A quantitative research:

Cultural amenities and the influence on residential property prices

ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Bachelor Thesis [program Urban, Port and Transport Economics]

Cultural amenities and the influence on residential property prices

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Abstract:

This research presents a quantitative report on cultural amenities and its influence on residential property prices in Rotterdam. The first part of this research is descriptive and presents the levels of possible influences of cultural amenities. Consumers are expected to derive utility from cultural amenities, both indirectly as directly. The direct utility is the utility derived from consuming the cultural good, the experience for instance. The indirect utility is presented in twofold, namely the existence value and its regeneration benefits. The utility derived by consumers can be reflected by a higher attractiveness (or: price) for a residential property or a neighborhood. The influence of the existence and proximity of cultural amenities is tested by means of a hedonic pricing model. This model (regression) is shaped with residential attributes and neighborhood characteristics as control variables. A differentiation is made between non-profit and for-profit cultural amenities. Because of their nature and characteristics, non-profit organizations are expected to have a different influence than for-profit organizations. The existence of cultural amenities is researched by adding a count of cultural amenities per neighborhood to the regression. The proximity of cultural amenities is researched by adding a count to the regression in an area (buffer) of different distances around one transaction. The influence of the existence of cultural amenities is different for non-profit and for-profit organizations. However, the results from the instrumental variable analysis are not significant and this causes the other results to be unreliable. Outcomes therefore cannot suggest causality between the existence or proximity of cultural amenities and the prices of residential properties.

Keywords: cultural amenities, hedonic pricing model, non-profit, for-profit, existence, proximity

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INTRODUCTION

'City life' becomes more and more attractive; as presented by the United Nations (2014) about 54 percent of the world's population lives in urban areas and the prediction is that this will increase to 66 percent in 2050. As argued by Glaeser, Kolko, and Saiz (2001), amenities have an important role in attracting households to live in modern consumer cities. They argue that consumer cities are subject to four urban amenities, namely the presence of a rich variety of services and consumer goods, aesthetics and physical setting, good public services, and speed. Ballas (2013) argues that these amenities are utility bearing attributes, influencing the attractiveness of a city and the quality of life. Cultural amenities, a segment of urban amenities, carry utility for consumers and residents both directly as indirectly.

The direct utility is derived from the consumption of cultural amenities, enjoying a theater show or going to the library. The indirect utility is derived from the existence value and regeneration benefits of cultural amenities. Considering the existence value, Clark and Kahn (1988) argue that cultural amenities carry utility for consumers, even though they may never intend to use the amenity. On the other hand, as argued by Kay (2000), regeneration benefits may occur in relation to neighborhood revitalization, both culturally and environmentally, as well as socially and economically. With an aim on one of these regeneration goals, one can consider cultural amenities as a possible tool in achieving that goal.

The economic regeneration benefit derived from cultural amenities is strongly connected to the economic direct impact of cultural amenities. As argued by Bille and Schulze (2006), employment growth, expenditures of cultural organizations, or expenditures of visitors are ways to indicate this impact. However, Towse (2003) argues that the direct economic impact studies are often misused for advocating public funding. The methods used in studies are not intended for advocating granting subsidies and therefore should be used more carefully.

Besides the difficulty of using direct impact studies in relation to cultural amenities, another pitfall lies in researching this subject. The definition of cultural amenities is often criticized and reconsidered. As argued by DeNatale and Wassall (2007), a *creative core* can be distinguished across organizations and companies. Florida (2002) defines this core as consisting not merely of museums or theaters, but book publishers,

public archives, and music instrument stores as well. Florida's views have been the subject of a lot of criticism because his definition of the *creative class* covers a broad spectrum of careers and organizations. His definition also includes managers and engineers, which makes the definition difficult to distinguish from other knowledge-intensive professionals. A narrower definition seems more useful in measuring the effects of culture and creativity on urban attractiveness.

In this research, the definition of DeNatale and Wassall (2007) is applied to measure the extent to which cultural amenities are utility bearing attributes for the attractiveness of a neighborhood. It is assumed that the value of an attractive neighborhood can be reflected by the residential property prices in that area. Potential buyers are expected to have a higher willingness-to-pay for neighborhoods with a higher utility value. The price of residential properties is often determined by the hedonic pricing method, based on standard characteristics such as the number of rooms and housing type (Muellbauer, 1974; Rosen, 1974; Ohsfeldt, 1988; Can, 1992). The method is also used to measure the effect of amenities on residential property prices to determine a certain willingness-to-pay (WTP) for certain attributes (Cheshire and Sheppard, 1995; Navrud and Ready, 2002; Van Duijn and Rouwendal, 2012). Each characteristic of the property or environment is valued for its utility for which an implicit price can be estimated.

This research captures the influence of cultural amenities on the attractiveness of neighborhoods in Rotterdam by examining residential property prices and the possible connection to the existence of cultural amenities in the neighborhoods. A research question is established. *To what extent do cultural amenities influence residential property prices?* For this questions to be answered, several sub-questions are established in the literature review. *How can cultural amenities be defined? Which utilities can be derived from cultural amenities and how are they perceived (positive, neutral, or negative)? How can the utility of cultural amenities be measured?*

A literature review presents the earlier studies on this subject and gives a preliminary answer to the research question. Relevant literature and concepts are discussed on cultural amenities and residential property prices. Then, the research continues by including several hypotheses based on the literature review. The hypotheses are tested by means of a hedonic pricing model (regression), in which attributes of residential properties and neighborhood characteristics are included. The log of residential property prices are regressed on these control variables, and indicators of

cultural amenities are included to assess their influence. The data of actual transaction prices of residential properties are provided by the Dutch Association of Realtors and Appraisers (NVM, 2016). The dataset consists of every transaction price from 2009 to 2016 in Rotterdam. A distinction is made between non-profit and for-profit cultural amenities. The nature and goals of for-profit organizations and non-profit organizations are expected to differ, and therefore the expectation is that the influence will differ as well. To correct for this possible difference, separate variables are included for both segments of cultural amenities. The data on non-profit cultural amenities are presented by reports of the municipality of Rotterdam, displaying all subsidized cultural organizations by national funds and the fund of the municipality from 2009 to 2016. The data on for-profit cultural amenities is based on a categorization of company codes by the Dutch chamber of commerce.

LITERATURE REVIEW

In the literature review, a preliminary answer to the research question is given based on literature on (cultural) amenities and property prices. Several sub-questions are answered in this literature review, for the main question to be answered. *How can cultural amenities be defined? Which utilities can be derived from cultural amenities and how are they perceived (positive, neutral, or negative)? How can the utility of cultural amenities be measured?* First, an extension of the definition of cultural amenities is given based on earlier research on this subject. Then, the utility bearing characteristics of cultural amenities are discussed and it is questioned if and how this can have an influence on residential property prices. Thereafter, the hedonic pricing method is discussed that indicates the extent to which an influence on residential property prices is present. In the last part of the literature review, hypotheses are stated to analyze the content more thoroughly. The hypotheses are tested in the next chapter to address the main question of this research.

Definition of cultural amenities

A definition of cultural amenities must be presented for this research to give reliable results. Several definitions of the *cultural* or *creative* class are attempted to be defined and often criticized. The definition of Florida (2002) is most often mentioned because it is different than other research on this subject before him. The *creative class* was presented as a population of well-educated and creative people, bringing human capital and knowledge to a city. This population values tolerance and is expected to be open to conversation. Therefore, knowledge spillovers should arise and more human capital is produced. However, this definition is often perceived as broadly defined and unrealistic (Markusen, 2006; Mcgranahan and Wojan, 2007). An example for clarification: also managers and engineers are included, and these types of professions are likely to lack a common cause with the cultural sector.

Therefore, other definitions should be considered in researching cultural amenities. In Stern and Seifert (2010), a cultural scene is presented based on four segments: resident artists, regional cultural participants, commercial cultural firms, and non-profit cultural providers. Together they form the *cultural assets* of a neighborhood or city and they are expected to provide a clear definition.

Regional cultural participants and resident artists are part of a social network during their participation and contribution to cultural activities in a neighborhood. Together they represent the human capital in a neighborhood, which will induce collaboration and knowledge spillovers (Mathur, 1999). This 'cultural' human capital is part of the *creative class* as argued by Markusen (2006). By collaborating and participating they can contribute to the vitality of neighborhoods, and this is expected to create an urban transformation.

Commercial cultural firms and non-profit cultural providers are defined by DeNatale and Wassall (2007). They argue that a creative core consists of a combination of non-profit and for-profit cultural organizations. They present a clear border of which organizations to include, and which not. Their creative core consists of both cultural as creative companies, such as book publishers, music instrument stores, and public archives. Besides a creative core, a creative periphery also exists in which non-cultural production is also considered. This periphery includes a broad definition of the cultural sector, which corresponds with the creative class of Florida (2002) discussed earlier. To avoid the critique on Florida (2002), the narrow definition of the creative core of DeNatale and Wassall (2007) is further used in determining cultural amenities. In Appendix C, a list of organizations in the creative core is presented for referrals in accordance with the narrow definition.

Cultural amenities can be categorized into several segments, in which each organization, researcher or government handle their own. As argued by Burger, Meijers, Hoogerbrugge and Masip Tresserra (2015) there are six categories, namely theaters, opera houses and music theaters, large music events, public art institutions, art fairs and film festivals, and art galleries. The advisory committee of the municipality of Rotterdam (RRKC, 2016), employs another categorization in their advice of distributing grants. Also, the national advisory committee (RvC, 2017) divides the cultural sector into other segments than the regional advisory committee. In Appendix A, Table 7 is presented with the categories of the advisory committees. Based on these categories, this research presents a category division that can be used in accordance with both committees, see Table 1. The tenth category is added for for-profit cultural amenities, such as jewelry stores and manufacturers, that otherwise could not be classified in the categories of the non-profit amenities.

Table 1 – Categories of for- and non-profit cultural amenities	
1	Theater
2	Dance
3	Music
4	Cultural heritage and museums
5	Visual Arts
6	Film
7	Literature
8	Creative industry
9	Supporting organizations
Additional segment for-profit cultural amenities	
10	Other cultural manufacturers

Source: RRKC (2016), RvC (2017), and own elaboration. See Appendix A for an elaborate explanation.

Based on the first part of the literature review, the first sub-question can be answered. *How can cultural amenities be defined?* It can be stated that the biggest pitfall relating to the definition of cultural amenities, is the risk of defining cultural amenities too broad. The *creative class* (Florida, 2002) is difficult to distinguish from other knowledge-intensive professionals, as argued by critics (Markusen, 2006; Mcgranahan and Wojan, 2007). Stern and Seifert (2010) include individual artists and participating residents, while this research will focus merely on organizations. As argued by DeNatale and Wassall (2007) cultural amenities are divided into non-profit and for-profit cultural organizations in the creative core. The categories of cultural amenities are presented in Table 1 and are based on reports of advisory committees, both national as regional. In addition, the organizations that are part of the creative core have a company code coinciding with Table 9 in Appendix C.

Utility of cultural amenities

As mentioned in the introduction, consumers can derive utility from cultural amenities both directly as indirectly. The indirect utility can be distinguished in twofold, namely in relation to its existence value and on the other hand on the regeneration benefits. They are discussed below and displayed in Figure 1.
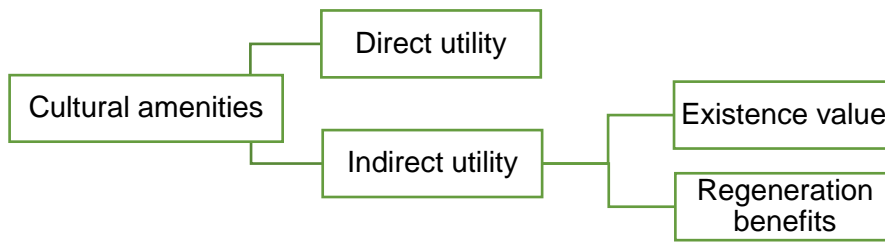
The direct utility that is derived from cultural amenities includes the consumption of cultural amenities. The experience of the participation in events or attendance at expositions is valued by consumers with a certain utility. As argued by Throsby (1994), the consumption of cultural amenities can be 'addictive' and influenced by taste. This indicates that the present consumption of cultural amenities is expected to increase future consumption. Human capital attributes of a consumer, such as understanding and knowledge, can be positively affected by consuming cultural amenities. The taste dependency of cultural consumption and its assumed addictiveness indicates the complexity of the consumption of cultural products. This research will not focus on the determination of the direct utility of cultural amenities but continues by researching the indirect utility bearing attributes of cultural amenities.

The first attribute of the indirect utility of cultural amenities is presented by its existence value. Clark and Kahn (1988) argue that people enjoy the existence of amenities in general, even though they may never intend to use the amenity. Especially cultural amenities may exhibit a high existence value, in which the option demand plays a significant role in valuing cultural amenities. People derive utility from the possibility of visiting cultural amenities, such as museums or theaters, for later purposes or experiences. Also, as argued by the *self-congruity theory* of Sirgy et al. (1986), consumers might relate their self-image to their consumption or their environment. This theory exhibits the idea that residents value an atmosphere in a neighborhood, separately from the consumption itself. The indirect existence value of cultural amenities for residents may arise since they value the environment or atmosphere that cultural amenities produce and not necessarily the consumption.

The second indirect utility that can be derived from cultural amenities, is connected to its possible regeneration benefits. As argued by Kay (2000), cultural amenities can influence a neighborhood both culturally and environmentally, as well as socially and economically. Cultural outcomes are related to the identity of a group, their 'culture' and how they see themselves as a group. Environmental regeneration benefits are the improvements of the area, such as buildings, and these are assumed to increase the quality of life. Thirdly, socially, cultural amenities can induce contact between different types of people and thereby positively influence the quality of life. By participating in cultural activities, a certain community empowerment takes place in which people learn skills and learn to express themselves. This social effect is captured by many researchers, examining the influence of cultural institutions. As argued by Sasaki (2010) and Belfiore (2002), cultural participation can have a positive effect on urban regeneration and social inclusion, alleviating social exclusion. Combining social and environmental effects, the Centre for Leisure and Sport Research (2002), presents several dimensions in which cultural projects can have a positive influence. By researching several cultural projects, the following dimensions were observed: education, crime prevention, health, employment, regeneration, equity, social engagement, and quality of life. This indicates the versatile character of cultural amenities and their possible influence on the surroundings.

The last regeneration benefit of cultural amenities is presented as an economic effect on neighborhoods. As impact studies indicate, a direct economic effect of cultural amenities can be indicated by employment growth, the expenditures of cultural organizations, or the expenditures of visitors (Bille and Schulze, 2006). For instance, as argued by Falck, Fritsch, and Heblich (2011) the proximity to opera houses increases the number of high-human-capital employees. As researched by Van Duijn and Rouwendal (2012) a positive willingness-to-pay exists to live close to cultural amenities.

However, this direct economic impact of cultural amenities is often misused as argued by Towse (2003). They are used for advocating public funding, for which the methods used are not intended and results are therefore biased. Examples of such studies are Seaman (1987) and Van Puffelen (1996). Biased outcomes can be caused by a reversed causality between cultural expenditures and economic or urban growth in neighborhoods. Cultural expenditures can influence urban growth, but this can be

reversed as well. It is possible that cultural amenities choose their location based on the surrounding environment, the popularity or esthetics. Unfortunately, this research is limited to time and measures which make it difficult to exclude all biased results. However, by choosing the right indicators of cultural amenities, biased measurements can be limited. By making a distinction between subsidized non-profit cultural organizations and not subsidized for-profit cultural organizations, an exogenous effect is included in the research. Subsidies and residential property prices are not expected to have an influence on each other and that is why this can limit the reversed causality in the measurements. This method (instrumental variable) will be highlighted further in the methodology chapter.

Based on the second part of the literature review, the second sub-question can be answered. *Which utilities can be derived from cultural amenities and how are they perceived (positive, neutral, or negative)?* The utility of cultural amenities can be derived in twofold (see Figure 1), being direct utility and indirect utility. The direct utility is represented by the consumption of cultural amenities and the consumer value derived from the experience of the consumption. The indirect utility is determined in twofold, namely the existence value and the regeneration benefits. The existence value of cultural amenities is perceived to be positive. As argued by Clark and Kahn (1988), people positively value the possibility of visiting cultural amenities. Also, regeneration benefits are perceived to be positive, as argued by Kay (2000). Most research focuses on the social benefit, in which it is argued by Belfiore (2002) and Sasaki (2010) that cultural amenities can alleviate social exclusion. Other regeneration benefits are cultural, environmental, and economic regeneration benefits. The economic regeneration benefit of cultural amenities is perceived as positive, as argued by Van Duijn and Rouwendal (2012). They present a positive willingness-to-pay to live near cultural amenities.

Hedonic pricing model

After reviewing the definition of cultural amenities and the nature of the influence on residential property prices, it is necessary to discuss possible methods for measurement. As argued by Storper and Scott (2009), attractive neighborhoods or cities can induce a certain (inter-city) migration. This is part of the idea the location choices of households are, at least partially, driven by the quality of life perceived in an area. This migration results in a growing urban population in attractive

neighborhoods. The assumption is made that attractive neighborhoods are represented by higher valued residential properties. If amenities drive the quality of life, it is not merely cultural amenities that influence the attractiveness of neighborhoods. For each amenity, or neighborhood characteristic, a certain utility is derived for households. Based on a hedonic pricing model, this utility can be valued and determined.

As presented by many, such as Rosen (1974), Muellbauer (1974), Can (1992), Sheppard (1999), Van Duijn and Rouwendal (2013), residential property prices are influenced by housing characteristics. The number of rooms, green areas, and others are known as attributes of residential properties. The simplest hedonic pricing models do merely take these attributes into account and do not focus on the influence of amenities. As Cheshire and Sheppard (1995) argue, land prices are driven by amenities, defined as location-specific characteristics. By using a hedonic pricing model, they find proof for their assumption of an influence of amenities.

Several characteristics of cultural amenities can be considered and added to the hedonic pricing model. Firstly, cultural amenities can be singularly counted to research the presence of such amenities. A distinction must be made between the existence and the proximity of a cultural amenity. The nature of the influence is unknown and therefore both must be considered. Whether the existence of cultural amenities has an influence on residential property prices, is different than assessing its availability or accessibility. The availability refers to the extent to which people can visit or consume the cultural amenity, while the existence does merely refer to the physical existence of a cultural amenity. Secondly, as argued by the *Love of Variety* theory by Dixit and Stiglitz (1977), consumers are assumed to prefer diversity in their consumption of products and services. In other words, a higher utility is provided by diversifying consumption. Cultural amenities are displayed in several forms, for instance, museums, theaters, or cinemas. Based on this theory, it is interesting to categorize existing cultural organizations and test whether a diverse supply of cultural amenities influences residential property prices. Lastly, a distinction will be made between subsidized and non-subsidized organizations. As the research of Sheppard, Oehler, and Benjamin (2006) shows, it is important to make this distinction because results can differ across these two segments.

Apart from cultural amenities, other factors can influence residential property prices. To ensure a limitation of biased measurements, also other factors are considered in estimating the hedonic pricing method. Apart from standard property attributes, neighborhood characteristics are included. Factors such as crime rates (Tita, Petra, and Greenbaum, 2006), racial segregation (Daniels, 1975), accessibility (So, Tse and Ganesan, 1997), commercial establishments (Li and Brown, 1980), are included in the estimation of the hedonic pricing model. As argued by the foregoing research, crime rates and racial segregation are expected to have a negative influence on residential property prices, where accessibility and commercial establishments are expected to have a positive influence.

The third sub-question can be answered based on the last part of the literature review. *How can the utility of cultural amenities be measured?* By using a hedonic pricing model, the utility of cultural amenities can be captured and valued in relation to residential property prices that represent the attractiveness of a neighborhood. The existence, quality, and variety of cultural amenities can influence residential property prices, as presented in the literature. The existence of cultural amenities is included in the regression of residential property prices, the hedonic pricing model. In addition, several other characteristics (crime rates, racial segregation, accessibility, and commercial establishments) will be included as control variables in estimating the hedonic pricing model. These factors also have an influence on residential property prices, and in the attempt to exclude biased measurements, they should be considered. The property attributes are included in the hedonic pricing model as well to correct for property specific characteristics.

Preliminary results

In the literature review, three sub-questions were answered for a preliminary result to be presented. *To what extent do cultural amenities influence residential property prices?* Cultural amenities, being non-profit organizations and for-profit organizations that can be categorized based on in Table 1, are expected to positively influence the attractiveness of residential properties as they are presumed to have utility bearing attributes for consumers. Either directly, through consumption, or indirectly, through their existence value and regeneration benefits, this influence can exist. The utility can be derived by the quantity, quality, and variety of cultural amenities and these characteristics should be considered if possible in the further analysis of the influence

on residential property prices. Unfortunately, not all of the assumption can be tested. This research will focus on the quantity and proximity of cultural amenities.

Hypotheses

Derived from the preliminary results of the research, the influence of cultural amenities can exist in several ways. On the one hand, the existence of cultural amenities, and on the other hand the proximity of cultural amenities can have an influence on residential property prices. Both perspectives are incorporated into hypotheses and the influence of non-profit and for-profit cultural amenities are separated.

The **existence** value of cultural amenities is determined by counting the cultural organizations in a neighborhood. As presented in the preliminary results, the influence of the existence of cultural amenities on residential property prices is expected to be positive. People are expected to derive utility from the existence because they value the option demand. The following hypotheses are determined to distinguish between non-profit and for-profit cultural amenities.

Hypothesis 1   The existence of non-profit cultural amenities positively influences residential property prices.

Hypothesis 2   The existence of for-profit cultural amenities positively influences residential property prices.

The influence of the **proximity** of cultural amenities on residential property prices is tested by counting the number of cultural amenities in a range of several distances. It is expected that people derive utility from the proximity of cultural amenities to residential properties, for instance, because it is easier to visit the amenity. The following hypotheses are determined, and again a distinction is made between non-profit and for-profit cultural amenities.

Hypothesis 3   The proximity of non-profit cultural amenities positively influences residential property prices.

Hypothesis 4   The proximity of for-profit cultural amenities positively influences residential property prices.

The separation of non-profit and for-profit cultural amenities is presented because the nature of these types of organizations are expected to be different and therefore the influence is expected to be different as well. Many of the non-profit cultural amenities (museums, theaters, libraries) are a place for cultural consumers, where the for-profit cultural amenities are not necessarily (publishers, music instrument manufacturers, print offices). Also, the subsidies that are granted to non-profit cultural amenities are seen as an exogenous factor, which can be used as an instrument to avoid biased measurements. An elaboration on this matter, and a description of the methods and data, follows in the next chapter of the research.

METHODOLOGY

In the previous chapter, the literature review presents a preliminary conclusion in relation to the main question by the means of the sub-questions. *To what extent do cultural amenities influence residential property prices?* Cultural amenities are determined as utility bearing attributes based on earlier research, in which the utility can be derived directly or indirectly. This research focuses on the indirect utility that can be derived from cultural amenities and measures the influence on the attractiveness of a residential property. This influence can exist in several ways, such as the differentiation by quantity, quality, and variety. This research focusses merely on quantity because of time restrictions. The count (quantity) of cultural amenities is determined in twofold, namely in its pure existence in a neighborhood and in a range around a specific transaction. In that way, both the influence of the existence of a cultural amenity as the proximity can be considered. The data and measurements are further described below.

Data description

RESIDENTIAL PROPERTY PRICES

The dataset of residential property prices is provided by the Dutch association of real estate agents (NVM, 2017) and includes 30.460 transactions of residential properties in Rotterdam from 2009 to 2016. Because of the conversion to coordinates in QGIS (see Appendix E), 429 observations were lost (1,41%) and 30.031 remain valid. The dataset includes postal codes and house numbers of the properties, and this is converted to coordinates for descriptive and statistical analysis. Each transaction includes several attributes of the residential property, such as number of rooms or the presence of a garden.

The attributes that are relevant for this research analysis are displayed in Table 2. Several attributes were distributed across several categories, such as the location, type of basement, or type of parking. These categories are grouped and converted to dummy variables and are marked with an asterisk for recognition in the table.

Table 2 – Attributes of residential properties		
Variable	**Type**	**Description**
Price/m^2	Numeric variable	Transaction price per square meter
Newly built*	Dummy variable	Built after 2001 (1) or before (0)
Monument*	Dummy variable	Built before 1930 (1) or after (0)
Basement*	Dummy variable	Presence of basement yes (1) or no (0)
Center*	Dummy variable	Located in (1) or outside (0) city center
Location (green) *	Dummy variable	Located near green area (1) or not (0)
Parking*	Dummy variable	Presence of parking yes (1) or no (0)
Good condition (inside)*	Dummy variable	Good or excellent condition yes (1) or no (0)
Good condition (outside)*	Dummy variable	Good or excellent condition yes (1) or no (0)
Shed*	Dummy variable	Presence of shed yes (1) or no (0)
Type of property*	Dummy variable	Property is a house (1) or an apartment (0)
Garden*	Dummy variable	Presence of garden yes (1) or no (0)
Attic	Dummy variable	Presence of attic yes (1) or no (0)
Elevator	Dummy variable	Presence of elevator in building yes (1) or no (0)
Balcony	Dummy variable	Presence of balcony yes (1) or no (0)
Rooms	Numeric variable	Number of rooms
Garden surface	Numeric variable	Number of square meters
* These variables are presented in de dataset as irrelevant categories, and therefore adjusted to dummy variables by grouping the values. A specification of this categorization can be found in Appendix E.		

The dataset is added in QGIS and by using the PDOK Geocoder the location of each transaction is determined. In Figure 2 and Figure 3, the transaction prices of residential properties from 2009 to 2016 in Rotterdam are displayed. The heat map in Figure 2 shows that the NVM data is represented mainly in the inner city of Rotterdam and has a lower market share in the south of Rotterdam. NVM owns Funda, which is the biggest platform for real estate in the Netherlands. Not all transactions are included in the dataset because other branch organizations and independent real estate agents are not affiliated with the NVM. However, the dataset includes a large sample of transactions, which is expected to represent the real estate market in Rotterdam properly.

The gradual classification of transaction prices, as Figure 1 presents, shows a dark-colored area in the north, center, and mid-east of Rotterdam. This indicates high transaction prices in the neighborhoods Rotterdam Centrum, Kralingen-Crooswijk, and Hilligersberg-Schiebroek. On the other hand, neighborhoods in the south of Rotterdam (Hoogvliet, Charlois, Feijenoord, and IJsselmonde) are displayed with a light-colored area that indicates low transaction prices of residential properties. The neighborhoods in Rotterdam are divided into small districts. This level of analysis is used in the research because it is preferred to keep the level of analysis as small as possible. However, for consistency with the research discussed in the literature review, this research will continue to refer to *neighborhoods* instead of *districts.* The list of neighborhoods, districts, and postal codes is presented in Appendix D.
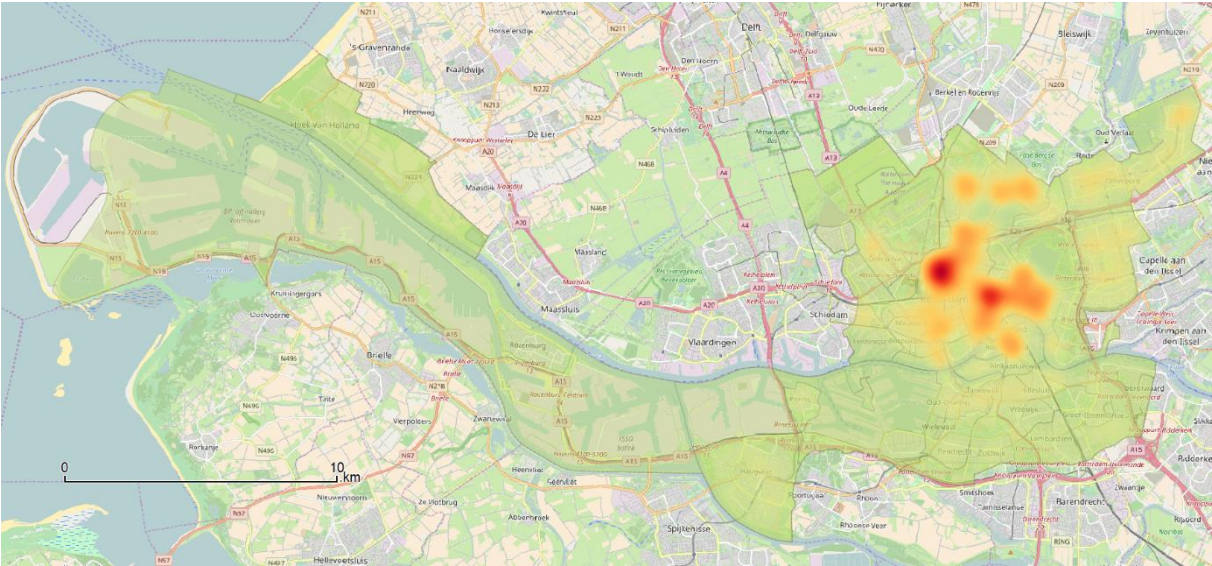
Figure 2 - Heatmap of transaction prices of residential properties in Rotterdam 2009-2016 (QGIS, self-made)

CULTURAL ORGANIZATIONS

Cultural amenities are determined as for-profit and non-profit cultural organizations that can be distributed across categories (Table 1). The data for non-profit cultural organizations is supplied by the municipality of Rotterdam after requesting the relevant data. All distributed grants across cultural organizations in Rotterdam are included from 2009 to 2016, both from the municipality of Rotterdam as national funds. This document is presented in Appendix B.

The dataset of for-profit cultural organizations is derived from a set of company codes by the Dutch chamber of commerce (SBI, Standaard Bedrijfsindeling) as displayed in Appendix C. This demarcation of company codes is based on the *creative core*, as defined by DeNatale and Wassall (2007). Their list was based on American company codes and therefore it is adjusted to Dutch company codes. Also, alterations are made after observing the data and the possible flaws. Company codes that present technical companies, such as Industrial Design, or Technical Ceramic Manufacturing, where deleted from the list. The level of cultural creativity in these companies is not compatible with the narrow definition discussed in this research.

This research considers the existence and the proximity of cultural amenities, therefore variables must be created that can indicate these attributes. A count of both types of cultural amenities is created, by using the tabulate command in Stata (see Appendix E) and adding the outcomes to the neighborhood characteristics. This count is merely

in a neighborhood and does not consider proximity. That is why another variable is added for both types of cultural amenities. This variable counts the amenities in a certain range around one transaction. These ranges are set at 50, 100, 250 and 500 meters, see Figure 4. By subtracting the variables in Stata (see Appendix E) these radii are donut shaped, as Figure 4 shows, and cultural amenities are not counted double. The counts are added as an attribute of each residential property transaction. This is executed in QGIS with the Python plugin, where a script is written by this research's supervisor, Jeroen van Haaren, to realize this analysis.
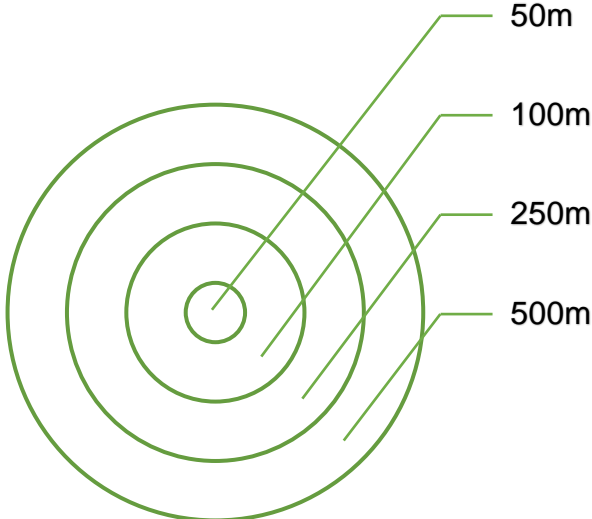
Figure 4 - Radii around transactions

NEIGHBORHOOD CHARACTERISTICS

The data for neighborhood characteristics are gathered from the Central Bureau of Statistics of the Netherlands (CBS) and from the municipality of Rotterdam. In Table 3, the neighborhood characteristics are displayed with description and source. The use of this data is based on the literature review, in which relevant characteristics are presented such as safety (crimes), population (non-western, density, income) and commercial activity (restaurants, supermarkets). The characteristics are assigned to the smallest level of analysis, which is districts of neighborhoods. Every district has a unique value of the characteristic and this makes the analysis on the smallest level possible. The neighborhood characteristics are then matched with each property, on the basis of the code of the district where it is situated (see Appendix D for the codes). The neighborhood characteristics then correspond with the district in which the property is located. This matching process is described in Appendix E and executed in QGIS.

Table 3 – Neighborhood characteristics			
Category	Variable	Description	Source
Socio-demographic	Density	Number of inhabitants per square kilometer	CBS
	Inhabitants	Number of inhabitants	MoR
	Non-western	Percentage of non-western population	CBS
	Ownership	Percentage of owner-occupied housing	CBS
	Income	Average income per income recipient	CBS
Public services	Distance to train station	Distance in kilometers	CBS
	Distance to highway entrance	Distance in kilometers	CBS
	Distance to hospital	Distance in kilometers	CBS
	Education	Number of elementary schools within one kilometer	CBS
	Crimes	Number of crimes per thousand inhabitants	MoR
Consumer goods and services	Restaurants	Number of restaurants within one kilometer	CBS
	Cafes	Number of cafes within one kilometer	CBS
	Supermarkets	Number of supermarkets within one kilometer	CBS
	Commercial activity	Number of companies in neighborhood	CBS
	Non-profit (count)	Number of non-profit amenities in neighborhood	Self-created
	For-profit (count)	Number of for-profit amenities in neighborhood	Self-created
	Non-profit (radii)	Number of non-profit amenities in ranges (50m, 100m, 250m, 500m)	Self-created
	For-profit (radii)	Number of for-profit amenities in ranges (50m, 100m, 250m, 500m)	Self-created
	Subsidies	Amount of money subsidized in neighborhood (in euros)	Self-created
Sources: Central Bureau of Statistics of the Netherlands (CBS) and Municipality of Rotterdam (MoR). The data from CBS is retrieved from "Proximity amenities" and "Key figures neighborhoods" in the years 2009-2012 and 2013, 2014, and 2015. The data from MoR is retrieved from the "Buurtmonitor", in the categories "Population" and "Livability and Safety".			

Research method

In this part of the research, the methods are described to test the hypotheses. As shown in Table 4, the hypotheses are divided into two themes: existence and proximity. Secondly, the hypotheses are divided into two segments: non-profit and for-profit cultural amenities. A hedonic pricing model is developed for the hypotheses to be

tested. This is a regression in which the attributes of residential properties (Table 2) and neighborhood characteristics (Table 3) are added as control variables.

Table 4 – Hypotheses and theme		
EXISTENCE	Hypothesis 1	The existence of **non-profit** cultural amenities positively influences residential property prices.
	Hypothesis 2	The existence of **for-profit** cultural amenities positively influences residential property prices.
PROXIMITY	Hypothesis 3	The proximity of **non-profit** cultural amenities positively influences residential property prices.
	Hypothesis 4	The proximity of **for-profit** cultural amenities positively influences residential property prices.

HEDONIC PRICING MODEL

The following expression represents the function of the log transaction price per square meter for property i and is based on the model of Can (1992).

$$\log(P_i) = \alpha + \beta S_i + \gamma N_i + \varepsilon$$

Where P_i represents the transaction price per square meter, S_i represents the structural characteristics (attributes) of property i, and N_i represents the neighborhood characteristics in which property i is situated, where β and γ are corresponding coefficients. The regression consists of a constant (α) and an error term (ε). The choice of a logistic regression is justified by the interpretation of the results. Each coefficient's influence on the dependent variable can now easily be compared and interpreted because the results are presented in a relative percentage rather than in absolute numbers. By creating this function, the influence of each neighborhood and structural characteristic can be analyzed on the size of its influence and the significance.

The first and second hypothesis consider the existence of non-profit and for-profit cultural amenities and the influence on residential property prices. As mentioned earlier, a count of both types of cultural amenities is added as a neighborhood characteristic. The third and fourth hypothesis focus on the proximity of non-profit and for-profit cultural amenities, rather than merely the existence as the first and second hypothesis suggests. Several radii are set (50m, 100m, 250m, 500m) and in each radius, the non-profit cultural amenities are counted and added as an attribute.

Attempting to correct for endogeneity, subsidies are added as an exogenous variable in neighborhood characteristics. Subsidies can be used as an instrumental variable to exclude endogeneity. This research tries to assess the influence of cultural amenities on residential property prices, but it can also be a reversed relationship. Cultural amenities might situate themselves near higher valued residential properties because of the attractiveness of such an environment. This might indicate that cultural amenities are likely to arise in high-valued neighborhoods. This reversed causality leads to biased coefficient estimates and is attempted to be excluded by introducing an instrumental variable, subsidies. On the other hand, cultural amenities might have less capital to situate themselves near high valued properties and therefore it is more likely that they are located in low valued neighborhoods.

It might also be possible that the effect of cultural amenities does not necessarily exist on the neighborhood level. The level of influence can also be indicated on the micro-level, the street level. That is why this research also zooms in at specific neighborhoods. Excluding neighborhoods effects, and merely test for the influence of property attributes and surrounding cultural amenities might give a different result.

Neighborhood characteristics are not unique values. Property i in neighborhood X, will have the same neighborhood characteristics as property k in neighborhood X. To correct for this fact, a cluster on neighborhood codes is added to the regression. The model will correct itself for these returning values.

The ordinal variables are converted into dummy variables by grouping the values. An ordinal variable indicates a non-hierarchical distribution between the values. By converting groups of values to dummy variables, the influence of each group can be considered. The conversion to dummy variables is executed in Stata and described in Appendix E; here the rationale for the choices made is also discussed. As with normal dummy variables, one of the categories should be left out in order for a reference value to be present in the regression.

Both the dependent variable (*Price/m²*) and the control variable *Income* are converted to logistic variables. The influence of income on transaction prices can then be interpreted relatively rather than interpreting absolute numbers.

The above described executed conversions and adjustments to the data are executed in Stata and described in Appendix E.

RESULTS

In this part of the research, the outcomes of the statistical analysis are presented and discussed. Table 5, the models are presented with control variables (m0), count of cultural amenities (m1), and the instrumental variable regression (m2).

		Control model	Count model
Table 5 – Hedonic pricing model, output			
		m0	m1
Property Attributes	Newly built	0.1185**	0.1135**
	Monument	0,0381	0.0151
	Basement	0.1535**	0.1565**
	Elevator	0.0451**	0.0382*
	Center	0.0156	0.0141
	Location (green)	0.0438**	0.0432**
	Balcony	-0.0232*	-0.0227**
	Rooms	-0.0095	-0.0110
	Parking	0.1643**	0.1584**
	Condition (outside)	0.0842**	0.0790**
	Condition (inside)	0.1369**	0.1362**
	Shed	0.0230*	0.0231*
	Housing type	0.0842**	0.0971**
	Garden	0.0625**	0.0615**
	Attic	-0.0306*	-0.0318*
Neighborhood characteristics	Crimes	-0.0005**	-0.0003
	Inhabitants	-0.0946**	-0.1270**
	Density	-6.30e-06	-6.93e-06
	Not western	-0.0072**	-0.0062**
	Ownership	-0.0027*	-0.0032*
	Station distance	-0.0275**	-0.0272**
	Highway distance	-0.0062	0.0106
	Hospitals distance	-0.0051	0.0022
	Primary schools 1km	0.0276*	0.0273*
	Restaurants 1 km	0.0047**	0.0051**
	Cafes 1 km	-0.0011	-0.0017
	Supermarkets 1 km	-0.0234	-0.0283*
Cultural amenities	Non-profit (count)		-0.0178*
	For-profit (count)		0.0015**
	Non-profit (IV)		
	Constant	8.4933**	8.7122**
	Number of observations	15365	15305
	R-squared	0.3178	0.3262
	Number of clusters	69	69
* significant at the 95% confidence level, ** significant at the 99% confidence level.			

As model m0 shows, several property attributes and neighborhood characteristics seem to have a significant effect on residential property prices. For clarity, a few variables are highlighted and interpreted. The variable *New built* is a dummy variable, when a house is built after 2001, the value is 1 and is multiplied by the coefficient. In a logistic regression, the coefficient must be multiplied by 100% in order for the result to be interpreted. The coefficient of 0,1185 indicates that when a house is built after 2001, the property value is expected to be 11,85 percent higher than when it is built before

2001. This positive result is significant at a confidence level of 99 percent (p < 0,01). Concerning the condition of the residential property, the regression indicates that when the condition is 'good' or 'excellent' from the outside, the transaction price is 8,42 percent higher than when it is not. On the other hand, the inside condition indicates a rise of 13,69 percent of the transaction price when it is 'good' or 'excellent', compared to when it is not. Both are significant at the 99 percent confidence level (p < 0,01) and suggest a positive relationship between the condition of the property and the transaction price.

As mentioned earlier, clusters are added to correct for neighborhood values. These values are not unique and therefore biased standard errors are likely to arise and this indicates non-reliable p-values. By adding clusters, this effect is bypassed. Also, a few variables in this category are highlighted for clarity. The variable *Crimes* and its coefficient indicate that at every additional crime per 1000 inhabitants, the transaction price is expected to fall with 0,05 percent with a confidence level of 99 percent. This indicates a negative influence of crimes on transaction prices. The influence of the percentage of the non-western population, the variable *Non-western*, is differently interpreted because the value itself is logistic (a percentage) rather than numeric. This coefficient can be interpreted directly instead of multiplying the coefficient with 100%. This indicates that at the 99 percent confidence level, a one percent rise in non-western population results in a decline in transaction price of 0,007 percent.

In the second model (m1, Table 5), the count of non-profit and for-profit cultural amenities is included. The count of non-profit amenities in a neighborhood seems to negatively influence transaction prices, by 1,78 percent with a significance level of 0,05. The coefficient related to the count of for-profit cultural amenities in a neighborhood indicates a positive influence on transaction prices of 0,15 percent at a significant level of 0,01. This shows that every additional non-profit and for-profit cultural amenity can influence the transaction prices with a 1,78 percent fall and 0,15 rise respectively.

		Radii model	Single neighborhood	Instrumental variable
	Table 6 – Hedonic pricing model, output			
		m2	m3	m4
Property Attributes	Newly built	0.1128**	0.1877**	0.1205**
	Monument	0.0281	Omitted	0.0368
	Basement	0.1523**	-0.0451	0.1556**
	Elevator	0.0435**	-0.0233	0.0417*
	Center	0.0160	0.0172	0.0097
	Location (green)	0.0459**	0.0448**	0.0444**
	Balcony	-0.0216*	0.0156	-0.0244**
	Rooms	-0.0106	-0.0285**	-0.0095
	Parking	0.1678**	0.1450**	0.1623**
	Condition (outside)	0.0822**	0.0181	0.0836**
	Condition (inside)	0.1342**	0.0992**	0.1365**
	Shed	0.0301**	-0.0019	0.0182
	Housing type	0.0969**	-0.0261	0.0836**
	Garden	0.0597**	0.0352	0.0631**
	Attic	-0.032*	0.0165	-0.0322*
Neighborhood characteristics	Crimes	-0.0005		-0.0004*
	Inhabitants	-0.0850		-0.0842**
	Density	-7.68e-06		-7.29e-06
	Not western	-0.0066**		-0.0068**
	Ownership	-0.0025*		-0.0026
	Station distance	-0.0272**		-0.0273**
	Highway distance	0.0089		0.0091
	Hospitals distance	-0.0031		-0.0030
	Primary schools 1km	0.0317**		0.0223*
	Restaurants 1 km	0.0039**		0.0076**
	Cafes 1 km	-0.0016		-0.0013
	Supermarkets 1 km	-0.0298*		-0.0259
Cultural amenities	Non-profit (50m)	0.0354*	0.0376	
	Non-profit (100m)	-0.0089	0.0485**	
	Non-profit (250m)	0.0018	-0.0082	
	Non-profit (500m)	0.0030	0.0073	
	For-profit (50m)	0.0088**	-0.0034	
	For-profit (100m)	0.0085**	-0.00004	
	For-profit (250m)	0.0012	-0.0025*	
	For-profit (500m)	0.0006	-0.0005	
	Non-profit (IV)			-0.0207
	Constant	8.3658**	7.6200**	8.3779**
	Number of observations	15365	781	15365
	R-squared	0.3257	0.4574	0.3186
	Adjusted R-squared		0.4380	69
	Number of clusters	69		
	* significant at the 95% confidence level, ** significant at the 99% confidence level.			

The several counts in radii in the fourth model (m2, Table 6) shows significant coefficients considering the first radius of 50 meters. Both non-profit as for-profit cultural amenities seem to positively influence transaction prices when they are 50 meters located from the property or closer. Every additional non-profit cultural amenity in a radius of 50 meters, indicates a rise in transaction price of 3,54 percent with a confidence level of 0,05. An additional for-profit cultural amenity in 50 meters indicates a rise of 0,88 percent, and in 100 meters a rise of 0,85 percent. Both are significant at a 0,01 confidence level. The influence of the other radii is not significant but suggests a small but positive effect on transaction prices.

Model m3 (Table 6) presents the outcomes for at a specific neighborhood, namely a district in the city center (Stadsdriehoek). Only data considering this neighborhood is used in the regression, without neighborhood characteristics and merely attributes of the transactions. One variable (*Monument*) is omitted and left out, this can be explained by the fact that the center of Rotterdam was bombed in WOII and few properties are therefore historical. The count in radii of cultural amenities is added and shows a different effect than m3. Only the 100-meter radius of non-profit cultural amenities is significant (4,85 percent, $p<0,01$) and the same accounts for the 250-meter radius of for-profit cultural amenities (-0,2 percent, $p<0,05$).

To correct for endogeneity, it is attempted to create an instrumental variable as described in the research method. The outcome is displayed in Table 6, m4. Subsidies are used as an instrument to test whether subsidies might influence the number of non-profit cultural amenities, and indirectly transaction prices. First, a first stage regression is performed to test whether subsidies as an instrument is valid and relevant. This is the case, *Subsidies* as an instrument is significant, and thus relevant. The raw output of this first regression is presented in Appendix F. The regression (2sls) contains the same variables as m0, but with the instrument (*Non-profit (IV)*) as an additional variable. The result is not significant, and this suggests that the other outcomes presented in the models are not reliable.

KEY FINDINGS

In the previous chapter, the results are presented considering the statistical analysis. The key findings are now discussed on the basis of the four analyses and the hypotheses (Figure 5).

	Non-profit	For-profit
Existence	Hypothesis 1 The *existence* of *non-profit* cultural amenities positively influences residential property prices.	Hypothesis 2 The *existence* of *for-profit* cultural amenities positively influences residential property prices.
Proximity	Hypothesis 3 The *proximity* of *non-profit* cultural amenities positively influences residential property prices.	Hypothesis 4 The *proximity* of *for-profit* cultural amenities positively influences residential property prices.

Figure 5 – Hypotheses, recap

The first test is a count of for-profit and non-profit cultural amenities, in which the influence of their existence on residential property prices is analyzed. The count is added as a neighborhood characteristic. It showed a significant result, in which non-profit showed a negative influence and for-profit a positive influence. The negative effect of non-profit cultural amenities can be explained by the fact that non-profit organizations have fewer funds to spend on housing than for-profit organizations. Non-profit organizations are more likely to situate themselves in lower-valued neighborhoods because they might rather spend money on their core business instead of location.

The first hypothesis cannot be accepted and the second hypothesis cannot be rejected. It cannot be stated that the existence of non-profit cultural amenities in a neighborhood positively influences residential property prices. It can be stated that the influence of the existence of for-profit cultural amenities in a neighborhood positively influences residential property prices.

In the second analysis, non-profit and for-profit cultural amenities are counted in a range around a transaction to test for proximity effects. The smallest radius of 50 meters suggests a positive influence of both non-profit and for-profit cultural amenities. It seems that the proximity of a cultural amenity, such as a museum or theater, or bookstore or library, positively influences the transaction prices when it is situated in a 50-meter range around the property.

A third analysis focuses on one neighborhood, and tests therefore without neighborhood characteristics. This shows a positive effect when a non-profit cultural amenity is situated between 100 and 50 meters and a negative effect when a for-profit cultural amenity is situated between 250 and 100 meters around the property.

The instrumental variable analysis tried to exclude an endogenous effect where cultural amenities are possibly more likely to situate themselves in higher-valued neighborhoods. However, the instrumental variable is not significant and therefore its result is not conclusive. This might be explained by the first analysis, where it is suggested that non-profit cultural amenities are likely to situate themselves in lower-valued neighborhoods because of budget restrictions. Because the instrument is not significant, a causal relationship between cultural amenities and residential property prices cannot be observed. The consequence of this is that in all hypotheses, insecurity and dubiety are present. They cannot be rejected or adopted with high certainty concerning the causal relationship between cultural amenities and residential property prices because the instrumental variable is not significant.

CONCLUSION AND DISCUSSION

This research focused on the definition of cultural amenities and on their possible influence on residential property prices. The residential property prices are expected to present the attractiveness of a property or the attractiveness of the surrounding neighborhood characteristics. Cultural amenities are divided into non-profit and for-profit cultural amenities and the influence was expected to exist in twofold, namely in existence and proximity. This is in relation to the indirect utility that can be derived from cultural amenities, as presented in the literature review. The statistical analysis showed a divergent result, in which the outcomes for the existence tests are different than the proximity tests. The results seemed significant, which indicates a positive influence of the existence and proximity of cultural amenities on residential property prices. However, the instrumental variable test showed an insignificant result which indicates that the stated influences above are not reliable and therefore do not indicate causality.

As discussed in the literature review, the variety of cultural amenities might influence residential property prices. This research presents an exploratory role for the deepening of this possible influence. The categorizations in this research can be used for further research to investigate this phenomenon. Also, the differentiation between non-profit and for-profit organizations is found to be important. The results of both types of cultural amenities are quite different, and this justifies the parting of the cultural amenities.

To correct for a lack of external validity, it might be interesting for further research to execute this analysis in different cities or even different countries. The limitation is, of course, the different data sources and ways of data gathering. However, it might be interesting to compare outcomes and test whether the effect of cultural amenities might be larger, smaller, or more significant in another environment.

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APPENDIX A

Table 7 – Categorization of cultural amenities		
Raad voor Cultuur	**Rotterdamse Raad voor Kunst en Cultuur**	**Own elaboration**
Performing arts: Theater	Theater	Theater
Performing arts: Youth theater		
Performing arts: Production houses		
Performing arts: Dance	Dance	Dance
Performing arts: Orchestras	Music	Music
Performing arts: Opera		
Performing arts: Festivals		
Museums	Municipal collections and heritage	Cultural heritage and museums
Museums (supporting organizations)		
Visual arts (presentation organization)	Visual arts	Visual arts
Visual arts (post-academic institutions)		
Films (festivals)	Film	Film
Films (supporting organizations)		
Literature	Literature and debate	Literature
Creative industry	Architecture, design and e-culture	Creative industry
Supporting organizations	Cultural education and societal bonding	Supporting organizations
Source: Raad voor Cultuur (2017)	*Source: RRKC, 2016*	*Source: own elaboration*

APPENDIX B

Table 8 – Subsidized cultural organizations in Rotterdam, 2009-2016*									
	Municipality		Basisinfrastructuur		National funds			Total	
	2009-2012	2013-2016	2009-2012	2013-2016	Name**	2009-2012	2013-2016	2009-2012	2013-2016
Arab Film Festival / WaaR art and Culture	57,500							57,500	
Archiprix			74,841		SFA		112,500	74,841	112,500
Architectuur Film Festival Rotterdam		25,000			SFA				25,000
Architectuur Instituut Rotterdam	406,500	406,500						406,500	406,500
Arminius	81,500	170,000						81,500	170,000
AVE (Stichting NIADEC)		100,000	5,931,441	8,681,153				5,931,441	7,910,000
Baroeg	252,000	250,000						252,000	250,000
Berlage Instituut			1,292,390					1,292,390	
BoekieBoekie	66,000		98,631					164,631	
Boijmans van Beuningen	9,663,500	9,025,500						9,663,500	9,025,500
Bonheur Theaterbedrijf Rotterdam	502,000							502,000	
Centrale Discotheek Rotterdam	289,500							289,500	
Centrum Beeldende Kunst	1,800,000	1,361,000						1,800,000	1,361,000
Chabot Museum	81,500	76,000						81,500	76,000
Circus Rotjeknor	47,000	47,000						47,000	47,000
Conny Janssen Danst	252,500	450,000			NFPK	669,000	468,000	921,500	918,000
Dance Works Rotterdam	598,000				NFPK			598,000	
Dansateliers	306,500	306,500	416,995					723,495	306,500
de Doelen, Concert- en congresgebouw	4,442,000	4,228,500						4,442,000	4,228,500
De Gouvernestraat	270,500							270,500	
De Unie in Debat (RKS)	500,000							500,000	
Designplatform Rotterdam	64,500				SFA			64,500	
Designprijs Rotterdam	49,000	49,000						49,000	49,000
Digital Playground	234,000	239,000			FCP	333,500		567,500	239,000

DoelenEnsemble	95,000	75,000						95,000	75,000
Epitome Entertainment (EE2)	50,000	50,000			FCP		100,000	50,000	150,000
Euro+ Songfestival		75,000			FCP	50,000	62,500	50,000	137,500
Europan Nederland			216,890		SFA			216,890	
Het Havenmuseum	1,429,000	1,000,000						1,429,000	1,000,000
HIJS	30,000	30,000						30,000	30,000
HipHopHuis	303,000	303,000						303,000	303,000
Hofplein Rotterdam	1,857,000	1,650,000						1,857,000	1,650,000
Hotel Modern	176,500	176,500			NFPK	455,603	501,000	632,103	677,500
Internationaal Danstheater					NFPK	3,280,801		3,280,801	
International Film Festival Rotterdam	1,215,000	1,000,000	1,234,941	1,284,668				2,449,941	2,145,000
Internationale Architectuur Biënnale Rotterdam	356,000	400,000	897,362		SFA		450,000	1,253,362	850,000
Jazz International Rotterdam	254,500	200,000						254,500	200,000
Jazzpodium BIRD		174,500							174,500
Jong Muziektalent Nederland	25,500							25,500	
Kosmopolis	897,500							897,500	
Kulsan	51,000				NFPK	221,343		272,343	
Kunst in de Klas	24,500							24,500	
Kunstbende Zuid-Holland	21,000							21,000	
Kunsthal Rotterdam	1,807,000	1,807,000						1,807,000	1,807,000
LantarenVenster	1,541,500	1,450,000						1,541,500	1,450,000
Laurenscantorij	66,000	65,500						66,000	65,500
Laurenskerk	152,500	102,000						152,500	102,000
Lezersfeest	63,500	63,500						63,500	63,500
LP2	254,000	250,000						254,000	250,000
Luxor Theater	3,484,000	1,100,000						3,484,000	1,100,000
<u>Maas:</u>		1,580,000		530,589					2,080,000
Max.	147,000		842,159					989,159	
Meekers	231,000		473,465		NFPK		367,500	704,465	367,500
Siberia	805,000				NFPK	222,189		1,027,189	
Mama	126,500	126,500	206,240		Mon		150,000	332,740	276,500

Maritiem Museum Rotterdam	4,672,000	3,864,000						4,672,000	3,864,000
Metropolis Festival	80,000	118,000			NFPK			80,000	118,000
Motel Mozaique	302,500	300,000			NFPK	80,947		383,447	300,000
Museum Rotterdam	5,411,500	3,750,000						5,411,500	3,750,000
Music Matters	397,000	250,000						397,000	250,000
Natuurhistorisch Museum	753,000	703,500						753,000	703,500
Nederlands Fotomuseum	806,000	753,000	1,363,143	1,101,082				2,169,143	1,848,000
Nieuw Rotterdams Jazz Orkest	50,000							50,000	
Nieuwe Oogst	700,000							700,000	
North Sea Round Town	71,500	71,000						71,500	71,000
Onafhankelijk Toneel / Opera O.T.	904,500				NFPK	1,334,831		2,239,331	
OorlogsVerzetsMuseumRotterdam	301,000							301,000	
Operadagen Rotterdam	398,500	199,250			NFPK	158,097	125,000	556,597	324,250
Passionate Bulkboek	183,000	183,000	396,607		Lett		210,000	579,607	393,000
Poetry International	249,000	249,000	486,984		Lett		210,000	735,984	459,000
Popunie		295,000							295,000
Prinses Christina Concours	21,500	20,000	136,274		FCP		167,500	157,774	187,500
Punt 5	15,500							15,500	
Rogie C.S.	40,500							40,500	
RoMeO		20,000							20,000
Rotown	169,000	217,500						169,000	217,500
Rotown Magic	51,000							51,000	
Rotterdam Circusstad		75,000							75,000
Rotterdam Festivals	619,000	300,000						619,000	300,000
Rotterdam Philharmonic Gergiev Festival	532,500	266,250			NFPK			532,500	266,250
Rotterdam Unlimited	399,000	407,000			NFPK	64,008		463,008	407,000
rotterdams centrum voor theater	196,500	196,500						196,500	196,500
Rotterdams Jeugd Symfonie Orkest	50,000	20,000						50,000	20,000
Rotterdams Philharmonisch Orkest	6,658,000	6,597,500	3,608,511	4,356,756				10,266,511	9,897,500
Rotterdams Wijktheater	403,500	428,500			FCP	81,500	100,000	485,000	528,500
Rotterdamse Poppenspelers	26,500	20,000						26,500	20,000

SBAW-cultuurscouts	383,000	363,000						383,000	363,000
SBAW-organisatieadviseur	103,000							103,000	
Scapino Ballet Rotterdam	1,008,000	1,115,000	2,666,396	1,640,766				3,674,396	2,615,000
Sinfonia Rotterdam	120,500	119,500			NFPK			120,500	119,500
SKVR	9,666,500	8,200,000						9,666,500	8,200,000
Stichting Kunst Accommodatie Rotterdam (SKAR)	375,500	375,500						375,500	375,500
Theater Maatwerk	50,000	50,000						50,000	50,000
<u>Theater Rotterdam:</u>		8,550,000							8,550,000
Productiehuis Rotterdam	433,000		574,225					1,007,225	
RO Theater	2,737,000		2,112,221	1,592,766				4,849,221	1,500,000
Rotterdamse Schouwburg	5,992,500							5,992,500	
Wunderbaum	156,000				NFPK	405,670	486,000	561,670	486,000
De Internationale Keuze					NFPK	158,285		158,285	
Theater Walhalla	175,500	215,500						175,500	215,500
Theater Zuidplein	2,526,500	2,250,000						2,526,500	2,250,000
TheaterNetwerk Rotterdam (TNR)	90,500	75,000						90,500	75,000
Tortuca	16,000	-						16,000	
V2_ Instituut voor de Instabiele Media	288,500	150,000	1,063,379		SFA		400,000	1,351,879	550,000
Villa Zebra	280,000	320,500			FCP	226,500		506,500	320,500
VIVID	39,500	39,500						39,500	39,500
Wereldmuseum Rotterdam	5,041,000	3,000,000						5,041,000	3,000,000
Witte de With	413,000	413,000	511,392	530,589				924,392	913,000
World Music en Dance Centre	254,000	175,000						254,000	175,000
Worm	404,000	600,000	309,361		Mon		145,503	713,361	745,503
Zomercarnaval Nederland	102,000							102,000	

* All numbers are in Euro's

** National funds abreviations: Stimuleringsfonds Architectuur (SFA), Nederlands Fonds Podiumkunsten (NFPK), Fonds Cultuurparticipatie (FCP), Mondriaanfonds (Mon), and Letterenfonds (Lett)

Source: distributed by the Municipality of Rotterdam and requested for this research.

APPENDIX C

	Table 9 – SBI codes in the Creative Core	
SBI-code	**Industry or type of work**	**Category**
18	Printing offices, and reproduction of recorded media	Literature
23.41	Domestic and jewelry work manufacturing	Other cultural manufacturing
32.1	Coins minting: gem processing and jewelry manufacturing	Other cultural manufacturing
32.2	Musical instrument manufacturing	Music
46.43.3	Audio- and video-equipment wholesalers	Film
46.43.4	Photographic supplies wholesalers	Visual arts
46.48	Jewelry and clockwork wholesalers	Other cultural manufacturing
46.49.5	Music instrument wholesalers	Music
46.49.8	Books, magazine and other printed material wholesalers	Literature
47.43.1	Audio- and video-equipment stores	Film
47.59.4	Music instrument stores	Music
47.61	Book stores	Literature
47.62	Newspaper and magazine stores	Literature
47.63	Audio- and videorecording stores	Film
47.77	Jewelry and clockwork stores	Visual arts
47.78.1	Photografic supply stores	Visual arts
47.78.3	Painting, art objects, and religious item stores	Visual arts
58.11	Book publishers	Literature
58.13	Newspaper publishers	Literature
58.14	Periodical publishers	Literature
58.19	Other publishers (not software)	Literature
59	Movie and television show production and distribution	Film
60	Radio and television broadcasting	Film
71.11	Architects	Creative Industry
74.2	Photography and photo and movie developing	Visual arts
77.22	Video stores	Film
85.52	Cultural education	Supporting organizations
90.01	Performing arts	Theater
90.02	Services for performing arts	Supporting organizations

90.03	Literature and other	Literature
90.04	Theaters and event halls	Theater
91.01	Cultural lending centers and public archives	Literature
91.02	Museums and galleries	Cultural heritage and museums
91.03	Cultural heritage	Cultural heritage and museums
Source: These Standaard Bedrijven Indeling (SBI) codes were retrieved from the Dutch Chamber of Commerce (Kamer van Koophandel, 2016) and based on the 'creative core' definition of the New England Foundation for the Arts (DeNatale and Wassall, 2007).		

APPENDIX D

Tabel 10 – Postal codes of neighborhoods and districts in Rotterdam		
Neighborhood	**Postal codes**	**Neighborhood code**
Rotterdam Centrum	**3011-3016**	
Stadsdriehoek	3011	5990110
Cool	3012	5990112
CS -kwartier	3013	5990113
Oude westen	3014	5990111
Dijkzicht	3015	5990119
Nieuwe Werk	3016	5990324
Delfshaven	**3021-3029**	
Middelland	2021-3022	5990325
Nieuwe westen	2023	5990324
Delfshaven	3024	5990320
Bospolder	3025	5990321
Tussendijken	3026	5990322
Spangen	3027	5990323
Oud-Mathenesse	3028	5990327
Schiemond	3029	5990329
Noord	**3032-3039**	
Rubroek	3031	5990814
Agniesebuurt	3032	5990515
Provenierswijk	3033	5990516
Nieuw-Crooswijk	3034	5990836
Oud-Crooswijk	3034	5990837
Oude Noorden	3035-3036	5990535
Liskwartier	3037	5990534
Bergpolder	3038	5990531
Blijdorp	3039	5990532
Overschie	**3041-3046**	
Diergaarde Blijdorp	3041-3042	
Overschie	3043	5990456
Spaanse Polder	3044	5991853
Zestienhoven	3045	5990454
Schieveen	3046	5990454
Hillegersberg-Schiebroek	**3051-3056**	
Hillegersberg-Zuid	3051	5990661

Schiebroek	3052-3053	5990660
Hillegersberg-Noord	3054	5990662
Molenlaankwartier	3055	5990665
Terbregge	3056	5990664
Kralingen-Crooswijk	**3031, 3034, 3061-3063**	
Kralingen-West	3061	5990841
Kralingen-Oost	3062	5990842
De Esch	3063	5990845
Struisenburg	3063	5990847
Prins Alexander	**3059, 3064-3069**	
Nesselande	3059	5991468
Kralingse Veer	3064	5991446
's-Gravenland	3065	5991444
Prinsenland	3066	5991448
Het Lage Land	3067	5991449
Ommoord	3068-3069	5991463
Zevenkamp	3068-3069	5991466
Feijenoord	**3071-3075**	
Kop van Zuid	3071	5990117
Noordereiland	3071	5991088
Feijenoord	3071	5991087
Afrikaanderwijk	3072	5991086
Katendrecht	3072	5991085
Bloemhof	3073	5991081
Hillesluis	3074	5991082
Vreewijk	3075	5991080
IJsselmonde	**3076-3079**	
Lombardijen	3076	5991284
Oud-IJsselmonde	3077	5991289
Beverwaard	3078	5991290
Groot-IJsselmonde	3079	5991289
Charlois	**3081-3089**	
Tarwewijk	3081	5991571
Oud-Charlois	3082	5991574
Carnisse	3083	5991572
Zuiderpark	3084	5991578
Zuidwijk	3085	5991573
Pendrecht	3086	5991577

Waalhaven-Oost	3087	No residencies
Waalhaven-Zuid	3088	No residencies
Heijplaat	3089	5991593
Hoogvliet	**3191-3194**	
Hoogvliet-Noord	3191-3192	5991692
Hoogvliet-Zuid	3193-3194	5991699
Hoek van Holland	**3151**	**5991702**
Pernis	**3195**	**5991391**

Source: data is retrieved from the Central Bureau of Statistics of the Netherlands (CBS). "Most common postal code" in a neighborhood, in "Key Figures" in 2009-2012 and 2013, 2014 and 2015. The district's codes are taken from the same source.

APPENDIX E

Stata commands

In Stata, several commands are executed for data editing and the analyses. Below is described which commands are used.

Tabulate (for count)

The command *tabulate [variable name]* is used for the count of for-profit cultural amenities. In each year (2009 to 2013), the outcome per neighborhood is included as a neighborhood characteristic and matched with the transaction (see QGIS proceedings later on in Appendix E).

Conversion to logistic variable

The dependent variable (*Price/m²*) and control variable *Income* are converted to logistic variables. The following command is used: generate log[*variable*] = log([*variable*]).

Clustering

In the regressions, clusters on the basis of neighborhood names is added. This is simply done by adding "*, cluster([variable])*" at the end of the regression. A correction is now made for frequent neighborhood values.

Conversion to categorical dummy variable

To convert an ordinal variable (nonhierarchical) to a categorical dummy variable, it needs to be considered first which values to group (categorize). Below in Table 11, the included variables are described for each converted variable. There is a set of commands used in the conversion. The first is the command when a specific value must be highlighted, for instance *Newly built*, where only the value *>2001* should be considered. The command is the following: *generate [new variable] = [variable] == value*. On the other hand, a certain range of variables must be converted to dummy variables, this brings the following: *generate [new variable] = [variable] > (or <) value*.

Table 11 – Conversion to dummy variables		
Variable	Group	Values
Newly built	Construction period	"> 2001" [9]
Monument	Construction period	"1500-1905" [1], "1906-1930" [2]
Basement	Basement	"Commission basement" [3], "Boiler room" [4], "Commission basement and boiler room" [5]
Center	Location (center)	"City center" [3]
Location (green)	Location (green)	"Edge of woods" [1], "Edge of water" [2], "Edge of park" [3], "Unobstructed view" [4]
Parking	Parking	"Parking spot" [2], "Carport, no garage" [3], "Garage, no carport" [4], "Garage and carport" [5], "Garage multiple cars" [6]
Good condition (inside)	Inside condition	"Good" [7], "Excellent to Good" [8], "Excellent" [9]
Good condition (outside)	Outside condition	"Good" [7], "Excellent to Good" [8], "Excellent" [9]
Shed	Shed	"Built stone" [1], Detached stone" [2], "Built wood" [3], "Detached wood" [4], "Inboard" [5], "Box" [6]
Type of property (house)	Type of property	"Simple" [2], "Houseboat" [3], "Single-family" [5], "Mansion" [7], "Farmhouse" [8], "Bungalow" [9], "Villa" [10], "Country house" [11]
Garden	Garden	"North" [1], "North-East" [2], "East" [3], "South-East" [4], "South" [5], "South-West" [6], "West" [7], "North-West" [8]

QGIS proceedings

QGIS is used for the locational analyses, described below. Each step is taken in the same CRS, namely Amersfoort 28992.

Conversion to coordinates

By means of the PDOK Geocoder, the data of transaction prices of residential properties is added to QGIS and converted to their location. For this the postal code, city, and address are necessary.

Join attributes (properties)

A match between the correct year, neighborhood, and transaction, is made by following the next steps. First, in Excel, the neighborhood characteristics are written down. This file is saved as a .csv file (comma separated values) and added as no geometry (attribute only table). In this file, the neighborhood codes are included which makes it possible to match the code of the transaction. Now, when transaction i is situated in neighborhood X, the neighborhood characteristics of transaction i will coincide with neighborhood characteristics of X.

Buffers (Python code)

By means of the Python plug-in, buffers are created around a transaction and a count is added to its attribute list. The script is written by Jeroen van Haaren, this research's supervisor.

The script uses the dataset of residential property prices (PR) and tests whether a non-profit (NP) or for-profit (FP) cultural amenity is situated in the buffer distance. The non-profit and for-profit datasets are added as delimited text layers, where their coordinates are used to determine their location. Buffers of 50, 100, 250 and 500 meters are used and for each distance and each layer (NP and FP), a variable is added to the attributes of PR. This script is also run for each year, 2009 to 2013. Therefore, the script was run 40 times. Eventually, all years are merged as one dataset in Stata.

APPENDIX F

Control model (m0)

```
Linear regression                              Number of obs   =     15,365
                                               F(32, 68)       =      66.25
                                               Prob > F        =     0.0000
                                               R-squared       =     0.3178
                                               Root MSE        =     .30002

                                    (Std. Err. adjusted for 69 clusters in obj_bu)
-----------------------------------------------------------------------------
             |               Robust
   logTRANSM2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
     DATAFM1 |   .0260691   .0115911     2.25   0.028     .0029394    .0491987
     DATAFM3 |   .0131828    .010907     1.21   0.231    -.0085817    .0349473
     DATAFM4 |  -.0193086   .0122223    -1.58   0.119    -.0436978    .0050805
     DATAFM5 |  -.0816526    .013828    -5.90   0.000    -.1092459   -.0540592
    NIEUWBOUW |   .1184872   .0260673     4.55   0.000     .0664707    .1705038
     MONUMENT |   .0381152   .0224953     1.69   0.095    -.0067735    .0830038
     WELKELDER |   .1534708   .0208178     7.37   0.000     .1119295    .1950121
         LIFT |    .045056   .0171093     2.63   0.010     .0109149    .0791971
      CENTRUM |   .0156317   .0179065     0.87   0.386    -.0201002    .0513637
      MOOILIG |   .0437949   .0090904     4.82   0.000     .0256553    .0619344
       BALKON |  -.0232337   .0089933    -2.58   0.012    -.0411796   -.0052878
      NKAMERS |  -.0095391    .006219    -1.53   0.130     -.021949    .0028708
      WELPARK |   .1643496   .0185479     8.86   0.000     .1273377    .2013614
      GOEDBUIT |   .0842295   .0146041     5.77   0.000     .0550874    .1133715
       GOEDBIN |   .1368926   .0104516    13.10   0.000     .1160367    .1577485
    WELSCHUUR |   .0229779   .0101489     2.26   0.027     .0027261    .0432298
         HUIS |   .0841964    .021189     3.97   0.000     .0419143    .1264784
      WELTUIN |   .0625373   .0136716     4.57   0.000     .0352562    .0898185
       ZOLDER |  -.0306461   .0150583    -2.04   0.046    -.0606944   -.0005977
    Misdrijven |   -.000527   .0001355    -3.89   0.000    -.0007973   -.0002567
   logInwoners |  -.0945522   .0275331    -3.43   0.001    -.1494936   -.0396108
      Density |  -6.30e-06   5.15e-06    -1.22   0.226    -.0000166    3.98e-06
      nietwest |  -.0071875   .0013496    -5.33   0.000    -.0098805   -.0044944
         Koopw |  -.0026831   .0013234    -2.03   0.047     -.005324   -.0000422
     Stationkm |  -.0274583   .0065097    -4.22   0.000    -.0404482   -.0144684
       OpritKM |   .0062197   .0163954     0.38   0.706    -.0264968    .0389361
       Basis1km |   .0275502   .0115733     2.38   0.020      .004456    .0506444
       Rest1km |   .0046932   .0014144     3.32   0.001     .0018707    .0075156
       Cafe1km |  -.0010667   .0013221    -0.81   0.423     -.003705    .0015715
      Super1km |  -.0233508   .0142685    -1.64   0.106    -.0518231    .0051215
       ZhuisKM |  -.0051413   .0111598    -0.46   0.646    -.0274103    .0171278
        _cons |   8.493379   .2887452    29.41   0.000     7.917196    9.069561
```

Count model (m1)

```
Linear regression                               Number of obs   =     15,305
                                                F(34, 68)       =      84.92
                                                Prob > F        =     0.0000
                                                R-squared       =     0.3262
                                                Root MSE        =     .29857

                                   (Std. Err. adjusted for 69 clusters in obj_bu)
--------------------------------------------------------------------------------
             |               Robust
   logTRANSM2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+------------------------------------------------------------------
      DATAFM1 |   .0395494   .0122937     3.22   0.002     .0150177    .0640811
      DATAFM3 |   .0035674   .0110668     0.32   0.748    -.0185159    .0256508
      DATAFM4 |  -.0238536   .0122831    -1.94   0.056    -.0483641    .0006569
      DATAFM5 |  -.0825488   .0138089    -5.98   0.000     -.110104   -.0549935
     NIEUWBOUW |   .1135361   .0261181     4.35   0.000     .0614183     .165654
     MONUMENT |   .0151351   .0227061     0.67   0.507    -.0301742    .0604444
    WELKELDER |   .1564995   .0210016     7.45   0.000     .1145914    .1984076
         LIFT |   .0392007    .015843     2.47   0.016     .0075864    .0708149
      CENTRUM |    .014138    .019869     0.71   0.479      -.02551    .0537861
      MOOILIG |   .0432335   .0090785     4.76   0.000     .0251177    .0613493
       BALKON |  -.0226971   .0084835    -2.68   0.009    -.0396257   -.0057686
      NKAMERS |  -.0110083   .0060693    -1.81   0.074    -.0231194    .0011028
      WELPARK |   .1584479   .0192673     8.22   0.000     .1200006    .1968953
      GOEDBUIT |   .0789819    .014101     5.60   0.000     .0508437    .1071201
       GOEDBIN |   .1361755   .0106204    12.82   0.000     .1149827    .1573683
    WELSCHUUR |   .0231248   .0103077     2.24   0.028      .002556    .0436935
         HUIS |   .0970578   .0222291     4.37   0.000     .0527003    .1414153
      TUIN_OPP |   1.57e-07   2.40e-08     6.54   0.000     1.09e-07    2.04e-07
      WELTUIN |   .0615094   .0137263     4.48   0.000      .034119    .0888997
       ZOLDER |  -.0317727   .0143997    -2.21   0.031    -.0605068   -.0030385
   Misdrijven |  -.0003428   .0001799    -1.91   0.061    -.0007018    .0000161
   logInwoners |  -.1269594   .0293347    -4.33   0.000     -.185496   -.0684229
      Density |  -6.93e-06   4.06e-06    -1.71   0.092     -.000015    1.17e-06
      nietwest |  -.0062309   .0012163    -5.12   0.000     -.008658   -.0038038
         Koopw |  -.0031627   .0012579    -2.51   0.014    -.0056728   -.0006526
     Stationkm |  -.0271722   .0057806    -4.70   0.000    -.0387072   -.0156371
       OpritKM |   .0105777   .0142661     0.74   0.461    -.0178899    .0390453
      Basis1km |    .027284   .0104709     2.61   0.011     .0063896    .0481784
       Rest1km |   .0051205   .0014668     3.49   0.001     .0021936    .0080473
       Cafe1km |  -.0016983   .0013043    -1.30   0.197    -.0043011    .0009045
      Super1km |  -.0282906   .0131155    -2.16   0.035    -.0544623    -.002119
       ZhuisKM |   .0021776   .0114899     0.19   0.850    -.0207502    .0251053
     Nonprofit |  -.0177915   .0076353    -2.33   0.023    -.0330275   -.0025555
       FPcount |   .0015195   .0004582     3.32   0.001     .0006052    .0024338
         _cons |   8.712215   .2875501    30.30   0.000     8.138418    9.286013
--------------------------------------------------------------------------------
```

Count in radii (m2)

```
LINEAR REGRESSION                           NUMBER OF OBS   =      15,365
                                            F(40, 68)       =      311.44
                                            PROB > F        =      0.0000
                                            R-SQUARED       =      0.3257
                                            ROOT MSE        =      .29834

                          (STD. ERR. ADJUSTED FOR 69 CLUSTERS IN OBJ_BU)
---------------------------------------------------------------------------
            |               ROBUST
  LOGTRANSM2 |     COEF.   STD. ERR.      T    P>|T|     [95% CONF. INTERVAL]
------------+--------------------------------------------------------------
    DATAFM1 |  .0350205    .011852     2.95   0.004     .0113702    .0586708
    DATAFM3 |  .0092377   .0111525     0.83   0.410    -.0130167    .0314922
    DATAFM4 | -.0223277   .0126961    -1.76   0.083    -.0476624     .003007
    DATAFM5 | -.0783793   .0142557    -5.50   0.000    -.1068261   -.0499326
   NIEUWBOUW |  .1128019   .0250509     4.50   0.000     .0628137    .1627901
   MONUMENT |  .0281139   .0215152     1.31   0.196    -.0148191    .0710469
   WELKELDER |  .1523245   .0203464     7.49   0.000     .1117238    .1929251
       LIFT |  .0435048   .0154844     2.81   0.006     .0126063    .0744034
    CENTRUM |  .0159683   .0173564     0.92   0.361    -.0186659    .0506026
    MOOILIG |  .0458534   .0088861     5.16   0.000     .0281215    .0635853
     BALKON | -.0216438   .0085202    -2.54   0.013    -.0386456    -.004642
    NKAMERS | -.0106364   .0062543    -1.70   0.094    -.0231167     .001844
    WELPARK |  .1678124   .0189649     8.85   0.000     .1299686    .2056562
    GOEDBUIT |  .0822433    .014371     5.72   0.000     .0535664    .1109201
     GOEDBIN |  .1342962   .0102656    13.08   0.000     .1138115    .1547809
  WELSCHUUR |  .0300716    .009722     3.09   0.003     .0106715    .0494716
        HUIS |  .0968597   .0217938     4.44   0.000     .0533709    .1403485
    TUIN_OPP |  1.68E-07   2.55E-08     6.58   0.000     1.17E-07    2.19E-07
    WELTUIN |  .0596312   .0136784     4.36   0.000     .0323364     .086926
     ZOLDER | -.0319845   .0144893    -2.21   0.031    -.0608975   -.0030715
  MISDRIJVEN | -.0005398   .0001282    -4.21   0.000    -.0007955   -.0002841
  LOGINWONERS | -.0850171   .0260116    -3.27   0.002    -.1369226   -.0331117
    DENSITY | -7.86E-06   4.89E-06    -1.61   0.112    -.0000176    1.89E-06
    NIETWEST | -.0066405    .001267    -5.24   0.000    -.0091687   -.0041124
       KOOPW | -.0025271    .001236    -2.04   0.045    -.0049935   -.0000607
   STATIONKM |  -.027253   .0058994    -4.62   0.000    -.0390251    -.015481
     OPRITKM |  .0088591   .0149708     0.59   0.556    -.0210146    .0387328
     BASIS1KM |  .0317289   .0107255     2.96   0.004     .0103265    .0531313
     REST1KM |  .0039375    .001252     3.14   0.002     .0014392    .0064358
     CAFE1KM | -.0016379   .0012832    -1.28   0.206    -.0041984    .0009226
    SUPER1KM | -.0298215   .0137575    -2.17   0.034     -.057274   -.0023689
     ZHUISKM | -.0031036   .0108154    -0.29   0.775    -.0246855    .0184783
      NP500B |  .0029779   .0030374     0.98   0.330    -.0030831     .009039
      NP250B |   .001797   .0088414     0.20   0.840    -.0158458    .0194398
      NP100B | -.0089064     .01589    -0.56   0.577    -.0406144    .0228015
        NP50 |  .0354456   .0158039     2.24   0.028     .0039094    .0669819
      FP500B |  .0005689    .000562     1.01   0.315    -.0005526    .0016904
      FP250B |  .0012041   .0014282     0.84   0.402    -.0016458     .004054
      FP100B |  .0085282   .0022198     3.84   0.000     .0040986    .0129578
        FP50 |  .0088082   .0032321     2.73   0.008     .0023587    .0152577
       _CONS |  8.365798    .270466    30.93   0.000     7.826091    8.905504
---------------------------------------------------------------------------
```

Single neighborhood (m3)

```
      Source |       SS           df       MS      Number of obs   =       781
-------------+----------------------------------   F(27, 753)      =     23.51
       Model |  18.4339101         27  .682737411   Prob > F        =    0.0000
    Residual |  21.8642497        753  .029036188   R-squared       =    0.4574
-------------+----------------------------------   Adj R-squared   =    0.4380
       Total |  40.2981598        780  .051664307   Root MSE        =     .1704

--------------------------------------------------------------------------------
    logTRANSM2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+------------------------------------------------------------------
      DATAFM1 |   .0278943   .0199711     1.40   0.163    -.0113114       .0671
      DATAFM3 |   .0035593   .0187851     0.19   0.850    -.0333182    .0404368
      DATAFM4 |  -.0409517    .019112    -2.14   0.032    -.0784709   -.0034325
      DATAFM5 |  -.0685048   .0210677    -3.25   0.001    -.1098632   -.0271464
    NIEUWBOUW |   .1867861   .0202754     9.21   0.000     .1469832    .2265891
     MONUMENT |          0  (omitted)
    WELKELDER |  -.0451316   .1729388    -0.26   0.794    -.3846311    .2943678
         LIFT |  -.0233302    .013856    -1.68   0.093    -.0505313    .0038709
      CENTRUM |   .0172144    .014628     1.18   0.240     -.011502    .0459308
      MOOILIG |    .044846   .0135932     3.30   0.001      .018161     .071531
       BALKON |   .0155666   .0136441     1.14   0.254    -.0112184    .0423516
      NKAMERS |   -.028523   .0083191    -3.43   0.001    -.0448545   -.0121915
      WELPARK |   .1450867   .0165303     8.78   0.000     .1126357    .1775376
      GOEDBUIT |   .0180987   .0411456     0.44   0.660     -.062675    .0988725
      GOEDBIN |   .0991633   .0205004     4.84   0.000     .0589185     .139408
    WELSCHUUR |  -.0019395   .0155703    -0.12   0.901    -.0325058    .0286268
         HUIS |  -.0261413   .1722098    -0.15   0.879    -.3642097     .311927
     TUIN_OPP |   8.13e-08   1.75e-07     0.46   0.642    -2.62e-07    4.25e-07
      WELTUIN |   .0351623   .0295815     1.19   0.235    -.0229096    .0932343
       ZOLDER |   .0164903   .0869019     0.19   0.850    -.1541084    .1870891
       NP500b |   .0072356   .0045104     1.60   0.109    -.0016188      .01609
       NP250b |   -.008194    .007201    -1.14   0.256    -.0223304    .0059423
       NP100b |   .0485183   .0117999     4.11   0.000     .0253537    .0716829
         NP50 |   .0375732    .024348     1.54   0.123    -.0102247    .0853712
       FP500b |  -.0005109   .0006341    -0.81   0.421    -.0017558      .000734
       FP250b |  -.0024894    .001028    -2.42   0.016    -.0045074   -.0004714
       FP100b |  -.0000355   .0021923    -0.02   0.987    -.0043392    .0042682
         FP50 |  -.0034071   .0036897    -0.92   0.356    -.0106504    .0038362
        _cons |   7.619791   .0656895   116.00   0.000     7.490834    7.748747
--------------------------------------------------------------------------------
```

Instrumental variable (m4)

```
First-stage regressions
-----------------------
```

```
                                    Number of obs   =     15,365
                                    N. of clusters  =         69
                                    F( 33, 15331)   =    1232.26
                                    Prob > F        =     0.0000
                                    R-squared       =     0.9429
                                    Adj R-squared   =     0.9428
                                    Root MSE        =     0.9082
```

```
--------------------------------------------------------------------------------
             |               Robust
  Nonprofit  |    Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+------------------------------------------------------------------
     DATAFM1 |  .0759617  .1267787     0.60   0.549    -.1725397    .324463
     DATAFM3 |   .176971  .1572445     1.13   0.260    -.1312468   .4851888
     DATAFM4 | -.0956612  .0582432    -1.64   0.101    -.2098247   .0185024
     DATAFM5 | -.2701875  .1424976    -1.90   0.058    -.5494996   .0091247
    NIEUWBOUW|  .0203997  .0952691     0.21   0.830    -.1663391   .2071386
    MONUMENT | -.0527875  .1699545    -0.31   0.756    -.3859185   .2803435
    WELKELDER|  .1039555  .0889807     1.17   0.243    -.0704572   .2783682
        LIFT | -.1141243  .0711787    -1.60   0.109     -.253643   .0253944
     CENTRUM | -.2354813  .1222005    -1.93   0.054    -.4750087   .0040462
     MOOILIG | -.0134904   .024499    -0.55   0.582    -.0615114   .0345305
      BALKON | -.0129534   .031082    -0.42   0.677    -.0738778   .0479711
     NKAMERS |  .0180002  .0183572     0.98   0.327    -.0179822   .0539825
     WELPARK | -.0475176  .0557163    -0.85   0.394    -.1567283    .061693
     GOEDBUIT| -.0229059  .0410279    -0.56   0.577    -.1033255   .0575138
      GOEDBIN| -.0154616  .0281428    -0.55   0.583    -.0706248   .0397015
   WELSCHUUR | -.1661019  .0545692    -3.04   0.002    -.2730639  -.0591398
        HUIS |  -.047868  .1104268    -0.43   0.665    -.2643176   .1685815
     TUIN_OPP| -3.72e-08  2.11e-07    -0.18   0.860    -4.51e-07   3.77e-07
     WELTUIN |  .0483037  .0258653     1.87   0.062    -.0023953   .0990028
      ZOLDER | -.0337859   .044837    -0.75   0.451    -.1216717   .0540999
   Misdrijven|  .0050696  .0020699     2.45   0.014     .0010124   .0091268
  logInwoners|  .1799749  .2643955     0.68   0.496    -.3382716   .6982214
     Density | -.0000236  .0000486    -0.49   0.627     -.000119   .0000717
     nietwest|  .0122996  .0098671     1.25   0.213    -.0070411   .0316403
       Koopw |  .0010014  .0087013     0.12   0.908    -.0160541   .0180569
    Stationkm|  .0220959  .0295148     0.75   0.454    -.0357567   .0799486
     OpritKM |   .114906  .1360271     0.84   0.398    -.1517233   .3815353
     Basis1km| -.2203035  .0697584    -3.16   0.002    -.3570384  -.0835687
     Rest1km |  .0691132  .0355646     1.94   0.052    -.0005975    .138824
     Cafe1km |   .006072  .0162785     0.37   0.709    -.0258358   .0379798
     Super1km|   .009253  .0969553     0.10   0.924    -.1807908   .1992969
     ZhuisKM |  .0630051   .050929     1.24   0.216    -.0368218   .1628321
        Subs |  1.78e-07  7.80e-08     2.28   0.022     2.52e-08   3.31e-07
       _cons | -2.381864  2.875701    -0.83   0.408     -8.01858   3.254852
--------------------------------------------------------------------------------
```

```
Instrumental variables (2SLS) regression          Number of obs   =     15,365
                                                  Wald chi2(33)   =    1839.45
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.3186
                                                  Root MSE        =     .29952

                                          (Std. Err. adjusted for 69 clusters in obj_bu)
------------------------------------------------------------------------------
             |               Robust
    logTRANSM2 |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Nonprofit |  -.0206877    .011639    -1.78   0.075    -.0434997    .0021242
     DATAFM1 |   .0316287   .0119804     2.64   0.008     .0081475      .05511
     DATAFM3 |   .0109961   .0113041     0.97   0.331    -.0111594    .0331517
     DATAFM4 |  -.0208089    .012371    -1.68   0.093    -.0450557    .0034379
     DATAFM5 |  -.0893871   .0145629    -6.14   0.000    -.1179299   -.0608443
    NIEUWBOUW |   .1205179   .0266908     4.52   0.000     .0682049     .172831
     MONUMENT |   .0367809   .0229095     1.61   0.108    -.0081209    .0816826
    WELKELDER |   .1555936   .0207691     7.49   0.000      .114887    .1963002
         LIFT |   .0416951   .0165546     2.52   0.012     .0092488    .0741414
      CENTRUM |   .0096861   .0192379     0.50   0.615    -.0280196    .0473917
      MOOILIG |   .0444287   .0089624     4.96   0.000     .0268627    .0619948
       BALKON |  -.0244204   .0086698    -2.82   0.005    -.0414129   -.0074279
      NKAMERS |  -.0095205    .006151    -1.55   0.122    -.0215762    .0025352
      WELPARK |   .1625677   .0186148     8.73   0.000     .1260834    .1990519
      GOEDBUIT |   .0835873   .0141403     5.91   0.000     .0558729    .1113017
      GOEDBIN |   .1365049   .0106728    12.79   0.000     .1155867    .1574232
     WELSCHUUR |   .0181904   .0105199     1.73   0.084    -.0024283     .038809
         HUIS |   .0835944   .0217967     3.84   0.000     .0408736    .1263152
      TUIN_OPP |   1.56e-07   2.83e-08     5.53   0.000     1.01e-07    2.12e-07
      WELTUIN |   .0631198   .0135739     4.65   0.000     .0365154    .0897241
       ZOLDER |  -.0321969   .0148102    -2.17   0.030    -.0612244   -.0031694
    Misdrijven |  -.0003857   .0001733    -2.22   0.026    -.0007254   -.0000459
    logInwoners |  -.0841648   .0281718    -2.99   0.003    -.1393805    -.028949
      Density |  -7.29e-06   4.37e-06    -1.67   0.095    -.0000158    1.27e-06
      nietwest |  -.0068096   .0012584    -5.41   0.000     -.009276   -.0043433
        Koopw |  -.0025928   .0013307    -1.95   0.051    -.0052009    .0000153
     Stationkm |  -.0272512   .0062535    -4.36   0.000    -.0395078   -.0149946
       OpritKM |   .0090842    .015713     0.58   0.563    -.0217128    .0398812
      Basis1km |   .0223219   .0108861     2.05   0.040     .0009856    .0436582
       Rest1km |   .0076076   .0022992     3.31   0.001     .0031013     .012114
       Cafe1km |  -.0013378   .0012169    -1.10   0.272    -.0037229    .0010473
      Super1km |  -.0258512     .01369    -1.89   0.059    -.0526832    .0009808
       ZhuisKM |  -.0030359   .0112111    -0.27   0.787    -.0250093    .0189374
         _cons |    8.37792   .2943869    28.46   0.000     7.800932    8.954908
------------------------------------------------------------------------------
Instrumented:  Nonprofit
Instruments:   DATAFM1 DATAFM3 DATAFM4 DATAFM5 NIEUWBOUW MONUMENT WELKELDER
               LIFT CENTRUM MOOILIG BALKON NKAMERS WELPARK GOEDBUIT GOEDBIN
               WELSCHUUR HUIS TUIN_OPP WELTUIN ZOLDER Misdrijven logInwoners
               Density nietwest Koopw Stationkm OpritKM Basis1km Rest1km
               Cafe1km Super1km ZhuisKM Subs
```