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A meta study of hedonic pricing models on housing

Abstract

In this paper four factors, *housing attributes, neighbourhood characteristics, recreational factors and accessibility to retail and work,* related to house prices are analysed. For each factor the most important papers are discussed and this results in an overview of how the literature has developed over the years. Comparing all the results of each paper, it seems that all four factors are mostly positively related to house prices, except for crime in the neighbourhood. There also seems to exist two periods in which different factors have been written about hedonic pricing models related to house prices. The first period is from 1970-1985 and focusses mainly on housing attributes related to house prices. While later research, after 1985, mostly focusses on location specific factors.

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Table of contents

I. Introduction

An essential element in housing is that people who look for a house, do not look for a 'homogenous product' but rather 'bundles of specific housing attributes'. This element is not in line with the traditional model, which assumes that 'households demand a homogeneous good which is produced competitively in a market characterized by long-run equilibrium' (Kain & Quigley, 1975). A homogenous good means that the goods only compete on price or availability and that there is no differentiation in terms of quality and features. It is illogical to think that a house is a homogenous good, because a house can differ in many ways. For example, if we look at the attributes of a house there are many options it can differ relative to other houses. But also the quality of a house can be very different to that of others ones. Also when we look at the neighbourhood, there seem to be multiple factors that can influence the value of house compared to other houses. Brigham stated in 1965 that 'the value of any particular site is assumed to be related to its accessibility index, its amenity level, its topography, and certain historical factors including the way the land is being used' (Brigham, 1965). So it is clear that there are multiple factors which play a role in determining the price of property.

From the amount of research that is done, it is obvious that the topic of house prices and its influencers is a scientifically relevant topic. However, the kind of analysis that is done in this paper has not been done before. There are some studies which do a literature research on one specific factor, e.g. Landis et al. (1994) on transport. But an analysis based on the four main factors has not been done before. One research that 'comes close' is that of (Sirmans, Macpherson, & Zietz, 2005). They examine 125 studies all related to hedonic pricing models and try explaining what the relationship is between various variables and the price of a house. They split up all the variables in eight different main categories and proceed by stating in a table how many times a specific variable appeared, was positive, was negative or was not significant. So for example, the variable 'garage', belonging to the main category 'external house features' appeared four times in all 125 studies and was three times positive and one time not significant. Thus, this paper gives a general indication of what the effect of each specific factor is on house prices. However, in this study the aim is to give a more specific indication of how the four main factors have developed over the years.

The topic about hedonic pricing models also has a social relevant aspect, because it addresses all homeowners. Homeowners are interested to see what affects their home's price. For example, if it turns out that a park has a significant positive effect on house prices, homeowners who live next to a park could ask a premium when they would sell their house.

In the past decades, there have been a lot of research about hedonic pricing models on housing. All these researches have some kind of the same main question, which is 'what factor/factors influence/influences housing prices?'. The value of a house is determined by attributes. These attributes can be sorted under two categories, namely the structural characteristics of a house, such as plot size and number of rooms and as second the locality of a house. These are factors that are related to where a house is located, so neighbourhood characteristics and accessibility to work (Luttik, 2000). This leads to the following factors**,** namely *housing attributes*, *neighbourhood characteristics, recreational factors* and *accessibility to retail and work.* This paper will look at the literature that is written the past decades about these four factors in general. It will look at how the literature has evolved around the hedonic pricing models on housing and how it will probably evolve in the coming years. The reason why this paper chose the order of housing attributes, neighbourhood characteristics, recreational factors and accessibility to retail and work is because the expectation is that there is chronological order between these factors. To clarify, the expectation is that most papers about housing attributes are written in the period 1970-1990, the factors neighbourhood characteristics and recreational factors in the period 1990-2005 and accessibility to retail and work mostly in the period 2000-2015. To strengthen this expectation, Cheshire and Sheppard (1995) state that until the year 1995, most attention was paid to housing attributes in the literature instead of location-specific factors. However, their results show that it is necessary to include also location-specific factors in the model because they are of significant interest. An hedonic model needs to be as fully specified to estimate the effects of these factors on house prices.

So now that the four factors have been mentioned and the expectations have been addressed, it follows that the aim of this thesis is to give an enhanced overview of the existing literature and the upcoming literature about hedonic pricing models on housing. The corresponding research question with this topic will be as follows:

'How did the literature about hedonic pricing models on housing develop in the last decades?'

The main research question can be divided into four sub questions, which are stated below:

- *'To what extend do housing attributes affect the housing prices?'*
- *'To what extend do neighbourhood characteristics affect the housing prices?'*
- *'To what extend do recreational factors affect the housing prices?'*
- *'To what extend do accessibility to retail and work affect the housing prices?'*

The first group, as already mentioned, is *housing attributes*. Where Sirmans et al. (2005) used three categories to describe all features belonging to a house (structure type, internal house features and external house features), this paper sorts them all under one group. This group has the most substantial influence on the price of a house. The bathroom or bedroom are for example attributes of a house. However, if we look at the neighbourhood of a house there are all kind of factors that play a role in determining the housing price. The *Neighbourhood characteristics* are essential in explaining house values. Think about schools for the children or stations. (Gibbons & Machin, 2003) found that an one percent increase in the proportion of children reaching the government-specified target grade will result in an 0.67% increase of housing values, for the UK market. Especially in first world countries, schools are important facilities a neighbourhood should have. Every child should have a proper education, so it can have a fair chance on good employment. *Recreational factors* in a neighbourhood are parks, recreational water and open space. It is logical to expect that households are willing to pay a premium for these factors. The expectation is that especially the demand for recreational space in dense areas is high. People who live in these areas have a lot of buildings surrounding them, so e.g. a park can be refreshing between all these buildings (Anderson & West, 2006). The last group of factors this paper will discuss is the *accessibility to retail and work*. Households need to do their daily groceries to fulfil their consumption need. So if a store is located just around the corner (walkable distance) or ten kilometres away (automobile distance), can have an effect on the price of properties. The same goes for work opportunities. Expectation is that households are willing to pay extra to live closer to the shops and their work. These are the four main factors that will be discussed in the rest of this paper.

All four factors will be individually analysed. As already mentioned, it is expected to see a clear or vague chronological order of when these factors were mostly written. The set-up of this paper is as follows, first the theoretical framework will be discussed, as second the analysis of the literature shall be discussed. At the beginning of this analysis the data and methodology used in this paper will be mentioned shortly. This paper will not use a separate section for these topics because they are quite simple to follow and are not a huge addition to this paper. Based on the analyzation, there will be given a conclusion, in which the research question will be answered. As last, there will be room to discuss limitations and recommendations for future research.

II. Theoretical framework

The main concept in this paper is the *hedonic pricing model*. Almost all research discussed in the analysis use the hedonic pricing model as their guideline on which they base their research. The only exception in this analysis are the papers which were written before the year 1974 (Rosen wrote his paper in 1974), such as Kain and Quigley (1970). So in this section the hedonic pricing model will be briefly explained, based on Rosen's theory, which can be seen as one of the founders of the hedonic pricing model.

Hedonic prices can be defined as the implicit prices of attributes, which can be observed from prices of differentiated products and the specific amounts of characteristics associated with them (Rosen, 1974). Rosen wrote this theory not exclusively based on a specific market, but the housing market is a well-suited market for the hedonic pricing model. Hedonic analysis allows the researcher to determine the price for a specific characteristic. Sheppard (1999) wrote a paper about the hedonic analysis in the housing market. The housing market can be seen as an implicit market, which means that all goods (houses) are traded in 'bundles'. The demand for these goods are based on the characteristics the good embodies (Sheppard, 1999). Each characteristic bears utility to the consumer and that results in a price for each characteristic of the good. So the hedonic pricing model decomposes the attributes of the composite good into implicit prices for each attribute. In this paper the composite good is a house and its attributes are for example an additional bedroom or proximity to retail facilities (Van Haaren, van Oort, & Wildeboer, 2017). However, the hedonic model does face some difficulties which could affect the results implemented from the model. Problems such as model specification, measurement error and nonlinearity in household budgets could temper with the results if not accounted for. For example, nonlinearity implies endogenous determination of attribute prices, which can be prevented by using multiple market data (Sheppard, 1999).

III. Analysis of the literature

This paper will start the literature analysis by discussing the most influential papers of the last decades in this field. We show that the literature has evolved from a discussion of housing attributes to comprehensive models with many different attributes. This part will also contain a table with four categories: study, scope, methodology and findings. The reason for this is so the reader can see in a glance what the most important papers and their findings are. In the next part of the analysis, all factors will be individually analysed based on a wide variety of studies. This will lead to a detailed representation of the how the literature developed per factor. The first factor will be *housing attributes*, then *neighbourhood characteristics*, as third *recreational factors* and as last *accessibility to retail and work*. At the end of each factor a short summary will be given with an indication of what the most important results are.

All papers used in this analysis are chosen based on their relevance and importance. This means that each paper needs to be relevant about the subject it discusses and it has to be important for the whole overview. An useful indicator to select the papers is by how many times a paper has been cited. But note that this is not the rule, it also has to add something new to the analysis. In the analysis, the results of each paper will be discussed and compared with each other.

Most influential papers of the last decades

Before we start with the analysis for each factor, this paper will start with an overview of the most influential papers of the last decades. Some studies really influenced the debate whether these factors have any effect on house prices or what the effect is. At the end of this chapter, there is a table of the studies which are most influential per factor. Per study the scope, methodology and findings are mentioned. Note that the papers addressed here will not be addressed again in the analysis per factor. And that the papers discussed in the 'normal' analysis are not less important. All papers add substantial value to this analysis, however the papers mentioned in this chapter are in my opinion more important in ways of changing the debate about these factors.

For the factor *housing attributes*, two studies really stand out. One of the two is the well-known paper of Kain and Quigley (1970). It is essentially the first study which focusses on the effect of housing attributes on house prices. In order to study this effect, they used a regression model with 28 independent variables. Especially the number of rooms has a big effect on housing values. But this result is not really shocking. It is obvious that the number of rooms has a significant effect on the price of a unit. Also the size of an unit has a proportional effect on the price. A second finding which is noticeable is that the quality of a bundle of

residential services has at least as much effect on its price as such quantitative aspects as number of rooms, number of bathrooms, and lot size. (Kain & Quigley, 1970) This means that adding for example an extra room to a house could have almost the same effect as improving the quality of a dwelling unit. Kain and Quigley (1970) also addressed that school quality and crime have a substantial effect on house prices, which laid the fundaments for later research.

The second study is that of Can (1990), who researched whether a different location produces different pricing differentials with the same housing attributes, so-called spatial dependence. He uses different kind of research methods which have not yet been used in the existing literature. These tests seem to be solid representations of the localized geographic complexities. Location as an influencing factor was not included in most of the models of previous research. Palmquist (1984) looked at seven different cities to see whether his variables changed per city. Kain and Quigley (1970) took into account that the ghetto versus a suburb could have different outcomes on the value of houses. So in former research some locational factors were considered in their research. But Can has improved the hedonic house price models in a methodological perspective (Can, 1990). He calculated the effect of spatial dependence that might occur in the data. Can (1990) stated that the variations in urban house prices seem to be better explained by the conceptualization of both spatial spill over effects and spatial parametric drift (Can, 1990). He expressed his criticism on the traditional hedonic model with this statement. Next to that, the prices of dwelling units in deteriorating neighbourhoods are raised if there are higher-priced units in the proximity. In that case, it seems that the effect of housing attributes are almost none on the price of a dwelling unit. Thus, not only structure attributes of a house are important for its price, but also the neighbourhood effects seems to play a role. Can (1990) amplified with this finding the debate for more research on neighbourhood effects on house prices.

For the relationship between schools and house prices, Jud and Watts (1981) set the line for future research. They stated that earlier studies that focus on either school quality or racial composition of a school could be biased. Namely, it could be that these two factors are correlated. This is why Jud and Watts (1981) study the effects of these factors simultaneously in one model. Their expectations are that the negative effect of non-white schools on housing prices are overestimated in earlier studies, because they did not control for variations in school quality (Jud & Watts, 1981). From their results follow that when school quality as well as racial composition of a school are controlled for, the negative effect of only racial composition is significantly smaller on house prices. Second finding is that households are willing to pay 6% extra for a house when the level grade of achievement improves with one point.

For both *recreational factors* and *accessibility to retail and work*, all studies seem evenly important in my opinion. None of these studies may be considered seminal in its own right, but collectively these studies have shaped the debate in hedonic house price models over the years. This is why the table below includes a broad elaboration of '*various studies*' based on the two factors.

Study	Sample	Methodology	Findings
Kain and Quigley (1970)	Surveys in the city St. louis in the year 1967, quality ratings of specific attributes	Factor analysis to derive best set of variables, followed by a regression model for owner and renter	Quality of dwelling unit has the same effect as the quantitative attributes such as number of rooms.
Can (1990)	Region Columbus MSA, 1980, single-family houses	Hedonic regression model modified with specification models to control for spatial heterogeneity and spatial dependence	urban house prices seem to be better explained by the conceptualization of both spatial spill over effects and spatial parametric drift
Jud and Watts (1981)	City of Charlotte, 1977, single-family houses, achievement scores as quality index for schools	Hedonic regression model followed by an economic model to estimate the demand and supply for school quality	When school quality as well as racial composition of a school are controlled for, the negative effect of only racial composition is significantly smaller on house prices. Second finding is that households are willing to pay 6% extra for a house when the level grade of achievement improves with one point.
Various studies on recreational factors	Varying samples from Hong Kong to Finland to US (e.g. Baltimore, Maryland)	Mostly hedonic regression models, difference-in-difference specification by Voicu and Been (2008)	Most findings indicate positive effect of recreational factors on house prices
Various studies on accessibility to retail and work	Mostly samples from the US, such as Boston and Washington	Mostly hedonic regression models	Most findings indicate positive effect of accessibility to retail and

			work on house prices

Housing attributes

Housing attributes are a key factor for determining the value of a dwelling unit. A house provides through these attributes a service to the consumer. The most important attribute is probably the size of a house (Kain & Quigley, 1970). This can then be divided into the number of rooms, the number of bathrooms and the size of the land around the house. Other features of housing attributes that have been researched by some papers are heating, plumbing and electrical systems (Follain & Jimenez, 1985). Some other attributes that are less common in the literature but still provide a service are the presence or absence of a basement, the age of a house and the number of stories. But not only the presence of these attributes are important, also the quality of these attributes play an important role in valuing houses (Kain & Quigley, 1970). It is expected that each of these attributes add value to a dwelling unit. But to make sure that they do, a lot of papers researched what the effect is of these attributes on the price of a dwelling unit.

Kain and Quigley laid the fundaments for research on housing attributes. However, Kain and Quigley stated that much research remains to be done on explaining the effects of external and internal aspects on market value of housing. Some papers that proceeded with the work of Kain and Quigley (1970) are Palmquist (1984), Wilkinson (1973) and Cobb (1984). Palmquist (1984) studied the demand side for attributes in developed countries. He made a regression model where he looked at seven different cities. The reason for this is to avoid the identification and endogeneity problems. From Palmquist's study follows that the price elasticity of demand for living space seems to be 'approximately unitary'. This means that the price elasticity is around one. So with a price increase of one percent, the demand for living space decreases with one percent. Whereas the demand for other attributes seems to be price inelastic, which means that an increase in price for a certain attribute will not have much effect on the demand for it.

Cobb and Wilkinson's research both show, as well as Kain and Quigley, a positive effect of housing attributes on the value of a house. Housing attributes determine the basis of the transaction price of a house, where other factors like geographical, racial or zoning can only influence the price to a certain extent (Cobb, 1984). But there seems to be a hierarchy in housing attributes wants, which means that certain attributes are more attractive to the consumer than other attributes (Wilkinson, 1973). However, this cannot be claimed to be conclusive but it seems logical that there is an underlying preference for individual attributes.

Worth mentioning is that Wilkinson (1973) used a different approach than most studies. Namely, he used a factor analysis which prevents the presence of multicollinearity.

Witte et al. (1979) hypothesized that the physical quality of a dwelling, dwelling size and lot size are the main variables of housing services. And that these three variables attract consumers and suppliers to form implicit markets. Variables like number of rooms, number of bathrooms and parcel area can all be sorted under the variable dwelling size. In contrast with Palmquist (1984), Witte et al. look at both the demand and the supply side. Witte et al. (1979) studied what the effect is of these three variables on the price of an dwelling unit. These three variables represent the independent variables. The dependent variables are divided into six groups. Each variable reflects either the bid price or offer price for dwelling quality, dwelling size and lot size. From the bid price function follows that each attribute has a negative coefficient. To simplify this, it means when the dwelling quality increases the bid price for a unit of dwelling quality decreases. For the offer price function the effect is the other way around, a positive or zero coefficient for every attribute. Witte et al. (1979) also found that the effect of higher income and status has a positive effect on the bid price function.

Papers like that of Kain and Quigley (1970) or that of Palmquist (1984) use a lot of variables in their research to account for probable biases that can occur. These variables work as control variables and make sure that the results are as unbiased as possible. Although most results seem to be strong and significant, researchers should take in mind that their results may be affected by specification bias because it is unrealistic to include all attributes into the model. Butler (1982) researched whether it is possible to 'present some evidence that approximate correctness can be achieved with significantly fewer characteristics than is generally supposed', a so-called parsimonious model (Butler, 1982). Butler tries to simplify the regression model by looking at the correct specification for housing characteristics. However, the problem that might occur is specification bias, but that is inevitable to reduce the potential error of other sources. Butler compares two hedonic indexes, one with a relatively large set of housing attributes and another with a restricted subset of these independent variables. The second index shall probably contain specification bias. The results between the two indexes will show what the relative weight is of specification bias when a simple specification is used. It follows that the impact of specification bias is relatively small. The impact on the explanatory powers of the models is negligible, even for the heavily restricted specification model (Butler, 1982). Other research still needs to be done to confirm this result, but if confirmed, than it means that researchers of the housing market who use the hedonic technique could economize.

The paper of Follain and Jimenez (1985) looked at housing attributes but with another angle. They investigated what a household is willing to pay for a certain variable, so-called household's preference. The household demand for household characteristics is an approach that is not used a lot by scientific papers. It gives a different image of the market for housing attributes. The population on earth is increasing fast and this means that the demand for housing is also increasing. Large investments in urban development projects are needed to keep up with the demand. The housing market in Amsterdam is a good example of this 'booming market', where buying above the asking price is becoming normal. Follain and Jimenez did a relatively similar regression as that of Palmquist. They did a regression for five different cities originating from three different developing countries. Their independent variables are in line with that of Palmquist. From the results follow that a household willingness to pay for extra space to live in is generally not large, when compared to household income (Follain & Jimenez, 1985). This means that when income increases, the willingness to pay for living space does not response heavily. The case for quality variables seems to be different. An increase in income seems to have a strong effect on the marginal rate of substitution for quality variables. However, there are very few studies about this specific topic, so it is hard to draw strong conclusions. Note that these results may not be conclude for every country, especially developed countries, because Follain and Jimenez's research is concentrated on developing countries.

From the first chapter of the analysis follows that housing attributes have a positive effect on the value of houses, which is logical. However, Can (1990) contradicts this with his findings by stating that the neighbourhood characteristics have a substantial effect on the price of a house. Two other valuable findings are that the demand for housing quality seems to be price elastic and that the impact of specification bias is relatively small. Note that all papers are written in the period 1970-1985, except for Can (1990). But Can can be arranged in all groups: housing attributes, neighbourhood characteristics, recreational factors and accessibility to retail and work. Namely, Can changed the whole debate for hedonic pricing models with his model on spatial spill over and spatial parametric drift.

Neighbourhood characteristics

In this chapter, the focus will be on the effects of public services, provided in a neighbourhood, on the value of housing. There has been a lot of research on this object, so to make it well-ordered, this paper will stay with three topics of public services. The three topics are 'schools in a neighbourhood', 'crime rates/ safety in a neighbourhood' and 'stations in a neighbourhood'. Each of these topics will be linked with the prices of housing of course. The reason why this paper chose for these three topics is because they are well represented

in the existing literature and because they are expected to have a substantial influence on house prices.

Schools in the neighbourhood

There are many more papers who discuss the correlation between schools quality and housing values, but it is hard to discuss them all in this analysis. This is why the most important papers, based on how many times they are cited and if they add something new to the literature, will be discussed. Another note is that most literature discussed below uses samples based on American house values and schools. Thus, to link these results to the European market could be difficult, because in Europe we use a different school system.[1]

A school is an important service in today's society. It lays the fundaments for everyone's lives. Children learn on school the basic things such as reading or writing, but also how to communicate with other people and to cooperate in group work. A good education can result in a good job and sometimes even in a fortunate life. Parents want their children to go to good schools and have a good education. They search for houses which are located in good neighbourhoods and are in the proximity to a good school. Black (1999) researched whether parents are willing to pay more for a house which is located in an area with better schools. From the results follows that this is the case, parents do value better schools. In overall, parents are willing to pay 2.1% extra for a house, which is located near a school with 5% better test scores above the mean. Thus, better test scores seems to lead to an increase of house prices.

Earlier studies measured the quality of schools either by school input variables or by student achievement levels (Jud & Watts, 1981). Other earlier research studied whether the racial composition of a school has an effect on the residential location and price for housing. An example of this is (Clotfelter, 1975), who studied the effect of school desegregation on housing values. The results are that house prices fall when located near high schools with greater desegregation. As already mentioned before in the chapter 'most influential papers of the last decades', these studies that focus on either school quality or racial composition of a school, could be biased. This is why Jud and Watts (1981) studied both factors in one model.

Later study seems to focus mostly on school quality in correlation to housing prices, instead of the racial composition of schools. A reason for this could be that a multicultural society is becoming more and more accepted by the people. People are becoming used to living next to different cultures and people with different skin colours, whereas 50 years back this was

[1] In the EU, parents are free to choose which school their children go to. In the US parents have no choice, because the school is based on the district where in you live.

not a common thing. However, a study from 2008, written by (Clapp, Nanda, & Ross, 2008), examined whether home buyers pay for better test scores or the demographic composition of a school. And the results seems to indicate that the demographic composition of a school still affects the prices of houses in the neighbourhood.

The paper of Haurin and Brasington (1996) provides a valuable addition to the literature, because they use a very wide data set. Their sample contains jurisdictions of multiple MSAs, which give them an advantage on other studies. Namely, most studies base their sample on one urban area, for example a central city. They found that school quality is the most important cause of variation in constant-quality house prices (Haurin & Brasington, 1996). Based on the pass rate of ninth grade students on a proficiency exam, when the pass rate increases with one percent the value of houses increase with one-half percent. (Bogart & Cromwell, 2000) took it from a whole other angle than the studies discussed previously. They studied the effects of school redistricting on the value of houses. School redistricting is an economy measure, by rearranging the school borders. So the total amount of schools is reduced, which leads to more students per school (Caro, Shirabe, Guignard, & Weintraub, 2004). Bogart and Cromwell (2000) expect redistricting to have three effects. Shortly described the three effects are ‘harmful for the quality of schools’, ‘changing of racial composition of schools’ and ‘bus service implemented into areas that first did not receive it’. The expectation is that through these three effects the prices of housing shall be influenced. The results show that school redistricting reduces house prices with 9.9% if all else is being equal.. However, the bus services that follow from redistricting have a positive effect of 2.6% on house prices.

Note that all the studies discussed above are based on data samples from the US. Gibbons and Machin (2003) are the first who studied the effect of primary school quality on house prices in the UK. As already mentioned in the introduction, the findings of their study are that parents are willing to pay a 6.9% premium on house prices, in order to have their kids score 10% better on their Key stage 2 tests. This can be translated in absolute values of £13,500 premium for the region Greater London. This result is in line with other studies which are based on the US, such as (Black, 1999).

So now that we discussed some important literature about schools and house prices, it seems reasonable that school quality has a positive effect on the value of property. But what is the most appropriate measurement of school quality? Brasington (1999) tries to answer this question in his study. The results are that proficiency test, expenditure per pupil and the student-to-teacher ratio are most consistently positively correlated with house prices. Interesting is that parents do not choose a school based on their ability to improve a

student's achievement, but instead they choose schools on their peer group effect. This means that parents are driven by socio-demographic characteristics (Brasington, 1999). Downes and Zabel (2002) found that only the effect of test scores is significant on house prices. The elasticity of house prices with respect to test scores is around one. Other measures of school quality such as changes in test scores and per pupil expenditures do not significantly influence house prices (Downes & Zabel, 2002). This is in contrast to earlier findings of Brasington (1999). The reason for this difference is, according to Downes and Zabel, because they use a rich data set.

Crimes rates/safety in a neighbourhood

Crime is a major problem for cities, because it affects the lives of the innocent people. There seems to be a link between city-size and crime. This makes it an interesting topic for research to see what people are willing to pay to live in a 'safe' neighbourhood. By safe it is meant that there is a low crime rate. The effect of crime on housing prices has not been studied much in the last 50 years, in comparison to other subjects like housing attributes or neighbourhood school. The first paper that started doing research to the effect of crime on housing prices was (Thaler, 1978). Based on an implicit price model, Thaler found that the average property crime lowered house prices with roughly $622. This number is adjusted for the actual crime rate, because only a fraction of the crimes are reported to the police. Otherwise the cost would be overestimated. (Hellman & Naroff, 1978) and (Rizzo, 1979) both found results corresponding with that of Thaler's. Property crimes plus violent crimes, such as rape, seem to have a bigger negative effect on housing prices. Later on (Cohen, 1990) tested whether these estimates are correct. Cohen found the same results as that of Thaler (1978) and Rizzo (1979) for the effect of crimes on property values.

(Lynch & Rasmussen, 2001) found that crime does not considerably affect the price of an average home. There even seems to be a positive effect of crime on prices. However, if a house is located in a neighbourhood with high crime rates, the price of an average house declines dramatically. Compared to the studies discussed above, the first result of Lynch and Rasmussen is contradictory. The reason for this is that there are higher reporting rates in wealthier neighbourhoods. Another surprising result is that burglaries have no effect on the price of houses, but criminal damage incidents do (Gibbons S. , The costs of urban property crime, 2004). Gibbons' argumentation for this result is that households can take actions to prevent burglary (implementing an alarm system for example). While criminal damage, such as vandalism, graffiti and arson seems to be indicators for instability, disorder and lack of social cohesion in the neighbourhood. So it seems that different crimes have different effects on the value of houses. But how about ex-criminals who come living in the neighbourhood?

In the United States it is bounded by law for sex-offenders to be publicly registered. (Pope, 2008) studied whether sex-offenders registries have an effect on the value of houses. It seems that when a sex-offender moves into a neighbourhood the prices fall with 2.3%, but if they move out the prices rebound immediately.

However, the average of impact of crime, calculated in these studies, can be misleading. There are differences of impact in poor, middle and wealthy neighbourhoods, which means that crime is capitalized at different rates between these neighbourhoods (Tita, Petras, & Greenbaum, 2006).

This paper is aware of the recent papers that are written in the last ten years, but for this analysis they are not relevant enough. But it is worth noticing that this topic has been popular for the last ten years.

Stations in the neighbourhood

In today's society the demand for transport is constantly increasing, which means that governments need to keep investing in a good infrastructure. If a government does not do this, the chance on congestion increases. This could have negative effects on the economy of a region. So it is important for an economy to have a solid infrastructure, but what are the effects of these new investments? In this part of the chapter the effect of new stations on housing prices will be reviewed, which is called transit capitalization. This review will be done in the same way the previous chapters were reviewed.

A lot of studies have empirically investigated the relationship between rail stations and housing prices. Each of these studies based their study on a specific rail system located in a metropolitan area. Some examples are the Miami Metrorail system, BART system in San Francisco and Rail line in Toronto. In the paper of Landis, Guhathakurta and Zhang (1994) there is detailed overview of all the papers that studied the relationship between stations and housing prices until the year 1994. Some examples of studies which are mentioned in the overview are (Dewees, 1976) and (Bajic, 1983), which both studied the Toronto subway. They both used a weighted travel-time based measure for their research. The BART system, which is studied in many papers, shows some interesting results. (Dornbusch, 1975) and (Burkhardt, 1976) were the first ones to study the BART system and found that property values reduced around some stations of the BART system. They attributed this decrease to increased noise and auto congestion (Landis, Guhathakurta, & Zhang, 1994). To show contrast, (Blayney, 1979) found that BART had a small but significant positive effect on the price of houses located near stations. Based on Landis et al. (1994) overview, the most used comparison method in former studies is 'sales prices'. The results of these former studies

seem to fluctuate between positive effect and negative effects. A reason for a positive effect could be better accessibility whereas increased noise and congestion could be a reason for a negative effect. However, the underlying factors that might influence this effect are not accounted for in these papers. In the rest of this chapter different papers will be discussed which were written after the year 1994. Hopefully will these papers give a better insight in what the effects of stations are on housing prices.

(Bowes & Ihlanfeldt, 2001) studied whether there are explainable factors that may account for the effect of rail station proximity on housing prices. Their expectations are that four factors may explain this effect, two positive factors on housing prices and two negative factors on housing prices. The two positive factors are 'access advantage provided by stations' and 'stations may attract commercial services, such as retail establishments'. The two negative effects are 'expected higher crime rates at stations' and 'negative externalities such as noise'. From Bowes and Ihlandfeldt's (2001) study follows that the effects of retail on house prices is greater than that of crime, except when a station is located close to downtown. And that the direct effects on house prices are greater than that of retail and crime effects. Direct effects are better accessibility and negative externalities. In addition, stations with parking facilities seem to have a more positive effect on house prices and when a station is located closer to the CBD than the positive effect is also greater on house prices.

So et al. (1997) researched whether the accessibility to transport plays an important role in determining house prices. Their study, based on Hong Kong, shows that all sorts of transport have a positive effect on house prices, except for buses. Especially minibuses seem to play a significant role in determining house values. The reason for this is that minibuses pick up commuters close to home and are widely connected to other transport modes (So, Tse, & Ganesan, 1997). A second interesting finding is that shopping centres and sport facilities are also important factors in determining house prices, but this topic will be discussed later on. Debrezion et al. (2006) based their study on the Netherlands (Amsterdam, Rotterdam and Enschede). According to Debrezion et al. (2006), most studies consider only the proximity of properties to the nearest stations. However, Debrezion et al (2006) state that people do not always use the nearest railway station for their travels. The choice for a departure railway station can be affected by the levels of rail service, network connectivity, service coverage and station facilities (Debrezion, Pels, & Rietveld, 2010). Railway accessibility is thus both proximity as service levels. From their study follows that house values are more influenced by the most frequently used railway station than by the nearest railway station. The paper of Hess and Almeida (2007) found that the effect of proximity to Metro Rail stations on house prices is not substantial in the region of Buffalo, which is a slow-growth city. The effect is

positive but it is weak compared with fast growing cities on the West Coast (Hess & Almeida, 2007).

As last the paper of Gibbons and Machin (2008) will be discussed. This paper discusses the effects of school quality, transport and crime on house prices all in one paper. The results are in line with most of the earlier discussed papers, which is that all three factors have a substantial effect on the price of houses. Spatially targeted crime policies can influence local house prices. These policies make people feel safer and take away their fear of crime. Also transport policies need to be adjusted so it can improve the accessibility of neighbourhoods and thus have a positive effect on house prices. This is in line with what is earlier discussed. As last, school is found to be the most important location factor. Parents are willing to pay a substantial premium on house prices, so that their kids go to better schools (Gibbons & Machin, 2008). However, Gibbons and Machin (2008) do not discuss the relationship between all three factors.

To summarize this chapter, schools and stations both have a positive effect on house prices. Especially for schools all results clearly indicate that households are willing to pay a premium to live near a school with better quality (better test scores). Crime seems to have a negative effect on house prices, but this effect differ between different sorts of crime, such as burglaries or criminal damage. Stations do have a positive effect on house prices but note that stations also bring negative externalities, such as noise and congestion. As last it is interesting to see that most papers for *schools and crime* are written in the period 1990-2010. However, there are papers for all three factors that are written before this period. Especially for the subject *stations in the neighbourhood*, it turns out that this subject always has been popular. This means that it is hard to conclude that the factor *stations* is mostly written in the period 1990-2010.

Recreational factors in the neighbourhood

In this chapter the effect of recreational factors on housing prices will be discussed. Recreational factors are open places where people can spend their free time. The most common example is probably parks, where people can relax. Most studies which discuss this topic, emphasize the pressure that policy makers have on making the right decision. What needs to happen with new land or abandoned buildings? Do they build new buildings to fulfil the demand for housing or do they build parks to satisfy the demand for recreational areas in a crowded city? These studies try to answer these questions by looking at the benefits of parks to the residents and city. In this chapter the emphasis shall be on parks, but the effect of open space on the price of housing will also be discussed. The reason for this divide is because there is a lot of literature which speaks about either parks in specific or about open

space. So to keep it orderly, this paper discusses the topics separately. First the studies about parks/forests will be analysed, after that the studies about open space.

Parks/forests in the neighbourhood

To analyse the effect of parks and forests on housing prices, first the costs and benefits of forests have to be determined. Determining the costs of parks and forests is a straightforward job but the benefits however is a lot harder to determine. Some decision makers or elected officials even say that a park or open space is a costly investment which yields no economic return to society. It only brings social merit to the community (Crompton, 2001). However, one possible way for determining the benefits of urban parks in monetary values is by applying the hedonic pricing model on the housing market. In 1988, (More, Stevens, & Allen, 1988) tried to determine the monetary value of urban parks. Their opinion is that parks have little to no influence on the purchase decision of a house. Their reasoning is that a park is one of the many variables that positively influences a neighbourhood. Neighbourhood quality is, in turn, one of the many variables influencing a purchase decision. This means that the effect of a park on the value of a property is relatively small. Thus, people may pay a premium to live next to a park, but this premium is only a small percentage of the purchase price. To determine whether this is true, this analysis will look at more recent papers. This is where the hedonic pricing model comes into play. By applying this model, the premium people are willing to pay to live close to a park or forest can be determined. Tyrväinen and Miettinen (2000) study aims on measuring the benefits of urban forests in monetary terms. Forest view and proximity to a forested park both seem to have a positive effect on house prices. Especially when a house is located within walking distance of a forested park the price effect seems to be strong. So leads an increase in distance of one kilometre to the nearest forest to a 5,9% decrease in property value. And dwellings with forest view are 4.9% more expensive than other dwellings with no forest view. However, earlier research of (Tyrväinen & Väänänen, 1998) states that larger recreational areas do not have a positive impact on the prices on houses. Worth mentioning is that both these studies use a data sample based on either towns in Finland (Salo and Joensuu). The difference in results is explained by different supplies of recreational areas in both cities. In Salo forested parks were scarce, where in Joensuu supply of forested parks was abundant (Tyrvainen & Miettinen, 2000).

An interesting phenomenon in the literature about parks and property values is ‘proximate principle’. In principle, it means that the value of property rises because of proximity to a park. This increase results in higher taxes paid by the homeowners, the increase in taxes pay the annual debt that was needed to acquire and develop the park. So “‘proximate

principle' is the process of capitalization of park land into the value of nearby properties" (Crompton, 2001).

Crompton (2001) studied if this proximate principle is true, based on the existing literature. He found that 20 of the 25 papers, which he studied, were supportive with empirical evidence. This means that parks increase the value of nearby properties. Also (Jim & Chen, 2006) found this result in their study, focussed on the Chinese real estate market. The view of green space and proximity to water bodies influence the residential price as well, but proximity to a wooded area which cannot be used by residents seems to have no contribution to the price of houses. So green-space usability is more attractive than just the appearance of green space. Later study of Jim and Chen (2010) focusses on what are residents, which live in an apartment, willing to pay for a neighbourhood park or different kind of views. It turns out that neighbourhood parks are valued highly by Hong Kong residents, with an increase in price of 14,93% if there is a neighbourhood park available. The availability of neighbourhood parks is even seen as the third most important attribute of an apartment. Park view and harbour view have a positive effect on the sales price of an unit, 1.95% and 5,1% respectively. Mountain view seems to have no effect and street view has a negative effect on the sale price. The reason why neighbourhood parks are so highly valued by the residents is because they provide public venues that are accessible for all social groups and foster social interaction. But they also offer environmental functions, such as air movement and solar access. (Jim & Chen, 2010).

Community gardens can be seen as recreational areas. The value of community gardens is that it stabilizes and improves their host neighbourhood. But gardens also provide social networks, bring fresh fruits and vegetables and provide recreation and exercise for the residents (Voicu & Been, 2008). Voicu and Been's study shows that community gardens, as well as parks, have a positive effect on the value of surrounding properties. Within five years' of the gardening's opening, the average value of surrounding properties rise with 9,4%. This means that investments in community gardens benefit the neighbourhood but also the city, because the rise in value means an increase in tax revenue on properties.

In the previous chapter, this paper looked at whether crime has a negative effect on property values. It turned out that this is the case for most studies, but what about the interrelationship between house prices, crime and parks? Parks are seen as a positive amenity for the neighbourhood. So if there is a park where crime happens, what will the effect than be on surrounding properties? (Troy & Grove, 2008) studied whether these three variables are related to each other. Their expectation is that high-crime parks have a negative effect on the neighbourhood, where as low-crime parks have positive effect. From their research follows

that these expectations are right. Parks with relatively low crime rates have a positive effect on housing prices, middle crime rates have an ambiguous effect and high crime rates have a negative effect. Noticeable fact is that park crime rates are not correlated with the size of parks or their configuration.

Open spaces and property values

Open spaces can be lots of things, such as public parks, natural areas and golf courses. In the previous part of this chapter, the focus was only on parks. In this part the focus will be on open spaces, which is a bit more general than parks. The preservation of open space has become an important policy topic. In the last decades, forestry and green spaces have become victim of the increasing demand for residential and commercial land use (Geoghegan, The value of open spaces in residential land use, 2002). In order to preserve the open spaces, many studies researched whether open spaces bring benefits to the society. One of the ways could be that open space positively affects the surrounding house prices. So found Geoghegan (2002) that if open space is 'permanent', the value of surrounding houses increases over three times as much as an equivalent amount of 'developable' open space. Policies could implement this argument to preserve open space.

Luttik (2000) studied the impact of ecological factors on housing prices. Her study is based on the Netherlands, which is a valuable addition because most studies focus on the US or UK. The results show that the view on open space has a premium of 6% and 12%. The difference between these numbers is because of the different cases Luttik studied. She studied eight cases in total, but for the view of open space only two were studied. An noticeable result is that in Luttik's study the effect of 'park view' on housing prices is insignificant for six of the eight cases. And for 'the vicinity to a park' only one out of four is significant. These results do not correspond with the results which were discussed in the previous part of this chapter, namely that these factors do have a significant effect on the housing prices.

Bolitzer and Netusil (2000) divided open space into four categories, namely public park, private park, golf course and cemetery. All four categories have a positive effect on the price of houses, if these houses are located in close range of open space. However, the results are not significant for the categories private parks, golf course and cemetery. Only public parks seems to have a significant positive effect, which is in line with the results which were discussed previously. (Lutzenhiser & Netusil, 2001) did a similar research as that of (Bolitzer & Netusil, 2000). But instead of four categories, they examined five categories of open space which are slightly different. Urban park, natural area park, specialty park/facility, golf course and cemetery all seem to have a positive significant effect on a home's sale price. This effect

varies for categories of open space and with the distance to an open space. Natural area parks have the largest effect on house prices and also the biggest reach of all categories. Interesting to see is that in Lutzenhiser and Netusil's study, golf course and cemetery seem to have a positive significant effect, whereas in Bolitzer and Netusil's study none of these categories were significant. Irwin (2002) found corresponding results with that of Lutzenhiser and Netusil (2001). Namely, open space significantly influences the values of houses and different types of open space have differing effects. Preserved open space has a significantly greater spill over effect than the effects of developable farmland and forests. Open space is most valued for providing an absence of development instead of providing open space amenities (Irwin, 2002).

Anderson and West (2006) studied different types of open space related to house prices. Again, these types of open space are very similar of that of previous discussed studies. However, the results of their study are not similar. According to Anderson and West's results, the effect of open space on a house's price depends on a home's location and neighbourhood characteristics. Households who live in a dense neighbourhood value open space a lot more in comparison to households in suburban neighbourhoods. Their second conclusion is that existing literature may be biased because of the unobserved neighbourhood characteristics, if uncontrolled for.

What most studies seem to have in common is that the results mostly are case study specific. Most results show a positive effect, however the values tend to vary widely when the size of the area, the proximity of the open space to residences, the type of open space and method of analysis differs (McConnell & Walls, 2005). More studies are needed which have a broader applicability. Although, from all the results discussed above it can be said that recreational factors do have a positive effect on house prices. Especially parks are valued high by households. Note that most papers are written in the period 2000-2010, which is around the same period as neighbourhood characteristics.

Accessibility to retail and employment

The last chapter which will be discussed is about the effect of accessibility and availability towards retail and work on the price of houses. Are people willing to pay extra to live in proximity of their work or nearby a grocery store for example? It is imaginable that when you live in a close distance to work, you will experience less inconvenience of congestion. People can take the bike or even walk to their work. The same goes for retail, if you live close to certain shops it can be convenient. But shops can also bring a nice atmosphere into the neighbourhood or an unpleasant atmosphere.

Retail and the value of houses

Retail is a wide concept, it is a collective term for all businesses that provide goods and services to the consumer. Some examples are restaurants, grocery stores and clothing shops. The aim of this chapter is to analysis the existing literature which studies the effect of retail on housing prices.

Since the 1960s, throughout the US it was common to isolate employment, shopping and services from residential housing. This resulted into neighbourhoods which were all located a substantial distance from jobs and services, so called urban sprawl. Negative effects of such zoning ordinances were excessive commuting times, traffic congestion, air pollution and loss of open space and habitat, just to name a few (Song & Knaap, 2004). Eventually, this led to new movements such as the 'Congress of New Urbanism' and advocates of 'Smart growth'. Both these movements support the idea of mixed land uses. Song and Knaap (2004) researched both the effects of new urbanism and that of mixed land uses on residential prices.

In 1993 a group of architects founded the 'Congress of New Urbanism' (CNU), which is dedicated to "create buildings, neighbourhoods and regions that provide a high quality of life for all residents, while protecting the natural environment" (Song & Knaap, New Urbanism and housing values: a disaggregate assessment, 2003). New urbanism states that "unmixed homogenous land use results in greater distances between houses and retail and other non-residential destinations. This leads to an increased usage of automobiles and discouraging walking and cycling." (Matthews & Turnbull, 2007)

Matthews and Turnbull (2007) studied whether the street layout, retail proximity and house values have any effect on each other. Proximity to retail sites, in neighbourhoods with traditional street layouts, which are pedestrian oriented, has a significant effect on house prices. In neighbourhoods which are automobile oriented, this effect seems to be non-existent generally. The effect of proximity to retail sites on house prices is positive when the neighbourhood streets are highly connected. The positive effects, convenient access to retail, outweighs the negative externalities, such as congestion and noise, in these neighbourhoods. In neighbourhoods which do not have highly connected streets, the negative externalities outweigh the positive effects. This leads to a negative effect on house prices (Matthews & Turnbull, 2007).

Song and Knaap (2003) studied whether this new urbanism has any virtues. By disaggregating the components of New urbanism, Song and Knaap try to see if homeowners are willing to pay for these features. It turns out that new urbanist neighbourhoods differ from

traditional neighbourhoods and that people are willing to pay for that. So are residents willing to pay a premium for better walking accessibility to commercial uses and pay extra to live in neighbourhoods with more commercial, multifamily and public uses (Song & Knaap, New Urbanism and housing values: a disaggregate assessment, 2003). Note that commercial uses can be seen as the same as the earlier discussed concept 'retail'. In 2004, Song and Knaap studied whether mixed land use has any influence on the value of houses. Mixed land use is a principle which means that 'neighbourhoods should contain a mix of shops, offices, apartments and homes'. From their research follows that mixed land use has a positive effect on residential values. Relevant results for this part of the analysis is that housing prices increase when located closer to neighbourhood-scale commercial uses. Also when a neighbourhood contains relatively more commercial uses, the housing prices increase in that neighbourhood. Thus, a neighbourhood store has a positive effect on the value of property and this effect is even stronger when it is in walking distance. Note that when the commercial development becomes more intense and larger, the more it could have negative effects on the surrounding housing prices (Song & Knaap, 2004).

(Geoghegan, Wainger, & Bockstael, 1997) found that diversity and fragmentation of land uses are valued positively in the highly developed suburbs of Washington DC. Such diversity and fragmentation of land use creates amenities which are valued positively by residents. For example walkable access to small shopping areas and schools. This result is in line with what Song and Knaap (2004) stated about the positive effect of walking distance to amenities. As already discussed by Song and Knaap (2004), mixed land uses seems to have a positive effect on the value of property. In 1981, Cao and Cory studied the same topic, namely whether mixed land used and land use externalities had any effect on the house prices. It follows that over low ranges, the value of houses rise when the amount of industrial, commercial and public land use is increased in a neighbourhood. Thus, the results support the idea that mixed land use should be implemented more, instead of the regional separation of activities (Cao & Cory, 1982).

(Li & Brown, 1980) researched whether micro-neighbourhood factors influence housing values. The micro-neighbourhood factors are divided into three types, namely aesthetic attributes, pollution levels and proximity. They expect that bias will occur in the estimates when these factors are not accounted for in the model. For this chapter only the results of proximity will be analysed. From Li and Brown's results follow that proximity to commercial establishments provides benefits and disadvantages. Housing prices seem to rise due to accessibility but fall due to problems such as congestion and pollution.

(Grether & Mieszkowski, 1980) used in their sample different kind of zones, such as highway, commercial strip, point commercial and garden apartments. By doing this, they can measure the effect of zoning and non-residential use of land on the price of housing. Their results are that non-residential land use has no systematic effect on house prices. This means that the houses located near commercial strip zones or point commercial zones did not experience a substantial increase in value. This result is surprising when compared with the results of Song and Knaap (2003 & 2004) and Geoghegan et al. (1997).

The next three papers all studied the effect of shopping centres on the value of residential properties. (Sirpal, 1994) found that the size of a shopping centre has a substantial influence on the surrounding property values. So bigger shopping centres seem to have a greater effect than smaller shopping centres on house prices. This research was based in Gainsville, Florida. (Rosiers, Lagana, Thériault, & Beaudoin, 1996) tried to reproduce Sirpal's research in Canadian context, namely the Quebec region. Where Sirpal (1994) only found evidence for the positive effect of size of shopping centres, Rosiers et al. (1996) states that the size of shopping centres as well as the distance to shopping centres has a positive effect on the house prices. In a different research, (Rosiers, Thériault, & Villeneuve, 2000) found the same results as their earlier research. They studied the largest commercial mall in East Canada. Such massive regional activity nodes attracts a lot of households, and this higher demand results in higher prices and higher rents for residential locations that are within close proximity of it.

Employment and the value of houses

In this chapter, the effect of employment on house prices will be discussed. Work is an important part of everybody's life, because work results in money which people need to consume goods. Most of the times, work is not just around the corner for people. People need to travel to their work, which can differ from 20 kilometres to perhaps 70 kilometres. This results in negative externalities, such as congestion and pollution. So what if people could live closer to their work? What are they willing to pay for that or are they even willing to pay?

Traditional urban economics states that accessibility to employment is a major factor in determining location choices and house values. People seem to sort themselves at residential locations which are convenient to work locations (Voith, 1991). One of the first in researching the relationship between work and house prices is Kain (1962). Kain (1962) studied the residential distributions of six rings, each ring has a different distance towards the central business district. He found that prices tend to decrease when the distance towards the central business district increases. The rate of decrease is greatest near the centre and

least in the periphery. Note that these findings do not say much whether better proximity to work increases house prices. But it does give an indication that houses in the centre of the city are more expensive and that most of the jobs are located in the centre. Another study which was written relatively early, is that of Brigham (1965). He found that accessibility to employment is positively related to house prices. However, this relationship can be disturbed according to Brigham by the existence of satellite employment and shopping centres located outside the CBD. (Visser, van Dam, & Hooimeijer, 2008) found the same result as that of (Kain, 1962), which is that house price levels decrease from the core to the periphery. They found also that the access to jobs has a positive effect on the value of a property. This is in line with earlier studies of (Miller, 1982) and (Kauko, 2003), which state that the accessibility to jobs is a dominant location factor, and therefore, has a positive effect on the price of houses. In addition, Song and Knaap (2004) found that neighbourhoods which have relatively more service jobs, experience higher house prices. Voith's (1991) study found that commuting times are evenly convenient in the Philadelphia metropolitan area, so residential locations all have around the same travel time to their employment location. This makes it hard to link house prices and better accessibility to work. Second finding is that houses located near the commuter rail systems experience a premium of 6% on their price. This is in line with the findings of the earlier discussed chapter '*stations in the neighbourhood*'. In addition, Follain and Jimenez (1985) found that the willingness to pay for an improvement of accessibility to work was not a large portion of household's income. This is in contrast to the earlier discussed results.

To summarize the last factor, it can be said that accessibility to retail and work both have a positive effect on house prices. Especially when retail opportunities are in walking distance, the effect on house prices is substantial. Also bigger shopping malls are valued more positively in comparison to smaller malls. And better accessibility to work is found to have a positive effect in most papers. As last, it is hard to state a specific time frame where in most studies have been written. It is varying from 1980 to 2010, which is a wide period. Another thing worth noticing is that especially the literature on 'accessibility to work and house prices' is underrepresented in the existing literature compared to the other factors. Not many studies seem to fully dedicate a whole study on the relationship between the two variables.

IV. Conclusion

At the beginning of this paper we addressed the research question which is 'How did the literature about hedonic pricing models on housing develop in the last decades?' From this followed four sub questions which were all related to a specific factor. In this conclusion all questions shall be answered, which leads to one conclusive answer. The analysis has shown that the first factor, *housing attributes*, has a substantial positive effect on the value of properties. Housing attributes seem to be the basis of the transaction price of a house according to findings of Cobb (1984). For the second factor, *neighbourhood characteristics*, the effect is found positive for schools and transport in the neighbourhood. Especially the quality of a school is a big influencer in determining the location to live for households. Crime is found to have a negative effect on house prices, which is to be expected. But there is a difference in effect for different sort of crimes. The third factor, *recreational factors*, has a positive effect on house prices. Households positively value a park or open space in the neighbourhood which means that the 'proximate principle' does work. The last factor, *accessibility to retail and work*, is as well as the other factors positively related towards house prices. But this effect on house price is relatively small when compared to the factors *housing attributes, neighbourhood characteristics* (especially school quality) and *recreational factors*. Now that we conclude what the relationship is of each factor with house prices, this paper will now answer the main question. At the end of each factor in the analysis, this paper already shortly mentioned the period in which the studies were written. It seems that the factor *housing attributes* is mostly studied in the period 1970-1985, which was also expected in the introduction of this paper. Latter research seems to focus more on location specific factors, such as the neighbourhood in which a house is located. This results in a period of 1990-2010, which is corresponding with the factor *recreational factors*. The reason for this is because *recreational factors* are location specific factors, as well as *neighbourhood characteristics*. However, the factor *stations* does not fully correspond with this time period. Landis et al. (1994) overview has shown that before the year 1994 many papers have been written concerning the subject *stations* and house prices. So for the factor *stations* there is no specific time period. The same goes for the factor *accessibility to retail and work*. It is hard to say a specific period in which most papers have been written. The period is broadly taken 1980-2010, which is a wide time frame. So for '*accessibility to retail and work*' and 'stations' we conclude that both can be seen as an independent vein in the overall literature, not bound to a specific time period. So as conclusion, in the existing literature there exists two periods. In the first period from 1970-1985 the emphasize of the studies was on *housing attributes*. For the second period the emphasize was more on location specific factors, namely

neighbourhood characteristics and *recreational factors*. This result is in line with what Cheshire and Sheppard stated in 1995.

Limitations and recommendations

First of this paper is aware of the fact that it does not contain every study which addresses the subject of hedonic pricing models. To include every study would make the overview obscure and hardly possible to do. This paper chose to include only the papers which were relevant and important to the debate about hedonic pricing model. This means that some new papers, for example about *crime in the neighbourhood*, are not included in the analysis because they were not important and relevant enough for the overview. However, it is possible that this paper has missed some important studies which should have been included in the overview. This would mean that the paper is incomplete. This paper regards the chances low that it has missed important papers, but the chance is always present. Regarding the timeline, if there are some important papers missing this can result in a timeline which is not explanatory enough. However, the analysis does show a clear line between housing attributes and location specific factors. Next to that, the analysis is sufficient enough to draw conclusions about the relationship between each factor and the price of houses.

Before writing the analysis, it came to the attention that the amount of studies on amateurish sport facilities and house prices is underrepresented. Amateurish sport facilities are local sports clubs which operate on an amateurish level. In the Netherlands, such sort of clubs are well represented for many kinds of sports, such as football and tennis. These sports clubs can be sorted under the factors *neighbourhood characteristic* and *recreational factor*. The existing literature is mostly focussed on the impact of a new stadium of a professional sports club on house prices. Some examples are (Tu, 2005), (Ahlfeldt & Maennig, 2010) and (Feng & Humphreys, 2012). However, the impact of an amateurish neighbourhood sports club on house prices has not been researched yet. New research can try to measure the impact of these amateurish sports clubs on house prices.

Another interesting path for new research is using ‘big data’ and new measurements, which can improve urban research and policymaking. (Glaeser, Kominers, Luca, & Naik, 2016) researched this topic and found that big data is an improvement in comprising to older techniques. Interesting for this paper is their finding about valuation surveys, which state the willingness to pay, for an amenity for example, of a specific individual. Glaeser et al. (2016) state that surveys should use different questions instead of asking ‘how much is Central park worth for you?’. Namely, these questions result in meaningless findings. Questions should more focus on aspects like trade-offs people need to make in everyday life, e.g. ‘Are you

willing to walk a block or two to travel down a street with shorter buildings?' (Glaeser, Kominers, Luca, & Naik, 2016). New research could implement these kind of surveys and study whether this will result in different findings concerning the topic house prices and amenities.

As last, this paper wants to address a new topic which may be interesting for further research. The topic concerns the trend of new technological companies which reshape the existing structure of some markets. Two well-known examples are Uber and Airbnb, which are both two companies which own no capital stock of respectively either taxis or real estate. Especially Airbnb is an interesting concept regarding the real estate market. For example, are house prices in a neighbourhood influenced if someone in that neighbourhood rents out his place on Airbnb? (Sheppard & Udell, 2016) researched this topic and expected Airbnb to have different kind of effects. On the one hand it is expected that Airbnb can result in negative externalities, such as upsetting quiet residential neighbourhoods, and providing black market hotels. This will result in depressed property values. On the other hand Airbnb results in a positive impact on house prices by the means of 'localized economic impact of guests', 'new income stream is available for residents' and 'increase in population demanding space driven by an increase in tourists and residents' (Sheppard & Udell, 2016). Sheppard and Udell (2016) found that property values rise with approximately 17.7% when localized Airbnb availability increases. This means that Airbnb is valued positively by residents and that the negative externalities of Airbnb seem to have no impact on house prices. However, much more research has to be done concerning this topic to check whether these findings are correct.

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