Proceedings of the Ninth International Space Syntax Symposium
Edited by Y O Kim, H T Park and K W Seo, Seoul: Sejong University, 2013

THE WILLINGNESS TO PAY FOR URBAN SUSTAINABILITY

Axel Heyman
KTH
e-mail : aheyman@kth.se

030

Alexander Ståhle
KTH
e-mail : alexander.stahle@arch.kth.se

Abstract

Quite recently certification systems for sustainable development of neighborhoods and communities, such as LEED ND and BREEAM for Communities, came to the market. These systems try to define urban sustainability through sets of criteria that in a variety of ways measure aspects in urban developments that have an influence on environmental, social and economical issues on a local level. This paper investigates the monetary values on these criteria, derived from property prices from apartments and single family houses in Copenhagen. In order to make proper estimates on the monetary values for certification criteria a hedonic price model is used. The model holds property prices from about 20 000 sales as dependent variable which is then correlated, through multiple regressions, with variables made out of the criteria through GIS-analyses. Translation from certification criteria into measurable variables is done with great consideration to contemporary urban theory. These variables are results from spatial analyses based on space syntax and other more standard spatial measures. The certification systems focuses on neighborhoods and communities, which is considered in the radiuses used for analyzing.

It turns out that 19 of the 30 measured criterions are statistically significant, but a majority shows negative correlations to price. It is also acknowledged that space syntax measures like integration and betweenness have an influence on prices. Local integration, used as a proxy for various urban qualities, is shown to have a negative impact on prices. On the contrary, betweenness on a global scale is valued as positive. From these results the conclusion is that people are generally not willing to pay for urban sustainability on the local scale, as defined in LEED and BREEAM certification systems. However, it is furthermore argued that this is a question of measure and definition. Previous studies, e.g. (Spacescape and Evidens 2011) and (Sjaastad et al. 2007), imply that many of the measures used in this study are positively correlated to price if done on a global scale. It is concluded that the urban sustainability should to be examined further before rejecting the hypothesis that it has positive monetary value.

Keywords: *sustainability, urban scale, willingness to pay, integration, betweenness.*

Theme: *Green Urbanism and Sustainable Developments*

Introduction

Sustainability as a mantra has been more or less an evident part in urban development for quite some time, and discussions on what it really means have been going on just as long. Today different certifications of sustainable urban development can be found, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (BRE Environmental Assessment Method). They all have a separate set of criteria for how a sustainable neighborhood should be developed. This gives decision makers, officials and developers an easy way of defining sustainability in new projects and perhaps somewhat distance themselves from the discussion on what sustainability really means.

A method to understand how people perceive sustainable neighborhoods is to value these criterions economically. The basic approach here is to measure criteria from the certification systems on individual addresses and its surroundings and correlate them with the price on the very same estate. In this way the willingness to pay for sustainability will measure how the public perceives the type of sustainable neighborhoods defined by the certification systems. More than that, it will be possible to get specific monetary values for every single criterion, ceteris paribus.

Purpose

This study aims at understanding not on what people think about how they want to spend their lives in a more sustainable way, but rather what they are willing to pay for urban sustainability. By knowing the willingness to pay for sustainability, the discourse on planning for sustainability in urban regions can be enriched with a measure for economic sustainability based on social and ecological ditto. It can then be calculated on the income-side of sustainable urban development.

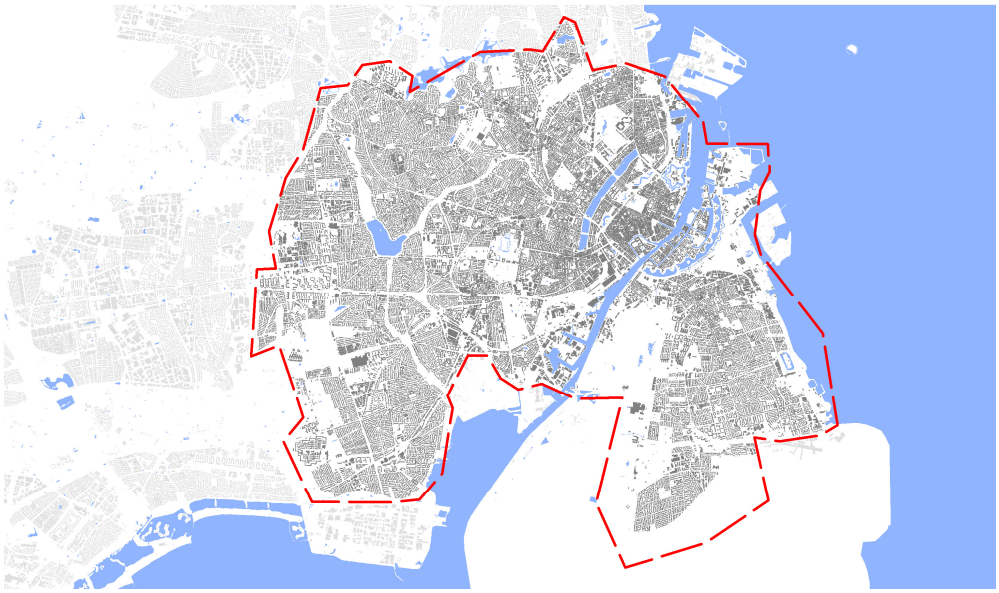

Figure 1: Area of investigation is the central parts of Copenhagen metropolitan area.

Methodological structure

In order to find out the willingness to pay for urban sustainability the general outline of this study is a property value study that describes the relation between sustainability, as defined by the two certification systems BREEAM for Communities and LEED Neighborhood Development, and property prices. That is, when looking at the sale prices on properties (both single family houses and apartments) and their relation to variables of sustainability, the willingness to pay for urban sustainability is revealed.

The sustainability measures are spatial measures in the sense of how the property relates to the geography or the spatial morphology in the city and is individual for every property. When economists do similar studies they tend to focus on the econometrics and less on the accuracy of spatial analyses, see for example (Kyrvobokov and Wilhelmsson 2007) and (Blomquist et al. 1988). From an urban planners perspective, however, the spatial analyses are of great importance, and consequently treated as the core issue in this study.

These two certification systems have a very broad approach to sustainability and the certification of it, which means a great number of criterions are set up to cover how a sustainable neighborhood is developed. This study has a clear physical urban planners focus and consequently only the criterions associated with the physical urban environment are taken into account.

The hedonic model

The statistical method that finally estimates the willingness to pay basically is a multiple regression model with property prices as dependent variable and environmental variables as independent. For the model to work it can only handle one market at a time which is why single-family houses and the apartments are treated as separate markets due to moderate transactions in between. In hedonic price modeling it is also important that the property prices has a stability over time, which has been an issue since price data is collected over a number of years during which Copenhagen prices have been fluctuating.

In this study the sustainability of neighborhoods is examined but more variables are controlled for in order to build up an accurate regression model. In principle, a regression model consists of environmental variables that explain the context of the property, the place, space and area specific characteristics.

Theoretical background

The measurement of sustainable development is mainly done with indicators on the macro scale today, see for example: (Parris and Kates 2003) and (Atkinson et al. 1997), which is hard to appreciate on a neighborhood designing level. To be able to conduct this kind of study the measurements must be much more precise and correspond well to urban form if the sustainability on a property level on the basis of a neighborhood is to be captured.

The criterions of the certification systems have a structure that is not able to fit in a regression model, which means that they have to be interpreted. The main theoretical background is presented below.

Sustainable transportation and urban form

To capture the criterions for sustainable travels it is important to find accurate variables specifically for walking and bicycling respectively. It is commonly suggested, when measuring how people move in urban areas in terms of spatial influence, that metric distance is the main factor to predict navigation among both pedestrian and vehicular movements (Hillier and Iida,

2005). However, much research shows that although metric distance indeed is a big part of the spatial influence it is not the only factor.

Pedestrian movements

Regarding general planning measures, the factors that affect walking the most are intersection density, jobs-housing balance and distance to stores (Ewing and Cervero 2010). It is also found that population density and commercial floor area ratio have a promoting effect towards walking. This is also confirmed by (Saelens et al. 2003) who states that population density and mixed land-use has significant effects on walking. On the lower scale, or the design level, there are three main characters that make a street attract non-residents to walk through it (Jacobs 1961). Firstly, it should be distinctive borders between private space and public space. Secondly, buildings should face the street in order to support residents to be able to watch the street as an issue of safety for those that are using it. Thirdly, the sidewalks should attract the residents to use it.

Models that are used to predict pedestrian flows are based on vehicular ditto and take the urban composition into account only as trip-generation potential (Hillier et al. 1993). Not only is the built environment mainly seen as a trip-generation potential, pedestrian movements are too frequently assumed to be driven by attractions in the city. According to (Hillier et al. 1993) the relationship is the opposite: pedestrian movements, which in turn are driven by urban composition, drive attractions in the city. They do not argue that it is the configurations of urban spaces that at all time influence the pedestrian movements the most, but in the evolution of urban pattern it is the main factor for attraction distribution after which pedestrian movements will follow. The movements driven by this are called the "natural movement". To be able to analyze this, the urban composition has to be measured in a quantitative way, which can be done through "axial maps" where, simplified, lines represents urban spaces which always connects to another and forms a continuous network (Hillier 1996). It is also possible to measure integration between these lines in order to capture the probability of natural movements. That is, if an axial line is well connected to other axial lines it is considered well integrated in the system. This can be done on different scales in the city, from local to global. It is the basics of space syntax and has been found to correlate very well with actual pedestrian flows. This method has been questioned due to the fact that axial maps end somewhere and leave loose ends that will impact the integration around the edges and, according to (Ratti 2004), perhaps the whole system, if the integration is analyzed on a large scale.

With the axial map one can measure axial steps, the number of changes of axial lines, instead of regular metrics and find a distance measure that takes cognitive aspects into consideration going from point A to point B. That is, while the integration measure of the axial maps measures urban space alone, the concept has been developed into including attractions and the cognitive distances between them called place syntax (Marcus 2007). He states:

> *Place syntax analysis can […] be said to deal with specific spatial accessibility, such as accessibility to different attractions, while integration analysis deals with general spatial accessibility, that is, accessibility to urban space in itself.*

Considering all factors that influence pedestrian movements it can generally be said that people are willing to walk about 400 to 500 meters for simpler errands or attractions (Gehl 2010). For other errands or attractions, e.g. work trips, people are willing to walk about three kilometers: the larger the cities the longer the distance people are willing to walk (Boverket 2007).

Bicycle movements

One of the most widely used bicycle analyzing models is BCI (Bicycle Compatibility Index). This tries to weight different physical attributes (e.g. bike lane width or motorized traffic volume) that have been shown to influence cyclist's perceptions of good bicycle paths (Harkey et al. 1998). Another well-known analysis tool for bicycling is BLOS (Bicycle Level of Service). This too is a form of index focusing on physical attributes that may correlate to the use of bicycle paths,

measured as grading of bicycling paths from actual cyclists (Landis et al. 1997). Through these kinds of models it has been proven that separate or striped bike lanes have a significant impact on the share of bicyclists in cities on the aggregated level (percent of length of lanes or stripes in the total network in a city) (Dill and Carr 2007). In addition to that, general traffic calming interventions are important (Pucher and Buehler 2008). However, (McCahill and Garrick 2008) points out that although these models are applicable to their intents they have shortcomings. The fundament of both models are to measure the quality of physical attributes on bicycle paths on segments which makes the models limited to a very small scale, not taking the whole network into consideration. In practice this would not be the most effective way for planners to upgrade the system since individual segments necessarily do not have a major effect on the network as a whole. Instead, seeing weak segments from a network point of view would be ideal when planning for maintenance or development of the bicycle network. As a solution they present a space syntax choice analysis which they have found predicts bicycle flows accurately down to segment level but in the context of the whole network. For obvious reasons this method would be highly operational from a planner's perspective because of its accuracy in predicting flows, but it might also be a functional tool for origin – destination studies where motorized traffic traditionally gets higher precedence (ibid).

The weakness of the more commonly used models, as well as the results from them, is pointed out also by (Raford et al. 2005) who found that when looking at the network scale, contrary to segment scale, angular depth explains the variations in number of cyclists very well. Through a regression model on the analysis of work trips by bike in central London, angular depth was proved to explain the variation approximately five times better than whether or not the route had bike lanes. Angular depth had the same probability as simple metric distance on segment scale in predicting cyclist flow volumes, whilst it correlated to almost 70 percent on the network scale. It is suggested that bicycle planning should originate from an analysis that considers this more cognitive route choice and at the same time manages single preferences. More precisely, there should be two steps where the first is an angular segment analysis from all points to all points and the second step is to add route choices based on physical shape, such as bike lanes (ibid).

Social sustainability and urban form

The built environment has to comprehend a certain density to increase the diversity of uses and people according to (Jacobs 1961). She also states that without the help of residential density there will be no or little services in the area. Density, she argues, can be looked at as a way of creating vitality and variations in a small area. Furthermore she emphasizes the mix of workplaces and housing on small scales like streets, or even blocks, in order to increase urban life and spread it on as many hours of the day as possible, which have an influence on the feeling of safety.

Human, social and spatial capital

Higher density of and accessibility to so called third places, cafés and bars etc., will increase interaction between people in a way that makes neighborhoods build social capital (Farr 2008). Though social capital has an effect on social sustainability within neighborhoods and communities it also has an effect on corporate revenue through increased productivity and technological advancement within clusters of industries (Porter 1998). While (Porter 1998) argues that it is within industries that most of the spillover effects occurs, (Jacobs 1969) argues that these spillover effects are more significant in between different industries in a dense and mixed city, which is their greatest advantage. Looking at cities as a whole it is evident that wages are higher in cities than in rural areas, much due to higher density (Glaeser and Mare 2001). Explanations to this are many and a standard answer is that density cuts transport costs and makes it easier to reach consumers (Krugman 1991). Related to this is human capital, which is a fundamental part in explaining density's influence on corporate productivity, since a diverse and large accumulation of workers makes it easier to match workers with jobs (Glaeser and Mare 2001). Considering these theories, it becomes evident that from a spatial point of view spillover

effects do not only occur at random, but is dependent of how space itself is configured. How and to what degree meetings occur is a result of the relation between the spatial structure and movement (Hillier 1996). The accessibility dimension of this can be translated into what (Marcus 2007) calls the spatial capital: the capacity of urban space to encourage urban life. No matter how skilled labor force there is, they will not be effective without effective urban spaces.

Closely related to this are employment rates, which are usually explained from a social perspective such as ethnicity or income class of neighborhood. However, John F. Kain came up with the spatial mismatch hypothesis (SMH), which states that the spatial context has an impact on the possibility to obtain an employment and the fluctuations in income level in the geography (Goblillon et al. 1973). This means that the further away from workplaces the less probable it is to get employed.

Since the social attributes in a city are hard for urban planners to have a direct impact on, a spatial variable as a proxy could fit the purposes for this thesis better. In a study made by (Zenou et al. 2006) in a Swedish context it is shown that there is a significant correlation between the accessibility of workplaces and employment.

Accessibility and use of green spaces
Measuring of green spaces is usually done through either accessibility to a certain minimum size green space within a set radius or area of green space per person within an area (Ståhle 2008). These methods promote sparsely planned urban structures in order to have a greater access to open green spaces. However, when taking urban spatial composition into consideration in the green space analyses it becomes evident that it is more a question of quality of planning integration-wise than of quantitative planning of green spaces (ibid.).

Execution and data

The structure of the measuring of variables is origins (sale points), networks (pedestrian/bike, car and axial) and destinations (everything from urban activities to mixture of rental apartments). Within this structure closeness and accessibility are measured, where closeness is the measure of how close the nearest attraction is from the origin. The idea of measuring accessibility is to get unique values for every sold property that derives from the spatial configuration rather than aggregated values for areas, which would not acquire the same accuracy in the model due to loss of variance (Reynolds 1998). Fetching aggregated values, e.g. the number of workplaces from administrative areas, will not tell the actual number of available workplaces since it is limited to administrative borders. This phenomenon is called the modifiable area unit problem (MAUP) and is common in these types of studies, either because of lack of accurate software or appropriate data. Even though the problem partly can be solved statistically it will take some effort (Reynolds 1998).

All variables used are constructed to fit the purpose of explaining the consumers view on attributes, in order to get an accurate model, and the purpose of making this a useful tool for urban planners and academia. For urban planners preferable distances are “real” distances, such as walking, biking or driving distance, since it is the actual distance people will have to travel. In that perspective straight line distance is not as relevant as it is not network based and consequently does not say anything about how movement occurs in the city. Walking and road distance is perhaps the most intuitive distance type as it is easy to relate to daily travel. The more complex axial distance is based on the intuition of pedestrians and cyclists and derives from space syntax theory. It measures changes of directions and is a more cognitive distance based on the axial map, which represents the orientation capacity of the urban space.

GIS modelling

Translation of certification criteria into variables

A total of 30 criterions have been identified as measurable and from them about 50 different spatial analyses have been made to try to fit the aim. The structure of translation is quite simple: first the aim and intent of each of the criterion are investigated together with the predefined measures in the certification systems. The aim or intent is then spatially measured in a way that corresponds to contemporary theory. In total 21 variables that explained the 30 selected sustainability criterions were added to the model. Some variables explain more than one criterion and some criteria are explained by several variables.

Since the study is within the research field of planning, it is less relevant to measure factors that urban planners cannot influence. For example socioeconomic mixture is not only measured through actual income and education level as a control variable, but also as the mixture of rental and asset apartments which is possible to plan for.

Additional variable
In order to get as exact result as possible it is important to try to explain as much as possible of the price difference to get an accurate model. Since it is not likely that the criterion variables will explain all the price difference, more variables are controlled for in the model.

Results and analysis

In total 19 out of the 30 measured sustainability criterions have been proven significant in the model, which means that people value them when they are buying apartments or houses. Some are negatively and some are positively valued and they also vary in how big the effect is. The results are divided between the two different markets for apartments and single family houses and are presented in Figure 2.

For apartments it is found that people value 19 of the criterions for sustainability for which 15 different GIS-analyses was made to support these. It turns out that 14 of them are valued as negative and five as positive. Among single family houses seven of all sustainability criterions are shown to influence how people valued the property. To describe them six analyses was made and four of them have a positive effect on the price and the other two have a negative effect. The parameter estimate on both walking distance to water and city center are negative since a shorter distance will result in a higher price, and so these two are valued as positive also in Copenhagen. In the same category comes socio-economic index, which is undisputedly positive; to live in a prosperous neighborhood is highly valued.

Interestingly enough it seems as though “location and capacity” and “availability and frequency” is positive for single family houses but negative for apartments. Furthermore, “smart location” is valued as positive among apartments whilst “compact development” is valued negative but among houses “compact development” is positively valued and “smart location” is not significant. Two things that are positively valued in both markets is “employment” and “design speeds for safe pedestrian and bicycle travel”.

	Parameter estimate	Pr > F
Walking distance to city center	-0,9	0,0001
Sold 2007	4400	0,0001
Socio-economic index	173	0,0001
Walking distance to water	-1,7	0,0001
Sold 2009	-1868	0,0001
Levels in building	423	0,0001
Mixed income diverse communities	-15	0,0001
Sold 2008	1359	0,0001
Street network & Walkable streets	-17	0,0001
Employment	0,7	0,0001
Ground level use and parking	-7,7	0,0001
Design speeds for safe pedestrian and bicycle travel	48	0,0001
Housing and jobs proximity	-16	0,0001
Facades and entrances 1/2	-5,4	0,0001
Form of development & Form of development – pedestrian & Inclusive design	-400	0,0001
Flat roof	-1460	0,0001
Bathrooms	1244	0,0001
Location and capacity & Availability and frequency	-154	0,0001
Brick house	954	0,0001
Compact development within and outside transit corridors	-0,001	0,0001
Smart location	0,004	0,0001
Mixed use neighborhood center	-0,06	0,0001
Area	-7,56	0,0001
Wildlife corridors	-1,4	0,0001
Thoroughly renovated	47	0,0001
Facades and entrances 2/2	-8,3	0,0008
Network & Bicycle network and storage	18	0,0078
Model R-square = 0.46		

Figure 2: Resulting table of variables that are statistically significant among asset apartments. The parameter estimate shows the change in mean price when one unit is changed in the corresponding variable.

	Parameter estimate	Pr >F
Walking distance to city center	-0,9	0,0001
Area	-79	0,0001
Sold 2007	3592	0,0001
Socio-economic index	202	0,0001
Basement	1978	0,0001
Employment	4,4	0,0001
Sold 2009	-2396	0,0001
Brick house	1588	0,0001
Design speeds for safe pedestrian and bicycle travel	60	0,0001
Sold 2008	1555	0,0001
Mixed use neighborhood center	-3,8	0,0001
Tile roof	1274	0,0001
Walking distance to water	-0,9	0,0001
Toilet	541	0,0001
Location and capacity & Availability and frequency	501	0,0001
Compact development within and outside transit corridors	0,2	0,0001
Facades and entrances	-6	0,0001
Walking distance to transit	0,8	0,0040
Loft area	-8,8	0,0053
Model R-square = 0.43		

Figure 3: Variables from the model that did not exceed the 0,1% level of significance.

Analysis of the results

Some of the control variables that was expected to correlate did not turn out as significant: accessibility to park, accessibility to street network, closeness to public transport, block shape and accessibility to urban services.

Street network and accessibility to urban services

It is unattractive to be located on a main street and attractive to be located in a blind alley. This may not come as a surprise since there are obvious negative effects involved with main streets, such as noise, crime and heavy traffic. It can be speculated that closeness to a main street but with a minimum distance added is preferable. The same phenomena can be seen among urban services, which have a negative effect on prices on the local scale in Copenhagen. Again, this might capture the fact that people want peace and quiet around the corner but access to restaurants and shops on a five minute walk.

Sustainable transportation in Copenhagen

A surprising result from this study is the negative effect of public transit on apartment prices. Other studies examining public transport, e.g. (McDonald and Osuji 1995), Baldwin (Hess and Almeida 2007) and (Duncan 2011) show an overall positive effect. However, part of the explanation to this might be that Copenhagen's metro is brand new (opened in 2007). Because of this recent opening of the metro one can speculate that the economic effect has not yet come. However, as (McDonald and Osuji 1995) found; property prices in Chicago went up well before opening of the light rail, this may not be the case. Instead the answer might lay in that Copenhagen has a great share of bicycle travels compared to public transit use, which could

make the transit less attractive. To further strengthen this argument, the only transportation that was measured for apartments that turns out as significant and positively correlated to prices is bicycle travel. (Baldwin Hess and Almeida 2007) concluded in their study that the effects on prices varies in accordance to what income level that surrounds the stations: higher income area means positive effect and vice versa. This is not analysed in the present study, since the variable only determines weather or not a property has access to a rail station within 500 meters walking distance. However, the income level could definitely have an effect in Copenhagen as well.

The further from the city center you get the sparser it becomes, more single family houses. With the increasing distance the number of people willing to bike will decrease. This argument could explain the fact that access to transit is positively correlated among single family houses as opposed to apartments but bicycle friendliness is not even significant. The mean distance from single family houses to workplaces or urban services might influence the choice of transit over bicycle

Implications and discussion on methodology

The results shows that much of the sustainability criteria actually is positively valued from owners of apartment and single family houses, more than was expected. However, the majority was valued negatively which also was unexpected since it has been indicated in other studies that urban qualities similar to the ones defined in these certification systems criteria have had a positive impact on property prices. Looking at the results from this study it becomes evident that people do not want some things in their neighborhoods but comparing with other studies (Spacescape and Evidens 2011) & (Sjaastad et al. 2007) it seems as though they at the same time want the same things in their city. This finding makes it clear that a city can be divided into at least two different scales in which different attributes are valued differently by the residents.

Implications in urban planning

The two scales are very important input in the way cities should be planned. This study shows that planner cannot neglect the fact that neighborhoods are both single entities and integrated parts of a whole city or metropolitan area. It cannot be a question of planning for new neighborhoods as just separated additions to the existing urban structure since it is so closely intertwined with the city scale. The other way around is not suitable either since just thinking about the city scale will falsely give the impression that the city is coherent while it is in fact not glued together with strong neighborhoods. As the results shows the willingness to pay for sustainability differs between the city scale on one hand and the neighborhood on the other; the things that are attractive within the neighborhood is perhaps not the same as in the city as a whole but the attractiveness of the city influences the neighborhood.

As an urban planner some of the results are hard to adapt because it contradicts what research holds as necessary for qualitative urban life. For example entrances facing the street and commercial space in the ground floor of buildings are considered to promote safety (Jacobs 1961) but are valued as a negative thing among residents. This makes decisions harder for the urban planner; peoples wishes on one hand and planning doctrine on the other.

This study can be used as a planning tool in order to evaluate economic effects when implementing sustainable development or in the process of choosing to asses a neighborhood with either LEED or BREEAM. In such calculation the fact that assessment of a certification system will lower the resource consumption should be included as well as the possibility that labeling a neighborhood as sustainable could increase the willingness to pay for it.

Methodology

The choice of a hedonic price model as a test for the willingness to pay for urban sustainability

in this thesis is based on the fact that it can put monetary values to attributes. One could also consider a survey among homeowners as an approach, where homeowners could specify which attributes that were important at the moment they bought the property. The survey would show better what attributes that were considered important in what situation, since it seems likely that the general life situation would influence preferences on apartments and single family houses. However, it is obviously not possible to conduct such a survey for about 20 000 properties but some kind of complementary study could be interesting.

It is clear that there is a clear division between neighborhood specific variables and variables general for a city as a whole. In this study the aim was to find out the willingness to pay for urban sustainability distinguished from the certification systems LEED and BREEAM, both of which have a neighborhood or community perspective. This means that it is people's preferences on a very close surrounding of their home that is analyzed and only a few variables go beyond that limit.

Construction of and translation into variables

In this thesis the aim with the construction of variables has been to keep them as neutral and continuous as possible. As soon as variables become categorized, the result will be harder to interpret as an urban planner and possibly makes it very place specific, since you also have to investigate what the categories are and if they fit the wanted purpose. The kind of sustainable urbanism characterized in the United Kingdom may not work in Sweden for example since the characterization in itself is based on British conditions, while the results from the present study can be directly interpreted and reproduced in any place due to the fact that there is no aggregation to a character of urbanism but only simple measures.

The hedonic price model

Some general concerns regarding the hedonic price model is that in order to predict prices exactly it requires a perfect market were no transaction, searching or moving costs significantly influences the price (Sjaastad et al. 2007), but which in reality could be influencing the choice of whether or not to move. However, the method is widely used and gives good indications of what is influencing the price even though it is important to take the exact parameter estimates with a pinch of salt. (Palmquist 2005) argues that it is important to think about when the change in price occurs due to a change in environmental variables. Particularly it can be speculated when and how the new metro affects the property prices. Even though earlier studies show that the property prices increases well before the opening, it could well be that since Copenhagen is such a bicycle friendly city the change might come later. However, it is interesting to see that it is still significant among apartments but negatively correlated, which indicates that apartment owners does not just not care about metro but they actually find them negative.

Conclusions

Based on data of the Copenhagen metropolitan area criterions from certification systems for sustainable development was translated into variables and put in a hedonic price model. The result showed that many of the criterions were negatively valued by consumers, which makes the short answer to whether or not there is a willingness to pay for urban sustainability: no.

However, indications are given that it is a question of measure and definition instead of structural values reflected in willingness to pay. The systems of criteria are made so that they actually answers only to a very limited area which can be considered as an own entity. This makes the translation sensitive because it somewhat contradicts what is sustainable according to theory. For example it is said that singular segments in bike lanes has a minor effect on bicycling flows compared to betweeness measures made on large radiuses. Nice bike lanes within a neighborhood do not make it much more bike friendly since most travels either ends or starts outside the neighborhood. There is a conflict in trying to certify single neighborhoods when they are so intertwined with the rest of the city on so many levels.

That conflict also occurs in planning practice due to legislations and governmental organization. What really can be said is that certification of neighborhoods are a good way to encourage

sustainable urban design but not a great planning tool except as argumentation in policy making. The way of measuring willingness to pay for urban sustainability, however, still is an interesting approach and could be a powerful planning tool but should be based less on set certification systems.

Further research

This study includes an iterative process in order to get valid results. For further research on this matter a closer look at testing variations of all variables would be interesting. On the same topic it could be interesting to try do define the neighborhood scale and search for definitions for other scales by testing different radiuses and look for thresholds in preferences. The most commonly used entities when measuring cities today is perhaps blocks, administrative areas and different definitions of a city or metropolitan regions, but an idea sprung from this study is to examine the "intra-city scale".

References

Atkinson, G. o.a. 1997. *Measuring sustainable development: macroeconomics and the environment.* Cheltnham: Edward Elgar.

Baldwin Hess, D., and M. A. Tangerine. 2007. "Impact of Proximity to Light Rail Rapid Transit on Station-area Property Values in Buffalo, New York." *Urban Studies* 44: 1041-1068.

Blomquist, G. C., M. C. Berger, and J. P. Hoehn. 1988. "New Estimates of Quality of Life in Urban Areas." *The American Economic Review* 78: 89-107.

Boverket. 2007. *Trafik för en Attraktiv Stad: Underlag,* u.o.: Sveriges Kommuner och Landsting.

Dill, J., and T. Carr. 2007. "Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them, Commuters Will Use Them - Another Look." *Journal of the Transportation Research Board* 1578(1997): 79-83.

Duncan, M. 2011. "The Impact of Transit-oriented Development on Housing Prices in San Diego, CA." *Urban Studies* 48(1): 101-127.

Ewing, R. and R. Cervero. 2010. "Travel and the Built Environment." *Journal of the American Planning Association* 76(3): 265-294.

Farr, D. 2008. *Sustainable urbanism: urban design with nature.* Hoboken: Wiley.

Gehl, J. 2010. *Life Between Buildings: Using Public Space*. Skive: Arkitektens Forlag.

Gehl, J., L. J. Kaefer, and S. Reigstad. 2005. "Close encounters with buildings." *Town Planning and Architecture* 29(2): 70-80.

Glaeser, E. L., and D. C. Mare. 2001. "Cities and Skills." *Journal of Labor Economics* 19(2): 316-342.

Goblillon, L., H. Selod, and Y. Zenou. 1973. "The Mechanisms of Spatial Mismatch." *Urban Studies* 44: 2401-2428.

Harkey, D. L., M. Knuiman, and D. W. Reinfurt. 1998. "Development of the Bicycle Compatibility Index: A Level of Service Concept Implementation." *Journal of the Transportation Research Board* 1636(0361-1981): 13-20.

Hillier, B. 1996. *Space is the machine.* Cambridge, UK: Press Syndicate of the University of Cambridge.

Hillier, B., and S. Iida. 2005. *Network effects and psycological effects: a theory of urban movement.* Amsterdam, Techne Press.

Hillier, B. o.a. 1993. "Natural movement: or, configuration and attraction in urban pedestrian

movement.*" Environment and Planning B: Planning and Design* 20: 29-61.

Jacobs, J. 1961. *The Death and Life of Great American Cities*. New York: Random House Inc.

Jacobs, J. 1969. *The Economy of Cities.* New York: Vintage Books.

Krugman, P. 1991. "Increasing Returns and Economic Geography." *Journal of Political Economy* 99: 483-499.

Kryvobokov, M., and M. Wilhelmsson. 2007. "Analysing location attributes with a hedonic model for apartment prices in Donetsk, Ukraine*." International Journal of Strategic Property Management* 11(3): 157-178.

Landis, B. W., V. R. Vattikuti, and M. T. Brannick. 1997. "Real-Time Human Perceptions: Toward a Bicycle Level of Service*." Transportation Research Record* 1578(0361-1981): 119-126.

Marcus, Lars. 2007. *Spatial capital and how to measure it: An outline of an analytical theory of the social performativity of urban form.* Istanbul, Istanbul Technical University.

McCahill, C., N. Garrick. 2008. "The Applicability of Space Syntax to Bicycle Facility Planning*." Journal of Transportation Research Board* 46-51.

McDonald, J. F., and C. I. Osuji. 1995. *"*The effect of anticipated transportation improvement on residential land values*." Regional Science and Urban Economics* 25: 261-278.

Palmquist, R. B. 2005. *Property Value Models: Handbook of Environmental Economics.* Amsterdam: Elsevier B.V. 764 - 808.

Parris, T. M., and R. W. Kates. 2003. "Characterizing and measuring sustainable development*." Annual Review of Environment and Resources* 28: 559-586.

Porter, M. 1998. "Clusters and the new economics of competition." *Harvard Business Review* 76(6): 77-90.

Pucher, J., and R. Buehler. 2008. "Making Cycling Irresistable: Lessons from The Netherlands, Denmark and Germany*." Transport Reviews: A Transnational Transdiciplinary Journal* 28(4): 495-528.

Raford, N., A. Chiaradia, and J. Gil. 2005. *Critical mass: Emergent cyclist route choice in central London.* Amsterdam, Techne Press.

Ratti, C. 2004. *"*Urban texture and space syntax: some inconsistencies." *Environment and Planning B: Planning and Design* 31: 000 - 000.

Reynolds, H. D. 1998. *The modifiable area unit problem: empirical analysis by statistical simulation.* Toronto: University of Toronto.

Saelens, E. B., F. J. Sallis, and L. D. Frank. 2003. "Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures*." Annals of Behavioral Medecine* 25(2): 80-91.

Sjaastad, M., T. Hansen, and P. Medby. 2007. *Bokvalitet i by: og etterspyrte bebyggelsetyper.* Oslo: SINTEF Byggforsk.

Spacescape and Evidens. 2011. *Värdering av stadskvaliteter.* Stockholm: Regionplanekontoret.

Ståhle, Alexander. 2008. *Compact sprawl: Exploring public open space and contradictions in urban density.* Stockholm: KTH.

Zenou, Y., and O. Åslund, and J. Östh. 2006. "Hur viktig är närheten till jobb för chanserna på arbetsmarknaden?*" Ekonomisk debatt* 34(6): 31-42.