Performance of parking garages

Evidence from the Netherlands

Master Thesis

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This thesis is written in the context of the Master program *Urban, Port and Transport Economics.*

September 2009

Preface

This thesis is the completion of my MSE Urban, Port and Transport Economics at the Erasmus University of Rotterdam. It is the result of my internship at Spark bv in Leidschendam. Spark is a consultancy company advising public and private parties in the development and exploitation of parking provision. The subject of the thesis is the performance of parking garages in relation with the urban environment. The research in this field of parking is quite limited until now and my wish is to provide useful findings to the parking industry.

Special thanks go out to my supervisor, Giuliano Mingardo, for his useful suggestions and recommendations. I would also like to thank Ernst Bos and his colleagues form Spark for their efforts to collect the necessary data. And finally, thanks to Erik Braun for reading my thesis.

It was very interesting to do this research and I am convinced that the MSE Urban, Port and Transport Economics is the most interesting phase of my academic career.

The God of Israel is he that giveth strength and power unto his people. Blessed be God.
(Psalms 68:35)

Kees van der Garde
September 2009

Executive Summary

The increased car use of the last decades has generated a high demand for parking, especially in city centers. The answer to the demand for parking was the construction of parking garages, operated by public or private organizations. The investments in parking garages are huge and parking garages are not movable. So it is very important to take the right decisions, based on the right information. Because the demand for parking is a derived demand, it is essential to know what factors influence this demand and what not. This is the goal of this study what leads to the following research question: *What is the relation among the performance of a parking garage, the users parking costs and the characteristics of the urban environment?*

In this research a linear regression model is used to test the relationship between the performance of parking garages and a number of variables. The performance of parking garages is measured by the parking production of a garage: the number of sold hours for short parking per parking place per year. The information of 40 parking garages in Dutch cities centers is used.

Most of the previous literature is concerned with the effects of policy measures on the behavior of people who want to park in a problem area, mostly the city center. There are several parking segments distinguished. In general, the reaction of people depends on how they evaluate the users parking costs, consisting of the parking tariff and the walking time to the final destination. Also some articles deal with the relation of parking and shopping behavior of visitors, but no significant relationships are proved.

In order to answer the research question, three main hypothesis and several sub hypotheses are tested. The first main hypothesis is the following*: H_1: The parking production of parking garages is negatively related with users parking costs*. The assumption is that people will prefer a parking place with the lowest users parking costs, consisting of the parking tariff and the walking time from the parking garage to the final destination. The variables 'parking tariff' and 'walking time to the city center' were tested in relationship with the performance of parking garages. There is no relationship between the level of the parking tariff up to €4,00 and the performance of a parking garage. This holds also for the relationship with the walking time to the city center, for walking times less than 10 minutes. So there is no negative relationship proved between the performance of a parking garage and the users parking costs.

The second hypothesis is: *H_2: The parking production of parking garages is positively related with the population density and size of a city.* A positive relationship is assumed among the parking production and the variables 'number of inhabitants', 'density of population', 'density of car ownership', 'value of real estate' and 'the percentage of built area'. The assumption is that cities with a lot of inhabitants, a high concentration of population and high real estate value will attract a lot of visitors and that the space in these cities is used as efficient as possible. There exist only for the variables 'density of population' and 'value of real estate' a positive relationship with the performance of a parking garages. For the other variables no relationship was proved or the relationship was not convincing. So the assumption that there is a positive relationship between the performance of a parking garage and several urban characteristics is partly supported.

The last hypothesis is: *H_3: The parking production of parking garages is positively related with the quality of urban amenities.* It is assumed that the more and different amenities are available, the more people will visit the city center and this will generate a demand for short parking. To measure the quality of urban amenities the variables 'density of commercial services', 'opening duration of shops', 'number of shops' and ' amount of floor space of shops' are used. For all these variables the relationship with the performance of a parking garage is positive and significant. Only the opening duration of shops don't seem to have large influence on the parking performance. So the assumption of a positive relationship between the performance of parking garages and the quality of urban amenities is strongly supported.

These important findings provide the following recommendations for the parking industry. First, for the investment in a new parking garage, the most important factor on the parking performance is the quality of urban amenities. The number and variety of shops, restaurants, et cetera are very important. A second good indicator is the value of the real estate. The third useful indicator is the density of population. For the exploitation of a parking garage, the tariff don't negatively influence the parking performance. So don't be afraid to increase the tariff and don't compete on price with other parking possibilities. This holds also for the walking time to the city center. People are willing to walk several minutes, so a parking garage can be located at some distance from the core area at a cheaper location.

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Introduction

During the last decades more and more people were able to own one or more cars. The number of cars in the Netherlands increased from 5,1 million in 1990 to 7,5 million in 2009 (CBS, 2009). Besides the advantages of increased mobility, this development has also negative aspects like congestion, air pollution and accidents. Especially in dense city centers serious problems were caused, not only when a car is driving but also when a car is parked. In larger city centers with a lot of visitors, the existing parking spaces near the roads were not sufficient. To provide sufficient parking spaces, parking garages were constructed. The main advantage of these garages is that a lot of cars can be parked on a relative small area. But the costs of a parking garage are a lot higher than the traditional on the ground located parking lots. The construction and maintenance costs of such buildings in expensive city centers are huge. The average investments costs of the construction of a place in a parking garage is € 28,000. Also the exploitation costs are high. For a average place in a parking garage these yearly costs are €1,310 (CROW, 2006). A recent example of the costs of a parking garage is the acquisition of the Mahler-4 parking garage in Amsterdam by Qpark. The average costs for a parking place in this garage were €52,500 (Elsevier, 2005). The revenues of parking has to come from car drivers. For the operator of a parking garage it is very important to be attractive for them. Important questions are: Where should a parking garage be located?; What about the tariffs?; How should we value a parking garage?; What are the effects of the city environment on the performance of a parking garage? These questions are the basis for a further focus on the relationship between the performance of parking garages and the city environment.

1.1 Problem definition and hypothesis

The operation of a parking garage can be compared with the operation of a regular firm. A parking garage offers a product, the parking space, for a price, the tariff, and has to attract sufficient customers, the visitors, to be profitable. The different with normal firms is that the demand for parking spaces is a derived demand. Parking is not a goal in itself. People want to park somewhere to reach another goal like shopping, working or visiting a friend. So the number of people who want to park in a city center depends on its characteristics. For a parking garage operator it is very important to know the influence of these characteristics on

the performance of parking garages. The answer to this problem is not given in previous research until now. This research tries to find the relation between the performance of parking garages in city centers and the environment where it is located. It is important to take into consideration that the performance of a parking garage may depend on internal factors and external factors. Internal factors are the tariff, the distance to the final destination of parkers, cleanness, additional services and so on. External factors are related to the environment where a parking garage is located. These are city characteristics like the relative importance of the city, the number of shops, the transport policy of the city government and the number of inhabitants. In this research we focus on some internal and some external factors. This leads to the following research question:

What is the relation among the performance of a parking garage, the users parking costs and the characteristics of the urban environment?

In order to measure the relationship among the performance of parking garages and other variables it is needed to define a indicator for the performance. In this research the indicator parking production is used. The parking production is the number of sold hours for short parking per place per year. Short parking means in general all sold tickets without long term tickets. The indicator parking production is calculated by dividing the total number of sold hours by the number of parking places in a garage. The number of sold hours is calculated by dividing the total revenue by the tariff. So the formula for parking production is:

$$P = \frac{\text{Number of sold hours}}{\text{Number of parking places}}$$

A condition for using this indicator is that there is a positive relationship between the size and the number of sold hours of parking garages. It is possible that the size of a parking garage is too large for a particular city. This will give a very low parking performance, caused by a too large parking supply. It is also possible that a parking garage has a lot of customers with long term tickets. The result would be that there is less space for short parking and so cause a low parking performance. Because of this the relationship between the number of sold hours and the number of parking places is tested. The result was that there is a positive and significant relationship between these two variables. So the larger the parking garage,

the more number of sold hours for short. The tables of this regression analysis are presented in Appendix I.

In order to test the relationship among the performance of a parking garage, the users parking costs and the characteristics of the urban environment the following main and sub hypotheses were examined:

H_1: The parking production of parking garages is negatively related with users parking costs

H_1a: The parking production of parking garages is negatively related with parking tariffs

H_1b: The parking production of parking garages is negatively related with walking time

H_2: The parking production of parking garages is positively related with the population density and size of a city

H_2a: The parking production of parking garages is positively related with the population density

H_2b: The parking production of parking garages is positively related with the density of inhabitants

H_2c: The parking production of parking garages is positively related with the density of car ownership

H_2d: The parking production of parking garages is positively related with the value of real estate

H_2e: The parking production of parking garages is positively related with the percentage of built area

H_3: The parking production of parking garages is positively related with the quality of urban amenities

H_3a: The parking production of parking garages is positively related with the density of commercial services

H_3b: The parking production of parking garages is positively related with the opening duration of shops

H_3c: The parking production of parking garages is positively related with the number of shops

H_3d: The parking production of parking garages is positively related with the amount of floor space of shops

1.2 Methodology

In this research the relationship of the performance of a parking garage and several variables is statistical analyzed. For the performance of a parking garage is the indicator parking production used. A linear regression model is used to model the relationship between the dependent and independent variables. A database of 40 parking garage in the Netherlands is used. The information of the parking garages is provided by the different operators of these parking garages. The names of the parking garages are presented in appendix II.
In chapter two the existing literature in relation with parking garages and parking behavior will be discussed. Further, in the following three chapters, respectively the first, second and third main hypothesis will be tested. Chapter six forms the conclusion of this research and will provide recommendations.

1.3 Limitations

The performance of a parking garage depends on a lot of factors, far more than the variables used in this analysis. One of the factors not included in this research is the availability and the quality of public transport. Cities with a good public transport network will attract more people by bus, train or metro than cities with a bad public transport network. The result would be that cities with good public transport has less visitors who are travelling by car and as a result a lower demand for short parking. So the performance of a parking garage is possible influenced by the quality of the public transport. Also the supply and tariff of on-street parking is not taken into account. Some cities promote off street parking by setting a high on street parking tariff. Also the number of on street parking differs between cities. This may have an influence on the performance of a parking garage. Because such factors are not included in this analysis we cannot give the complete explanation for the performance of a parking garage. Another limitation in this research is that only data of short parking is used. This because the data of long parking were not available for a lot of parking garage. A problem with this is that a parking garage with a lot of long parking customers has a relative

lower parking performance for short parking. Such garages has a lower performance because a large part of the garage is not used for short parking. This is not taken into account in the calculation of the parking production.

H2. Literature review

The exploitation of a parking garage can be done by the city government or by a private company. There are also other variances like a public private partnership or a private company in ownership of the city government. The way of exploitation depends largely of the type of ownership. If it is a private company, the goal is to maximize profit. The more people will visit the parking garage, the better. To reach this, the exploitant has to deal with a lot of factors to be a attractive parking place. If the city government has the exploitation the goal is less clear. The city government can use the parking places and prices to influence parking behavior in order to reach the broader goals of their urban policy. Typical objectives of urban policy are the following:

- A strong and vibrant economy supported by an efficient transport system;
- Better accessibility;
- A clean and high quality urban environment;
- A safe and secure environment;
- A more equitable society (May, 1996; Marsden and Wootton, 2001)

This objectives has to be combined with a economic sustainable city governance. In relation with parking there exist three objectives a city government can follow:

- 'The desire to use parking measures as a means of regenerating a specific part of the urban area such as the town centre (i.e., providing more parking to attract business);
- The desire to use parking controls as a means of restraining vehicle traffic and improving environmental quality, or to encourage the use of non-car modes;
- The need to secure sufficient revenue from the parking operation to cover costs or to make a surplus to fund other activities' (IHT, 2005, p.64)

The impact of parking is large and can influence a lot of urban activities and development, like:

- Changes in the provision of parking and its price will affect the cost and convenience of travel, and influence transport choices such as mode choice and time of day of travel;
- Ease of parking will influence the perceptions of attractiveness of destinations for travelers, and among decision-makers seeking to (re)locate their activities or develop

new sites. This may have impacts on the economic and demographic growth of an area such as its mix of economic activities.;

- Parking occupies urban space, and hence changes in parking provision can affect the amount and quality of space available for other activities;
- Parking can also generate revenue as an economic activity in its own right. (Still and Simmonds, 2000)

These influences of parking are illustrated in figure 1.

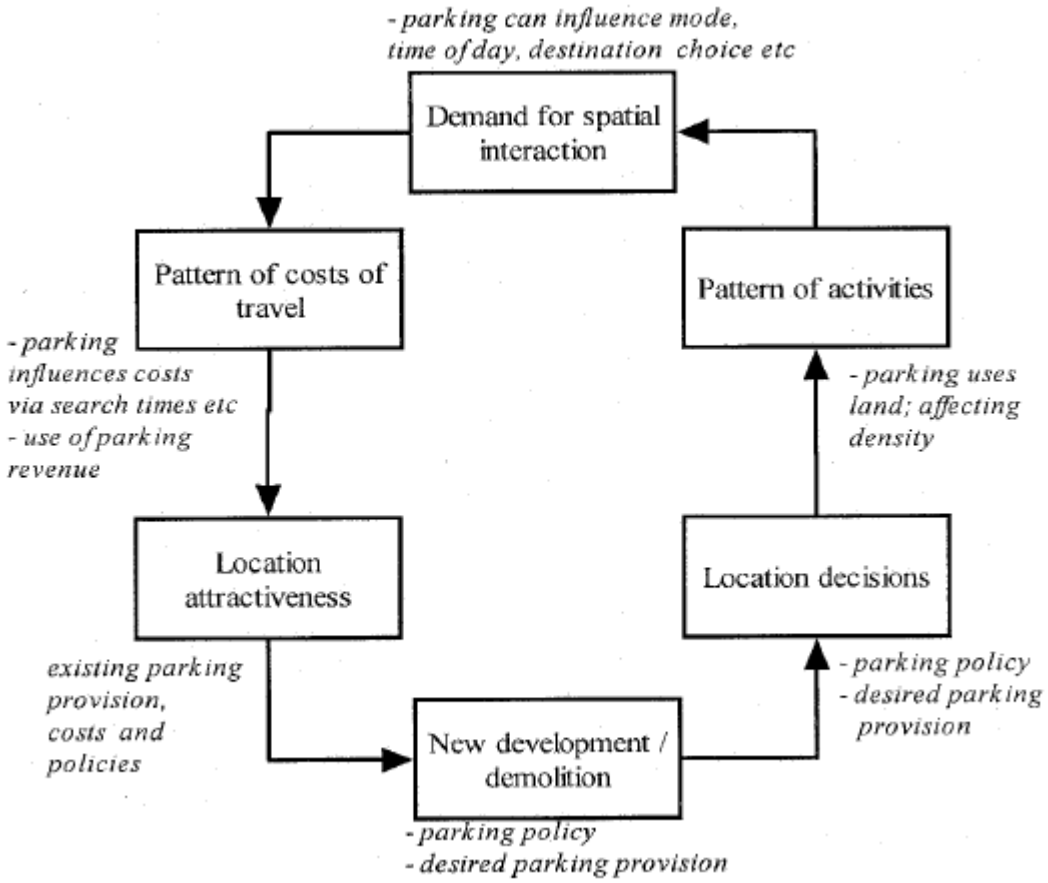

Figure 1 influence of parking. Source: Still and Simonds, 2000

The most literature is concerned with the effects of policy measures on the behavior of people who want to park into a problem area, mostly the city centre or the Central Business District. Also some articles are concerned with the relation of parking and shopping behavior of visitors.

First of all, I will present an article of Arnott (2006) dealing with the economic and operational side of parking garages. He developed a economic model of a parking garage in a downtown area and with competing parking garages in the neighborhood. The first aspect

with operating a parking garage are the high fixed constructing costs. This provides horizontal economies of scales. The result is that there are some parking garages with a lot of parking places at discrete intervals. Because a car driver would like to park as close as possible to the destination, he will pay a higher parking price in a parking garage close to the city centre. The result is that a parking garage can ask a higher price than the marginal costs, so there is some market power. Besides the market power, there is also competition between the other parking garages and the profit maximizing choice of a operator depends on the behavior of these competitors. If one operator increase the price, he will loss customers to other parking garages and vice versa. This is illustrated in figure 2. Each circle is a parking garage and d is the distance between the parking garages. In the left square the parking price is higher and in the right square the price is lower than the other parking garages, resulting in a smaller or larger market area. The social optimum is where the walking and garage costs are minimized. This is the case if the average costs of the construction of the parking garage and the average costs of walking to the final destination are equal to the marginal costs of it. In a later stage of the model is the possibility of on-street introduced. This leads to the advice to set the price of on-street parking more on the level of off-street parking. This because with higher off-street parking tariffs more people will park in a parking garage. This will reduce the number of parkers who drive to search a parking place, the total parking revenue increase and traffic congestion will decrease.

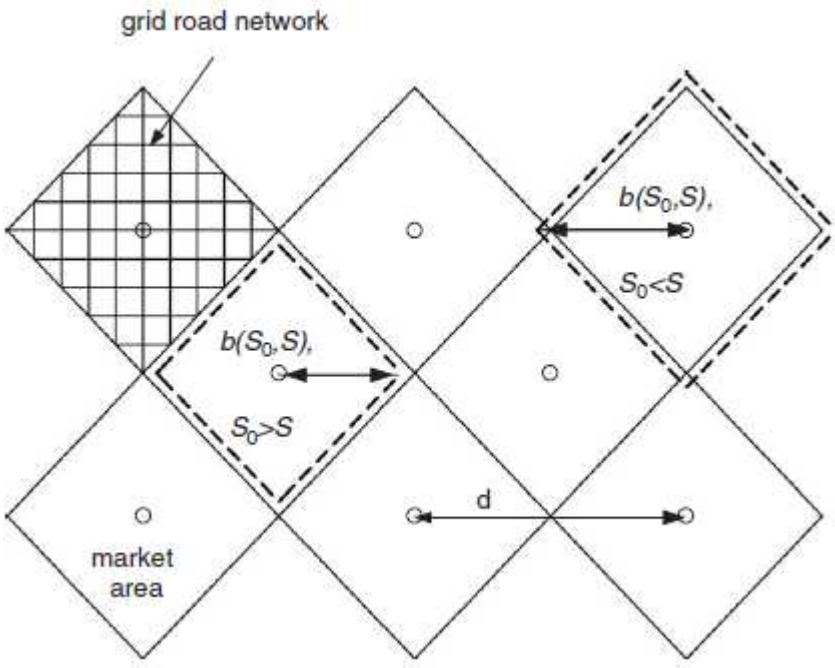

Figure 2 competition between parking garages. Source: Arnott, 2006

The first studies to parking behavior and parking segments originates of the 1980s. In this time the negative effects of the increasing mobility became more and more visible. In many European cities the major retail areas (especially inner cities) suffer from congestion due to an ever increasing car use. Congested urban network and urban parking facilities surrounding business areas lead to a decrease of accessibility for residents, employees, customers and visitors, and for service and delivery traffic (Topp, 1991).

One of the first attempt to indentify different parking segments and their behavior is done by Axhausen (1988). In this study were different groups made based on on-street, off street and illegal parking. The differences in the results made it impossible to indentify these groups by socio-economic characteristics. The implications out of this study were that it is necessary to indentify different parking groups and that the gender of the respondents is not influential on the parking choice. So this first study did not explain a lot. There was a need for more suitable models: “It should be noted that driver behavior in relation to parking choices is complex and involves individual differences difficult to predict unless suitable models are developed” (Polak, 1988).

The relation between parking tariffs and parking supply and the behavior of visitors of the central business district (CBD) in Sydney is investigated by Hensher and King (1999). They used a stated preference survey among car drivers and public transport users. These people were asked to consider different parking prices and parking opening times and to give their reaction on this different situations. The options to choose were: 1) to drive or to park close in the CBD, 2) to drive or to park elsewhere in the CBD, 3) to drive or to park outside the CBD, 4) to drive or to park for free beyond the fringe of the CBD and travel by public transport to the CBD, 5) to travel by public transport to the CBD and 6) to cancel the whole trip to the CBD. In this study the authors make a segmentation of four parking market segments with different characteristics. They suspect different parking behavior based on this characteristics. The first group are people who have to pay the parking themselves and are not guaranteed with a parking place. This are the so called casual parkers who have to park for shopping and recreational trips. The second segment has to pay themselves and is also not guaranteed with a parking places. The different with the first group is that this people has to park for their work and they get tax benefits. Thirdly, there are people who are provided with a guaranteed parking place but they have to pay the parking place. This people are typically commuters and are permanent parkers. The last group indentified are

also permanent parkers with the different that they don't have to pay for the parking place themselves. The costs are for the firm where they work. The result of the survey was that the parking price per hour is the most statistically significant variable and that there is a high sensitivity for parking prices. The parking price elasticity was for the area close in the CBD -0,54, for the area elsewhere in the CBD -1,02 and for areas outside the CBD -0,48. An increase of the parking price result in more people using the public transport and in relocating the parking place to a cheaper area. People who park close in the CBD seems less sensible for price increases than people who park elsewhere in the CBD. The variable opening hours of the parking garages has much less influence on the parking behavior. There are also some interesting results based on the characteristics of the people. The categories of people who has to pay themselves tend to park outside the CBD or in a cheaper area in the CBD. Commuters, shoppers and recreational people don't prefer to park in the expensive areas close in the CBD. These people prefer to walk to their destination for a lower parking price. In the parking possibilities was also a parking garage very close to the main retail area. People who park in this garage for shopping are less willing to park further away. So there is a small number of people who are not sensitive for parking prices and want to park as close as possible in the centre and a larger group of people who want to walk a certain distance for a lower parking price. They found also a significant relation with income. The higher the income, the more people park close in the CBD.

In a study by Griifioen-Young and Janssen (2004) to investigate parking behavior, they suggest the following groups of people with different parking requirements. The first group is parking for business and travel. For this segment the proximity to the destination is important while the parking price is not important. For shopping and daytime recreation proximity to the destination is less important than for business and travel. For night-time recreation is safety the most important aspect. For all segments is room for manoeuvrability important and for none of the groups is the parking price the most important factor.

Also distinguish Topp (1991) several parking segments in an article that deals with parking policies in larger cities in Germany. These are residents, employees, customers and visitors and city delivery service. The parking demand of the segments differs in the duration of their visit, the time on the day, the possibility to walk to the final destination, the willingness to pay, preference for on-street or off-street parking and the possibility to change to another

transportation mode. The attitude of the different segments to these variables is illustrated in figure 3.

Table 2. Characteristics of parking demand by different user groups.

	Residents	Employees	Customes Visitors	Delivery service
Parking length				
Long duration	●	●		
Short duration			◑	●
Depending on parking in the street area*	◑	○	◑	●
Preparedness to pay*			◑	
Willingness to walk*	◑	◑		
Responsive to information systems		○	●	

* Applies to problem districts: inner cities, inner residential and mixed areas.
● completely the case, ◑ partly the case, ○ slightly the case.

Figure 3 Source: Topp 1991

Golias et al. (2002) examined the determinants of choice between on street and off street parking. They did a questionnaire based survey among visitors of the city centre of Piraeus (Greece) how people make a parking decision. The final conclusion was that parking costs has the most influence on the choice decision for a parking place. The cheapest parking places are the most attractive to park. Also the time factor was important. Time to find a parking place, walking time to the final destination and the duration of parking were taken into consideration to make a parking choice. So time and costs were the most important factors to choose for a particular parking lot. In this analysis were characteristics of the driver and the trip (age, gender, income, trip purpose , trip frequency) not influential on the parking choice decision. This research shows that people don't make distinction between on-street and off-street parking, but only look for the lowest combination of time and money costs. The authors recommend policy makers to replace on-street parking places to off street parking lots in order to get more safe and cleaner streets in city centers.
Another study based on a large scale survey among parkers was done by Lambe (1996). This survey was done among 10,000 people parking at 55 parking places in Vancouver (Canada). For each trip, the origin of the driving component for each trip, the walking distance to the final destination, the arrival and departure time, and the parking costs were collected. The

result of the study was that people perceive walking to be about six times more costly than driving. So he concluded with the recommendation to keep walking distances as short as possible, with parking garages directly connected to the final destination points. But he mentioned also the fact that people are willing to walk some distance for a lower parking price.

Also a research related to parking location choice was done by Muromachi (2003) for the city centre of Tama (Japan). The purpose of this study was to find a relation between the driving route of the parker and the parking location. The result was that there is a inter-relationship between the driving route and the choice for a particular parking location. So based on this findings he concluded that the demand for a new parking lot depends on the topological location, besides other variables like the tariff and distance to the final destination. Parking garages located near a parking route or parking ring are more attractive than other parking places.

A different study by Van der Waerden et al. (1993) was concentrated on the behavior of motorists if a parking place is occupied. They developed a stated preference model of adaptive parking choice behavior. Respondents were asked what to do if the preferred parking place is occupied. A couple of attributes were put in the model like expected waiting time, numbers of car waiting, number of parking lots visited before, travel time to alternative parking lot, parking costs at alternative parking lot, possibility of illegal parking, risk of getting a penalty and probability of free space at the alternative parking lot. The results are the following. First, the probability that a motorist will wait depends on expected waiting time, numbers of cars waiting and number of parking lots visited before. Second, the probability that a person will look for another parking place depends on expected waiting time and number of parking lots visited before. Third, the probability that a parker will park his car at a illegal place depends on expected waiting time, possibility to park illegal and the risk of a fine. Furthermore, they mentioned some characteristics of motorists who want to park in relation with shopping behavior. 68 percent of the respondents said that they take all shops they want to visit in consideration to choose a parking place. And if motorists have to choose another parking place will 86 percent still visit the same shops.

For retailers, shopping behavior in relation with parking facilities is very important. Retailers have a strong perception that the supply of parking places is positively related with their turnover. In a review by Still and Simonds (2000) are some examples presented. It is believed

that shoppers consider being able to park as important as the location of the shopping centre (Walters, 1996). The importance of accessibility is also stressed in a study by Timmermans (1986). He used a stated preference method to examine the importance of location factors for retailers. Accessibility was mentioned by all the respondents as the most important. Also Hunt (1997) did a stated preference method among retailers. The results of this study were that restricing parking possibilities and higher parking tarrifs got a lot of opposition of retailers while a improving in accessibility was regarded very positive.
The impact of the parking situation in shopping centers on store choice behavior is analyzed by van der Waerden et al. (1998). They distinguish two different levels of which parking measures may affect shopping and travel behavior of consumers, the macro and micro level. The effect on the macro level are related to shopping destination, mode, route, and parking lot choice. The effects on the micro level form the choice of individual stores and the choice of routes through the shopping area. The study is concentrated at the impact of parking policies on the micro level. For this study is the parking situation used of the city of Veldhoven. In this city centre the parking situation changed and people were interviewed before the changing and afterwards. The results of this research were not very strong. They found that the choice for a supermarket is influenced by store characteristics and also by parking lot characteristics.
Another study regarded to the relation between parking supply and parking tariffs and the turnover of retail shops was done by van Meerkerk, Mingardo and Bosch (2008). The results of this analysis were the following. First, the number of parking places related to the m2 of retail area has no influence on the shop turnover. Only in specific situations there is a weak positive relation between parking and shop turnover. This is the case in shopping areas what serve a large area and where no additional shopping centers are located in the neighborhood. Second, the parking tariff has no influence on the shop turnover. So the conclusion of this study was that the number of parking spaces and the parking tariff has no influence on the performance of a retail area.

2.1 Conclusion

The way of operating a parking garage depends largely on the goals of the owner. A private company maximize its profit, while a public company can have a broad range of goals. Economic characteristics of parking garages are economies of scale and competition

between different parking possibilities. Parking garages have some market power to ask a higher price than the marginal price.

In order to investigate the parking behavior of people, it is needed to indentify different parking segments. In general, the reaction of people depends on how they evaluate the users parking costs, consisting of time and money.

Retailers suspect that the accessibility of the shops and also the availability of parking places has a positive influence on their sales. But this perception is not supported by different research on this topic. In general, no statistic significant relations are proved between parking and shop turnover.

Chapter 3. Users parking costs and the performance of a parking garage

In this chapter I will focus on the relationship between the users parking costs and the performance of a parking garage. The users parking costs consist of two parts. The first part is the tariff and the second part the walking time to the final destination. The assumption is that a car driver makes a decision to park on that parking garage with the lowest total parking costs in order to get the highest utility. So the assumption for parking tariffs is that higher tariffs decrease the attractively of a parking garage. The same holds for the walking time from the parking garage to the final destination. People will prefer a parking garage as close as possible to the final destination, in this research the city centre. So the smaller the walking time, the more attractive is the parking garage. The main hypothesis of this chapter is: *H_1: The parking production of parking garages is negatively related with users parking costs,* with the following sub hypotheses:

H_1a: The parking production of parking garages is negatively related with parking tariffs

H_1b: The parking production of parking garages is negatively related with walking time

3.1 Research method

For this analysis the data of 40 parking garages in the Netherlands is used. The data of these parking garages is showed in table 1. For privacy reasons the names of the parking garages are not mentioned in combination with the values of the different variables. The data is obtained from the operators of these parking garages[1]. The used variables for the hypotheses in this chapter are parking production, tariff and walking time. The highest parking production is parking garage D in Amsterdam with a parking production of 3590 while the lowest parking production is in the parking garage A in Almere with a parking production of 287. The average parking production is 1311.The parking production per city is illustrated in figure 4. There is also a lot of variation between the parking tariffs. Amsterdam is the most expensive place to park with a tariff of €3,80/h, while Middelburg has a parking

[1] The names of the parking garages are presented in appendix II

City	Parking Garage	Parking spaces	Opening hours/week	Tariff/ Hour	Turnover/ Year	Parking production/ year	Walking time/ minutes
Alkmaar	A	141	168	1,30	547091	3552	6,50
Alkmaar	B	435	168	1,30	986541	2076	5,25
Alkmaar	C	335	168	1,30	403453	1102	8,50
Alkmaar	D	400	168	1,30	951048	2176	6,25
Almelo	A	600	82	1,00	193918	385	4,50
Almere	A	450	89	1,50	162545	287	3,80
Almere	B	246	89	1,50	531273	1713	4,00
Almere	C	90	89	1,50	121091	1067	6,40
Almere	D	417	89	1,50	226909	432	6,60
Almere	E	390	89	1,50	329455	670	4,60
Almere	F	423	89	1,50	329455	618	6,60
Almere	G	400	89	1,50	684000	1357	4,80
Almere	H	360	89	1,50	230182	507	6,20
Amersfoort	A	347	168	1,81	276803	524	11,60
Amersfoort	B	406	168	1,81	1154424	1869	4,00
Amersfoort	C	177	168	1,81	365859	1359	3,00
Amstelveen	A	473	82	1,50	515577	865	4,00
Amsterdam	A	460	168	3,24	3247894	2593	7,67
Amsterdam	B	400	168	3,80	3186234	2494	3,30
Amsterdam	C	350	168	3,40	1195937	1196	16,30
Amsterdam	D	400	168	3,40	4102588	3590	10,60
Amsterdam	E	218	123	3,27	817908	1365	11,67
The Hague	A	210	60	2,00	167076	473	8,66
The Hague	B	351	119	1,90	257009	459	5,00
The Hague	C	93	120	2,40	451603	2408	7,33
The Hague	D	276	122	1,63	645101	1706	4,33
Deventer	A	561	69	1,20	788305	1393	4,00
Dordrecht	A	414	72	1,90	935996	1416	2,67
Hoorn	A	220	57	1,00	141884	767	7,25
Hoorn	B	120	112	1,00	86352	856	17,25
Leiden	A	269	99	1,00	329400	1457	6,80
Middelburg	A	80	63	1,00	73022	1086	9,00
Middelburg	B	302	63	1,00	359056	1415	5,00
Middelburg	C	342	63	0,75	144577	671	12,66
Middelburg	D	275	63	1,00	200345	867	7,66
Oud Beijerland	A	120	63	0,75	66199	875	3,67
Terneuzen	A	79	105	0,90	35949	602	5,50
Terneuzen	B	290	105	0,90	242538	1106	3,00
Terneuzen	C	240	105	0,90	137117	755	6,50
Utrecht	A	105	168	1,10	225628	2325	14,33

Table 1 Data parking garages

fee of €0,75/h. The average parking tariff is €1,61. The third used variable is walking time. This is the walking time from the parking garage to the city centre.
A important question is: What is the city centre? In general the city centre is an area in a city where a lot of commercial activities are concentrated. To define the city centre for this research, four retail shops of the top-100 retail formules in the Netherlands were selected (Locatus 2009). These shops are Blokker, Vroom & Dreesman, Etos and Hema. The walking time from the parking garage to these different shops is calculated by Tom Tom technologies[2]. The average of the walking times of these four shops is calculated per parking garage and this defines the variable walking time[3]. The most (82,5%) of the city centre parking are within 10 minutes reachable by foot from the parking garage.
To model the relationship between parking production and the variables parking tariff and walking time, linear regression is used. The standard alpha of 5 percent is used.

3.2 Parking tariff and the performance of a parking garage

As already mentioned, I suspect a negative relationship between parking productivity and the tariff of parking garages. In this part the hypothesis *H_1a: The parking production of parking garages is negatively related with parking tariffs* will be tested. In figure 5 the results of the regression analysis are presented. The coefficients of the regression line shows that the expected parking production is equal to 491,59*the tariff + 455,96. This means that for a tariff of €2,50 the expected parking production is 1684,94. Surprising is that there exist a positive relationship between parking production and tariff, while a negative relationship was suspected. The model shows that in parking garages with a higher tariff there is also a higher parking production. The ρ-value of 0,001 shows that the relationship between parking production and tariff is significant. The strength of the relationship between parking production and tariff is also important. The strength of the relationship of the two variables is described by R. This is the linear correlationship between the values predicted by the model and the observed, real values. If the value of R is squared, we obtain R square. The value of Rsquare shows the percentage of explained variation in parking production by the model. In general, the higher R square the better the model. In this analysis, R square is 0,275. So 27,5 percent of the variation in parking production is explained by the model.

[2] Walking time is calculated by Tom Tom Navigation Technologies with Global Positioning System (GPS).
[3] The walking times per shop to the specific parking garages are presented in appendix III

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,275	14,063	1	37	,001	455,955	491,586

The independent variable is Tariff.

Figure 4 Regression analysis parking production and tariff

The relationship between parking production and the tariff is illustrated in figure 6. We can observe that there is a positive relationship, but the most (81%) of the values are scattered around a tariff of €0,75 to €2,00. If the values with a tariff of above €2,00 are removed, the relationship is no longer significant. On this insights we can no longer argue that there is a significant positive relationship between parking production and tariff. But the assumption of a negative relationship is also wrong. We can conclude that there is no significant relationship between the two variables.

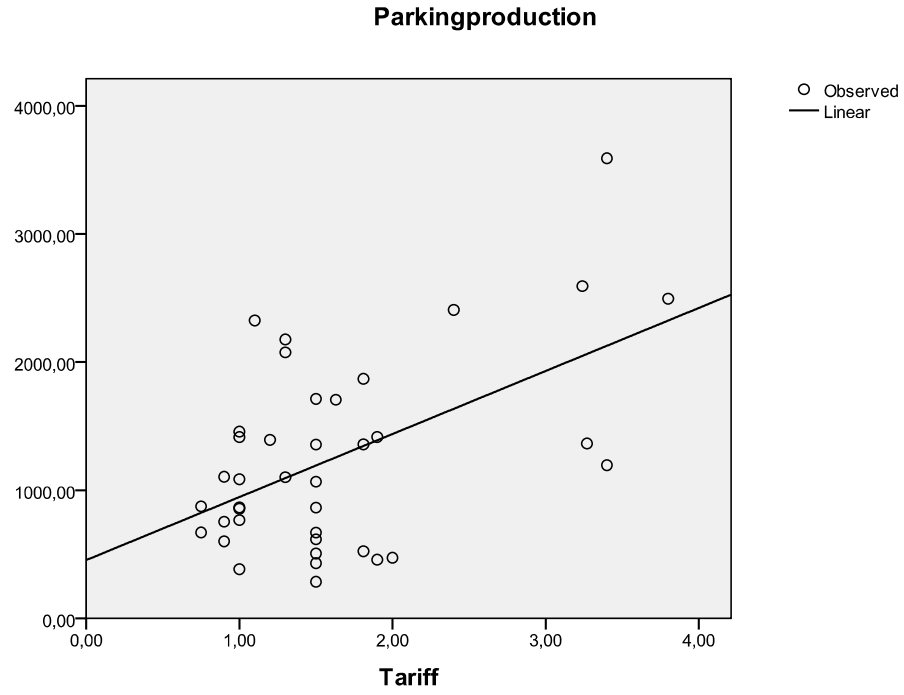

Figure 5 Relationship parking production and tariff

3.3 Walking time and the performance of a parking garage

The second part of this chapter is the relationship between parking production and walking time. A negative relationship is suspected because people would like to park very close to

their final destination in order to decrease their walking costs. The sub hypothesis is: *H_1b: The parking production of parking garages is negatively related with walking time.* In figure 7 the results of the regression analysis are presented. The most important conclusion out of this analysis is that there is no significant relationship. Also R square is very low with 0,002 percent. This means that only 0,2 percent of the variation in parking production is explained by the model.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,002	,089	1	37	,767	1183,836	10,047

The independent variable is Walkingtime.

Figure 6 Regression analysis parking production and walking time

That there is no relationship becomes clear as we consider figure 8. But also in this relationship we can see that the most (81%) parking garages are located within a walking time to the final destination of 10 minutes. If we consider only the parking garages with a walking time less than 10 minutes the relationship remains insignificant. The different is that the relationship becomes negative. But because it is a insignificant relationship we cannot prove that a shorter walking time leads to a higher parking productivity. So the assumption of a negative relationship between parking production and walking time cannot be supported by this empirical research.

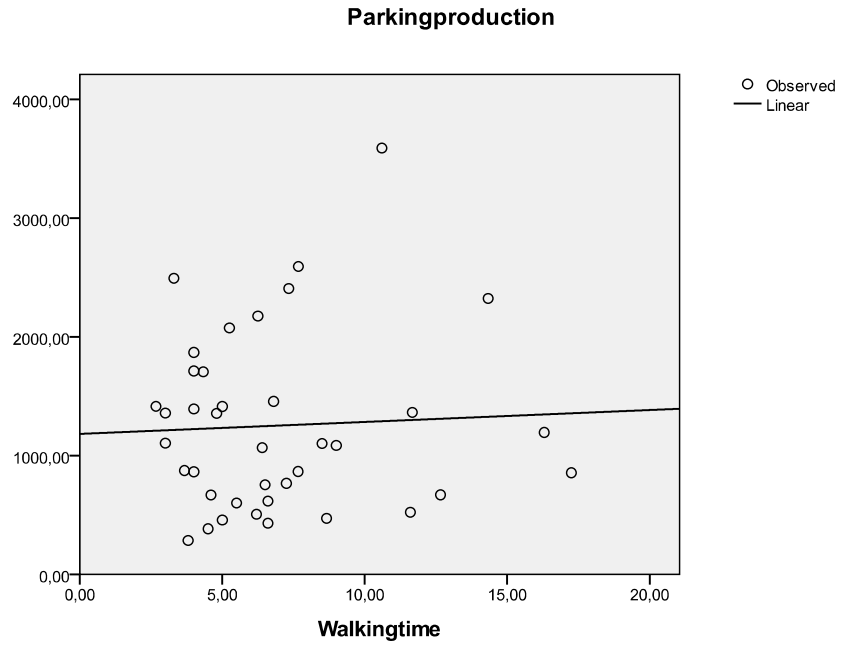

Figure 7 Relationship parking production and walking time

3.4 Users parking costs and the performance of a parking garage

So far we considered the two sub hypotheses *H_1a and H_1b* and now we are able to consider the main hypothesis of this chapter: *H_1: The parking production of parking garages is negatively related with users parking costs.* First, there is a positive and significant relationship between parking production and parking tariff. The model indicates that parking garages with a higher tariff have a higher productivity. But there is no significant relationship between parking production and tariff if only parking garages are considered with a tariff less than €2,00,-. Because of this there is no support for this hypothesis. Second, there is a positive but no significant relationship between parking production and walking time. If we consider only parking garages with a walking time less than 10 minutes, it becomes a negative relationship but insignificant. So based on this findings there is no empirical support for hypothesis *H_1.* The last aspect we have to recognize is that there may be a inverse relationship between parking tariff and walking time. It is reasonable that parking garages with a higher walking time have a lower tariff. For this reason it is possible that people decide to walk some minutes more to obtain a lower parking tariff or vice versa. The result would be that there is no relationship between parking production and walking time caused by a difference in the tariff. An regression analysis of parking tariff and walking time shows that there is no significant relationship between these variables. The results are presented in figure 9. The ρ-value of 0,292 shows that the relationship is insignificant. R square is 0,030 what means that only 3 percent of the variation in walking time is explained by the model.

Model Summary and Parameter Estimates

Dependent Variable:Walkingtime

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,030	1,140	1	37	,292	5,646	,791

The independent variable is Tariff.

Figure 8 Regression analysis Tariff and Walking time

So the conclusion is that there is no significant relationship between parking tariff and walking time. There is no multicollinearity between the two variables. Because of this the relationship between parking production and tariff and the relationship between parking production and walking time can be seen as independent.

Chapter 4. Urban characteristics and the performance of a parking garage

In the previous chapter the relation between users parking costs and the performance of a parking garage is analyzed. There was no empirical support found for this hypothesis. This chapter will deal with the relation among the performance of a parking garage and several urban characteristics. Because the database of cities is quite diverse in different urban characteristics, it is possible to test this relationship. Urban characteristics tested in this chapter are the total number of inhabitants, the density of population, the density of car ownership, the average real estate value and the percentage of built area in a city. The assumption in this chapter is that cities where relative a lot of people live there is relative a large demand for parking. This because a concentration of people will attract other people. Also in dense city centers the scarce space is used as efficient as possible. Because of this city governments and private companies will provide parking spaces in parking garages. So the main hypothesis in this chapter is: *H_2: The parking production of parking garages is positively related with the population density and size of a city.* And the sub hypotheses are the following:

H_2a: The parking production of parking garages is positively related with the number of inhabitants

H_2b: The parking production of parking garages is positively related with the population density

H_2c: The parking production of parking garages is positively related with the density of car ownership

H_2d: The parking production of parking garages is positively related with the value of real estate

H_2e: The parking production of parking garages is positively related with the percentage of built area

4.1 Research method

Also for this part of the research, the data of 40 parking garages in Dutch cities is used. The variable parking production in table 1 is tested in relation with the variables number of inhabitants, density of population, real estate value, density of cars, and built area (%). The

values of these variables are showed in table 2. These data is provided by the CBS for the period 2003-2008. The data of the parking production is of different years. Some of the parking garages provided information of some years old, while other parking garages provided the most actual data. Because of this, we combined for each parking garage the same years for the variables. So a parking garage with a parking production of 2006 is combined with values for the different variables of the same year. The values of the variables density of population, real estate value, density of cars and built area (%) are of the postal code area (4 digit) in which the parking garage is located. In the most cases this is the same area as the city centre but not for all parking garages. The reason for this choice is that the demand for a particular parking garage in a city depends in my opinion of the direct environment. For example, if there are two parking garages in a city, A and B. If A is located in a very dense area with no space left to park your car elsewhere and B is located in a less dense area with more on street parking possibilities it is to suspect that parking garage A has a higher parking production as parking garage B while the characteristics of the city centre are the same. So for these variables the values are taken of the postal code area (4 digit) in which the parking garage is located. In the database there is a large variation between the different cities. Amsterdam is the city with the most inhabitants, 739100, while Oud Beijerland has a population of 23370. The average number of inhabitants is 188396. Leiden has the highest density of population, 14141, while Terneuzen has a density of population of 2560. The average density of population in the database is 6797. This value is the number of inhabitants per km2. Leiden has also the highest density of car registration per km2 and Terneuzen the lowest density. This value is in Leiden 3587 and in Terneuzen 1056. The average value of the density of cars is 2325 cars per km2. The average real estate value is based on the Wet Waardering Onroerende Zaken (WOZ). The highest average real estate value is in Amstelveen, €283.300,-, and the lowest average real estate value is in Almelo, €87.500,-. The average real estate value in all cities was €195.210,-. The last tested variable in this chapter is the percentage of built area. This is all area used for housing, shopping, public buildings and culture. Amersfoort has the highest percentage of built area, 96%, while Leiden has the lowest percentage of built area, 60%. The average percentage of built area in this database is 82 percent. Also for this part of the research linear regression is used to model the relation between parking production and the different city related variables. The standard alpha of 5 percent is used.

City	Number of inhabitants	Density of population	Real estate value / €	Density of car ownership	Built area (%)	Density of commercial services	Number of shops	Area of retail(m2)	Opening duration shops
Alkmaar	94270	7269	192000	2959	0,87	13,1	793	228940	53,50
Alkmaar	94270	7269	192000	2959	0,87	13,1	793	228940	53,50
Alkmaar	94270	8757	159000	2909	0,85	13,1	793	228940	53,50
Alkmaar	94270	7269	192000	2959	0,87	13,1	793	228940	53,50
Almelo	72230	3005	87500	1318	0,72	1,6	496	147718	54,00
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Almere	170700	4341	154000	1335	0,66	5,2	578	203429	56,92
Amersfoort	141210	5210	229000	2545	0,96	8,8	776	201888	55,30
Amersfoort	141210	5210	229000	2545	0,96	8,8	776	201888	55,30
Amersfoort	141210	5210	229000	2545	0,96	8,8	776	201888	55,30
Amstelveen	78870	5901	283000	2524	0,94	2,7	440	110445	57,70
Amsterdam	739100	8422	241000	1927	0,88	14,1	5869	790834	59,57
Amsterdam	739100	8422	241000	1927	0,88	14,1	5869	790834	59,57
Amsterdam	739100	12295	259000	2551	0,78	14,1	5869	790834	59,57
Amsterdam	739100	12295	259000	2551	0,78	14,1	5869	790834	59,57
Amsterdam	739100	12295	259000	2551	0,78	14,1	5869	790834	59,57
The Hague	469060	9975	153000	2993	0,90	7,1	3681	615078	58,75
The Hague	469060	9975	153000	2993	0,90	7,1	3681	615078	58,75
The Hague	469060	3737	280000	1958,5	0,93	10,0	3681	615078	58,75
The Hague	469060	9975	153000	2993	0,90	7,1	3681	615078	58,75
Deventer	89140	6296	208000	2378	0,85	5,9	589	193204	52,13
Dordrecht	119650	8537	162000	3080	0,91	5,4	828	162281	52,69
Hoorn	68700	5108	237000	2369	0,84	7,8	473	110213	53,88
Hoorn	68700	5108	237000	2369	0,84	7,8	473	110213	53,88
Leiden	116880	14141	212000	3587	0,60	9,4	904	143599	57,50
Middelburg	47320	5471	182000	2288	0,86	4,7	399	88201	53,66
Middelburg	47320	5471	182000	2288	0,86	4,7	399	88201	53,66
Middelburg	47320	5001	115000	1876	0,67	4,7	399	88201	53,66
Middelburg	47320	5471	182000	2288	0,86	4,7	399	88201	53,66
Oud Beijerland	23370	4379	186500	1883	0,86	2,3	223	47244	52,33
Terneuzen	55160	2560	101000	1056	0,75	2,6	196	62548	53,75
Terneuzen	55160	2560	101000	1056	0,75	2,6	196	62548	53,75
Terneuzen	55160	2560	101000	1056	0,75	2,6	196	62548	53,75
Utrecht	270240	8729	268000	2638	0,88	8,0	1907	591135	59,50

Table 2 Data city characteristics

4.2 Number of inhabitants and the performance of a parking garage

The number of inhabitants is a main characteristic of a city. In many cases is the number of inhabitants a sign for the importance of a city. For example, in the most countries the capital city has the most inhabitants. So the assumption in this part of the research is that the importance of a city is related to the number of its inhabitants. And based on this, I suspect that the more important a city is, the more people will come to visit it. This will result in a higher demand for parking. This leads to the following sub hypothesis:

H_2a: The parking production of parking garages is positively related with the number of inhabitants. A first look at the database shows that there are two outliers, parking garage Helicon en parking garage Muzenplein, The Hague. These parking garages have a relative very low parking performance while they are located in a city with a lot of inhabitants. A possible reason for this underperformance in short parking is that both parking garages are located in a area with a lot of offices. The turnover for long parking for these parking garages is higher than the turnover for short parking what support this reason[4]. For example the ministry of Volksgezondheid, Welzijn en Sport (VWS) is located here and a lot of space in this parking garages is occupied by these offices. Because of this these two parking garages are not taken in this analysis. Figure 9 shows the results of the regression analysis.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,364	20,030	1	35	,000	878,779	,002

The independent variable is Numberofinhabitants.

Figure 9 Regression analysis parking performance and number of inhabitants

The coefficients of the regression line shows that the expected parking production is equal to 0,002*the number of inhabitants + 878,78. This means that for each extra inhabitant the parking production is expected to grow with 0,002. So there is a positive relation between parking production and the number of inhabitants. The ρ-value of 0,000 indicates that the relationship is significant. The relationship is quite strong. The value of R square is 0,364

[4] The percentage of short parking is respectively 39% and 41% of the total turnover for the Muzenplein and Helicon parking garages while the average percentage of the remaining parking garages is 79%

what means that 36,4 percent of the variation in the parking production is explained by the model. The relationship between parking production and the number of inhabitants is illustrated in figure 10. It is clear that the different parking garages are not equally scattered along the regression line. The most cities in the database have less than 200.000 inhabitants. The relationship within this category shows less strong. This is partly explained by the fact that there are in the database 8 parking garages located in Almere. The parking production differs strong between these parking garages while the number of inhabitants remains the same. If we do a regression analysis with the cities with 200.000 or less inhabitants, we get much less convincing results. In this case the relationship is insignificant with a ρ-value of 0,942 and a R square value of 0,000. So for this category of city size we can state that there is no significant relationship.

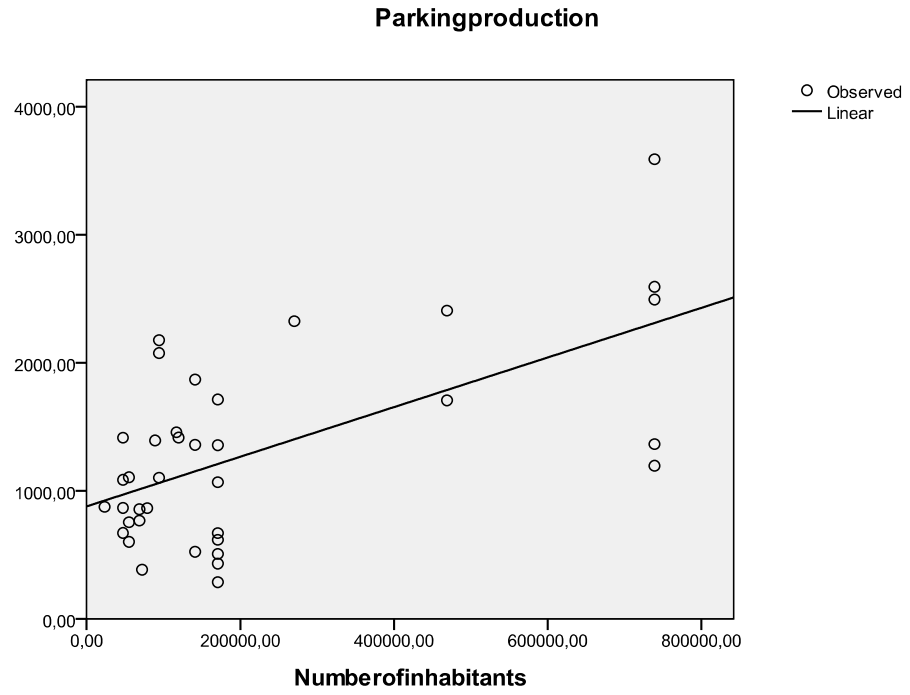

Figure 10 Relationship parking production and number of inhabitants

The conclusion of this part is that there is no convincing empirical support for the hypothesis. As we include all parking garages there is a significant and quite strong relationship. But most of the cities have 200.000 or less inhabitants and within this category the two variables are completely unrelated. The cities with more than 200,000 inhabitants has a relative too large influence on the regression line. So the assumption that there is a positive relationship between the number of inhabitants in a city and the performance of parking garages cannot be supported.

4.3 Population density and the performance of a parking garage

The assumption in this part of the research is that there is a positive relation between parking performance and density of population in the area where the parking garage is located. The argument is that if there live relative more people on a particular area there will be less space available for parking. Visitors of a very dense area will not find another parking possibility than the parking garage. The result will be a higher parking production in such areas. Another reason is that dense urban areas attract more people because the density of population gives several advantages. The wide range of people living within a small geographic area means that big cities offer access to desirable interpersonal relationships (Glaeser et al., 2001), for example. The sub hypothesis is: *H_2b: The parking production of parking garages is positively related with the population density.* Also in this analysis the parking garages Muzenplein and Helicon, The Hague are removed for the same reason as in part 4.2. These parking garages have a very low parking performance while they are located in an area with a high density of population. But because the space in these garages is occupied for a large part by the surrounding offices, there is much less space available for short parking. The results of the regression analysis are presented in figure 11.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,280	13,630	1	35	,001	464,713	,133

The independent variable is Densityofpopulation.

Figure 11 Regression analysis parking production and density of population

There exist a positive and significant relationship between parking production and density of population. The expected parking production by the model is the following: parking production = 0,133*number of inhabitants per km2 + 464,71. A parking garage located in a city area with 5500 inhabitants per km2 is expected to have a parking production of 1196 for example. The relationship is significant because the ρ-value is 0,001. The model explains for 28 percent the variation in parking production. The relationship between parking production and density of population is illustrated in figure 12.

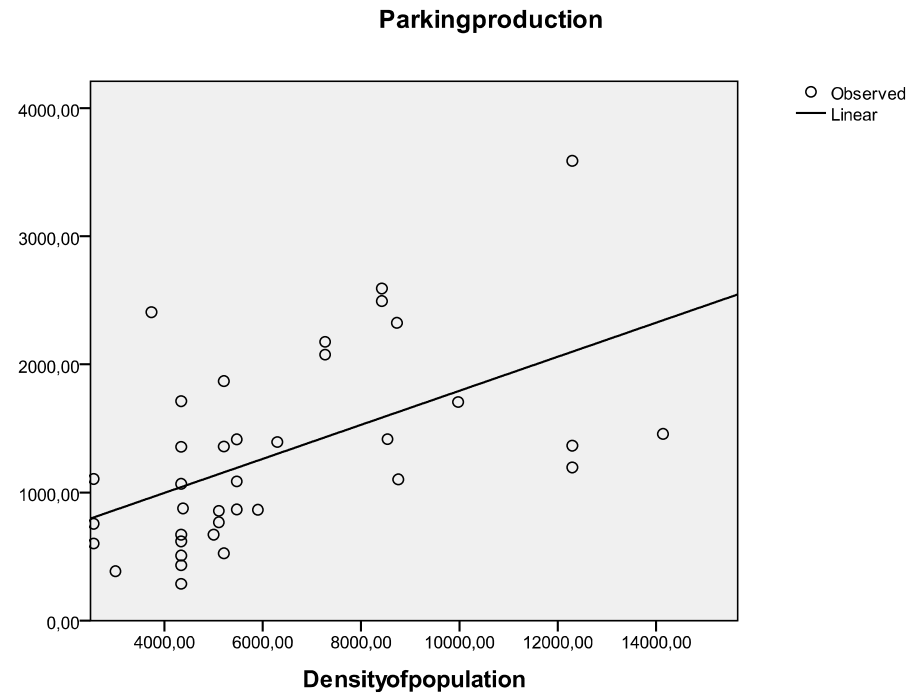

Figure 12 Relationship parking production and density of population

To conclude, there is a significant and positive relationship between parking production and the density of population.

4.4 Density of car ownership and the performance of a parking garage

The following urban characteristic is the density of car ownership in the postal code area where the parking garage is located. The assumption is that there is a positive relationship between the parking production of a parking garage and the number of owned cars per km2 in this area. This because all owned cars have to be parked somewhere. And in city centers most of the houses don't have sufficient parking place, so it is reasonable that people will park their car in a parking garage. Also in an urban area where people have relative a lot of cars the existing parking space near the houses will be used more intense. The result is that there is less space available for people who want their car for shopping or something else. These people are forced to park elsewhere, in parking garages for example. The sub hypothesis is: *H_2c: The parking production of parking garages is positively related with the density of car ownership.* The results of the regression analysis are showed in figure 12.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,101	4,172	1	37	,048	520,819	,342

The independent variable is Densityofcarownership.

Figure 13 Regression analysis parking production and density of car ownership

First, the ρ-value is 0,048. Because this value is below the standard alpha of 5 percent, the relationship is significant. However the difference with the maximum allowed value is very small so the significance level is not very convincing. The relationship is positive and the expected parking production by the model is: parking production = 0,342*number of owned cars per km2 + 520,819. For example, an urban area with 1500 cars owned per km2 is expected to have a parking production of 1034. Besides the relative high ρ-value, the relationship is also not strong. The value of R square is only 10,1 percent, so 10,1 percent of the variation in parking production is explained by the model. Based on this findings, we cannot state that there is a strong relationship between the density of owned cars and the production of a parking garage. A possible reason for this is the following. In the data used for this research only short parking information is used. People who park their car for a short

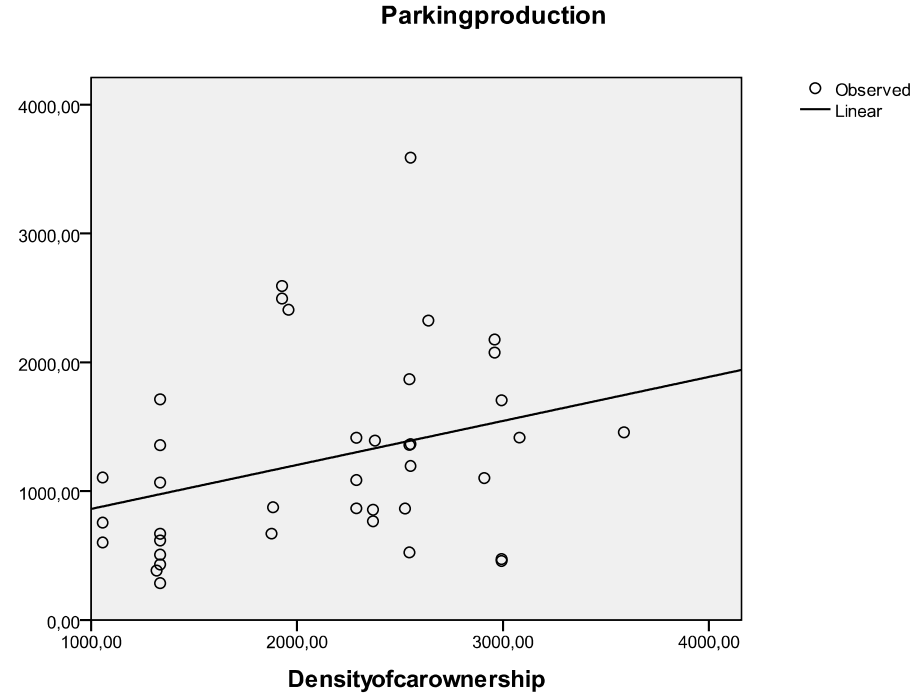

Figure 14 Relationship parking production and density of car ownership

time do this for shopping, visiting or another short time reason. And for people who have to park their car for a longer time, or each day, there is in the most of the parking garages a possibility to buy a long term ticket. This parking possibility is not taken into the database because this information was not available for a lot of parking garages. So the possible reason why this relationship becomes not clear is probably caused by the fact that people who own a car will use a long term ticket. The relation between parking production and the density of car ownership is illustrated in figure 15. It is clear that there is a slight positive relation, but the variation is very large.

The conclusion of this part of the research is that the relationship between parking production and the density of car ownership is not strong and the significance level is just below the maximum standard alpha of 5 percent. The empirical support is insufficient to prove a relationship. An possible explanation for this is that people who have a car and park it in a parking garage will use a long term ticket for a lower price.

4.5 Value of real estate and the performance of a parking garage

Another important urban characteristic is the value of real estate in the urban area where the parking garage is located. The value of real estate reflects the equilibrium between supply and demand. In general, the more attractive the city environment, the higher the real estate value. People are willing to pay a premium to live in the city center with a lot of services, famous buildings and so on. And such cities will attract also a lot of visitors and the result is a demand for parking. So the assumption here is that the higher the value of real estate in a urban area, the higher the demand for short parking. This results in the following sub hypothesis: *H_2d: The parking production of parking garages is positively related with the value of real estate.* In figure 16 are the results of the regression analysis presented.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,303	16,089	1	37	,000	-188,303	7,697

The independent variable is Realestatevalue.

Figure 15 Regression analysis parking production and real estate value

The relation between these variables is with a ρ-value of 0,00 significant. It is also a positive relation. The expected parking production by the model is: parking production = 7,697*real estate value – 188,303. This means that the parking production is expected to increase with 7,697 if the average real estate value increases with €1000,-. The relationship is also quite strong. The model explains 30,3 percent of the variation in parking production. The relationship between parking production and the real estate value is illustrated in figure 17.

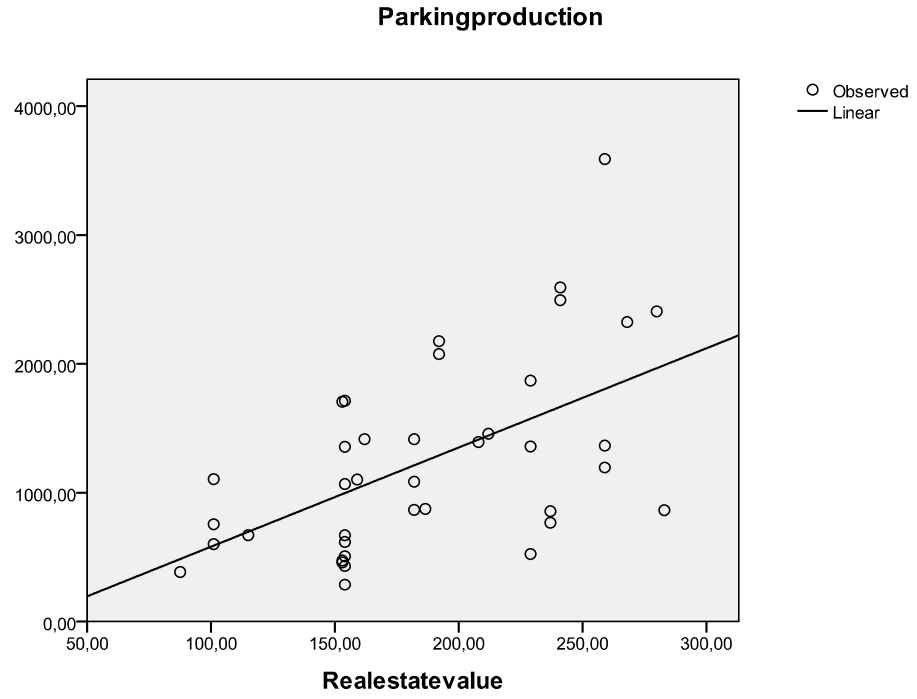

Figure 16 Relationship parking production and real estate value

So there is a clear positive relationship between the parking production of a parking garage and the real estate value in this urban area. So the assumption of a positive relationship is empirically supported. Interesting is also that in the urban areas with a high real estate value the tariff is also high. There is a positive and significant relationship, with a ρ-value of 0,00, between the tariff and the average value of real estate.

4.6 Percentage of built area and the performance of a parking garage

The last urban aspect in this chapter is the percentage of built area in the urban area where the parking garage is located. For this part the data of the CBS of ground utilization is used. CBS distinguish six forms of space utilizing. One of these forms is built area, area used for living, shopping and cultural purposes. The assumption here is that in an urban area with a high percentage of built area, there is a high demand for parking in garages. So I suspect a

positive relation between the parking production of a parking garage and the percentage of built area in a urban area. This because in urban areas where almost all of the space is used for shopping, housing and cultural purposes, there will be a high demand for parking. People who visit shops, who live there or people who visit the area for cultural sites will park their car. Also if a large part of the urban area is built, there will be less opportunities for car drivers to park their car elsewhere. In such situations is a parking garage the most likely option. This leads to the last sub hypothesis: *H_2e: The parking production of parking garages is positively related with the percentage of built area.* The results of the regression analysis are presented in figure 18.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,091	3,690	1	37	,062	-443,103	2108,034

The independent variable is Builtarea.

Figure 17 Regression analysis parking production and built area

There is no significant relation between these two variables. With a ρ-value of 0,062 the standard alpha level of 5 percent is exceeded. Also R square is very low. Only 9,1 percent of the variation in parking production is explained by the model. Because of this there is no empirical support found for the assumption that there is a positive relation between parking production and the percentage of built urban area. The relation between the production of the parking garages and the percentage of built area is showed in figure 19.

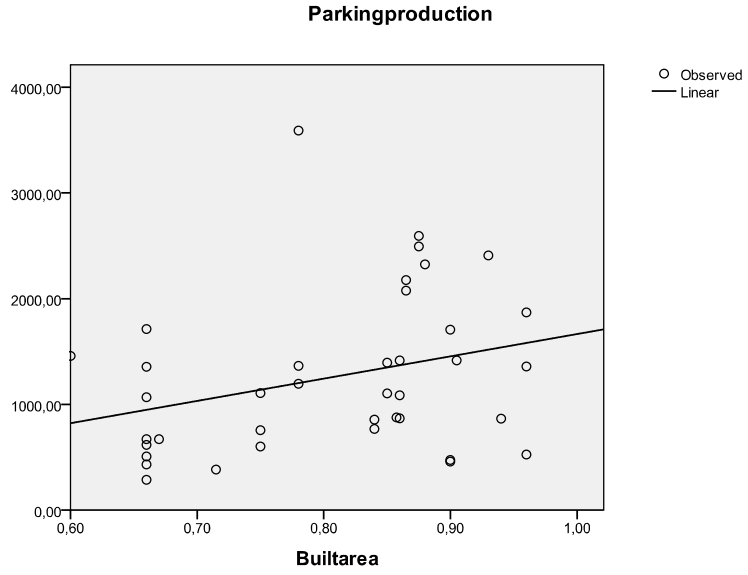

Figure 18 Relationship parking production and built area.

4.7 City size and population density and the performance of a parking garage

So far the different urban characteristics are tested in relation with the production of a parking garage. With urban characteristics like the number of inhabitants, population density, density of car ownership, the real estate value and the percentage of built area we are able to deal with the second main hypothesis: *H_2: The parking production of parking garages is positively related with the population density and size of a city.* The first sub hypothesis assumed a positive relationship between the number of inhabitants in a city and the performance of a parking garage. It seemed that there was a strong and significant relationship but a further focus on the data resulted in a insignificant relationship. So the number of inhabitants is not positively related with the production of a parking garage.

Two of the other results of the sub hypotheses were conform the assumptions. We found a positive and significant relation for the variables 'population density', and 'real estate value'. The variable 'density of car ownership' was not convincing, but a plausible reason for this is that car owners don't use short parking tickets. They will use long term tickets and this information is not used in the database. The last sub hypothesis was insignificant. The percentage of built area does not relate with the performance of a parking garage.

Based on these results, we can partly support the main hypothesis of this chapter. We can support that the parking production of parking garages is positively related with the population density and the real estate value. The other variables, the number of inhabitants, density of car ownership and the percentage of built area were insignificant or not convincing.

H5 Urban amenities and the performance of a parking garage

In the previous chapters the relationship between users parking costs and the performance of a parking garage is examined. Also the relationship among several city characteristics and the performance is tested. In this chapter I will focus on the more qualitative side of a city. It is important that a city is a pretty place to live. The quality of life will become increasingly critical in determining the attractiveness of particular areas (Glaesser et al., 2001). There are four critical urban amenities according to Glaesser et al (2001). The first and most obvious is the supply of different services and consumer goods. This are services like shops, restaurants and hotels. The second amenity is the architecture of the buildings. The third amenity are public goods like schools and health services. The last mentioned amenity is speed. This chapter is concentrated on the first amenity, the supply of different services and consumer goods. It is broadly recognized that amenities attract people. Glaesser et al (2001) mentioned an example of France where the relationship between population growth and the number of hotels per capita was examined. The demand for hotel rooms is a derived demand, like parking space. So the number of hotels reflect the attractiveness of a city. There was a strong positive relationship found between city growth and the number of hotel rooms. Because urban amenities attracts people, the result will be a demand for parking. So the assumption in this chapter is that there is a positive relationship between the quality of urban amenities and the production of a parking garage. This leads to the main hypothesis of this chapter:

H_3: The parking production of parking garages is positively related with the quality of urban amenities.

The sub hypotheses are:

H_3a: The parking production of parking garages is positively related with the density of commercial services

H_3b: The parking production of parking garages is positively related with the opening duration of shops

H_3c: The parking production of parking garages is positively related with the number of shops

H_3d: The parking production of parking garages is positively related with the amount of floor space of shops

5.1 Research method

Also in this chapter the database of 40 Dutch cities is used. The variable parking production is tested in relation with the variables density of commercial services, the opening duration of shops, the total number of shops and the amount of floor space of shops. The values of these variables are presented in table 2. The variable density of commercial services is measured by the number of commercial services per hectare in the city centers. The location of the city centers is given by the CBS based on postal codes (four digit). Commercial services are defined by the CBS. This are firms registered in the Standaard Bedrijfs Indeling (SBI) 50-74[5]. The second variable, opening duration of shops, is measured by the average opening times per week of four firms of the top 100 firms in the Netherlands. For each city the opening times of the shops Blokker, Vroom & Dreesman, Hema and Etos are measured[6]. This gives a good impression of the average opening duration of firms in a city. The last two variables, the total number of shops and the total floor space of shops are measured by Locatus. This are values for the whole cities and not specified on postal codes.

The city center of Amsterdam has the highest density of commercial services with 14,1 commercial services per hectare. Almelo has the lowest density with 1,6 shops per hectare. The average density is 6,79 commercial services per hectare. Shops in Amsterdam have also the longest opening duration with 59,75 hour per week. In Deventer the shops are opened the shortest, with 52,13 hour per week. The average opening duration is 55,64 hour per week. Amsterdam has also the most of the shops, 5869, while Terneuzen has 196 shops. The average number of shops is 1568. Not surprising is that for the total floor space of shops Amsterdam is also the highest. Oud Beijerland has the smallest total floor space. The average floor space of shops is 246450 m2.

In this chapter the parking garages Muzenplein and Helion, The Hague are not taken into the analyses for the same reason as in part 4.2. These parking garages are located in a urban area with a lot of shops while the parking performance is relative low caused by a high percentage of long term parkers. These parking garages are relative far more used for office and housing purposes than the other parking garages in the city.

Also for this part of the research linear regression is used to model the relation between parking production and the urban amenities. The standard alpha of 5 percent is used.

[5] See appendix IV

[6] The average opening duration per week per shop per place is presented in appendix III

5.2 Density of commercial activities and the performance of a parking garage

As already said, I suspect a positive relationship between the density of commercial activities and the production of parking garages. This because shops, restaurants and other economic services will attract visitors. A city with a flourishing economic centre will attract more visiting people and so more demand for parking garages. Because the term commercial activities comprise a whole range of economic activities it gives a good impression of the total supply of amenities in a city centre. The sub hypothesis is: *H_3a: The parking production of parking garages is positively related with the density of commercial services.* The results of the regression analysis are presented in figure 20.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,445	28,073	1	35	,000	373,330	125,478

The independent variable is Densityofcommercial.

Figure 19 Regression analysis parking production and density of commercial activities

With a ρ-value of 0,000 it is clear that there is a significant relationship. The relationship is also positive. The expected parking production by the model is the following formula: parking production = density of commercial activities*125,478 + 373,330. A city center with a density of commercial activities of 13 is expected to have a parking production of 2005, for example. There is also a strong relationship. R square has a value of 0,445 what means that 44,5 percent of the variation in parking production is explained by the model. That there is a positive and strong relationship becomes clear as we see figure 21.

It is also interesting to investigate if there exist a relationship between the tariff of a parking garage and the density of commercial services. In part 3.1 the conclusion was that there is no significant relationship between the parking production of a garage and the tariff. The relationship between the tariff and the density of commercial services is positive and significant with a ρ-value of 0,000. The value of R square is 0,523, what means that there is a strong relationship. Not surprisingly, urban areas with a high density of commercial activities seems to have a higher tariff.

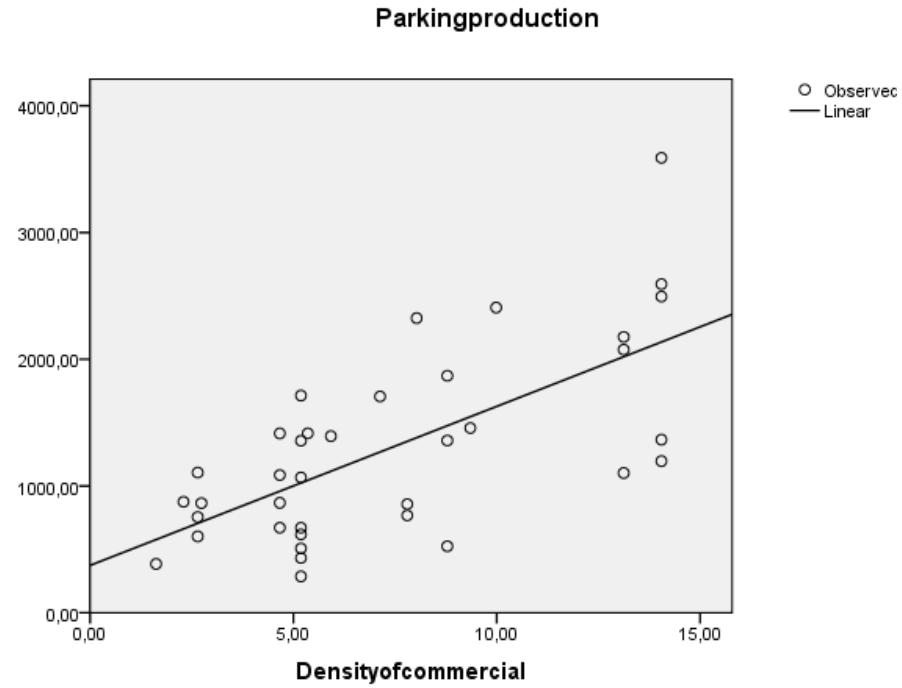

Figure 20 Relationship parking production and density of commercial activities.

In conclusion, the relationship between the density of commercial activities and the performance of a parking garage is positive, significant and strong. Cities with a higher density of commercial activities will have a higher parking production.

5.3 Opening duration of shops and the performance of a parking garage

The following aspect with regarding to economic urban activities is the opening duration of shops. In many discussions with retailers it becomes clear that they suspect more customers, and as a result, a higher turnover if they are opened longer. If a shop is longer opened, more people are possible to visit the shop. The result would be that there is in total a higher demand for parking space per day. This leads to the following sub hypothesis: *H_3b: The parking production of parking garages is positively related with the opening duration of shops.* Figure 22 presents the results of the regression analysis.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,184	7,900	1	35	,008	-6036,858	131,286

The independent variable is Openingduration.

Figure 21 Regression analysis parking production and opening duration of shops

The relationship between the opening duration of shops and the performance of parking garages is positive and also significant with a ρ-value of 0,008. Furthermore, there is a weak relationship. Only 18,4 percent of the variation in parking production is explained by the model. The expected parking production by the model is: parking production = 131,286*opening duration of shops per week – 6036,858. The relationship between the parking production and the opening duration of shops is illustrated in figure 23. There is a high variation in parking production for different opening durations. The parking garage Stadhuisgarage in Amsterdam seems to have a very large influence on the regression. This parking garages has a parking production of 3590 and the shops in Amsterdam are opened for 59,57 hours a week. If this parking garage is removed from the regression analysis the relationship remains significant with a ρ-value of 0,033. R square decreases to 0,127. The result is a significant but a very weak relationship. The conclusion of this regression analysis is that there is a significant relationship between these two variables, but the relationship is not strong. So the opening duration of shops seems not to have much influence on the production of parking garages.

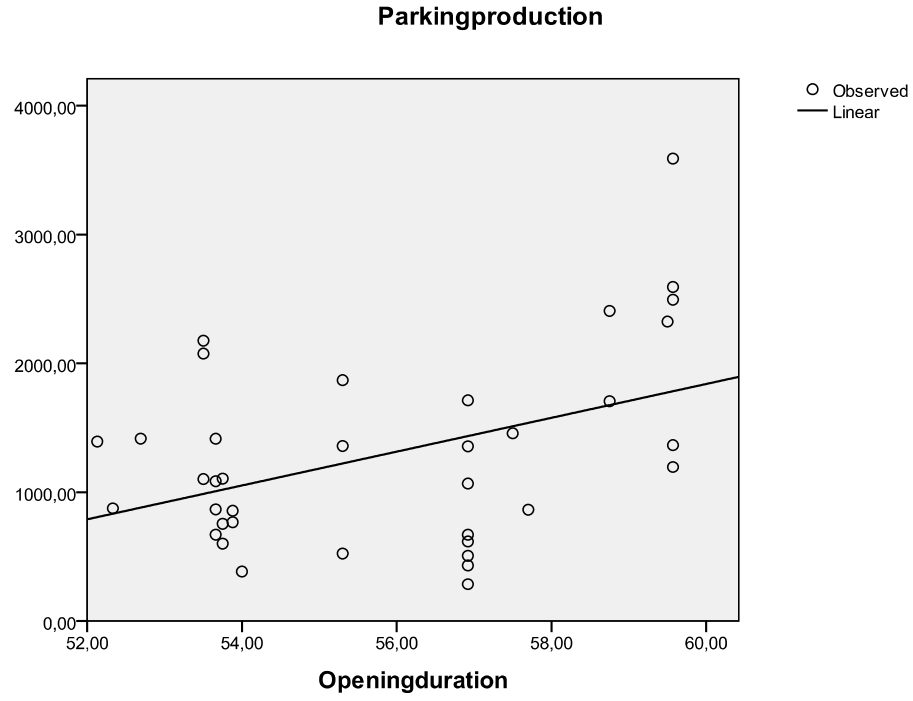

Figure 22 Relationship parking production and opening duration of shops per week

5.4 Total shops and the performance of a parking garage

This part is concentrated on the number of shops in a city. In part 5.2 were all economic activities involved, in this part only shops. The assumption here is the same: there is a positive relation expected between the performance of a parking garage and the number of shops in a city. The argument in favor of this is that more shops will attract more people. Also if there are more shops, we can assume more variety between shops. A city center with a complete range of different shops can serve more consumer segments. So in this part the following sub hypothesis will be tested: *H_3c: The parking production of parking garages is positively related with the number of shops.* Figure 24 shows the results of the regression analysis. The relationship between the parking production of a garage and the total number of shops is significant with a ρ-value of 0,000. The relationship is also positive with a slope of 0,247. For each extra shop in the city the parking production is expected to increase with 0,247. The expected parking production of the model is the formula: parking production = 0,247*total number of shops + 931,103. The value of R square is 0,409. This means that there is a strong relationship because 40,9 percent of the variation in parking production is explained by the model. So the total number of shops In a city and the performance of parking garages in that city are strongly related.

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,409	24,214	1	35	,000	931,103	,247

The independent variable is totalnumberofshops.

Figure 23 Regression analysis parking production and total number of shops

If we see the relationship between the total number of shops and the parking production in figure 25, it is clear that there is a positive relationship but the most parking garages are located in a city with less than 1000 shops. It is interesting to examine if we do the same regression analysis with this sample of parking garages. The results of this analysis are that the relationship remains significant, but the R square decreases to a much lower value of 20,7 percent. The problem here is that the city of Almere has 8 parking garages with a large

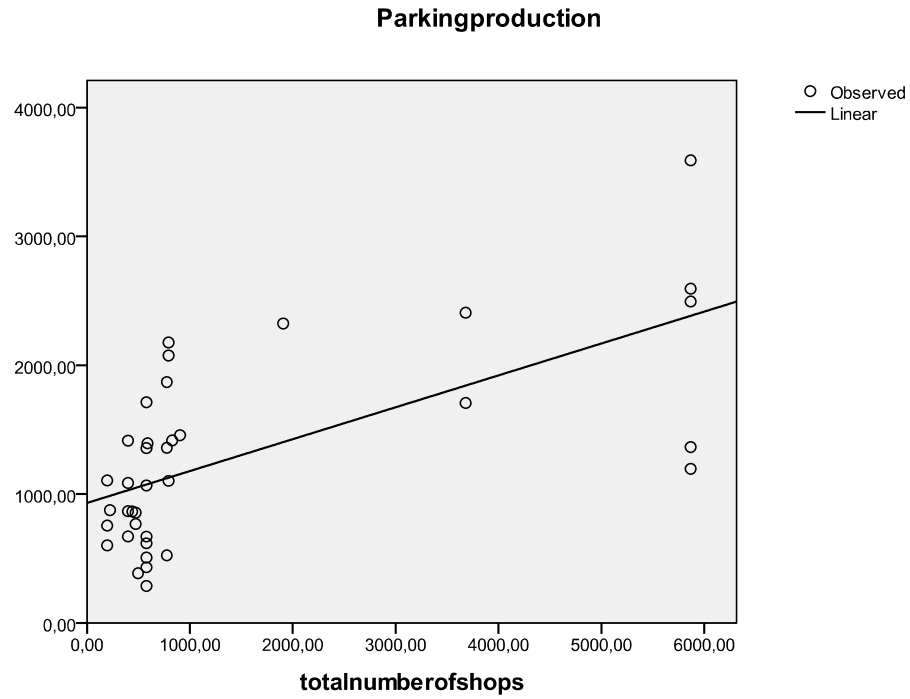

Figure 24 Relationship parking production and total number of shops

variation in parking production while the total number of shops is the same. Without the parking garages in Almere the relationship is also significant with a R square of 0,337. The number of parking garages in this group decreases to 20. This number is too small to give a conclusion, but it indicates a strong, positive and significant relationship. So there exist a positive and significant relationship between the total number of shops in a city and the performance of a parking garage. A disadvantage of the used variable in this part, the total number of shops in a city, is that the different parking garages in a city cannot be compared. Because it is unknown where the shops are located it is not possible to focus on specific characteristics of the relationship between parking garages and shops. But because in common the most shops in cities are located in the city centre it seems not a large problem. It is also possible to separate the total number of shops into daily shops and non daily shops. Daily shops are supermarkets and personal care shops. Non daily shops are shops like shoe shops, clothing shops, department shops and furniture shops. It is interesting to examine if there is a different in the relationship between these two shop types and the parking performance of a garage. The relationship between the parking production and the total number of daily shops is significant and positive. The value of R square is 0,397. The formula of the predicted parking production is: parking production = 0,774* total number of daily shops + 970,272. The relationship with the total number of non daily shops is also strong.

This relationship is also significant and positive. The value of R square is 0,414. The predicted parking production by the model is: parking production = 0,363*total number of non daily shops + 913,060. If the two relationships are compared, we can see that the relationship between the parking production and the total number of non daily shops is somewhat stronger. But the influence of one extra shop on the parking production is higher with daily shops. With the addition of one daily shop the parking production is expected to increase with 0,774, while with an addition of one non daily shop the parking production is expected to increase with 0,363. So daily shops seem to generate more parking demand than non daily shops.

To conclude this part, we found empirical support for the hypothesis that there is a positive relationship between the total number of shops in a city and the performance of a parking garage.

5.5 Floor space of shops and the performance of a parking garage

The last part of this chapter is concentrated on the amount of floor space of shops. Besides the number of shops, it is also important to investigate the size of the shops. A city center can have hundreds of small shops, while another city center has only a few but very large shops. Larger shops will attract more people and so generate a higher demand for space in parking garage. The assumption here is that there is a positive relationship between the size in retail space in m2 and the performance of a parking garage. So the sub hypothesis is: *H_3d: The parking production of parking garages is positively related with the amount of floor space of shops.* The results of the regression analysis are presented in figure 26. There is a positive and significant relationship with a ρ-value of 0,000 between the amount of floor space of shops and the performance of parking garages. The relationship is also strong with a R square value of 0,451. So 45,1 percent of the variation in the parking production is explained by the model. The predicted parking production by the model is: parking production = 0,002 *amount of retail floor space in m2 + 734,999. So for each extra meter of shop space the production of a parking garage is expected to increase with 0,002. This means that the number of sold hours per parking space per year is expected to increase with 1 if the amount of retail floor space in the city will increase with 500 m2.

The relationship between the amount of floor space of shops in a city and the production of a parking garage is showed in figure 27. It is clear that there is a positive relationship, but

Model Summary and Parameter Estimates

Dependent Variable:Parkingproduction

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,451	28,754	1	35	,000	734,999	,002

The independent variable is totalshoparea.

Figure 25 Regression analysis parking garage and amount of floor space of shops

most of the shops has a floor space below or around 200.000 m2. A regression analysis for this group of shops gives a insignificant relationship with a very low R square value. This effect is caused by the parking garages in Almere, already mentioned in part 5.4. Without

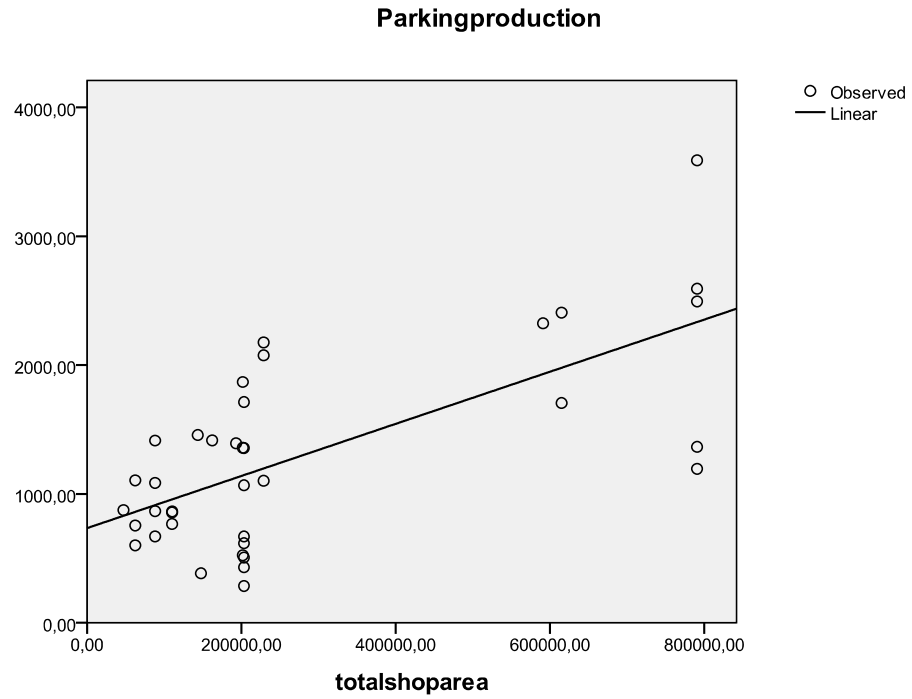

Figure 26 Relationship parking production and amount of floor space of shops

these parking garages the results of the regression are a significant relationship with a ρ-value of 0,006 and a R square value of 0,338. Because the number of parking garages in this regression analysis is 20, it is insufficient to give a conclusion for this sub group. This result support the first analysis of the complete dataset. For the whole dataset we can conclude that there is a positive, strong and significant relationship between the amount of floor space of shops and the performance of a parking garage.

Also for the amount of floor space of shops it is possible to divide the data into floor space of shops for daily consumption and floor space for non daily consumption. For daily

consumption the regression analysis shows that there is a significant and positive relationship with a ρ-value of 0,000. The strength of the relationship, measured by R square, is 0,444. This indicates a strong relationship, because 44,4 percent of the variation in parking production is explained by the model. The predicted parking production by the model is: parking production = 0,007*amount of floor space of shops for daily consumption + 834,672. This means that the parking production is expected to increase with one if the amount of floor space for daily consumption is expanded by 143m2. Also the regression analysis for non daily consumption gives a significant and positive relationship with a ρ-value of 0,000. The 'value of R square is about the same with 0,436. The following formula presents the predicted parking production by the model: parking production = 0,003 * amount of floor space of shops for non daily consumption + 719,486. So the amount of floor space for non daily consumption has to increase with 333 if the parking production will increase with 1.
If these two analysis are compared, it becomes clear that floor space for daily consumption generates a higher parking production than floor space for non daily consumption.
The conclusion of this part is that there exist a positive, strong and significant relationship between the amount of floor space of shops and the performance of a parking garage.

5.6 Number of urban amenities and the performance of a parking garage

To define the quality of urban amenities the variables 'density of commercial services', 'opening duration of shops', 'the total number of shops' and 'the total amount of floor space of shops' were used. After the regression analyses of these variables in relation with the production of parking garages, we can concentrate on the main hypothesis of this chapter:
H_3: The parking production of parking garages is positively related with the quality of urban amenities.
The first important aspect is that all the relationships were positive and significant. The first examined variable, the density of commercial services, comprises a whole range of commercial activities, from restaurant to a car rental firm. So this variable includes the most different urban amenities. The third and fourth variables, the total number of shops and the total amount of floor space of shops, are only concentrated on shops. These three variables show a strong, positive and significant relationship. So both the density of economic activities, the total number and the total floor space of shops explain a large part of the performance of a parking garage. The variable 'opening duration of shops' seems of much

less importance on the level of the parking production of a garage . The relationship is significant, but not strong.

Based on these findings we can conclude that there is empirical support for the hypothesis that assumes a positive relationship between the quality of urban amenities and the performance of a parking garage. The number and size of shops and the concentration of commercial activities are strongly related and have a large influence on the performance of a parking garage, while the opening duration of shops seems much less important.

Chapter 6. Conclusions and recommendations

The goal of this research was to find relationships among the performance of a parking garage, measured by the parking production of a garage, and different kind of variables: the users parking costs, general urban characteristics and characteristics of the commercial activities in a city or city center. It is very important to know if there are relationships between these variables for different reasons. First, the costs of constructing and operating a parking garage are very high. And secondly, in order to reduce parking problems in city centers, the parking garage has to be a attractive place to park. So it is important to investigate what factors has an influence on the performance of a parking garage and what factors has not or little influence. The research question is: What is the relation among the performance of a parking garage, the users parking costs and the characteristics of the urban environment? To answer this research question, three main hypotheses were tested. For the research a database of 40 Dutch parking garages was used.

6.1 Conclusions

In the first part of the research the relationship between the performance of a parking garage and the users parking costs was tested. The hypothesis was: *H_1: The parking production of parking garages is negatively related with users parking costs*. A negative relationship was assumed because rational people prefer a parking place with the lowest users costs. The users parking costs consist of two parts, the parking tariff and the walking time to the final destination. For the relationship between the parking production of a garage and the tariff it became clear that there exist no negative relationship. Also there was no significant relationship found for the production of a garage and the walking time to the final destination. Because the variables walking time and the parking tariff were not related, there was no multicollinearity. So the result of this first part was that there is no empirical support for hypothesis 1. It is not proved that the parking production of parking garages is negatively related with users parking costs.

In the second part the relationship among the performance of a parking garage and several city characteristics was analyzed. The hypothesis was*: H_2: The parking production of parking garages is positively related with the population density and size of a city.* The assumption was that large and concentrated cities will attract a lot of visitors and that the space in cities

is used as efficient as possible. The result would be the supply of parking in parking garages and a relative large demand for parking. The tested variables were 'number of inhabitants', 'the population density', 'the density of car ownership', 'the value of real estate' and 'the percentage of built area'. Two of the tested variables showed a significant and positive relation with the production of a parking garage. These variables were 'the population density' and 'the value of real estate'. The other tested variables showed a insignificant or a not convincing relationship. So there is only partly empirical support for the hypothesis in this part of the research.

In the last part a positive relationship between the quality of urban amenities and the performance of a parking garages is assumed. This because urban amenities like shops and restaurants will attract people and finally give a demand for parking. The hypothesis is: *H_3: The parking production of parking garages is positively related with the quality of urban amenities.* The quality of urban amenities in this research is measured by the following variables: 'the density of commercial services' in the city center, the opening duration of shops in the city center, 'the number of shops' in the city and 'the amount of floor space of shops' in the city. The result of the analysis was that all variables were positively and significant related with the performance of a parking garage. However, the opening duration of shops seems of little importance on the performance of parking garages. But in total there is a very clear and convincing support for the hypothesis that there is a positive relationship between the parking production of parking garages and the quality of urban amenities.

6.2 Recommendations

After these analyses we have proved a number of relationships with regarding to the performance of a parking garage. A very important task is to translate these findings into recommendations for the parking industry. The main question here is: what can we do with these results? As already mentioned the construction and operating of parking garages can be done by private parties, like Qpark, or by public parties, the city governments. Some of the recommendations are dealing with the development of new parking garages and some are dealing with the operating of existing parking garages.

In my opinion, the most important finding is the relationship between the urban amenities and the performance of a parking garage. There is a strong relationship between the concentration of commercial services in city centers and the production of a parking garage.

Also the relationships between the number of shops and the amount of floor space of shops in a city and the parking production of garages is strong. So the number of shops, the size of shops, and the concentration of commercial services seem to have a large influence on the production of parking garages. A relevant aspect here is that the opening duration of shops has a weak relationship with the performance of parking garages. So this variable is not important in the decision where to locate a parking garage. Because the commercial services are a broad range of firms, it is difficult to say what kind of commercial services has to be present in a city center. But it is reasonable that this are all kind of different shops and restaurants as important factors. For the variables 'number of shops' and 'amount of floor space of shops' it was possible to divide the data into daily shops and non-daily shops. The result was that the relationship between daily shops and the production of parking garages was a bit stronger than the relationship between non daily shops. These findings form a main criteria for the investment in a new parking garage. The formulas of the predicted parking production for these variables are:

parking production = 125,478*density of commercial activities + 373,330

parking production = 0,247*total number of shops + 931,103

parking production = 0,002*amount of retail floor space in m2 + 734,999

The first formula implicates that the production of a parking garage is predicted to increase with 125,478 if the number of commercial activities per hectare increases with one. A city center with 10 shops per hectare generate a parking production of 1628,11 (125,478*10 + 373,33).

The second formula predict an increase of 0,247 in parking production for each extra shop in the city. In a city where 800 shops are located is the predicted parking production 1128,7 (0,247*800 + 931,103).

The third formula implicates that for each extra m2 in retail floor space an increase of 0,002 in parking production is expected. If the total amount of retail floor space is 150,000m2 in a city, the predicted parking production is 1034,99 (0,002*150,000 + 734,999).

For the development of a new parking garage or for the acquisition of a parking garage it is crucial to know these values in order to make the right decisions.

Another important result is the proved relationship between the real estate value and the production of parking garages. Parking garages located in an urban area with relative expensive buildings perform better than garages located in an urban area with relative

cheaper buildings. Such areas with historical buildings or modern architecture seem to attract more people. The formula of the predicted parking production for this variable is:

parking production = 7,697*real estate value – 188,303.

This means that the parking production of a garage is expected to increase with 7,697 if the average value of the real estate increases with €1000,-. If a parking garage is located in a area where the average real estate value is €275,000, the predicted parking production is 1928,372 (7,697*275 – 188,303), while a parking garage located in an area with a average real estate value of 125,000 will generate a production of 773,822 (7,697*125 – 188,303). So the average value of real estate in an urban area is a influential factor on the performance of a parking garage.

A different urban characteristic is the population density in the area where the parking garage is located. Parking garages located in an area with a relative high number of population per km2 perform relative better. The formula of the predicted parking production for this variable is:

parking production = 0,133*number of inhabitants per km2 + 464,71

A parking garage located in an urban area with a population density of 8000 inhabitants per km2 will generate a production of 1528,71 (0,133*800 + 464,71)

This are the variables positively related with the parking production of a garage. For the development of a parking garage I should recommend to focus first on the commercial activities in the city and especially in the city center. After that, I would select that location with the highest real estate value. The last aspect is the density of population. But it are not only that variables with a positive and significant relationship we have to consider. Also the variables with no relationship can have important implications for the parking industry. This is the case for the users parking costs, consisting of the parking tariff and the walking time to the final destination.

There is no support for the assumption that there is a negative relationship between the parking tariff and the production of a parking garage. This can we prove for the tariffs with a maximum of €4,00 per hour. This provide some interesting recommendations. First, for operating a parking garage, don't be afraid to increase the tariff. In my opinion, an increase with 5 or 10 percent would not result in a lower demand for short parking. It is not the tariff why people park their car, it are other factors. Second, the tariff is not a good instrument to improve the performance of a parking garage. The underperformance of a parking garage

has probably other reasons. Third, there is no price competition needed between different parking garages in a city. A parking garage can better invest in better services or a pretty image than waste money by competition on price.

There is also no relation found between the walking time to the final destination and the production of a parking garage. The most parking garage were located within 10 minutes walking time to the final destination. So we can state that it don't matter for a parking garage to locate at a short distance from the final destination. For short parking purposes a walking time of 10 minutes don't seem to be a problem. This implicates for the development of a parking garage that it can be optimal to locate at some distance from the direct city center. In general the land value close to the shops is much higher than the land value at some distance from the core area.

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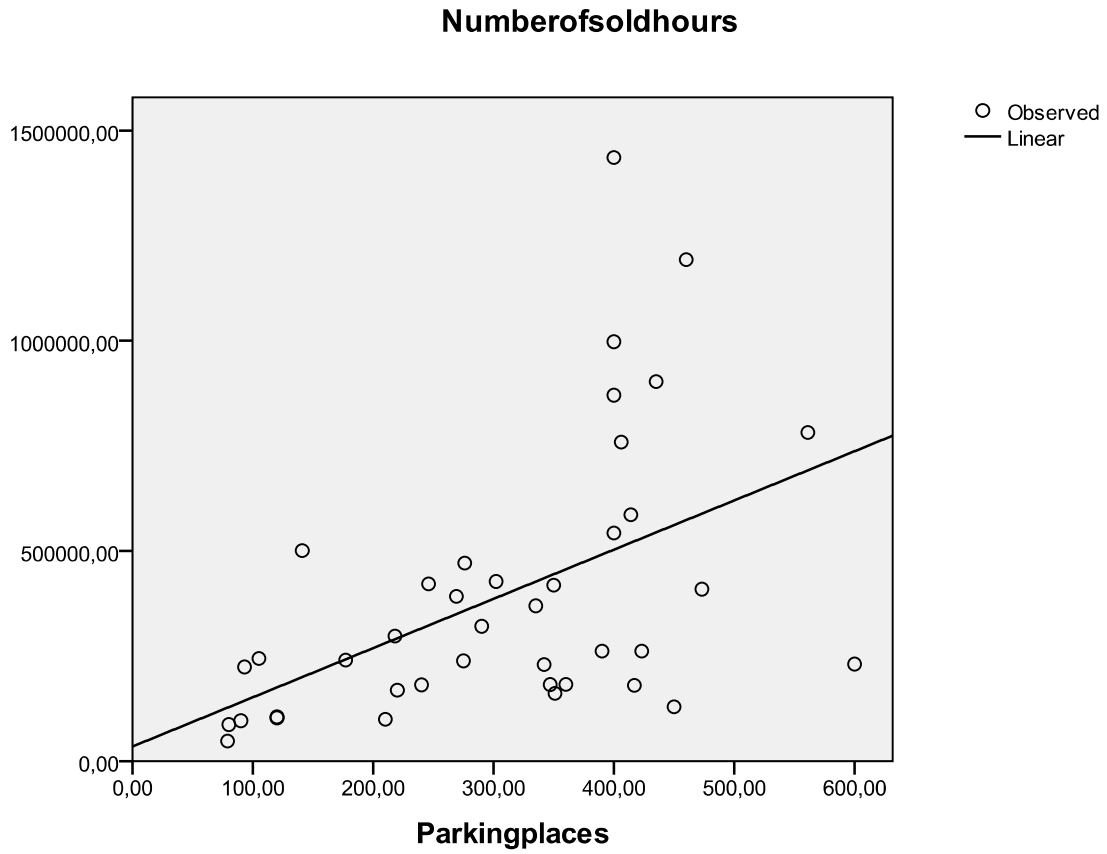
Appendix I

Model Summary and Parameter Estimates

Dependent Variable:Numberofsoldhours

	Model Summary					Parameter Estimates	
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	,245	12,345	1	38	,001	34687,750	1170,999

The independent variable is Parkingplaces.



Appendix II

City:	Name:
Alkmaar	De Karpeton
Alkmaar	De Vest
Alkmaar	Singelgarage
Alkmaar	Kanaalschiereiland
Almelo	Hagenborch
Almere	Metropolegarage
Almere	Muntgarage
Almere	Flevogarage
Almere	Leerlinggarage
Almere	Krakelinggarage
Almere	Schoutgarage
Almere	Regisseurgarage
Almere	Schippergarage
Amersfoort	Flintplein
Amersfoort	Koestraat
Amersfoort	Stadhuisplein
Amstelveen	V&D
Amsterdam	Stadhuisgarage
Amsterdam	Amsterdam Centraal
Amsterdam	Markenhoven
Amsterdam	Waterlooplein
Amsterdam	De Kolk
The Hague	Spui
The Hague	Muzenplein
The Hague	Helicon
The Hague	Noordeinde
Deventer	Seisenbaan
Dordrecht	Drievriendenhof
Hoorn	Park/Schouwburg

Hoorn	Jeugdje
Leiden	Haarlemmerstraat
Middelburg	Kanaalweg
Middelburg	Kousteensedijk
Middelburg	Achter de houttuinen
Middelburg	Geere
Oud Beijerland	De Veiling
Terneuzen	Oostkolk
Terneuzen	Axelsedam
Terneuzen	Theaterplein
Utrecht	Kruisstraat

Appendix III

City	Shop	Location	Opening duration	Walking time A	Walking time E	Walking time B	Walking time C	Walking time D
Amsterdam	Blokker	Damrak	68	10	11	2	16	10
	Blokker	Kalverstraat	57,5	12	11	7	16	11
	V&D	Kalverstraat	58	12	11	7	16	11
	Hema	Kalverstraat	61,5	12	11	7	16	11
	Hema	Nieuwendijk	61	1	13	1	17	10
	Etos	Kalverstraat	56	12	11	7	16	11
	Etos	Nieuwendijk	55	1	13	1	17	10

				A
Amstelveen	Blokker	Binnenhof	57	3
	V&D	Buitenplein	53,5	2
	Hema	Binnenhof	54,5	3
	Etos	Binnenhof	59,5	7
	Etos	Rembrandhof	64	4

				A
Deventer	Blokker	Lange bisschopstraat	52	4
	V&D	Brink 11	53	3
	Hema	Korte bisschopstraat	52	4
	Etos	Korte bisschopstraat	51,5	4

				A			
Oud Beijerland	Blokker	Oostdijk 39-41	50	5			
	Hema	Oost Voorstraat	54	2			
	Etos	Veilingpassage	53	4			
				A			
Dordrecht	Blokker	Statenplein 129	57	2			
	V&D	Voorstraat 258	47,25	4			
	Hema	Bagijnhof 15	55,5	2			
	Etos	Statenplein 44	51	3			
				A			
Utrecht	Blokker	achter clarenburg	57,5	14			
	Etos	Steenweg	53,5	12			
	Etos	Voorstraat	73	7			
	Etos	Godebaldkwartier	59	17			
	V&D	Rijnkade	56,5	13			
	Hema	Steenweg	53	12			
	Hema	Godebaldkwartier	64	15			
				C	D	B	A
Den Haag	Hema	Grote Marktstraat	59	7	5	5	9
	Blokker	Spuistraat	58	7	7	6	10
	Etos	Spuistraat	57	7	7	6	10
	V&D	Spui	61	8	1	4	7

				A	B	C	D	E	F	G	H
Almere	Hema	De diagonaal	59,5	3	4	8	7	6	7	4	8
	Blokker	Korte promenade	57	4	3	3	6	2	6	5	4
	Blokker	Corridor	55	2	4	9	10	7	10	2	9
	Etos	De diagonaal	57	3	4	8	7	6	7	4	8
	Etos	Stationsstraat	53	8	7	5	2	4	2	9	4
	V&D	Citadel	60	2	2	7	8	4	8	4	6

				A
Almelo	Hema	De Galerij 14	50,5	5
	Blokker	Grotestraat	52	4
	Etos	Grotestraat	54	4

				B	C	A
Terneuzen	Hema	Havenstraat 7	52	3	8	5
	Blokker	Arsenaalstraat 2	55,5	3	5	6

				B	A	C
Amersfoort	Blokker	St. Jorisstraat 65	57,5	4	11	1
	Hema	Utrechtsestraat 16	54,5	4	12	4
	V&D	Utrechtsestraat 25-37	52,5	4	12	4
	Etos	Langestraat 3	56	3	10	3
	Etos	St.Jorisplein 28	56	5	13	3

				B	A
Hoorn	Blokker	Breed 41-43	53,25	8	16
	Hema	Gouw 4-14	55,25	5	20
	V&D	Grote Noord 68-70	53,75	7	17
	Etos	Grote Noord 134	53,25	9	16

				A			
Leiden	Blokker	Haarlemmerstraat 145	59,5	6			
	V&D	Aalmarkt 22	57,5	7			
	Hema	Haarlemmerstraat 130	59,5	6			
	Etos	Haarlemmerstraat 113	55,5	8			
	Etos	Donkersteeg 11	55,5	7			

				B	D	A	C
Middelburg	Blokker	Lange delft 12	54	5	8	9	13
	Hema	Lange delft 31	54	5	7	9	12
	Etos	Lange delft 21	53	5	8	9	13

				A	D	B	C
Alkmaar	Blokker	Lanstraat 84	57	6	6	5	7
	V&D	Laat 143	52,5	5	6	9	11
	Hema	Langstraat 72	54	6	6	5	7
	Etos	Langstraat 46	50,5	4	7	7	9

Appendix IV

50 Handel in en reparatie van auto's en motorfietsen; benzineservicestations
501 Handel in en reparatie van auto's (1)
5010 Handel in en reparatie van auto's (1)
5010.1 Import van nieuwe bedrijfsauto's
5010.2 Import van nieuwe personenauto's
5010.3 Handel in en reparatie van bedrijfsauto's (geen import van nieuwe)
5010.4 Handel in en reparatie van personenauto's (geen import van nieuwe)
5010.5 Handel in aanhangwagens, opleggers e.d.
502 Handel in en reparatie van auto's (2)
5020 Handel in en reparatie van auto's (2)
5020.1 Auto-onderdelenservicebedrijven
5020.2 Bandenservicebedrijven
5020.3 Reparatie van specifieke auto-onderdelen
5020.4 Carrosserieherstel
5020.5 Overig onderhoud en slepen van auto's
503 Handel in auto-onderdelen en -accessoires
5030 Handel in auto-onderdelen en -accessoires
5030.1 Groothandel en handelsbemiddeling in auto-onderdelen en -accessoires
5030.2 Groothandel en handelsbemiddeling in banden
5030.3 Detailhandel in auto-onderdelen en -accessoires
504 Handel in en reparatie van motorfietsen en onderdelen en accessoires daarvan
5040 Handel in en reparatie van motorfietsen en onderdelen en accessoires daarvan
5040.1 Groothandel en handelsbemiddeling in motorfietsen en onderdelen en accessoires daarvan
5040.2 Detailhandel in en reparatie van motorfietsen en onderdelen en accessoires daarvan
505 Benzineservicestations
5050 Benzineservicestations
51 Groothandel en handelsbemiddeling (niet in auto's en motorfietsen)
511 Handelsbemiddeling
5111 Handelsbemiddeling in landbouwproducten, levende dieren, textielgrondstoffen en -halffabrikaten en grondstoffen voor de voedings- en genotmiddelenindustrie
5112 Handelsbemiddeling in brandstoffen, ertsen, metalen en chemische producten
5113 Handelsbemiddeling in hout, vlakglas, sanitair en bouwmaterialen
5114 Handelsbemiddeling in machines, technische benodigdheden, schepen en vliegtuigen
5115 Handelsbemiddeling in meubels, huishoudelijke artikelen en ijzerwaren
5116 Handelsbemiddeling in kleding, overig textiel, schoeisel en lederwaren
5117 Handelsbemiddeling in voedings- en genotmiddelen
5118 Gespecialiseerde handelsbemiddeling in overige goederen
5119 Niet-gespecialiseerde handelsbemiddeling
512 Groothandel in landbouwproducten en levende dieren
5121 Groothandel in granen, zaden en veevoeder
5121.1 Groothandel in granen
5121.2 Groothandel in zaden, pootgoed en peulvruchten
5121.3 Groothandel in hooi, stro en ruwvoeder
5121.4 Groothandel in meng- en krachtvoeder
5121.5 Groothandel in veevoeder (geen ruw-, meng- en krachtvoeder)
5121.6 Groothandel in ruwe plantaardige en dierlijke oliën en vetten en oliehoudende grondstoffen
5121.7 Groothandel in akkerbouwproducten en veevoeder algemeen assortiment
5121.8 Groothandel in overige akkerbouwproducten
5122 Groothandel in bloemen en planten

5123 Groothandel in levende dieren
5123.1 Groothandel in levend vee
5123.2 Groothandel in huisdieren, siervissen, siervogels en wilde dieren
5124 Groothandel in huiden, vellen en leder
5124.1 Groothandel in huiden en vellen
5124.2 Groothandel in leder en -halffabrikaten
5125 Groothandel in ruwe tabak
513 Groothandel in voedings- en genotmiddelen
5131 Groothandel in groenten, fruit en consumptieaardappelen
5131.1 Groothandel in groenten en fruit
5131.2 Groothandel in consumptieaardappelen5132 Groothandel in vlees en vleeswaren, pluimvee, wild en gevogelte (geen levende dieren)
5132.1 Groothandel in pluimvee, wild en gevogelte (geen levende dieren)
5132.2 Groothandel in vlees en vleeswaren
5133 Groothandel in zuivelproducten, eieren, spijsoliën en -vetten
5133.1 Groothandel in zuivelproducten, spijsoliën en -vetten
5133.2 Groothandel in eieren
5134 Groothandel in dranken
5135 Groothandel in tabaksproducten
5136 Groothandel in suiker, chocolade en suikerwerk
5137 Groothandel in koffie, thee, cacao en specerijen (geen ruwe tropische producten)
5138 Gespecialiseerde groothandel in overige voedings- en genotmiddelen
5138.1 Groothandel in snacks
5138.2 Groothandel in vis, schaal- en weekdieren
5138.3 Gespecialiseerde groothandel in overige voedings- en genotmiddelen n.e.g.
5138.4 Groothandel in bakkerijgrondstoffen
5138.5 Groothandel in overige grondstoffen en halffabrikaten voor de voedings- en genotmiddelenindustrie
5139 Groothandel in voedings- en genotmiddelen algemeen assortiment
514 Groothandel in overige consumentenartikelen
5141 Groothandel in kledingstoffen, fournituren en huishoudtextiel
5141.1 Groothandel in kledingstoffen en fournituren
5141.2 Groothandel in huishoudtextiel (beddengoed inbegrepen)
5142 Groothandel in kleding, schoeisel en modeartikelen
5142.1 Groothandel in bovenkleding
5142.2 Groothandel in werkkleding
5142.3 Groothandel in onderkleding
5142.4 Groothandel in schoeisel
5142.5 Groothandel in modeartikelen
5142.6 Groothandel in textielwaren algemeen assortiment
5143 Groothandel in elektrische huishoudelijke apparaten, audio- en videoapparaten, beeld- en geluidsdragers en verlichtingsartikelen
5143.1 Groothandel in elektrische huishoudelijke apparaten (witgoed)
5143.2 Groothandel in audio- en videoapparaten
5143.3 Groothandel in beeld- en geluidsdragers
5143.4 Groothandel in verlichtingsartikelen
5143.5 Groothandel in overige elektrische huishoudelijke apparaten
5144 Groothandel in glas-, porselein- en aardewerk, behang en reinigingsmiddelen
5144.1 Groothandel in glas-, porselein- en aardewerk
5144.2 Groothandel in behang
5144.3 Groothandel in was-, poets- en reinigingsmiddelen
5145 Groothandel in parfums en cosmetica

5146 Groothandel in farmaceutische producten, medische en tandheelkundige instrumenten, verpleegartikelen en laboratoriumbenodigdheden
5146.1 Groothandel in farmaceutische producten
5146.2 Groothandel in medische en tandheelkundige instrumenten, verpleeg- en orthopedische artikelen en laboratoriumbenodigdheden
5147 Gespecialiseerde groothandel in overige non-food consumentenartikelen n.e.g. (1)
5147.1 Groothandel in sportartikelen (geen watersportartikelen)
5147.2 Groothandel in watersportartikelen
5147.3 Groothandel in kampeerartikelen
5147.4 Groothandel in speelgoed
5147.5 Groothandel in optische artikelen
5147.6 Groothandel in juweliersartikelen en uurwerken
5147.7 Groothandel in fotografische artikelen
5147.8 Groothandel in muziekinstrumenten
5147.9 Groothandel in huismeubilair
5148 Gespecialiseerde groothandel in overige non-food consumentenartikelen n.e.g. (2)
5148.1 Groothandel in woningtextiel en vloerbedekking
5148.2 Groothandel in huishoudelijke artikelen
5148.3 Groothandel in papier- en kartonwaren (geen verpakkingsmateriaal)
5148.4 Groothandel in boeken, tijdschriften en ander drukwerk
5148.5 Groothandel in kantoor- en schoolbenodigdheden (geen schoolboeken, kantoormeubels en -machines)
5148.6 Groothandel in fietsen en bromfietsen
5148.7 Groothandel in overige non-food consumentenartikelen n.e.g.
515 Groothandel in intermediaire goederen (geen agrarische), afval en schroot
5151 Groothandel in brandstoffen en andere minerale olieproducten
5151.1 Groothandel in vaste brandstoffen
5151.2 Groothandel in vloeibare en gasvormige brandstoffen
5151.3 Groothandel in minerale olieproducten (geen brandstoffen)
5152 Groothandel in metalen en metaalertsen
5152.1 Groothandel in metaalertsen
5152.2 Groothandel in ferrometalen en -halffabrikaten
5152.3 Groothandel in non-ferrometalen en -halffabrikaten
5153 Groothandel in hout en bouwmaterialen
5153.1 Groothandel in hout en plaatmateriaal
5153.2 Groothandel in verf en verfwaren
5153.3 Groothandel in vlakglas
5153.4 Groothandel in zand en grind
5153.5 Groothandel in tegels en plavuizen
5153.6 Groothandel in sanitaire artikelen en sanitair installatiemateriaal
5153.7 Groothandel gespecialiseerd in overige bouwmaterialen
5153.8 Groothandel in bouwmaterialen algemeen assortiment
5154 Groothandel in ijzer- en metaalwaren en verwarmingsapparaten
5154.1 Groothandel in ijzer- en metaalwaren
5154.2 Groothandel in verwarmingsapparaten
5155 Groothandel in chemische producten
5155.1 Groothandel in chemische grondstoffen en chemicaliën voor industriële toepassing
5155.2 Groothandel in bestrijdingsmiddelen en kunstmeststoffen
5155.3 Groothandel in rubber en overige chemische producten
5156 Groothandel in overige intermediaire goederen
5156.1 Groothandel in textielgrondstoffen en -halffabrikaten
5156.2 Groothandel in papier en karton

5156.3 Groothandel in overige intermediaire goederen n.e.g.
5157 Groothandel in afval en schroot
5157.1 Groothandel in autosloopmateriaal
5157.2 Groothandel in ijzer- en staalschroot en oude non-ferrometalen
5157.3 Groothandel in overige oude materialen en afvalstoffen
518 Groothandel in machines, apparaten en toebehoren
5181 Groothandel in gereedschapswerktuigen
5182 Groothandel in machines voor de bouw
5183 Groothandel in machines voor de productie van textiel; naai- en breimachines
5184 Groothandel in computers, randapparatuur en software
5185 Groothandel in kantoormachines en -meubels
5185.1 Groothandel in kantoormachines
5185.2 Groothandel in kantoormeubels
5186 Groothandel in elektromotoren, elektrotechnische en elektronische instrumenten, schakelkasten
en ander installatiemateriaal
5187 Groothandel in overige machines en apparaten voor industrie en handel
5187.1 Groothandel in machines voor de grafische industrie
5187.2 Groothandel in machines voor de productie van voedings- en genotmiddelen (geen verpakkingsmachines)
5187.3 Groothandel in intern transportmaterieel
5187.4 Groothandel in machines en apparaten voor de warmte-, koel- en vriestechniek
5187.5 Groothandel in verbrandingsmotoren, pompen en compressoren
5187.6 Groothandel in appendages, technische toebehoren e.d.
5187.7 Groothandel in meet- en regelapparaten
5187.8 Groothandel in overige machines en apparaten voor industrie en handel
5188 Groothandel in landbouwmachines, -werktuigen en -tractoren
519 Overige gespecialiseerde groothandel en groothandel met een algemeen assortiment
5191 Overige gespecialiseerde groothandel
5191.1 Groothandel in bedrijfsmeubels (geen kantoormeubels)
5191.2 Groothandel in scheepsbenodigdheden en visserijartikelen
5191.3 Groothandel in emballage
5191.4 Groothandel in vakbenodigdheden n.e.g.
5191.5 Overige gespecialiseerde groothandel n.e.g.
5192 Groothandel met een algemeen assortiment
5192.1 Niet-gespecialiseerde groothandel in consumentenartikelen
5192.2 Niet-gespecialiseerde groothandel in overige goederen
52 Detailhandel en reparatie van consumentenartikelen (geen auto's, motorfietsen en motorbrandstoffen)
521 Supermarkten, warenhuizen en dergelijke winkels met een algemeen assortiment
5211 Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen
5212 Warenhuizen en dergelijke winkels met een algemeen assortiment
5212.1 Warenhuizen
5212.2 Winkels met een algemeen assortiment (geen warenhuizen)
522 Winkels gespecialiseerd in voedings- en genotmiddelen
5221 Winkels in aardappelen, groenten en fruit
5222 Winkels in vlees en vleeswaren, wild en gevogelte
5222.1 Winkels in vlees en vleeswaren
5222.2 Winkels in wild en gevogelte
5223 Winkels in vis
5224 Winkels in brood en banket, chocolade en suikerwerk

5224.1 Winkels in brood en banket
5224.2 Winkels in chocolade en suikerwerk
5225 Winkels in dranken
5226 Winkels in tabaksproducten
5227 Winkels in kaas, reformartikelen, buitenlandse voedingsmiddelen en voedings- en genotmiddelen n.e.g.
5227.1 Winkels in kaas
5227.2 Winkels in natuurvoeding en reformartikelen
5227.3 Winkels in buitenlandse voedingsmiddelen
5227.4 Winkels gespecialiseerd in voedings- en genotmiddelen n.e.g.
523 Winkels in farmaceutische en medische artikelen, parfums en cosmetica
5231 Apotheken
5232 Winkels in drogisterij- en medische artikelen
5232.1 Winkels in drogisterijartikelen
5232.2 Winkels in medische en orthopedische artikelen
5233 Winkels in parfums en cosmetica
524 Winkels gespecialiseerd in overige artikelen
5241 Winkels in kledingstoffen, huishoudtextiel, breiwol, handwerken en fournituren
5241.1 Winkels in kledingstoffen
5241.2 Winkels in huishoudtextiel
5241.3 Winkels in breiwol, handwerken en fournituren
5242 Winkels in kleding en modeartikelen
5242.1 Winkels in herenbovenkleding
5242.2 Winkels in damesbovenkleding
5242.3 Winkels in baby- en kinderkleding
5242.4 Winkels in bovenkleding algemeen assortiment
5242.5 Winkels in onderkleding, foundations e.d.
5242.6 Winkels in modeartikelen en bijouterieën
5242.7 Textielsupermarkten en andere winkels in textiel algemeen assortiment
5243 Winkels in schoeisel, lederwaren en reisartikelen
5243.1 Winkels in schoeisel
5243.2 Winkels in lederwaren en reisartikelen
5244 Winkels in meubels, woningtextiel, verlichtings- en huishoudelijke artikelen
5244.1 Winkels in meubels
5244.2 Winkels in woningtextiel
5244.3 Winkels in verlichtingsartikelen
5244.4 Winkels in artikelen voor woninginrichting algemeen assortiment
5244.5 Winkels in glas-, porselein- en aardewerk
5244.6 Winkels gespecialiseerd in huishoudelijke artikelen n.e.g.
5244.7 Winkels in huishoudelijke artikelen algemeen assortiment
5245 Winkels in witgoed, bruingoed, telecommunicatieapparaten, geluidsdragers en muziekinstrumenten
5245.1 Winkels in witgoed
5245.2 Winkels in bruingoed
5245.3 Winkels in geluidsdragers
5245.4 Winkels in telecommunicatieapparaten en overige elektrische huishoudelijke apparaten
5245.5 Winkels in onderdelen voor elektrische huishoudelijke apparaten
5245.6 Winkels in witgoed, bruingoed en geluidsdragers algemeen assortiment
5245.7 Winkels in muziekinstrumenten
5245.8 Winkels in naai- en breimachines
5246 Winkels in ijzerwaren, gereedschappen, verf en bouwmaterialen (doe-het-zelfartikelen)
5246.1 Winkels in ijzerwaren en gereedschappen

5246.2 Winkels in verf, verfwaren en behang
5246.3 Winkels in houten bouw- en tuinmaterialen
5246.4 Winkels in tegels
5246.5 Winkels in keukens
5246.6 Winkels in parket-, laminaat- en kurkvloeren
5246.7 Winkels gespecialiseerd in overige bouwmaterialen
5246.8 Bouwmarkten en andere winkels in bouwmaterialen algemeen assortiment
5247 Winkels in boeken, tijdschriften, kantoor- en schoolbenodigdheden
5247.1 Winkels in boeken, tijdschriften en kranten
5247.2 Winkels in kantoor- en schoolbenodigdheden
5247.3 Winkels in boeken, tijdschriften, kantoor- en schoolbenodigdheden algemeen assortiment
5248 Overige winkels (1)
5248.1 Winkels in fotografische artikelen
5248.2 Winkels in optische artikelen
5248.3 Winkels in juweliersartikelen en uurwerken
5248.4 Winkels in schilderijen, lijsten, prenten, kunstvoorwerpen en religieuze artikelen
5248.5 Winkels in fietsen
5248.6 Winkels in watersportartikelen (geen hengelsportartikelen)
5248.7 Winkels in sportartikelen (geen watersportartikelen)
5248.8 Winkels in kampeerartikelen
5248.9 Detailhandel in caravans
5249 Overige winkels (2)
5249.1 Winkels in bloemen en planten, zaden en tuinbenodigdheden
5249.2 Tuincentra
5249.3 Winkels in dieren, dierbenodigdheden en hengelsportartikelen
5249.4 Winkels in computers
5249.5 Winkels in speelgoed
5249.6 Winkels in babyartikelen algemeen assortiment
5249.7 Winkels in vloerbedekking
5249.9 Winkels gespecialiseerd in overige artikelen n.e.g.
525 Winkels in tweedehands goederen en antiek
5250 Winkels in tweedehands goederen en antiek
5250.1 Winkels in antiek
5250.2 Winkels in tweedehands kleding
5250.3 Winkels in tweedehands goederen (geen kleding)
526 Detailhandel niet in winkel
5261 Postorderbedrijven
5262 Markthandel
5262.1 Markthandel in aardappelen, groenten en fruit
5262.2 Markthandel in overige voedingsmiddelen
5262.3 Markthandel in bloemen, planten, zaden en tuinbenodigdheden
5262.4 Markthandel in kleding en textiel
5262.5 Markthandel in tweedehands goederen
5262.6 Overige markthandel
5263 Straathandel, colportage e.d.
5263.1 Colportage
5263.2 Straathandel
5263.3 Overige vormen van detailhandel
527 Reparatie van consumentenartikelen (geen auto's en motorfietsen)
5271 Reparatie van schoeisel en lederwaren
5272 Reparatie van elektrische huishoudelijke apparaten
5273 Reparatie van uurwerken en juweliersartikelen

5274 Reparatie van consumentenartikelen n.e.g
55 Logies-, maaltijden- en drankenverstrekking
551 Hotels, pensions en conferentie-oorden
5510 Hotels, pensions en conferentie-oorden
5510.1 Hotel-restaurants
5510.2 Hotels (geen hotel-restaurants), pensions en conferentie-oorden
552 Kampeerterreinen en overige voorzieningen voor recreatief verblijf n.e.g.
5521 Jeugdherbergen, kamphuizen e.d.
5522 Kampeerterreinen
5523 Vakantiehuisjes, -bungalowparken en overige voorzieningen voor recreatief verblijf
553 Restaurants, cafetaria's, snackbars e.d.
5530 Restaurants, cafetaria's, snackbars e.d.
5530.1 Restaurants
5530.2 Cafetaria's, lunchrooms, snackbars, eetkramen e.d.
5530.3 IJssalons
554 Cafés e.d.
5540 Cafés e.d.
555 Kantines en catering
5551 Kantines
5552 Catering
60 Vervoer over land
601 Vervoer per spoor
6010 Vervoer per spoor
602 Vervoer over de weg
6021 Geregeld personenvervoer over de weg
6021.1 Openbaar personenvervoer over de weg
6021.2 Geregeld besloten personenvervoer over de weg
6022 Ongeregeld personenvervoer per taxi
6023 Ongeregeld personenvervoer per autobus
6024 Goederenvervoer over de weg
6024.1 Verhuisvervoer
6024.2 Goederenvervoer over de weg (geen verhuisvervoer)
603 Vervoer via pijpleidingen
6030 Vervoer via pijpleidingen*61 Vervoer over water*
611 Zeevaart
6110 Zeevaart
6110.1 Vracht- en tankvaart (zeevaart)
6110.2 Passagiersvaart, veerdiensten en sleepvaart (zeevaart)
612 Binnenvaart
6120 Binnenvaart
6120.1 Vrachtvaart (binnenvaart)
6120.2 Tankvaart (binnenvaart)
6120.3 Sleep- en duwvaart (binnenvaart)
6120.4 Passagiersvaart en veerdiensten (binnenvaart)
62 Vervoer door de lucht
620 Vervoer door de lucht
6200 Vervoer door de lucht
63 Dienstverlening voor het vervoer
631 Laad-, los- en overslagactiviteiten en opslag
6311 Laad-, los- en overslagactiviteiten
6311.1 Laad-, los- en overslagactiviteiten voor zeeschepen
6311.2 Laad-, los- en overslagactiviteiten (niet voor zeeschepen)

6312 Opslag
6312.1 Opslag in tanks
6312.2 Opslag in koelhuizen e.d.
6312.3 Opslag (geen opslag in tanks, koelhuizen e.d.)
632 Overige dienstverlening voor het vervoer n.e.g.
6321 Overige dienstverlening voor het vervoer over land n.e.g.
6322 Overige dienstverlening voor het vervoer over water n.e.g.
6323 Luchthavens en overige dienstverlening voor het vervoer door de lucht n.e.g.
633 Reisorganisatie en -bemiddeling; informatieverstrekking op het gebied van toerisme
6330 Reisorganisatie en -bemiddeling; informatieverstrekking op het gebied van toerisme
6330.1 Reisorganisatie
6330.2 Reisbemiddeling
6330.3 Informatieverstrekking op het gebied van toerisme en dienstverlening voor het personenvervoer n.e.g.
634 Expediteurs, cargadoors en bevrachters; weging en meting
6340 Expediteurs, cargadoors en bevrachters; weging en meting
6340.1 Expediteurs, cargadoors, bevrachters en andere tussenpersonen in het goederenvervoer
6340.2 Weging en meting
64 Post en telecommunicatie
641 Post- en koeriersdiensten
6411 Nationale postdiensten
6412 Lokale postdiensten en koeriersdiensten
6412.1 Lokale postdiensten
6412.2 Koeriersdiensten
642 Telecommunicatie
6420 Telecommunicatie
65 Financiële instellingen (uitgezonderd verzekeringswezen en pensioenfondsen)
651 Geldscheppende financiële instellingen
6511 Centrale banken
6512 Algemene en coöperatieve banken, spaarbanken en effectenkredietinstellingen
6512.1 Coöperatief georganiseerde banken
6512.2 Effectenkredietinstellingen
6512.3 Spaarbanken
6512.4 Algemene banken
652 Hypotheekbanken, bouwfondsen, financierings- en participatiemaatschappijen, beleggingsinstellingen, financiële holdings
6522 Hypotheekbanken, bouwfondsen, financierings- en participatiemaatschappijen, wisselmakelaars e.d. kredietverleners
6522.1 Hypotheekbanken en bouwfondsen
6522.2 Volkskredietbanken en commerciële financieringsmaatschappijen
6522.3 Participatiemaatschappijen
6522.4 Wisselmakelaars, banken voor ontwikkelingslanden, kredietverlening n.e.g.
6523 Beleggingsinstellingen, financiële holdings, pensioen BV's, stamrecht BV's e.d.
6523.1 Beleggingsinstellingen in financiële activa
6523.2 Beleggingsinstellingen in vaste activa
6523.3 Beleggingsinstellingen met beperkte toetreding
6523.4 Financiële holdings
66 Verzekeringswezen en pensioenfondsen (geen verplichte sociale verzekeringen)
660 Verzekeringswezen en pensioenfondsen (geen verplichte sociale verzekeringen)
6601 Levensverzekeringen, naturaverzekeringen en spaarkassen
6601.1 Levensverzekeringen
6601.2 Naturaverzekeringen

6601.3 Spaarkassen
6602 Pensioenfondsen
6602.1 Bedrijfspensioenfondsen
6602.2 Ondernemingspensioenfondsen en -spaarfondsen
6602.3 Beroepspensioenfondsen
6602.4 Overige pensioenfondsen
6603 Schadeverzekeringen
67 Financiële beurzen, effectenmakelaars, assurantietussenpersonen, administratiekantoren voor aandelen, waarborgfondsen e.d.
671 Optie- en effectenbeurzen, commissionairs in effecten, administratiekantoren voor aandelen, hypotheek- en kredietbemiddeling, bank- en spaaragentschappen
6711 Optie- en effectenbeurzen
6712 Commissionairs en makelaars in effecten, beleggingsadviseurs e.d.
6713 Administratiekantoren voor aandelen, hoeklieden en marketmakers, hypotheek- en kredietbemiddeling, bank- en spaaragentschappen
6713.1 Administratiekantoren voor aandelen en obligaties
6713.2 Hoeklieden en marketmakers
6713.3 Hypotheek- en kredietbemiddeling, geldwisselkantoren, bank- en spaaragentschappen e.d.
672 Verzekeringsbeurzen, assurantietussenpersonen, waarborgfondsen, schade-expertise, actuarissen, beheer en administratie van pensioenvermogens
6720 Verzekeringsbeurzen, assurantietussenpersonen, waarborgfondsen, schade-expertise, actuarissen, beheer en administratie van pensioenvermogens
6720.1 Verzekeringsbeurzen
6720.2 Assurantietussenpersonen
6720.3 Actuariële en pensioenadviesbureaus; beheer en administratie van pensioenvermogens
6720.4 Waarborgfondsen
6720.5 Schade-expertise, tarifering verzekeringen, opstellen polissen, opsporen van verzekeringsfraude e.d.
70 Verhuur van en handel in onroerend goed
701 Projectontwikkeling en handel in onroerend goed
7011 Projectontwikkeling
7012 Handel in onroerend goed
702 Verhuur van onroerend goed
7020 Verhuur van onroerend goed
7020.1 Woningbouwverenigingen en -stichtingen
7020.2 Gemeentelijke woningbedrijven
7020.3 Verhuur van overige woonruimte
7020.4 Verhuur van onroerend goed (geen verhuur van woonruimte)
703 Bemiddeling in en beheer van onroerend goed
7031 Bemiddeling bij handel, huur en verhuur van onroerend goed
7032 Beheer van onroerend goed
71 Verhuur van transportmiddelen, machines en werktuigen zonder bedienend personeel en van overige roerende goederen
711 Verhuur van personenauto's
7110 Verhuur van personenauto's
7110.1 Verhuur van personenauto's (geen operational lease)
7110.2 Operational lease van personenauto's
712 Verhuur van transportmiddelen (geen personenauto's)
7121 Verhuur van transportmiddelen voor vervoer over land (geen personenauto's)
7122 Verhuur van schepen
7123 Verhuur van vliegtuigen
713 Verhuur van machines en werktuigen

7131 Verhuur van landbouw- en bosbouwmachines en -werktuigen
7132 Verhuur van bouwmachines en -werktuigen
7133 Verhuur van computers en kantoormachines
7134 Verhuur van overige machines en werktuigen
7134.1 Verhuur van automaten
7134.2 Verhuur van machines en werktuigen n.e.g.
714 Verhuur van overige roerende goederen
7140 Verhuur van overige roerende goederen
7140.1 Videotheken
7140.2 Verhuur van sport- en recreatieartikelen
7140.3 Verhuur van leesportefeuilles
7140.4 Verhuur van kleding, huisraad e.d.
7140.5 Verhuur van overige roerende goederen n.e.g.
72 Computerservice en informatietechnologie
721 Hardware consultancy
7210 Hardware consultancy
722 Ontwikkelen, produceren en uitgeven van software; softwareconsultancy
7221 Ontwikkelen, produceren en uitgeven van standaard software
7222 Ontwikkelen en produceren van maatwerk software; softwareconsultancy
723 Computercentra en data-entry; webhosting
7230 Computercentra en data-entry; webhosting
724 Exploitatie van databanken, zoekmachines, startpagina's, informatieve websites e.d.
7240 Exploitatie van databanken, zoekmachines, startpagina's, informatieve websites e.d.
725 Onderhoud en reparatie van computers en kantoormachines
7250 Onderhoud en reparatie van computers en kantoormachines
726 Netwerkbeheer, computerbeveiliging, automatiseringsdiensten n.e.g.
7260 Netwerkbeheer, computerbeveiliging, automatiseringsdiensten n.e.g.
73 Speur- en ontwikkelingswerk
731 Natuurwetenschappelijk speur- en ontwikkelingswerk
7310 Natuurwetenschappelijk speur- en ontwikkelingswerk
7310.1 Speur- en ontwikkelingswerk op het gebied van landbouw en visserij
7310.2 Technisch speur- en ontwikkelingswerk
7310.3 Medisch en farmacologisch speur- en ontwikkelingswerk
7310.4 Overig natuurwetenschappelijk speur- en ontwikkelingswerk
732 Maatschappij- en geesteswetenschappelijk speur- en ontwikkelingswerk
7320 Maatschappij- en geesteswetenschappelijk speur- en ontwikkelingswerk
74 Overige zakelijke dienstverlening
741 Rechtskundige dienstverlening, accountants, boekhoudbureaus, belastingconsulenten, markt- en opinieonderzoekbureaus¸ economische adviesbureaus en holdings
7411 Rechtskundige dienstverlening
7411.1 Advocatenkantoren
7411.2 Rechtskundige adviesbureaus
7411.3 Notariskantoren
7411.4 Deurwaarderskantoren
7411.5 Octrooibureaus
7412 Accountants, boekhoudbureaus, belastingconsulenten en administratiekantoren
7412.1 Registeraccountants
7412.2 Accountants-administratieconsulenten
7412.3 Administratiekantoren (boekhouden)
7412.4 Belastingconsulenten
7412.5 Overige administratiekantoren
7413 Markt- en opinieonderzoekbureaus

7414 Economische onderzoeks-, advies- en public relationsbureaus
7414.1 Organisatieadviesbureaus
7414.2 Public relationsbureaus
7414.3 Overige economische onderzoeks- en adviesbureaus
7415 Concerndiensten en holdings (geen financiële holdings)
7415.1 Concerndiensten
7415.2 Holdings (geen financiële holdings)
742 Architecten-, ingenieurs- en overige technische ontwerp-, teken- en adviesbureaus
7420 Architecten-, ingenieurs- en overige technische ontwerp-, teken- en adviesbureaus
7420.1 Architecten- en technische ontwerp- en adviesbureaus voor burgerlijke en utiliteitsbouw
7420.2 Technisch ontwerp en advies voor stedenbouw-, verkeers-, tuin- en landschapskunde, ruimtelijke ordening en planologie
7420.3 Technisch ontwerp en advies voor grond-, water- en wegenbouw
7420.4 Technisch ontwerp en advies voor elektro-, installatietechniek en telematica
7420.5 Technisch ontwerp en advies voor werktuig-, machine- en apparatenbouw
7420.6 Technisch ontwerp en advies voor de procestechniek
7420.7 Technisch ontwerp en advies niet gespecialiseerd
7420.8 Overig technisch ontwerp en advies
743 Keuring en controle
7430 Keuring en controle
7430.1 Keuring en controle van agrarische producten en voedingsmiddelen
7430.2 Keuring en controle van machines, apparaten en materialen
7430.3 Overige keuring en controle
744 Reclamebureaus e.d.
7440 Reclamebureaus e.d.
7440.1 Reclame-, reclameontwerp- en -adviesbureaus
7440.2 Overige reclamediensten
745 Uitzendbureaus, uitleenbedrijven, arbeidsbemiddeling, testen, werven en selecteren van personeel
7450 Uitzendbureaus, uitleenbedrijven, arbeidsbemiddeling, testen, werven en selecteren van personeel
7450.1 Uitzendbureaus
7450.2 Uitleenbedrijven
7450.3 Arbeidsbemiddeling, testen, werven en selecteren van personeel
7450.4 Banenpools (werkgelegenheidsprojecten)
746 Beveiliging en opsporing
7460 Beveiliging en opsporing
747 Reiniging van gebouwen en transportmiddelen e.d.
7470 Reiniging van gebouwen en transportmiddelen e.d.
7470.1 Reiniging van gebouwen
7470.2 Reiniging van transportmiddelen en overige reiniging n.e.g.
748 Fotografie, pakken en sorteren in loon, secretariaats- en vertaalwerk, zakelijke dienstverlening n.e.g.
7481 Fotografie en ontwikkelen van foto's en films
7481.1 Fotografie
7481.2 Ontwikkelwinkels
7481.3 Ontwikkelcentrales
7482 Pakken, sorteren e.d. in loon
7485 Secretariaats- en vertaalwerk
7486 Call centers
7487 Kredietinformatie en incasso, organiseren van beurzen, tentoonstellingen e.d., veilingen, interieur-en modeontwerp, overige zakelijke dienstverlening n.e.g.

7487.1 Kredietinformatie- en incassobureaus
7487.2 Organiseren van beurzen, tentoonstellingen, braderieën e.d.
7487.3 Veilingen van landbouw-, tuinbouw- en visserijproducten
7487.4 Veilingen van huisraad, kunst, antiek, machines e.d. roerende goederen
7487.5 Interieur-, modeontwerpers e.d.
7487.6 Overige zakelijke dienstverlening n.e.g.