Mann Whitney U test. As incomes are not normally distributed, no t-test could be applied. The Mann-Whitney U test is non-parametric, which solves this problem. The average incomes of the greened area were compared to every non-greened neighbourhood of the same city. The H0 was that there is no significant difference between the average income per inhabitant of both neighbourhoods. After all tests, only the neighbourhoods with an accepted H0 were taken for the next test. The second proxy was, in contrast to income, harder to test and estimation was necessary. As density of an area is often stable in time, and does not vary strongly within a neighbourhood, the chance is higher that -even when the densities were close to each other- the p-value approaches 0.000, because the variances around the two means are very small. For example, when the densities are 300-500 and 5000-5100, the p-value approaches 0.000. This is also the case when the densities are 1000-1200 and 900-950. However, in the second situation the densities are that close to each other that the character of the neighbourhood could be similar. In this case, estimation is stronger than a significance test, because the chance that the p-value approaches 0.05 is nihil. The estimation and comparisons were based on expert-knowledge. When the densities were almost the same, it was accepted and taken for a third test. The third proxy was also an estimation based on expert-knowledge. The percentages of occupied houses were also often stabile, which makes testing weaker than estimation. When all three characteristics were still close to each other, the designation plans were compared for functions. In all cases, one neighbourhood was selected as control group. Not all neighbourhoods were taken into account. Some neighbourhoods did not have enough data, because the area was too industrial and had no or not many inhabitants.

3.2.2 WOZ-trends

After selecting the control groups, the WOZ-trends were compared. To answer the research question, it was necessary to know if there raises a significant difference between the housing prices before and after the construction of the park. However, as it is unknown when exactly the difference –if any- becomes visible, the time series were split after every possible year, thus after 1999, after 2001, after 2003 etcetera. The period before the split is called period 0, the period after is called period 1. To compare the WOZ-trends, a Mann-Whitney U test is used. The main hypothesis was that a significant difference arises between the two neighbourhoods in period 1, while there is in period 0 no significant difference between the two neighbourhoods. In period 0, the WOZ-values should not be significantly different. When there is no difference, period 0 can be seen as a stable time period. For period 0, the following sub-hypothesis was tested: 'there is no significant difference before completion of the park'. The second sub-hypothesis focused on period 1: 'there is a significant different after completion of the park'. When both hypotheses were accepted, the main hypothesis could be accepted. According to the hypothesis, the greened neighbourhood's WOZ-value should increase over the WOZ-value of the control neighbourhood. As a Mann-Whitney U test does not explain the direction of the significance, there is always a need for a scatterplot to explain the results.

4 Results

4.1 Control neighbourhood selection

Table 3 shows the selected control neighbourhoods. The comparison of the proxies resulted in this selection of control neighbourhoods. The most similar neighbourhoods became the selected control groups. Table 3 shows also the average outcomes per proxy for all years. Some neighbourhoods had a control group that was highly similar, e.g., the two neighbourhoods by Westerpark are similar for every proxy: the function is the same, the average income differs annualized €500, the percentage of occupied houses only 4% and the density 4 houses per km^2. In other cases, the control group showed less similarity. An example is Stadspark, this renovated park is most similar to the neighbourhood De Held, but De Held is more than twice as densely built as Stadspark. In all other cases, differences became visible as well. However, these were the most similar neighbourhoods for these cases.

Park	Greened Neighbourhood					Control Neighbourhood				
	Name Neighbourhood	Income per inhabitant (€)	Occupied houses (%)	Density (houses per M^2)	Function*	Name Neighbourhood	Income per inhabitant (€)	Occupied houses (%)	Density (houses per M^2)	Function*
Museumkwartier	Museumkwartier	28,435	33	8,034	M	Willemspark	24,409	38	7,649	M
Westergasfabriek	Spaarndammer-Zeeheldenbuurt	15,587	11	5,152	M&R	Stadionbuurt	15,548	7	5,077	M&R
Presikhaaf	Winkelcentrum Presikhaaf	13,700	66	2,192	M&R	Brouwerijweg e.o.	13,600	63	1,730	R
Phoenixtuin	Centrum-West	17,641	52	4,460	M	Centrum-Oost	19,162	61	4,022	M
Westerpark	Deuteren	13,940	26	1,609	R	De Schutskamp	13,446	30	1,613	R
Oude Krispijn	Krispijnse Driehoek	8,940	21	3,515	R	Dorus Rijkersstraat e.o.	10,066	13	3,132	R
CiBoGa I	Binnenstad Noord	13,596	35	5,634	M	Binnenstad Zuid	13,564	24	5,367	M
CiBoGa II	Gorechtbuurt	13,552	34	4,368	M	Oosterpoortbuurt	13,281	39	3,506	M
Stadspark	Stadspark	17,908	84	415	R	De Held	15,168	77	1,154	R
Afrikaanderplein	Afrikaanderwijk	9,524	8	5,010	R	Bloemhof	10,157	19	6,001	R
Proefpark de Punt	Bospolder	10,713	14	5,026	M	Tussendijken	10,205	10	5,824	M
De Schat van Schoonderloo	Delfshaven	12,033	18	4,410	M	Hillesluis	9,842	22	4,562	M&R
Griftpark I	Tuinwijk Oost	16,395	60	5,148	R	Oudwijk	18,188	61	4,313	R
Griftpark II	Zeehelden-Hengeveldstraat	18,535	53	3,890	M&R	Tuindorp en Van Lieflandlaan-West	18,675	62	3,774	M&R
Griftpark III	Wittevrouwen	17,905	66	4,792	M&R	Oudwijk	18,188	61	4,313	R
Waterwinpark	Dijnselburg	13,603	37	1,442	R	Vogelwijk	11,668	36	1,520	R

*Table 3: selected control neighbourhoods per park. All control neighbourhoods are located in the same city and have the similar characteristics. The average characteristics per neighbourhood are showed. * Function can be R=Residential, M=Mixed (residential and business).*

4.2 WOZ-trends

The WOZ-data between 1997 – 2013 were used. WOZ-trends all follow a somewhat similar development: the average WOZ-value was relatively low in 1997, increased quickly in the beginning of the 2000's, has stabilised, and then decreased due to the crisis at the end of the 2000's.

4.2.1 Period 0

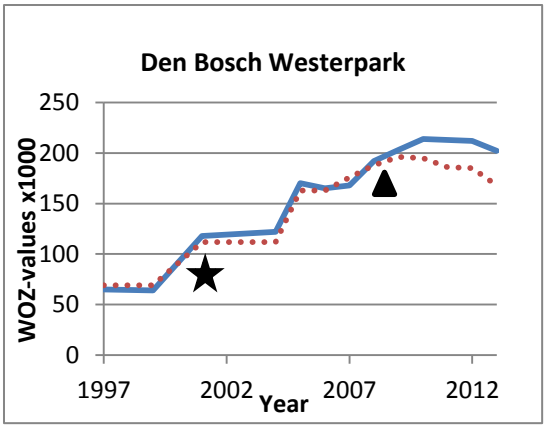
The hypothesis 'there is no significant difference in period 0' is in all testable case studies accepted. However, in the case of Museumkwartier, Westerpark, Schat van Schoonderloo and in all three cases of Griftpark, there is no result for period 0. The parks were constructed or completed before 1999. As the data collection of WOZ starts in 1997, it was impossible to test these case studies, due to lack of data. In all testable cases, no significant difference was found. This applies to the case studies of Westergasfabriekterrein, Presikhaaf, Phoenixtuin, Krispijnse Driehoek, in both cases of CiBoGa, Stadspark, Afrikaanderplein, Proefpark de Punt and Waterwinpark. In all cases, the p-value was not even close to 0.05, but mostly above 0.100.

4.2.2 Period 1

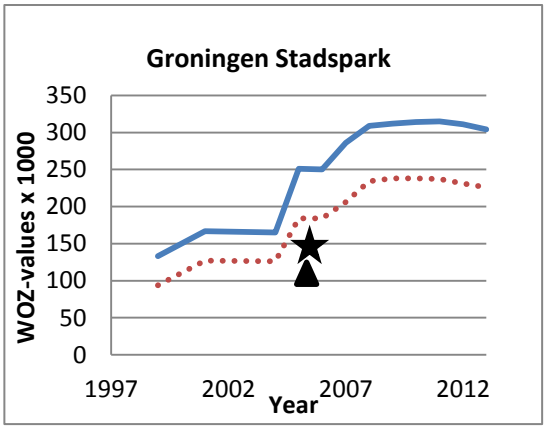
The second part of the test was to see if a significant difference came to exist after the realisation of the park. Four neighbourhoods showed a development that deviated significantly from their control group in period 1, seven showed no deviating development, and five neighbourhoods showed a development that deviated significantly from their control group, but in favour of the control neighbourhood. The first group supports the hypothesis, but the second two groups do not. Below, the three groups are discussed one by one.

4.2.2.1 Significant neighbourhoods

In four cases, a significant difference was found, which means that the WOZ-values of the greened neighbourhood increased compared to the control neighbourhood's WOZ-value. Figures 1 A-D show the WOZ-trends of the neighbourhoods including the first moment and the peak of significance. The Westerpark (1A) was developed between 1997-2000, but WOZ values do not respond immediately. While in 2001, the p-value of period 1 was still 0.168, in 2008 this was already decreased until 0.041. The peak was 0.010 in 2009. In the other cases, there was a direct response visible. In the case of Stadspark (1B), there was a constant significant difference between the greened area and its control group in period 1, but the peak was directly after the completion of the park in 2005. The first significant result was even before the completion of the park. In the case of Proefpark de Punt (1C) a significant difference was visible a year after the completion of the park. In 2005 the peak of P was showed with a value of 0.000. In this situation, the first significant result was arisen also before the completion of the park. In the case Schat van Schoonderloo (1D), there was also a constant significant difference after the completion in 1999, but the difference between the neighbourhood and its control group reach its maximum in 2005 (P value of 0.000).



1A



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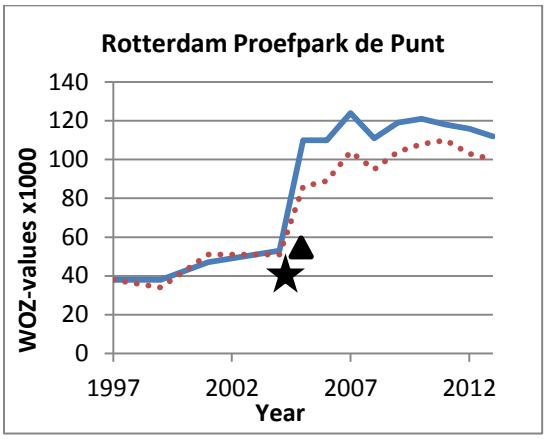

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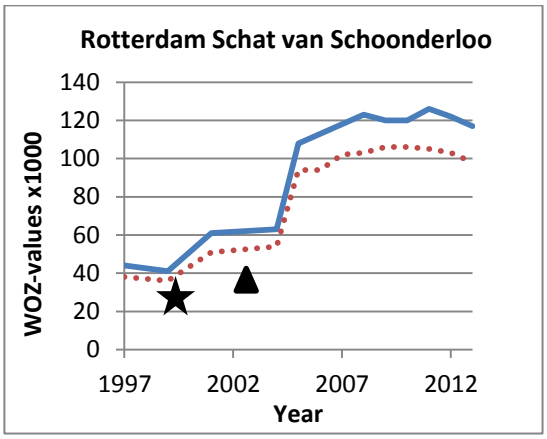


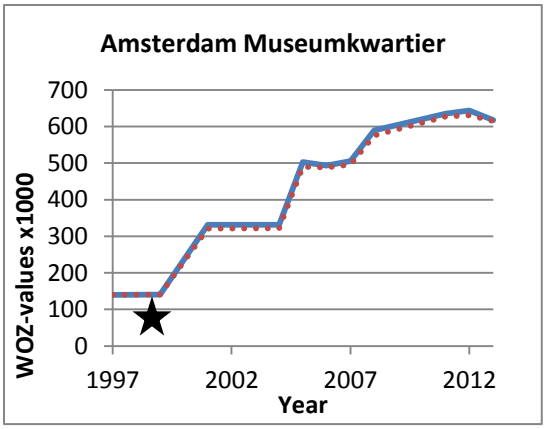
1D

Figure 1 A-D: In these four cases, after the construction of the park, the differences between the two neighbourhoods became significant or more significant.

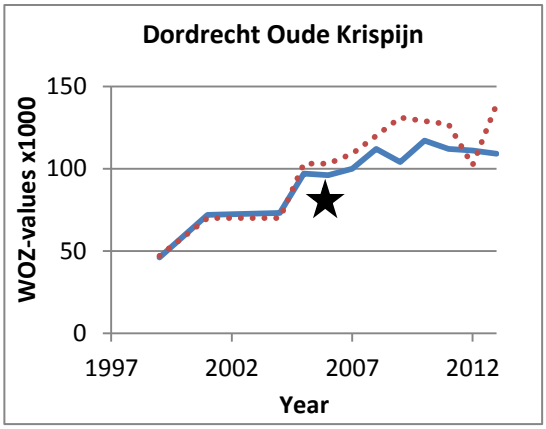
Legend:
Greened neighbourhood
Control neighbourhood
Completion of greening
Peak significant result

4.2.2.2 Not significant

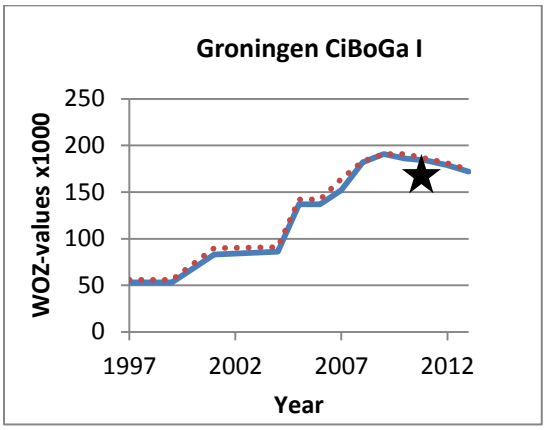
Six times, the WOZ-trends of both neighbourhoods were so close to each other that there was no significant difference at any moment in time. Figures 2A-F show the WOZ-trends of these cases. In some cases, there is a difference visible after completion of the park. This is for example the case by Afrikaanderplein (2D). After completion in 2005, the neighbourhood's WOZ-values increased little, which increases the divergence between the two neighbourhoods. In the case of Oude Krispijn (2B), a difference is visible; however, never significant. This is also the case by Griftpark I (2E) and Griftpark II (2F). However, there is a possibility that there is a difference after 2010, but this is not testable as there are not enough data available after 2010 (only four data per neighbourhood).



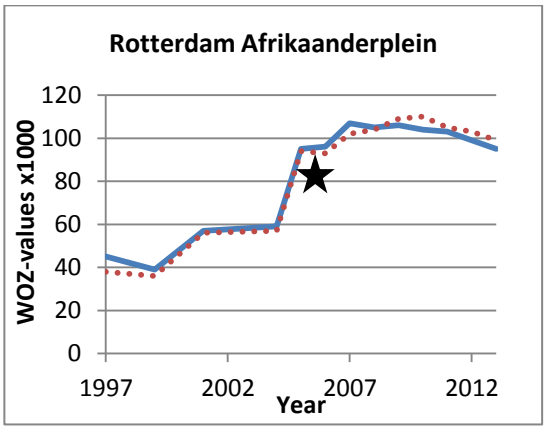
2A



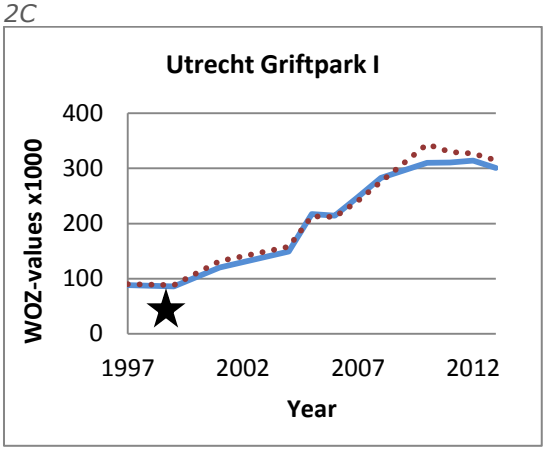
2B



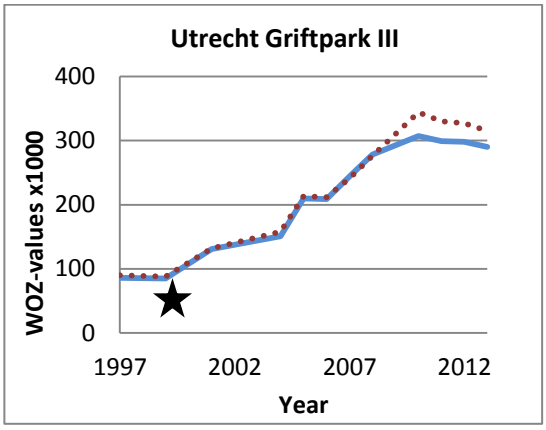
2C



2D



2E



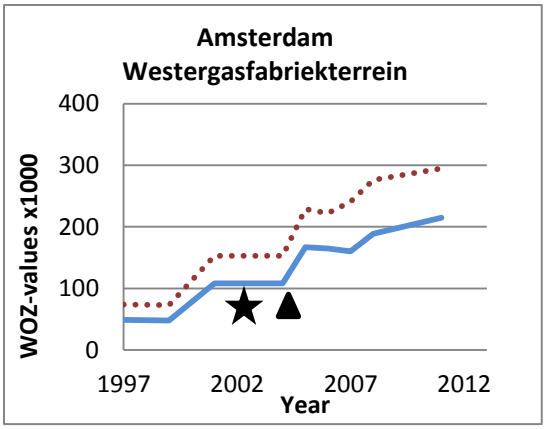
2F

Figure 2 A-G: In these seven cases, there was no significant difference.

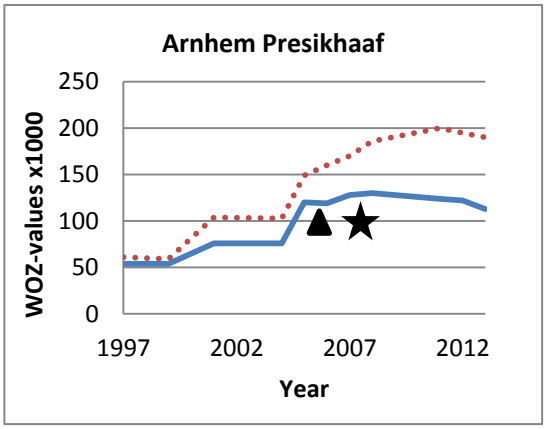
Legend:
Greened neighbourhood
Control neighbourhood
Completion of greening

4.2.2.3 Significant in favour of control neighbourhood

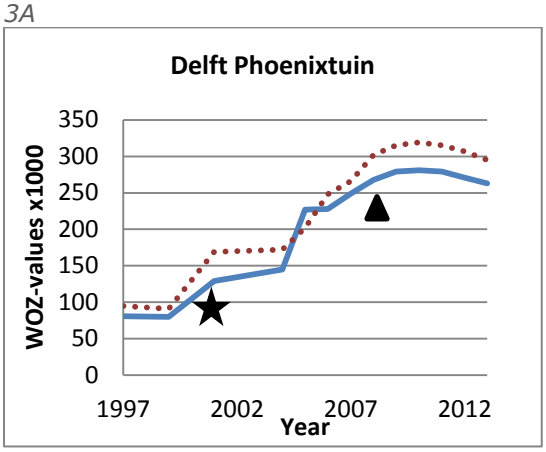
In the last six cases, the hypothesis was rejected as well. Figures 3 A-F show cases where instead of the greened neighbourhood, the WOZ-trend of the non-greened neighbourhood increased. In the situation of the Westergasfabriekterrein(3A), the housing prices in the control neighbourhood increased over those of the greened neighbourhood. Already before the completion of the park, a significant difference arose. It reached it maximum in 2005 with a p-value of 0.002. In the case of Presikhaaf (3B) and CiBoGa II (3D), the peak of the p-value in period 1 was already before the completion of the park. The two neighbourhoods became after construction closer to each other, but there is still a continue significant difference. In the case of Phoenixtuin (3C), there was no direct result visible. The first significant difference became visible in 2007; the peak year was in 2008. In the case of Griftpark II (3E), the same situation occurred. There became a significant difference visible after 2006, while this park was already completed in 1999. The peak of the p-value was in 2008. In the case of Waterwinpark (3F), the WOZ-values of the control neighbourhood increased directly after the completion of the park in 2010, while the greened area stayed stabile. The peak occurred also in 2010.



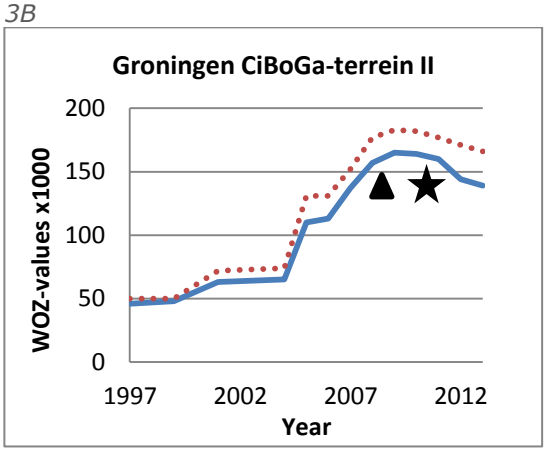
3A



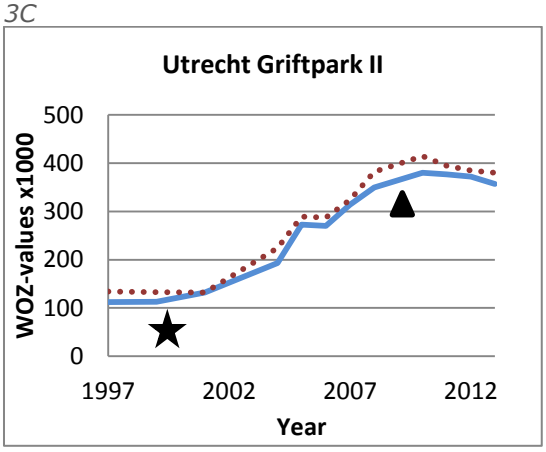
3B



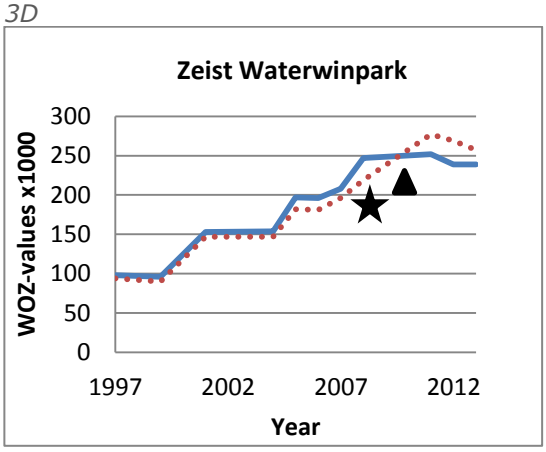
3C



3D



3E



3F

Figure 3 A-F: In these six cases, there was no significant difference in favour of the control neighbourhood.

Legend:
Greened neighbourhood
Control neighbourhood
Completion of greening
Peak significant result

5 Discussion

This research has examined the longitudinal effect of urban green on housing prices in sixteen different cases. These cases were researched to see if and to what extent the construction of green areas influences the housing prices in a positive manner. The tested main hypothesis was that a significant difference has to arise between the two neighbourhoods in period 1, while in period 0 there is no significant difference between the two neighbourhoods. Period 0 is roughly before greening the neighbourhood, period 1 is roughly after greening. In case the hypothesis is accepted, the housing prices grew significantly over the non-greened neighbourhood, which would demonstrate a positive relationship between the construction of urban green and the housing prices.

5.1 Analysis and interpretation

The results of this research showed that in almost all cases, namely twelve out of sixteen cases, the hypothesis had to be rejected. So, no relationship was found between the housing prices and urban green. In these cases, there was no positive significant difference found in favour of the greened neighbourhood. Only in four out of sixteen cases, the hypothesis could be accepted due to a positive significant difference, which shows a relationship. These results are not in line with former research that shows a premium on houses near green. However, there has been some research that also showed different outcomes about the effect of green on the housing prices (Bervaes and Vreke, 2004; Luttik, 2000). The research of both Bervaes and Vreke (2004) and Luttik (2000) showed as well significant as non-significant results during the same tests in different cities and locations, which is similar to the outcomes of this examination.

In this research, it was chosen to compare in every case study two neighbourhoods to each other. Next to two selected greened areas, more neighbourhoods were surrounding the greened area and were seen as separate case studies. Interesting was to see that these gave different results. Griftpark accepts one time the hypothesis and rejects it twice. The CiBoGa-terrein rejects both times the hypothesis, however one time the control group is significantly in favour. We can conclude that there are more elements influencing the housing prices than those included in this study. Visser and Dam (2006) and Bervaes and Vreke (2004) show this as well in their research. Green can be seen as a physical and functional character of the neighbourhood that has influence on the housing price. Except these characters, other aspects influence the housing prices, and green is only one of them. This can be the reason why green became not significantly visible in the housing prices. This is also the reason Fennema (1996) gives for the fact that green will never result in a high R-value in a regression analysis: there are too many not quantifiable aspects that can influencing the value of the house. Berveas and Vreke (2004) do not provide an explanation for non-significant results; neither does Luttik (2000).

However, there are four case studies where the outcomes showed a significant difference in favour of the greened neighbourhood. This can be ascribed to green, or to other aspects, such as renovations or improvements in the neighbourhood. Three out of four cases had other major changes in their area as well. Stadspark Groningen was reconstructed in the same time that a new main road was constructed in the neighbourhood (SJLS, 2007). This improvement of the reachability of the area may influence the housing prices as well. In the neighbourhood of Westerpark Den Bosch, the area was in the same time partly reconstructed (Bastion Oranje, 2011), which was not the case in the control neighbourhood. In the case of Proefpark de Punt Rotterdam, also reconstructions were taking place. The two neighbourhoods are similar to each other, but Tussendijken has different social problems, that influence the housing prices in a negative way (dS+V, 2007). In the last case, that of Schat van Schoonderloo Rotterdam, there were no new constructions. However, the park is constructed by the neighbourhood itself, which shows already a positive social structure that may influence the housing prices as well (De Schat van Schoonderloo, 2014).

There are also cases where the control neighbourhood's housing prices arise significantly over the greened neighbourhood. To control these results, real estate agents were interviewed about the cases where the control neighbourhood increased over the greened neighbourhood. The agents agreed that many aspects are influencing the value of the houses and the area, both positively and negatively. For example, in Waterwinpark in Zeist, where an intensively used road is surrounding the park, that can result in nuisance of cars, but it creates also the feeling of disconnection to the park. A second example, the CiBoGa-terrein in Groningen became a perfect spot for temporary events, such as festivals and markets. The real estate agency responded that these events attract many visitors, which results in nuisance during day and night, litter afterwards and destruction of the green field by the intensive use. This all influences the housing prices; therefore, it could be possible that these are the reasons no significant increase of the housing prices became visible. During earlier research, negative aspects connected to green were not included or examined.

A second focus point of this research was the moment when -if any- the significant difference became visible. In the cases with a significant difference, no relation can be found about when the significance becomes visible or reaches its peak moment. This was sometimes before the construction, sometimes, directly or even years after the construction of the park. This could be explained from the fact that an increase in housing prices becomes only visible after the selling of houses. Some parks, such as Waterwinpark are surrounded by rental houses and the influence became not visible yet, because the houses were not sold in the meantime. The WOZ-value is based on selling prices of houses, when no houses are sold, there is no change in the housing price. When one house will be sold, all WOZ-values of similar houses will raise or decrease.

The difference of this research was the use of a longitudinal study instead of a cross-sectional regression method, in order to avoid the problem of structurally correlated price-determining factors. These structural relationships can arise while using the hedonic price analyses. The different variables can be structurally connected to each other, which influences on the outcomes. Thereby, the housing price may be influenced by something else, which is not taken into account or cannot be taken into account. For example data that are not rational or interval data and when it is not possible to create dummies out. The aesthetics of the house are an important example. While using the Mann-Whitney U test, qualitative elements can be taken into account, because the totality of two groups is compared to each other. When two groups are compared to each other, the results cannot be linked to one specific element, except when this is the only changing element in the two neighbourhoods. This is in this case the construction of a green area.

Overall, the results point to a general tendency of divergence between the prices of neighbourhoods and control groups. This may be ascribed to overall price increases, which makes that initial differences become amplified: relative differences may remain constant, but absolute differences became larger. A peak in the WOZ-values of the control neighbourhood can for example be assigned to building projects. In the case of Waterwinpark, the control neighbourhood had a project where the houses were sold at the peak before the collapse of the housing market. This resulted in extreme high WOZ-values. Also in Oude Krispijn, many houses were rebuilt, renovated or demolished; thereby, new schools and neighbourhood centres improved the neighbourhood (Onderzoekscentrum Drechtsteden, 2014; Platform 31, 2009). However, in all cases these types of improvements could take place in both neighbourhoods. This counts as well for individual improvements by owners. As both neighbourhoods are reacting in the same way to the selected proxies, the chance is the same that the neighbourhood may react in the same way. This does therefore not explain the divergence between the neighbourhoods.

5.2 Limitations and recommendations for further research

This research has its limitations, like every research. First, the used data were WOZ-values. WOZ-values are set every year for all houses that have the same characteristics. As every house is different and subjective valuated, this is a limitation of the data. However, WOZ-values are set by the use of a model, which results in a standardised construction, instead of assumptions. This makes the dataset more stable over the years and useful for a longitudinal study. The used dataset of CBS reduced the data to one value per neighbourhood per year, because of the privacy of inhabitants. A more detailed dataset could give more insight in locations of specific interest, for example houses located next to the greened area. This limited data was also the case for the selection of control neighbourhoods. The data that were used to create the proxies came also from CBS and were limited due to privacy rights.

Secondly, the analysis of the data: the used data resulted automatically in limitations in the used methods. As method to select control neighbourhoods, proxies were used. The use of proxies results automatically in the fact that it is only a mirror of the reality, which does not explain the real situation. This limited the selection of the neighbourhood. Due to the privacy rights of CBS, only a small dataset could be created. This resulted in the use of a non-parametric test, namely the Mann-Whitney U test. This test is weaker than a t-test, due to its characteristics. It ranks the different WOZ-values and by a small dataset, it becomes more likely that this situation occurred because of accident. This makes it impossible to read the data of 1997-1999 and 2012-2013, because the dataset includes only two data that cannot be ranked.

A recommendation for further research would be to use a bigger and more detailed dataset. This would help to improve the used methods and statistics, which gives a more in-depth result. It is also possible to explore the situation more in-depth by interviewing more real estate agencies. A second recommendation is to change the absolute data into relative data. By the use of relative data, the data are connected to the absolute data. These numbers are in this case stronger than absolute numbers, because relative data can be stay the same where absolute numbers are increasing and getting more divergent. Another recommendation is to repeat this research when more years of WOZ-values are available. The research could be repeated, to see what more data does to the outcomes.

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