An analysis of the city centre car parking market: The supply side point of view

Guido Ferilli

School of Engineering and the Built Environment

Edinburgh Napier University

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ABSTRACT

Parking plays an important role in mobility, access and the economic development of cities; at the same time, it is a profitable business for both the private and public sectors. The city centre car parking market is a sector of the economy that has increased in importance as the market for cars has grown. Cars have become a fundamental element of journey mobility and, in consequence, parking has as well.
The car-parking sector has always been of great importance in terms of urban mobility, since it is a fundamental element in achieving a high level of accessibility in the city centres. In fact, many businesses and municipalities see an adequate supply of parking, especially for visitors, as crucial for their competitive growth. Yet, at the same time parking is, and will remain for most cities, the most powerful means of traffic restraint available. The economics of car parking is also important because it is, both for public and private organizations, a key source of revenue.

Despite the importance of the sector, knowledge of the car parking market has been until very recently, sparse and limited. This thesis is focused on the car parking operator's point of view, analysing and appraising this industry and the actors involved. The related literature investigates the car parking sector analysing the variables that influence its behaviour. The literature review also appraises whether and how far car parking operators are considered as key transport actors by local and national authorities, comparing Italy and the UK. The information collected is used to structure an econometric model, using the variables chosen as important and simulating the strategic behaviour of the car parking operator in a city centre context. The research also deepens the analysis of the car parking sector with a survey of car parking operators and policies in some Italian and UK cities. In this way the research achieves its aims to contribute to filling the knowledge gap on the city centre car parking market, both theoretically and empirically. Theoretically because the literature on car parking is very recent and little investigated; empirically, because research in this field is also sparse.

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CONTENTS

1.

Introduction

The car-parking sector has always been of great importance in terms of urban mobility, since it is a fundamental element in achieving a high level of accessibility in the city centres. In fact, many businesses and municipalities see an adequate supply of parking, especially for visitors, as crucial for their competitive growth. Yet, at the same time parking is, and will remain for most cities, the most powerful means of traffic restraint available. The enhancement of the urban environment is also partly dependent on adequately managing parking. Various studies have considered the problem of car parking in the city, analyzing and appraising the parking variables that influence the behaviour of motorists. The results of these studies have helped the development of varied organizational and infrastructural policies. These policies have allowed a substantial improvement in accessibility within and towards the city centres, and a more efficient use of car parking. It is also important to bear in mind that car parking is, both for public and private organizations, a key source of revenue.

Most of the literature has considered this sector only very recently. For these reasons, this research investigates the sector of parking from the car parking operator's point of view, analysing and appraising this industry and the actors involved.

General objectives

The research carried out for this project seeks to investigate those economic variables that are of most importance to off-street car parking operators in choosing their location and the nature of their operation (in terms of factors such as price and quality). It does this in a comparative context – looking at the quite different car parking markets in Italy and the UK – and also considers the important issue of how off-street car parking operators are considered within overall local and regional transport policies.

Anderson and De Palma (Anderson and De Palma, 2004) argue that location is an important variable, in particular, when we refer to the city centre. In this area the concentration of car parking facilities heightens competition between them. Since the city centre is an important destination for drivers, the location of the car park close to potential customers' destinations becomes an important factor (Froeb et all, 2003), especially if we consider the high costs of city centre land, as noted by Shoup (Shoup., 1999). In addition, the parking price structure is an important tool to attract more drivers (see Feeney (1989) and Young et al. (1991) for surveys), and its pricing levels will in part be dependent on its proximity to the city centre (Anderson and De Palma, 2004). In order to make money, the car park operator will decide the location and the price of the ticket in relation to the presence of other car park competitors near the chosen location, and their ticket price.

Another variable that is considered important in this research is the quality of service offered to the drivers. Examples of quality include payment systems, services control, tourist information etc. These elements should be adding value for the drivers when they decide where to park their cars. These variables are normally considered by the literature to determine the choices of drivers but, on the other hand, they could also be considered as tools to attract them.

The general objectives of this thesis emerged from discussions with the car parking operators and the managers of the municipal and regional public authorities in Italy,

during the researcher's past and current jobs. For the seven years from 1999 to 2006, the researcher occupied a post of consultant for public authorities in Italy at local and regional levels, in the field of transport and logistics planning, in several projects supported by EU program funding, such as INTERREG III, VI FP, etc. During that period, he dealt with the question of car park facilities for drivers, also in the context of city logistics, from both public authority and private operators' point of view. Hence, he decided to deepen his knowledge in the sector. Talking with colleagues in Italy and in other European countries, the researcher decided to undertake a PhD in the UK, where high quality standards of research in this field are acknowledged.

His current job is Assistant Professor of Economics at the Faculty of Economics, University of Bologna. In addition, he is Premises Director of one of the three branches of the Institute of Transport and Logistics of the Region of Emilia-Romagna. The research experience accumulated up until now is very useful when discussing issues and trying to suggest solutions with the stakeholders of the car park sector in the region.

Moreover, in reading the related literature, the researcher's initial idea was confirmed. It became obvious that there is a gap of knowledge in the available published literature, compared to the knowledge of the car park operators, or the information available on web sites, in brochures etc published by car park associations, such as the Italian and UK National Car Parking Associations. Whilst the literature typically focuses on the car parkers' point of view, relating predominantly to satisfying drivers' demands in terms of routing, time searching for parking, effect of new parking rules, etc., the interests of the car park operators are typically to gain more profit, to improve their services, and to discuss the changing transport policies that aim to reduce the impact of cars in city centres, or the parking standards required for new constructions[1]. In other words the operators talk about their problems, their market, while the research talks about the problems of the drivers and the policy makers' decisions.

[1] Several examples are available on web sites of the European Parking Association – EPA; the British Parking Association – BPA; the Italian Parking Association – AIPARK.

There seems to be an important gap in matching the drivers' needs with the requirements of the car park operators in order for their enterprise to be profitable. Almost all of the research analysing and appraising the car park market, deliberates only about the demand side of the market, while the supply side has been considered only in recent years (Arnott, 2006).

Indeed, when analysing the car park market, as all other markets, we must consider both the demand and the supply sides. One of the basic assumptions, taken from the field of economics, is that the demand side of the market is studied considering only the buyers' point of view (i.e. preference of buyers, price, availability of product/service etc.). In the same way, the supply side of the market is analysed considering the "producers" point of view (cost, revenue, profits, innovations, behaviour, etc.) (Mankiv, 2000).

In the case of car parking, we have also to bear in mind the fact that the car park market is almost always at least partially controlled by public authorities (national, regional and local). This happens because car parking, especially in the city centre, plays a key role in mobility, access and economic development of what appears to be an ever more car-dependent society (Rye, 2005). For this reason, there are obviously different points of view: public interest for the municipality (less traffic, congestion, pollution, general enhancement of the quality of life for the citizens in the city centre area) and car park sector interests (profit, leadership of the market, etc.).

In addition, there seems to be a limited number of studies that consider the supply side (Arnott, 2006 for a survey) and none of these take into account an important variable: the quality of the service. It is not considered as a whole, but always in terms of an individual tool, such as safety systems (Chow, 1998), parking guidance and information systems (Thompson et all, 2001), or the indoor environment of enclosed car parks (Chow, 1995), etc.

The location of a car park is very important for the operator. If it is in the city centre, it is likely to be more attractive for drivers, because in most Italian and UK's cities many parts of the city centre are dedicated to shopping, public and private services etc., and these are potential places where drivers choose to park their vehicles, as argued by Lambe (Lambe, 1996). From the city centre to the outskirts, the possibility for a car operator to have more and more clients is reduced, because there are more alternative spaces available to park the car and fewer reasons for driver attraction.

On the contrary, in the city centre, in particular in the typical historical city centre of most European cities, the space available to park on-street is limited, as is the space for off-street car parks. The price of the parking bay is very important too. Low price is more attractive, especially if the clients must still then walk to reach their final destination. For this reason, car parks far from the city centre normally charge low prices, and normally they are not of very high quality, as car park operators are interested in reducing their costs in such locations. An example related to this is the park & ride type of parking: if it is to be used, it must include some benefit in comparison to city centre parking, such as a low (or free) price, and speedy bus services linking it to the city centre (Parkhurst, 1995, Cairns, 1997). Car parks on the edge of city centres will often be relatively basic in the quality that they offer and attract commuter parkers with cheap all day parking offers. In the city centre, in contrast, most of the car parks have high price and good standards of service quality standards.

There are several industries that offer new tools to the car park operators, to improve the service that they offer. Why are these tools being produced, and bought? A first impression is that quality of service is always very important. Looking at the field of economics again, it is clear that normally (if not always) service producers focus on the attractiveness of their service, and competition with other services industries on the quality of the service they are offering (Asubonteng, 1996). The car park sector is a service sector, and as such, it places great importance on the quality of the services it offers.

Before going any further the researcher decided to deepen his knowledge of the sector. His aims are not to work for the benefit of the car park market, but rather to carry out an objective study, whilst bearing in mind the car park operator's point of view.

During the research, the researcher deepened his knowledge of the car park market by the analysis of the literature. Then he analysed the car park policy in UK and Italy to understand how this sector is regulated. He compared these issues in UK and Italy; from these two pieces of work, research hypotheses emerged. An econometric model was then developed. It was set up in a way to show in theory how parking suppliers might maximise profits in a competitive market. In order to compare the car parking sector in Italy and in the UK, the researcher has also carried out a survey of the sector in some Italian and UK cities. The survey verified the general hypothesis of the research and deepened the knowledge of the city centre car parking market, verifying parts of the econometric model. In this way, with this piece of research, new data was captured, which can be used to enhance the literature and assist car park operators in improving their services and their competitiveness.

Organisation of the thesis

During the first phase of the research the related literature has been considered, in order to appraise how the supply side of the car parking sector has been analysed to date, and how important the variables of location, price and quality are in influencing the behaviour of the car parking operators, and to identify the possible existence of other variables. Related literature has also been considered in order to appraise whether car parking operators are taken into account by local and national authorities when they draw up their mobility and parking policy. This was done by analysing the car parking policy in Italy and in the UK, and through interviews with stakeholders of the sector.

The second phase of the research was dedicated to structuring an econometric model, using the variables chosen as important and simulating the strategic behaviour of the car-parking operators in a city centre context.

The third phase of the research was dedicated to deepening the analysis of the car parking sector in the real world. For this reason, a structured questionnaire was submitted to car parking operators in some Italian and UK cities. The information collected contributed to an understanding of their market and helped to verify the results of the economic model – findings that are used to draw the final conclusions of the thesis

2. Critical overview of car parking: literature review and review of UK and Italian parking policy

2.1 Introduction

Parking areas in urban centres are becoming increasingly important, due both to the fact that almost every private car trip involves two parking acts and that cars spend over 80% of the week parked (RAC Foundation, 2004). However, technical/organisational and regulatory innovation has mainly focused on public and private transport mobility within urban areas; parking has been relatively neglected.

The main sectors that have been the subject of the greatest interest are particularly the following:

- means of transport: from practical and environmental standpoints;
- drivers: in terms of route optimisation to reach destinations as well as travel reasons (work, shopping, etc.), striving to minimise the time spent within urban areas (e.g. through road pricing);
- infrastructure: roads, direction signs, etc.

Although a car is parked – in a variety of places – for a large part of its life, little or no debate has focused on parking areas as hubs where transport converges. If parking areas are in fact seen as transport hubs where the interchange between a variety of transit means takes place, (e.g. car/bus, car/underground, car/walking, etc.) – it can be argued that not much has been done for parking, despite the vital role that it plays (Kelly, 2006).

Urban car parks and especially those open to the public, play a fundamental role in encouraging/regulating/restricting access to the city or town in or near to which they are located. These reasons are of a social, financial and policy nature.

The first category of reasons mainly relates to people's need for public (post offices, banks, hospitals, etc.) and private (lawyers, accountants, etc.) services that are usually to be found concentrated in the city centre. In residential areas it is also essential for car parks to be available for long-term round-the-clock parking, generally during non-working hours. Other users have different requirements, which are mainly concentrated in daytime hours – when shops, offices, etc. are open.

The second group of reasons (the financial ones) are fundamental to the dynamism of economic activity: shops, manufacturing businesses and service industries. Allowing access to and the possibility to remain in the urban area is essential, even if the trend in almost all cities in industrialised countries is gradually to restrict vehicle time access to urban centres and historic cities, by introducing or increasing parking charges and general traffic restraint. (Marsden, 2006).

These rules have become increasingly necessary to cut gas emission levels, to satisfy size limitations (this is more applicable for goods vehicles) and also with regard to the areas that are occupied by parking as opposed to other uses for public space. This can affect profits for car parking operators, in particular for those that are wholly private, because changes in accessibility can reduce the number of cars in some city areas, and hence parking demand. Nevertheless, demand for private car access to cities and towns continues to grow[2], because of the presence of many attractions, such as public and private services, shopping and tourist attractions.

The policy context and car parking operators

In this context car park owners are a largely passive element in regulatory and management policy-making, because they must respect public policies with regard to urban mobility that may include construction and management standards and attempts

[2] The trends in the growth of car ownership and car parking demand by type of destination is estimated in a recent UK national report on parking (RAC Foundation study, 2004). The report also considers the growth in demand for residential parking due to increasing population and the increasing tendency for people to live in smaller households. This fact is even more evident in the city centre where the price of houses tend to strengthen this tendency.

to influence how people travel to city centres, and elsewhere. If we add to this the fact that recent policy on mobility is tending to stop or reduce traffic level in the city centre, the problem for the operator could became dramatic.

Policy aspects are likewise important. Only recently has the need arisen, according to reports (EPA, 2000), to integrate car parks with general urban mobility management. Yet once again, decisions are made at a political level, with little regard – this thesis argues – to the real needs of car park owners[3]. In Italy, for example, the PUP (Urban Parking Plan) sets out the regulations for the management and standard construction of new car parks in the city centre, without any consideration of the needs of parking operators. This means that new car parks may not be profitable – and so require public subsidy – whilst existing car parks may be rendered less attractive.

In the UK, also, it is typical to find policies that aim to control the activities of the off-street car park operator, to meet the policy objectives of the local council, but with little regard to the operators. For example, Cornwall County Council's strategic policy document on parking points out that since the off-street parking supply is privately owned and managed, County Council policies can apply only on a voluntary basis; it then sets out a series of strategies to "encourage" private parking operators to follow their policies. These include discouraging car access in areas of traffic restraint, providing for the improvement of public transport, or contributions to park and ride provision[4]. There is no indication that the Council is interested the effect of such policies on operators' activities, even though such an approach could encourage operators to pay more attention to Council policies.

It is no coincidence that many parking area operators face serious economic difficulty, while others who have found themselves at modal interchange hubs because of the

[3] Marsden argues that parking policy identified a multiple objective of local Government policies, according to their mandate: parking measures as a tool to regenerate specific part of the city, parking controls as a means of restraining vehicle traffic, and the need to secure sufficient revenue from parking operation to cover costs or to make a surplus to fund other activities (Marsden, 2006).
[4] http://www.cornwall.gov.uk/index.cfm?articleid=28942

mobility policies introduced have benefited financially from those public decisions. [5]. The former group, however, are forced to passively accept the variations in access to their facilities – often with accessibility hindrances for drivers, who subsequently are induced to (Feeney, 1989):

- change their parking location;
- change the starting time of their journey;
- change the mode used[6];
- change their destination;
- abandon the trip.

In other case the drivers are induced to park illegally or, in the (many) cases where on-street parking is cheaper than off-street, cruising to find parking spaces on-street (Shoup, 2006).

The car park can be seen as a transport hub, the mode of transport changes from car to walking, or to alternative public/private transport such as bus, train, plane, or, rarely in most countries, to cycling. These 'hub' car parks can be seen to be operating in a competitive market in the urban network, where each strives to implement strategies to make itself more attractive than the others. Examples of this kind of vision of are train and buses terminals, which use innovative ways of attracting clients on to other forms of transport such as car sharing or cycling to the final destination. The new Local Transport Plan for Greater Nottingham 2006/7-2010/11 proposes the development of an initiative for commuters who use public transport combined with cycling and walking in place the car. In Italy, several local authorities have funded a

[5] In London, for example, the introduction of road pricing has generated a noticeable rise in private parking prices, to such a point that inhabitants consider the purchase of a parking space to be an advantageous investment. In areas such as Knightsbridge where there is a great shortage of underground car parks, the price of a parking space may reach sums as high as £100,000. http://www.cnn.com/2004/WORLD/europe/02/25/offbeat.london.park.reut/index.html

[6] In Italy, for example, local councils must follow the PUP (Urban Parking Plan). The Italian Government intended to encourage the development of urban parking areas through this plan (Law Tonioli No.122 of 1989). However, the expected results were not achieved and due to the serious environmental situation, the PUP has become a tool for gradually reducing the number of car parks and for discouraging private car use in urban centres in favour of public transport or other mobility solutions (walking, cycling, etc.).

combination of the train or bus service with the availability (often for free) of a bicycle close to the terminal, for the last part of the journey into the city centre[7].
While this competition is less obvious in the case of public car parking, which is an integral part of local authority policy planning to modify the accessibility and mobility of cars in the city, for private operators, the attractiveness of their car parks is always very important. For the private car park operator all decisions and investment aimed at increasing the number of clients, must be based on profitability, not the aims of the public authority.

However, as said before, if the decisions made by the private car park operator do not fit in with municipal transport policies, his strategies could fail. This is an interesting aspect of the city centre car parking market, where the decisions of the public authority can play an important role for the operators, positive or negative. Another factor worthy of investigation is the way in which the operators of the car park/hub can use a wide range of measures to increase the attractiveness of their car parks. It is useful, by means of this research, to collect and analyse this information.

Indeed evidence shows that the motorist is prepared to pay an appropriate parking fee if in turn, he receives good-quality service, and it is possible for him to park the car close to his desired destination[8]. On the contrary, if parking prices are not structured according to a clear policy, the driver is attracted to any part of the urban centre where price are lower, thus generating an increase in congestion (Anderson and De Palma, 2004, Shoup, 2005). The city centre car parking market is a very interesting field of analysis in the context of both mobility and general economic activity. The literature review will try to detail how research has dealt with this sector, in particular appraising the importance of the variables used to describe the city centre car parking market, from the point of view of the operator.

[7] Prima Conferenza Nazionale della bicicletta, Milan 9-11 November 2007.
http://www.bici2007.it/bici/temi/mobilita/tesi_mobilitx.html
[8] EPA Urban Parking Policy Guide Lines, Statement for COST 342.

2.2 Parking literature

Parking plays an important role in the transport system since all vehicles require a storage location when they are not being used. Various aspects of parking have been considered in the literature, but the subject of this research, the car park operator, is generally not considered. Nonetheless, many aspects of the city centre car parking market *have* been studied. The present overview will try to show where and how the car parking sector has been studied, ending with some consideration of the limited work on the supply side of the sector.

There have been various aspects of car park sector analysed over time from various points of view, drawing conclusions and, in some cases, offering recommendations and suggestions for researcher, policy maker and operator. These aspects can be summarized under the headings parking policy, parking economics, on-street parking economics, off-street parking supply, quality of service. This categorisation reflects the predominant issues in the parking literatures and also highlights what could be considered as missing. Overall, and relative to the wide range of results obtained from demand side analysis, the interest in the supply side of the parking industry is relatively recent. In addition, our review of the car parking literature here also shows the complete absence of any comparative studies of the car parking sector between countries – no authors have explored this potentially fruitful area of study.

Parking policy

On parking policy, much work in this area concerns discussions about parking policy and its effects. The solutions to correct the distortion between marginal costs paid by the private car commuter during rush-hours and those absorbed by the rest of the community through failure to charge rental (interest and depreciation) for much of the street and highway area used or taxes (property and profit taxes) on the capital invested was investigated by Segelhorst and Kirkus (1973). In another case, the

provision of free parking for employees and customers as an additional subsidy that further distorts price below resource cost was investigated through four sets of before-after study results when the U.S. Federal government raised solo driver parking prices in fifteen central city and suburban facilities in Washington D.C. in 1979 (Miller & Everett 1982). The result was the reduction of parking subsidies for commuters who drive alone, and so dramatic changes in mode split were realised. The study pointed out the importance of evaluating unintended effects of parking policy changes, such as creating spill-over parking around the employment site, but did not say anything about the fraudulent individual behaviour in respect to parking fee variation as was pointed by Adiv and Wang (1987). Their study analyzed the relationship between fraudulent parking demand and both the parking fee and the enforcement level for the achievement of general transport policy aims. Another important study on the relation between violation and enforcement rates to on street parking regulation was developed by the US DOT in 1982. It summarized the results of experiments in a large number of U.S cities. But is the recent study of Willson and Shoup (1992) that describes the incidence of employer-paid parking and its effects on congestion, commuting patterns, and externalities such as land use and air quality. The authors offer a number of important recommendations, such as changes in federal and state tax policies to influence commuting behaviour.

Another point of view in parking regulation is the work of Ferguson (Ferguson, 2004). He shows the most important changes in policy in this field during the last half century, in particular the enlargement of the spatial dimension, land-use classification and minimum parking requirements for these different land-uses. Other publications have concentrated their attention on reviewing the literature on parking policy, highlighting the importance of them in the general framework of transport policy (Shoup, 2005 and Litman, 2006). They underline the necessity to integrate parking policy in transport policy for the future, but the effect of parking policy, as was emerging in several case in terms of its impact on the vitality of city centre, was most recently analyzed by Marsden (2006). To fully understand the effects of these policies, he argues that several areas of research need to be deepened, such as on

standards for new build residential parking, and the understanding of zoning per impact of parking restraints, walk time and parking behaviour.

As well as policy dealing with parking problems, the regulatory aspect of parking has been studied on the demand side. Some empirical work has been done identifying the determinants of modal choice (Hunt 1993, Lambe 1996, Russell 1998) and parking location (Gillen (1977a,b, 1978), Westin and Gillen (1978), Hunt (1988)), combining various variable such as driving distance to the city centre, walking distance and parking fee (Thomas A. L. 1996). In particular, Hunt (1993) used a set of data from a survey of 80 different employer locations, determining that modal choice is influenced by monetary cost, proximity to final destination and other factors such us the position of the parking space relative to the trip being made, the nature of the parking surface and whether or not it is likely that it will be necessary to spend some time searching and/or waiting for a space. Also Westing and Gillen (1978), because of the effect of the increasing of the price of fuel of the auto trip, considered the parking fee as a fixed fee added to the end of the auto trip and developed a model where the parking fee affects travel demand and modal choice. Gillen (1978), studying individual parking location choice, found that parking fees, time restrictions, and search and transaction costs were significant. Lambe (1996) tried to investigate the relevance of a set of variables in a scenario of 5.000 motorists travelling to 13 final destinations within the city, using 55 parking lots and garages. It found that walking distance to the final destination is six more time costly than driving, a multi - storey car park is 4 time more attractive than a surface car park, the key threshod distance for walking from parking space to final destination is 400 metres, but the duration of parking was not found to be a significant variable in parking location choice.

Parking economics

Part of the literature considers the economic analysis of urban parking policy, even if this is only a recent development in the academic study of parking. Various studies

have focused on local problems such as the privatisation of the parking management system in some Greek cities, as a consequence of insufficient parking fees to cover the service costs (Matsoukis (1995). The study analysed the case of the city of Patras, which is the third most populous city in Greece. The introduction of paid parking in all the parking spaces in the city centre and the implementation of an automatic ticket service was carried out by one private operator. The results was the improvement of the parking situation in the city and the emulation of this approach by other Greek cities.

Bonnel (1995) took a different approach to the study of parking in some European countries. In Switzerland he studied the case of the reduction of the amount of car parking space in the city centres of Zurich and Bern, as a means of restraining car traffic so as to reduce the level of pollution and improve living environments. In parallel, improvements in public transport has switching the driver to the public transport. In contrast, in the France cities of Grenoble, Lyon and Montpellier the provision of new public car parks is considered as a way to give users a choice of mode of transport.

Some authors concentrate on the use of parking pricing as a means to charge for road congestion externalities. While Glazer and Niskanen (1992) showed that raising parking prices, by deterring trips to the city centre, may just encourage more through-traffic, the use of a numerical simulation model was also able to show that a second best pricing of all parking spaces can produces higher welfare gains than a simple-ring cordon scheme.

But is the work of Verhoef, Nijkamp and Rietveld (1995) that first analyzed the general case that showed how the use of parking fees rather than supply constraints can internalise the external costs of road transport. However, parking policies take place at the end of the trip, which generally rules out differentiation according to the trip length or road followed. They also considered the disadvantage of regulatory parking policies in comparison to a system of road pricing. These are, firstly, that all external costs will, to some extent, depend on trip length and road followed.

Secondly, there are the private parking places that are not subject to the public parking policies. Thirdly, there is the risk of adverse spill over effects to adjacent areas. The solution suggested is restrictive parking policies, preferably supported by supplementary instruments such as fuel taxes, as an alternative to urban traffic regulation because road pricing is not likely to be introduced on a large scale in the short run. They did not consider, in this case, as with the previous works, the specific effects of such policies on the city centre car parking market, because they are considered to be an unavoidable consequence of such policies. This is one of the main gaps in the literature on the car parking market. The effect of policies on drivers (demand side of the market) is often underlined and analyzed (or it is suggested that the effect on driver behaviour must be analyzed). On the other hand, when the literature discusses the operator (the supply side of the city centre car parking market) the analysis considers only how policies can be applied for other purposes such as mobility, reduction of time travelling, environmental effect, but does not consider the direct effect on the car parking operator and his business. It seems that research on the city centre car parking market is primarily driver-focused whilst the operators are "orphans".

On-street parking economics

The investigation of parking economics in the literature has been almost entirely theoretical rather than empirical. A recent exception to this is from RAC (2006), which presents broad data on the economic size of the parking market in the UK.

Most of the work are related to the demand side of the car park market, analysing various aspects of this. Arnott, De Palma and Lindsey (1991) demonstrate that spatially differentiated parking fees increasing the price from the periphery to the CDB, can induce drivers to park further from the city centre, or can concentrate arrival times closer to work start times as workers try to get the best parking places. Other authors investigate the first best regulation of on-street parking: Vickrey (1959) makes the case for a peak-load pricing of on-street space during rush hour, but it is more recently that the problem of congestion externalities has emerged as very

important in most of the CBD. Arnott and Rowse (1999) constructed a model which simulate the stochasticity of vacant on-street parking space give the policy recommendation that the per time unit parking fee should be set to reflect the value of the parking congestion externalities. With the same objective Calthrop and Prost (2004) developed a model, integrating it into a private off-street market, which alters on-street parking policy and uses time restrictions in the place of meter fees. The result in this case is that when the off-street market is competitive, on-street fees are more efficient than simply time restrictions. When on-street parking is free, albeit subject to a time restriction, too many drivers choose to engage in socially wasteful searching for on-street spaces. In contrast, with a meter fee, the relative benefit of parking on-street is reduced, and total search costs can be optimised. A linear meter fee structure is shown to be minimised and optimal. Added to this, a simple policy prescription is suggested: meter fees should equal the off-street price, but – crucially from the point of view of the parking operator - they do not explain whether these solutions will maintain the profitability of the off-street operator (although, intuitively, they should do so, since they will tend to make more drivers use off-street car parking in preference to on-street). Also in this case, as for the previous one, only the public sector of the car park market is considered, while our aims is also to focus our attention on the private.

Again dealing with the case of on street car parking, there is a study from Tsai and Peng Chu (Tsai and Peng Chu, 2006) that analyzes the possibility of the co-existence of the private and public parking management system, using the case of a private firm that collects fees for the local government in Taiwan, in a Stackelberg context[9], where the private operator assumes the role of leader of the market, while the public operator is the follower which imitates the behaviour of the leader. In this case, the choices of the driver make it possible for both firms to co-exist, even if the public firm has fewer parking spaces, because of its (assumed rather than empirically demonstrated) lower efficiency with respect to the private sector operator.

[9] Stackelberg model is a strategic game model in economics used in an Oligopoly context where one firm has there role of Leader, moving as first, wile the other firms are follower of the leader and move consequently after him. This model take the name of the German economist Heinrich Freiherr von Stackelberg who published the description of the model in 1934. In the case of car parking sector in Taiwan the leader is assumed to be the firms who lead the car parking market sector.

Off-street parking supply

Work involving studies of the supply side of the off-street car park are fewer and very recent, and almost all of them deal with policy consideration for public authorities, but not for car parking operators.

Most of the recent studies in this area are by Calthrop (2000; 2002). As well as the works cited previously by Calthrop and Proost (2000), his other work considers both the impact on reducing search externalities on the on-street market itself, and the impact on (under priced) road congestion. The model demonstrates with a numerical simulation the order of magnitude of an optimal parking fee, taking into account effects on other distorted transport markets (off-street parking market and the rail market), when deciding upon price levels for on-street parking. The results show that reforming on-street parking pricing may have significant impacts on parking search time but the effects on road-congestion levels are marginal (Calthrop 2002). Calthrop and Proost (2000) carried out an analysis of the optimal on-street parking pricing with the presence of an off-street market. In this case, a single off-street supplier was playing as a Stackelberg follower to the government regulated on-street market (Leader). Based on a numerical example (calibrated to London), optimal on-street policy is shown to either involve setting a relatively high on-street price, such that the monopolist is induced to undercut and gain the entire parking demand, or setting a relatively low price, while the monopolist maximises profit on the residual demand curve. Which strategy is optimal has been shown to be parameter dependent (search costs, supply of on-street spaces and resource cost of off-street parking). The number of on-street searchers will depend on price and supply conditions in both markets. Relatively low on-street pricing will induce more and more drivers to search on-street until the equilibrium cost equals the off-street price. The model considers in some mode the relation between on and off-street parking, but only in terms of policy regulation and possible intervention in the first type of parking, whilst the off -street

parking market is a follower. As other parts of this thesis will show, this is not necessarily a realistic assumption.

In other case the car park market has analyzed in terms of merger firm, till the presence of a monopoly. In the first case Froeb Tschants and Crooke (2003) developed a numerical model of price-setting behaviour based on Bertrand competition between multi-product firms differentiated by location and capacity, where each firm changes his price assuming that the other firms do not change their price. This computational experiment evaluated the effects of the merger as the difference between pre- and post merger by applying an algorithm. Even though the model was not estimated in the paper, the result is that constraints on merging lots are likely to be more important than constraints on non-merging lots in determining the merger. Merger price effects are attenuated by capacity constraints on merging firms more significantly than they are amplified by capacity constraints on non-merging firms.

In the second case the monopoly analyzed was motivated by the merger between the two largest parking companies in the United States (Froeb et al., 2003), which has spurred much recent interest in the supply side of the off-street car parking market. In March 1999, the Antitrust Division of the U.S. Department of Justice approved Central Parking's $585 million acquisition of Allright Parking after the companies agreed to divest 74 off-street parking facilities in 18 cities (U.S. Department of Justice, 1999). From the Division's press release, "Without these divestitures, Central would have been given a dominant market share of off-street parking facilities in certain areas of each of the cities, and would have had the ability to control the prices and the type of services offered to motorists" (U.S. Department of Justice, 1999). Some development of this model was applied with numerical models (Werden, 2000), and since then a numerical approach to the economic modelling of parking (Judd, 1998) and merger policy (Werden and Froeb, 1996, and Froeb et al., 2003) has begun. Nonetheless, in this case, as for the previous cases, the supply side point of view was again ignored. The interest of these studies was only in terms of regulation of the market, not in terms of economic results for the private operator.

In any case the studies reviewed above demonstrate that analyses of the supply side point of view in the literature are relatively recent, few in number and without a clear direction. In a very recent work Richard Arnott, an acknowledged expert in the study of the car parking sector, has tried to underline the importance of the car parking operator's point of view: "no paper in the current literature concentrates on parking garages, which are the key element in the parking picture for central business and commercial district" (Arnott, 2006)[10]. Considering his newest argument, Arnott used a simple model, based on the Tirole literature, to suggest parking policy in the case where there is only off-street parking, followed by the entrance of on-street parking into the market and, finally, with an addition of mass transit. This work, as well as the other works above mentioned, underlines the lack of research on the supply side of the parking market.

The literature on the economics of parking also shows that location and price are key factors that determine the choices of the drivers. These are also variables used to implement policy to control and manage mobility in the city centre. Indirectly they also have effects on the strategic behaviour of the car park operator, in particular in relation to city centres where space for new parking construction is limited and current car parks must compete with one another in trying to attract as many new clients as possible, as shown by the empirical survey work and interview with the British Parking Association, carried out for this research presented later in the thesis.

Quality of service

Even if the available literature does not acknowledge, either through empirical studies or through modelling, the importance of the quality of service, evidence demonstrates that this is an important variable in all fields of services provision. Olorunniwo (2006), reviewing the quality of the service product, underlines the importance of the

[10] The first version of my model, highlighting the gap of the literature in this field of research was presented at the Annual UTSG Conference 2005 held in Bristol, one year before Arnott's paper was published.

service sector in the US, where in 2002 it contributed 80% of the Gross National Product and accounted for nearly 80% of the US workforce. This evidence is the reason for more and more attention to be focused on the service sector and the quality of service produced. In the case of the car parking sector some notable examples are from the Italian Parking Association – AIPARK[11] - which has set up a national Annual Award for the best and most innovative quality of service in new car park construction in Italy.

In the United Kingdom, the British Parking Association organises the British Parking Awards for the best car parks in terms of customer service, achievement in outstanding innovations and the industry's most committed parking employees and teams[12].

At the European level, the European Parking Association (EPA[13]) has established a biennial award for excellence in parking operations. In this case, the assessment criteria applied are related to the level of internal, external and general quality, defined as follows:

1. External quality:
   - Quality of green areas and surfaces around the car park
   - Structure
   - Design
   - Primary design principles used to enhance the general appearance and aesthetic quality of the car park
   - Construction/columns etc.
   - Construction characteristics chosen to enhance the quality of use of the car park, such as an open view
   - Materials/quality of finish, in terms of general use of materials and any innovative features to enhance the quality of use and/or maintenance
2. Internal quality:
   - Layout, routing, size of bays
   - The overall layout and traffic flow system for cars and other users (motorcycles, bicycles, etc.) inside the car park
   - Pedestrians, routing, orientation
   - Safety and security (closed-circuit television, attendance etc.)

[11] http://www.aipark.org/
[12] http://www.britishparkingawards.co.uk/
[13] http://www.europeanparking.com/

- Parking equipment
- General system type, including available means of payment, and any out the ordinary advantages offered to the customer, related to the parking equipment
- Lighting
- Quality of materials, colouring, decoration, music

3. General quality:
   - Supervision and management
   - Marketing information and type of media;
   - Safety routines for evacuation etc.
   - Information and service
   - Cleanliness and maintenance
   - Safety and security.

The importance of quality is also shown by the evidence from RAC Foundation (2005), citing the example of a study in Cambridge, where it was found that drivers are prepared to pay 10% more for a space that is secure and well lit. Consequently the RAC Foundation recommend that planning and charges for parking should take into account the case of higher quality.

These examples serve to outline the importance of quality of service. Price, location and quality of service should be considered as very important variables for car parking operators, in particular when the research is focused on the city centre context.

Given the main gaps identified in the literature review, the research will investigate *from the car park operator point of view*:

- Parking policy in UK and Italy;
- The interaction of these variables, using a model able to interpret the behaviour of the car park operators in the local city centre market;
- Surveying the car park operator point of view in Italy and UK, to find out empirically how they regard these variables.

Firstly, however, this chapter moves on to set the context for the research by considering the differences in car parking policy between Italy and the UK. It is worth noting, by way of introduction to this section, that the economics of off-street parking provision are not particularly healthy in the UK at the present time (BPA, p.c., 2005), and in Italy new parking provision is heavily dependent on state aid. This should be borne in mind when reading this section.

2.3 Car Parking policy in Italy

In Italy the car parking sector has had historically very little policy in place. In marked contrast to the UK, where there is much policy and guidance on parking, in Italy there are only two national laws, from the late 1960s and the early 1990s. These laws form the basic framework of regional and local rules across the country. The situation in Italy is considered from 1967 because this was the first date that a significant law relating to parking was past. The situation in the UK is considered from 1991 because, although previous laws gave local authorities the opportunity to manage on-street parking, there was little advocacy of a more coordinated approach until the early 1990s.

The car parking sector in Italy began to be considered by government as one worthy of consideration from 1967, when law 765/07.08.1967 was passed. This defined the minimum infrastructural standards required for new construction (residential, commercial, industrial, for leisure, etc.). Among these standards, the most important characteristic is the legal obligation on the developer to provide parking areas for private vehicles and in a way related to the overall floor space of the building.

However, this law did not consider parking provision as a component of a more comprehensive and general urban mobility theme. It was only a pure town-planning rule aim at guaranteeing an adequate provision (or reserve) of land for new urban facilities such as schools, green areas, parking and social activity centres, so as to cope with problems of overspill parking due to high increases in building development experienced in these years. It prescribed only how many spaces were to be built to provide adequate parking space for social-economic urban development.
This law remained the only point of reference till 1989, when the Parliamentary law number 122, dated 24.03.89 called “legge Tognoli” (Tognoli law) after its first proponent, changed this static concept.

This new law included the consideration of people's mobility as one of the most important fundamentals of human activity. This law is still the basic planning and regulatory tool regarding private and public parking sectors in Italy, even if the recent transfer of legislative powers from national to regional and municipal governments, whether completed or in progress, will probably create some differentiation in implementation and regulation in different geographical areas, according to the needs of different communities.

According to the definitions contained in law 211/89, parking areas are classified in three basic categories:

- "pertinence" (private residential) parking: it is inside the property or near a property and is addressed specifically to residents for long stay parking (daily or/and night);
- "destination" parking: this is located near central business areas or historical centres where there is an high concentration of commercial, leisure, tourist activities and there is the need for short or medium stay parking;
- "Park and ride" parking areas where people interchange with public transport service, in order to reduce the number of private cars travelling to and from city centres. From its utilisation and the legal point of view, this could further be differentiated as private parking and public parking.

It is also important to point out that – due to a widespread shortage of private parking spaces in most Italian towns – the above-mentioned law has been conceived with the aim of fostering the construction of new private parking. It allows real estate owners to build boxes or parking bays (only for uses strictly related to the residential activities) even where these may conflict with general urban planning rules.

In particular, the law gives private owners the possibility to avoid acquiring the "building concession", and only asking for a simple authorisation from the municipality free of charge. They can also use public land under the "right to public space" for a fixed period (in any case not exceeding 99 years) in order to provide more parking.

On the other hand in the late 1980s an increasing and widespread consciousness of the negative effects of mobility on the urban environment convinced central administrations to promote and introduce at a local level more effective tools for the management of urban traffic related issues, setting up a new framework of technical instructions particularly addressed to the main municipalities. Furthermore, it must be noted that in this period public referendums were held in the larger Italian cities, including Milan, Rome, Bologna and Florence, to gauge public support for the introduction of traffic restrictions. The referendums succeeded (everywhere 70% of the votes were for the option of "shutting down" city centres to vehicle circulation). The Italian municipalities introduced a policy based on ZTLs (Zone a Traffico Limitato - Zones with Limited Traffic). This policy has been widely implemented since then in almost all medium and large cities and often in little towns (Legambiente Italia, Ecosistema Urbano, annual reports: 2000-4)

Alongside this development, in 1992 a general revision of the national 1959 "Road Code" was carried out, and formal approval was given to the revised Code and its Rules of Application. This work, completed in 1995, produced "Instructions for the drawing up and implementation of a general urban traffic plan" by the Ministry of Public Works (Directorate for Safety and Road Circulation). According to Article 36 of the "Road Code", all municipalities with more than 30,000 residents, together with tourist centres identified by each region, are obliged to adopt this plan with strict rules regarding utilisation of public parking spaces, given their scarcity and high value in urban areas.

In particular, for the first time the legal power was clearly established for local authorities to define urban areas, apart from city centres already classified as historical centres - accordingly to Ministry Decree 1444 dating back to 1968 - where restrictions on vehicle circulation and the imposition of on-street parking charging can be applied automatically.

These new rules have allowed public authorities to overcome legal claims and to support the adoption of economic levies (on-street paid parking, road pricing) instead

of, or in addition to, traffic restrictions to control traffic or parking demand. Last but not least, efficient forms of enforcement were necessary in order to implement these policies: the legal definition in 1997 of the "ausiliari del traffico" (traffic wardens), led to the appointment of personnel specifically trained as "criminal police officers" and concerned with parking regulation offences.

One of the main goals of the Tognoli law was to foster the creation of new public parking by setting up a specific fund addressed to the larger cities and the regions.
In fact, public parking is often infrastructure that could benefit from private initiatives for its construction and operation. This is especially true in the Italian context where many cities are under-equipped (with respect to parking facilities) and there is little availability of suitable public spaces in the inner city. Therefore, private operators could find it financially rewarding to invest in the development of this type of infrastructure, providing public authorities can guarantee a stable situation in the medium to long term in relation to mobility policies (traffic schemes, circulation rules, etc.). This aspect is very important for car park operator, to provide stability of income. Conversely, Italian law makes this problematic as the municipality has the power to close the city centre (and other areas, if necessary) to traffic to meet pollution thresholds for PM10, Ozone and NOx.

However, bearing these eventualities in mind, another law (122/1989) has, for the first time, established real and attractive conditions to bring private capital into public parking construction and management.
The incentives are in the form of:
- Concessions to build and operate;
- Land rights for a specified time up to 99 years
- Possibility to resell up to 30% of the total amount of places built to private bodies;
- Public financial contributions on a long-term basis (15-year term).

This financial contribution from the Government is determined on the basis of standard costs that are fixed for each possible form of parking provision (under/above ground, in elevation, at ground) referring to a single parking bay space. It is reviewed and updated periodically by the Ministry of Public Works. At present, it corresponds

to about two thirds of the actual total costs (construction, marketing, overheads, engineering, etc.).

The planning activity provided by the law requires local authorities to follow a series of procedures if they are to use it. Firstly, they must make a detailed assessment of the quantitative requirements of public and "pertinential" parking for each zone of the city, based on specific surveys and analysis, fixing for each different type of parking the relevant amount of places needed. Secondly, every municipality interested in obtaining financial support has to adopt the "Piano Urbano del Traffico - PUT" (General Master Plan for Urban Traffic), to be drawn up according to the technical specifications given by the Ministry of Public Works. The PUT must aim to improve traffic circulation, reduce road accidents, guarantee better environmental conditions and energy efficiency utilisation by adopting appropriate measures to manage urban mobility and its impacts (demand control, optimisation of traffic flows, parking management, bus corridors, separated bicycle lanes, on-street paid parking, etc.). On the basis of the two previous actions the local authorities approve and put into operation a specific programme named "Piano Urbano Parcheggi – PUP" (Urban Parking Programme) with 3 years of parking planning and with a programme for building parking infrastructure specifying locations, capacities, legal and contractual conditions, financial procedures, scheduling of works, etc.

The Tonioli Law has introduced a new standard for private residential parking incentives for the construction of new car parking (1space/10sqm). This applies throughout Italy, but in reality, availability of space for new construction in city centres is so limited and costs so high, that is difficult to meet the full level of provision.

An example of a city that has used the law is the Municipality of Turin which in 1990 implemented its Urban Parking Programme. The plan set out in detail the new car parks required. For the construction of new car parking spaces the Municipality has chosen from one of two solutions: construction by the Municipality or by the private operators. In both cases the Municipality has used finances supplied by national

government under the Tonioli Law. The Municipality carried out an international tender process for the car parking concession, but the problems of managing the financial flows from the Ministry of Economy reduced the number of participants in the tenders. This problem was resolved by the Regional Government of Piemonte, which provided the funds for the tenders in advance. In this way the Municipality has provided the tender participants with a feasibility study of each car parking structure required. The results of this new procedure and financial support were very good: in the years 2000-02 4 new car parks were opened (containing 835, 858, 338 and 500 parking bays respectively).

Recently, project financing made available under the 109/1994 legislation has been used more and more for the creation of public works with private finances. As opposed to "concessions", the project financing is not subject to constraints defined by local authorities on private bodies that manage the public parking. This has led to an increase in the number of new car parks being constructed under this law from 11 in 2000 to 113 in 2004.

These policies are increasing the number of car parks in cities, redressing the balance between supply and demand. Because these initiatives are public, even if only in terms of the project financing procedure, the project must be approved by the municipality, if the car park operator is to obtain the financial incentives. The standards set by the municipality will often relate to car parking standards, the range of prices applicable, and the services offered. In other words, the municipality specifies the quality of service, such as security, disabled facilities, short and long-term rates, payment systems, etc. – yet this should be, arguably, the preserve of the car park operator.

Added to this, while the car park operator's objective is to maximise profits, the local authority may have a range of other objectives when deciding to apply new policies. They may wish to reduce the effect of the presence of cars in the city centre, limiting their access, or to promote the turnover of car park bays, to make them available for short stay visitors and shoppers at a relatively low hourly price, and high price for

long-stay commuters (to reduce the peak hour traffic). In other cases, the local authority can influence the mobility and accessibility by car, changing the accessibility of the car park, and reducing the potential demand – yet this may markedly impact on the viability of the car park and hence the interest of the private investor in that car park.

This section has shown that there appears to be a situation in Italy where national law fosters the construction of new car parks, both public and private. In addition, at local level, the municipalities have the Urban Parking Programme as a tool for programming new car park development. The result of these policies is the increase of new car park construction in city centres, despite the high cost of construction and land use, because of the public incentives. On the other hand, the behaviour of car park operators in the market will be affected very considerably by the high level of public sector involvement in the financing of town and city centre car parking, and the conditions attached to that finance. So, even if it is possible to build new car parks in the more remunerative city centre, indeed the operating conditions are strongly influenced by public intervention. The next section shows how different the situation is in the UK.

2.4 Car parking policy in UK

In the UK, as in most EU countries, national legislation provides policies on car parking. In comparison to the evolution of parking policy and regulation in Italy, in the UK this sector has been taken into account a number of times in terms of new legislation, and has changed over time with respect to the national context (car standards, mobility trends and regulation, parking standards, etc.).

An important early piece of legislation passed was the 1991 Road Traffic Act, which enabled those local authorities that wished to do so, to take the enforcement of on-street parking regulations from the policy and to manage this important activity in a decriminalised environment; the majority of English towns and cities now do this, which has implications for the attractiveness of off-street parking. In 1994, the new

version of Planning Policy Guidance 13 (PPG13, Transport) was published and advocated for the first time the use of restraint in parking provision to stimulate the use of alternative modes. (The role of PPGs is discussed in greater detail later in this section.)

However, perhaps the most key recent document for the car parking sector is the White Paper; *A New Deal for Transport: Better for Everyone* published in July 1998 by the new Labour Government. This document identified the Government's new approach to transport and identified the framework within which detailed policies would be taken forward. It was also envisaged that improved access by public transport, walking and cycling could help reduce car dependency. The consultation paper 'Breaking the Logjam' published in December 1998 set out the government's thinking in more detail. It proposed the introduction of road user and workplace charging, as well as the effective control of on-street parking.

The White Paper set out a framework within which more detailed policies would be taken forward. The key element in relation to parking was the Government's commitment to introduce legislation that would enable local authorities to levy a charge on private workplace parking spaces. It was proposed that this levy would primarily address peak hour congestion but would also be a way for local authorities to raise revenue that could fund transport improvements. The Government also issued a series of planning policies (PPG) notes with which local authorities are expected to comply in drawing up their local development plan (now known as a Local Development Framework in England).

This background forms the context for local government strategies for better parking management. In the UK, Regional Planning Guidance sets the regional context for transport policy, but responsibility for transport delivery rests with local councils, which include the English County Councils as well as a larger number of Unitary authorities. These County Councils are sub-divided into a number of Districts. District Councils are themselves allowed to provide and operate off-street car parks

and may do, but they are not in any other way transport authorities – this responsibility rests with the County, where it exists.

Transport authorities (Counties and Unitaries) have to include their parking strategies when preparing the Local Transport Plan (LTPs, in England) and should do so in their Local Transport Strategies (LTSs, in Scotland). These plans also form the basis for provision of government capital funding for local transport.

Current UK central government policy advice is clear that there is a need for local authorities to adopt more restraint-based parking standards, both in order to reduce reliance on the private car, and to produce a built environment that is more conducive to walking, cycling and public transport use. At the same time, guidance also emphasises the need to ensure that the economic viability of shopping centres in particular is not compromised.

Another important point in Government transport policy was a report from the Standing Advisory Committee on Trunk Road Assessment (SACTRA, 1995), which recognised that new road construction simply generated more traffic. Awareness of the need to reduce traffic growth was also reflected in PPG13 on Transport, which clearly recognised the need to promote acceptable alternatives to the private car. It provided a clear attempt to guide local authorities to locate new developments in areas more easily served by public transport, or more accessible by walking and cycling.
In general, it would appear that those areas that have had most success in linking parking controls and standards with their planning objectives are historic (university) cities such as York, Chester, Oxford and Cambridge. Oxford's "Balanced Transport Policy" has been in place since 1973 and has combined a reduction in city centre on- and off-street parking (both public and privately controlled) with the provision of improved cycle and pedestrian facilities, bus priority and the UK's most successful park and ride system. This policy can be seen to have achieved its objectives in that the number of vehicles entering the city centre every year over the past 25 years has been kept constant, it is crucial to note that this success has been achieved by the consistent application of a policy over a long period of time

The first five years of Local Transport Plan - LTP was announced in the White Paper: A New Deal for Transport: Better for Everyone, published in July 1998. The new LTP for the period 2005/6-2010/11 was produced by local transport authorities last year. An analysis of some LTPs was undertaken to determine what they said about car parking. Councils selected were Manchester, Nottingham, Bristol, Leicester, York, Oxford and Surrey. All UK transport policy from the publication of PPG13 Transport in 1994 onwards, has confirmed the importance of parking as a means to manage transport demand.

The tendency of all LTPs is to reduce the number of cars entering the city centre. One of the targets set for 2011 in York is the decrease of car drivers from 48.2% to 44.5% by demand management through parking controls and access restrictions in the city centre. The Council states that "*the management and control of car parking spaces are essential components of an effective transport strategy. Parking control by both capacity and price has historically been, and will continue to be used*"[14].

Similarly, Nottingham Council considers parking policy to be the most powerful tool to manage travel demand in terms of location, pricing and times of availability[15]. The provision of its LTP is the restraint and reduction of off-street parking and the careful management of on-street parking. However, there is no provision to increase the number of off-street car parks. On the other hand, parking controls in the city centre have the scope to balance between short and long-stay car parks and level of charge, in favour of short stay, geared to attract shoppers and visitors to the city. Nottingham aims to promote and extend short stay space in the city centre; however, because of rigorous application of parking standards and pricing, the only alternatives available to commuters without parking space provided by their employers will be commercial off-street parking, Park and Ride or transfer to other sustainable modes.

[14] City of York Local Transport Plan 2006-2011, p. 92, http://www.york.gov.uk/content/45053/64877/64891/Local_transport_plan/Full_LTP
[15] Local Transport Plan for Greater Nottingham | Final Plan 2006/7 - 2010/11, http://www.nottinghamcity.gov.uk/ltp_complete_document.pdf

All councils are concerned about maintaining the vitality of their city centres. For example, Leicester Council found that although there are few large employers in the city centre, there are many small and medium employers with a total of 24,000 private non residential parking spaces, 16,000 of which are in the Controlled Traffic Zone. The Council has postponed until the third LTP period any action aimed at reducing the number of cars coming into the city centre, because they do not wish to hamper the regeneration of the area[16].

York and Oxford Councils have also introduced provision for the reduction of private commuter parking spaces through negotiations with site owners as redevelopment proposals[17]. These are the only cases of inclusion of private off-street car parking in the LTP. Bristol, declaring their difficulties in relation to private car parks, because the operational control is not with the Council, on one hand express the interest in working closely with the private sector providers of public parking, to ensure the consistency in the management and supply of their spaces. However, on the other hand, the Council proposes to investigate innovative measures for managing these spaces and look to national government for guidance and legislative powers. Nottingham foresees that off-street parking provision will be further restricted in the interests of efficient land use[18].

All the councils examined provide for an increase of residents' zones, but there is no evidence of considering the effect of this on car parking operators. Provision for increasing parking prices should be an opportunity for private operators who are not controlled by LTPs, to increase their business. But this depends on the mobility of drivers into the city centre. In any case the LTPs offer as an alternative to long stay parking in the city centre, the provision and reinforcement of park and ride, at the

[16] Second Central Leicestershire Local Transport Plan (2006 – 2011) and Environmental Report, p. 49, http://www.leicester.gov.uk/your-council--services/transport--traffic/transportpolicy/transport-plan/second-local-transport-plan

[17] Oxfordshire County Council's Local Transport Plan 2007/2011, http://www.oxfordshire.gov.uk/wps/portal/publicsite/councilservices?WCM_GLOBAL_CONTEXT=http://apps.oxfordshire.gov.uk/wps/wcm/connect/Internet/Council+Services/Roads+and+transport/Plans+and+policies/Local+Transport+Plan/RT+-+Local+Transport+Plan

[18] West of England Final Joint Local Transport Plan 2006/07-2010/11, http://www.westofengland.org/site/FinalJointLocalTransportPlan200607201011_2870.asp

edge of the city centre, as well as into other transport interchanges such as train and bus stations and cycle parks.

One example of improved integration of car parking policy with demand management, supported by the LTPs, could be seen to be the success of Park and Ride. For this reason the provision of funding for new parking is only for the enlargement of existing park and ride or for new build. For this reason also the "charges will be consistent to ensure that park and ride maintains a competitive advantage over the centres they serve"[19]. Of course the reduction of drivers into the city centre is another pitfall for the business of the off-street car park, whilst increasing the price of parking bays could be an opportunity to redress the balance.

Also the tendency to improve control of on-street parking, using new technology (CCTV cameras) or making enforcement the responsibility of police as in Leicester, could have the potential to increase demand for off-street car parks. In some cases reduction of on-street car parking is linked with better provision for pedestrians and cyclists, as in the City of York. Also the extension of residents' zones is a common method of parking control in all LTPs.

Particular attention is given to the provision of more parking spaces for powered two wheelers (PTWs) in city centre car parks, because increasing the use of PTWs can facilitate more efficient use of road space, and consequently contribute to reducing levels of congestion (York).

In addition, special attention is given to the needs of disabled people, for city centre parking space.

The analysis of LTPs indicates the priority given by Local Transport Authorities to the use of parking management in transport policy. In general, the tendency is towards a change in the culture of the use of the city centre, reducing the presence of car parking space, primarly the on-street and then the off-street, accompanied by the improvement of alternative modes of transport, such as cycling, public transport

[19] West of England Final Joint Local Transport Plan 2006/07-2010/11, p. 79.

and/or walking. When the policy documents refer to off-street car parkz, they do not consider the operators or, at least the LTP seeks the limitation or, at most, the removal of this infrastructure. On the other hand, the increased price of public parking and, in some cases, also the reduction of on-street car parking, could facilitate an increase of business for car park operators in the city centre; although this will still depend on car mobility policies in terms of accessibility to the off street parking and the competitiveness of Park and Ride, improved by measures such as increased services or decreased ticket prices (i.e. free or low price for the tram shuttle service). In summary the future of the private car park market is not wholly an optimistic one.

2.5 Car parking market trends in Italy and in UK

In general in both countries the data on the car parking market is poor, in spite of the economic (and transport) importance of the sector. This section of the chapter attempts to present the data that is available.

In Italy pricing parking bays in the city centre is one of the main measures applied from the early '90s onwards. The main reason for this change was to control cars in city centres, where they are considered the main cause of environment problems, such as pollution, congestion, noise, and general reduction of the quality of life. While in 1999 some 82.8% of municipalities had applied this measure to at least some parking spaces, by 2002 the percentage of had risen to 92%. The measure was considered an alternative to access controls (see ZTL policies in Italy, in chapter 2.3).

Municipalities have also been constructing new off-street car parks under the Tognoli law. While initially, the trend was for surface car parks, at the present the tendency is the construction of new off-street car parks with a minimum impact on the city centre landscape: underground car parks and automatic "silos". For example, "silos" are found in several cities in Italy (Rome, Milan, Brescia, Cesena and Turin), and the same cities also have underground car parks. These innovative constructions are

considered a useful option, especially when pressure on the land for parking provision tends to intensify (http://www.parcheggi.it).

Table 1: Car parking pricing in the Italian Municipalities - % of municipalities pricing at least some on-street spaces

Area	% of Municipalities (1999)	% of Municipalities (2002)
North West	81	90.9
North East	81.3	100
Centre	91.7	100
South	64.3	86
Total	82.8	92

Source: Federtrasporto et al., TPL 2000 n.3/2002

The proportion of priced car parking spaces has increased significantly in all the Italian municipalities (other than the North West), even if percentages differ for each one. Table 2 shows the number of car park bays (public off-street car parks) priced in the main Italian cities. In general, we can say that the proportion is large, and is related to the new policy local government policy for car access control into the city centre. The number also relates to the existing car parks in the city centre (less to the new construction), but in several cases, it does not appear to be related to the size of the city (e.g. Bologna is a relatively small city but one that has experienced a huge increase in the proportion of parking bays that are priced).

Table 2: Number of car park bay priced

City	2001	2003	variation
Rome	4,540	18,900	+416%
Milan	3,030	13,900	+459%
Bologna	1,551	9,421	+607%
Florence	1,380	3,907	+283%
Ravenna	674	1,756	+261%

Source: Aipark (2001, 2003)

The differing results show that use of this policy depends on the individual policy of each municipality, the general acceptability of pricing to the community, and the availability of spaces per inhabitant. In fact, if in some cases the number of priced

bays per inhabitant is around ten (La Spezia 9.58, Bologna 11.44 or Pavia 12.21), there are cases of cities with numbers much higher, such as Genoa (17.43), Messina (101.76) or Palermo (97.6), where the proportion of priced bays that are priced has not increased as quickly.

Table 3: price of the first hour off and on-street

City	N° of inhabitants	Off-street	On-street
Milan	1,304,000	2,00	1,50
Bologna	371,000	1,65	1,25
Turin	908,000	1,20	2,00
Cesena	90,000	1,10	1,10
Ravenna	138,000	1,50	1,20
Forli	107,000	0,70	1,00

Source: Aipark (2003)

In addition, the rates applied are quite different, and not related to city size. Table 3 shows some examples. It is interesting that in some cases the on-street price is higher then the off-street price, but this is not a general rule. This happens when the local policy aim is to incentivise drivers to leave their car off-street, to improve general mobility. Of course this policy is simpler if the municipality is the owner and manager of the off-street car park, while if the management is given to a subcontractor it is more complex. It is not at all simple in the case of a private car park, managed by a private company, even if it is convinced indirectly to align on the market price. The municipality may increase the cost of on-street parking but the private operator may then simply follow suit.

The pricing of bays, as said before, is a local policy tool for the control of cars being driven into the city centre. As can be seen, the on-street car parking price is generally lower than off-street. This leads many drivers to choose if possible the on-street bay, with negative economic consequences for the off-street operator. Also when on-street and off-street are controlled and managed by the public authority if the price is not determine on the basis of maximum profitability, the effect for the private operator

could be negative if they are not located close to a public off-street parking that is part of the whole public parking system. But also in this case the private operator could suffer from the presence of the public facility if the price applied is lower than the price for market equilibrium. Even if this is an obvious consequence of this policy, there is not evidence in the literature to demonstrate that it occurs.

In the UK data on car parking market trends are really poor, as in Italy. Some data are available from the recent RAC Foundation study (RAC Foundation, 2005). By 2030 it is predicted that there will be 45% more cars on the road (from 27 to 39 million).
The availability of car park space now is 53% in garages, 24% off-street and 23% on-street. Referring to the residential parking, the forecast for 2030 suggested by RAC report is an additional requirement for off-street parking for 9.2 million cars, and 2.8 millions cars for on-street. But this data does not give a realistic picture of the car park market, and its potential for growth, if it is not considered also the estimates of car parking act by journey purpose that show the growth of travel purpose for shopping, business, entertainment, education, holiday; all destination that are often in the city centre. On the contrary, only 3% of people pay to park every day, and even then they pay less then £2, excluding London – so even a 100% growth in this market means that a small proportion of drivers will be paying for parking in 2030, unless there are major changes in parking policy.
Because so many car trips in the UK do not result in any payment for parking, then the use of parking charges is only one-sixth as efficient as the congestion charge scenario. This is to say that parking pricing is not economically efficient at capturing the welfare losses resulting from congestion.

London itself accounts for some 44% of the total gross parking income of England and over a half of the net income. It is interesting to note, moreover, that income from penalties exceeds income from parking itself in London and in the English unitary authority areas. The net surplus made on parking per year (minus the expenditure for operation, maintenance and enforcements) in England is around £350 million. The revenue generated is used for other transport policy areas.

One view into policy on parking in the UK is given by the data regarding annual public expenditure for this sector which is around £28.7 million in England, while the funds for cycling are £47.7 million and £75.0 million for pedestrians. This helps to explain the tendency to reduce car parking facilities in town and city centres, and the greater improvements in other areas of trasnport. The use of supply restriction as a tool of demand restraint is combined with parking pricing policy. The expansion of the Controlling Parking Zones and the long terms charging policies are the most usual way to do this.

If we consider that actual parking pricing and supply restrictions are the major tools used by local authorities to restrain demand in town and cities across the UK, we can better understand the situation of the car parking market in the UK. However the solution proposed in the RAC report to the problem of an increased number of cars needing new space to park, takes the opposite tack. In fact, the RAC report suggests reducing the number of on-street car parking spaces, and developing in the main new off-street ones, reducing the problem of cars occupying road surface in our towns and cities. For off-street the report suggests the use of new technology, i.e. "silos", supported by Government funds. However, this thesis argues that the policies suggested in the RAC report cannot be firmly grounded without covering the significant gap in knowledge about this sector and in particular its suppliers: how do they view parking supply, management, and strategy? This thesis hopes to fulfil some of this need.

A recent interview conducted with Mr. O'Brian, Manager of the British Parking Association (BPA) provides other interesting information about the British car park market. Until the 1990s, on-street car park was the most developed part of the market, because it is cheap and because there was little space available for off-street car park construction. New off-street car parks were seldom built, mainly because of their high construction costs. From the 2000s, off-street car parks are again becoming popular, in particular multi story car parks at the periphery (Park and Ride site). Some examples can be found in Manchester and Oxford.

The most common solution is the PFI – the Private Finance Initiative - because the local councils cannot support the high cost of construction. Normally the procedure is a public tender where the local council asks for the construction of a new car park on a public area. The Council permits the new construction (for social reason), and the private operator builds and manages it (for profit, including an annual servicing fee from the public sector).

Referring to the focus of this research, Mr O'Brian commented that location is very important, immediately followed by price, for the success of an off-street car park. In addition, quality is becoming more and more important. Some examples of quality tools are security systems, self-prevention, disabled facilities, and payment systems supported by new information technology products. But a key problem for UK towns and cities is the high cost of land in the city centre and the tendency to want to reduce the number of cars travelling to that area, so private sector parking companies are exploring new business opportunities such as airport and railway station areas.

Another strategy is the construction of new car parks in the proximity of the congestion charge area of the city. For example in London, NCP has decided to build a new car park near the congestion charging area, where drivers can leave their cars and go to the city centre using public transport. This strategy of course only works if the congestion charge area remains constant in size. Mr O'Brian could offer no evidence of the involvement of car park operators in the London Transport Authority's policy and decision-making process, even when these affect their business.

Differences between parking policy in Italy and the UK

This section has reviewed parking policy in Italy and the UK. This comparison is important, as it has implications for understanding the results of a survey of parking operators conducted for this thesis, the results of which are presented later. Essentially, there are three key differences between parking policy in the two countries:

- Firstly, there is significant government aid for local authorities and car parking operators wishing to construct new off-street car parks in Italy. This money is released in the context of parking management strategies that generally seek to relocate surface on-street parking underground, and to reduce parking pressure in the historic core of Italian cities, many of which now also have Traffic Limited Zones (ZTL) in place. Such aid is not in place in the UK.
- Secondly, and related to the above point, municipalities in Italy continue to play an active part in the provision and management of off-street parking in that country. In contrast, in the UK, very few authorities are currently building new city centre car parks, and the ownership and management of existing car parks varies considerably, with some authorities divesting themselves of existing facilities in order to fund their refurbishment. Large scale new off-street parking investment is concentrated around airports, instead, since these provide greater revenues and lower investment costs.
- Thirdly, UK transport policy has, since 1994 at least, advocated the use of restraint in parking provision as a means of influencing people's choice of mode of transport. This has been a much less explicit part of Italian transport policy, as ZTL have been introduced more for environmental reasons than for congestion reduction. Nonetheless, there is a similarity, as argued throughout this thesis, in that the role and situation of existing and new off-street parking operators has largely been taken as a given in the development of urban transport policy in both countries.

2.6 Conclusion

The analysis of the related literature has demonstrated that the car parking sector is a market only recently analysed and little investigated. There are no documents that try to analyse the car parking sector from the operator point of view. Operators are instead, always considered as followers of policies suggested by the policy maker. In particular, there are very few works relating to the off-street car park sector. This points to the need for further investigation and an attempt to fill in the literature gap.

Location is a very important factor for the car park operator. The nearer a car park is to the city centre, the greater is the possibility to gain profitable business. The reasons are various. The city centre is a place of attraction for many drivers, due to the various activites present there: shopping, work and services. In the meanwhile parking policy tends to use parking pricing as tool to control the pressure of car in the city centre (short stay parking). In the UK the supply of off street car parks in the city centre is not adequate with respect to the demand, and the tendency is towards a growth in this trend[20]. In Italy there is the provision of new car parking construction in the city centre, but is not adequate in relation to the total demand for parking space. In both countries the price of parking decreases from the centre to the periphery, where the cost of land is lower, the space available is higher, as well as the demand for parking space available during the day due to shoppers, visitors etc..

Price is the second crucial factor in attracting or deterring customers. For example, public parking policy uses price to discourage drivers from parking in the city centre, or shifting them from one area to another.

Quality is the third key aspect considered in the literature, but always as a single tool to modify the behaviour of the driver. There is as yet no work that considers quality of service as a tool to manage car parking services as a whole. This is an important gap of the literature. The three variables, in spite of their importance, are never considered together, in particular the quality of car parking in relation to the other two variables. This gap is the main issue to be explored by this research.

Regarding the policies, the tendency in the UK is to restrict new car park construction, because the control, and if possible the reduction, of the number of cars in the city centre is very important for the environment and the quality of life for inhabitants. This target is achieved by intervening in the area of mobility, and so parking is considered a demand management tool. Another reason for the restraint of new car

[20] Local authority have serious difficulties to build new constructions. Also the present multi storey car park are "not adequately maintained and standard are frequently low such that some users avoid them because of security concerns" Local authority non-residential, RAC Foundation study, 2004, p. 29.

park construction is the high cost of land. The effect on the car park sector is not analysed, yet this should be an important part of the evaluation of the effect of these policies. In some cases an LTP has prevented the reduction of off-street parking through negotiation with site's private owner. A consequence for the car park sector is their consideration of new potential business opportunities, such as airports and railway stations.

In terms of spatial localization of car parks, the policies are focused on the city centre and areas adjacent to it, where the number of cars is increasing. Price also in this case is a tool to control the number of drivers. Also private operators are controlled, but indirectly, because they are affected by the price of other publicly managed car parks in the area – this applies mainly to on-street parking, but in some cases off-street as well. In terms of quality of service, while some services are required by new laws, such as disabled facilities, others are chosen by the operator to meet the needs of clients. From the point of view of car park operator location, price and quality of service are key factors to consider to ensure optimum profitability for their businesses.

In Italy, by contrast, thanks to significant public subsidy, the number of car parks is continuously increasing, but the effects on the market are not really clear, for example in terms of profitability of the activities, and whether there are sufficient clients for all the new car parks. It is also the case that new car park construction, or the management of public construction by a private company, must meet some conditions set by the public sector, such as opening times and the range of prices applicable. In addition, there are many cases where the price of on-street car parking is fixed for reasons other than market reasons (public acceptability, to enlarge/restrict the availability of the car park, long/short stay parking etc.), yet this can have serious consequences for the profitability of the off-street operators.

The literature considers various aspects of the car park sector, almost all from the point of view of drivers, or as a policy tools, with little investigation of the car park industry as a market. Location and price are variables investigated and considered to be very important but rarely quantified in terms of their impacts on competition

between operators, while quality is considered only as an individual characteristic, but not as a whole factor of the service offered. Furthermore, there appear to be no analyses of the car park market in terms of competition between its actors, the car park operators, analysing their business.

Policy in UK and Italy uses different approaches to solve the problem of the increasing number of cars in the city centre. For both countries the car park sector is a tool to achieve this aim, but there is little evidence in the literature of analysis of the sector as an economic sector in itself, so policies are related to the need to control or satisfy the drivers, and not to how car park operator react to the effect of such policies.

In summary, a number of key gaps have emerged from the literature review and policy analysis:

a) that almost no authors have looked at the city centre parking market from the supply side point of view;
b) that there is a lack of econometric analysis of the supply side of the parking market;
c) that local authorities and other policy makers tend to treat car parking operators as a "given", rather than engaging with them actively when they shape their transport policies;
d) that quality as a key variable by which car parking operators differentiate themselves has been overlooked in the literature;
e) that there has been a lack of empirical research (even by the industry itself) that has tried to find out what car parking operators want and how they see their own markets; and
f) that there has also been no cross-national comparison of car parking markets and operator behaviour.

This gap analysis leads to the development of hypotheses, nested within the research objectives, that will be investigated in the rest of this thesis.

Research hypotheses

From this review of the related literature and policy in the UK and Italy, two hypotheses emerge, the exploration of which will structure the rest of the investigations in this thesis. The first hypothesis to be explored is that "when a parking operator chooses whether or not to enter a new parking market, he considers the location of his car park and those of his competitors as the key variable in his decision, followed by thereafter by price and quality". The variables are assumed to be important when the car park operator decides whether or not to enter into the market, but also during its operation, within the context of the other parking facilities offered by its competitors in the same city zone.

The second Research Hypothesis is that "the needs and views of car parking operators are not taken into account by local and national authorities when they draw up their mobility and parking policy". This aspect is very important because it appears from the literature review that the operators, although they are important actors in the field of urban mobility, are nonetheless excluded when new transport policies are applied, without consideration of these policies on them.

The following chapters now go on to explore these hypotheses using a variety of methods, as outlined in the next chapter, on research methodology.

3. Methodology

3.1 3.1 Introduction

In this chapter the methodology adopted and the rationale for its choice is explained in the following two sections. As discussed previously, there is little existing research in this area, and this makes problematic any attempt to build an analytical framework in which competition in car parking markets can be rationalized. Consequently, the author had a relatively free hand in selected a methodology for the investigation of the research hypothesis – bearing in mind always that the methodology should be suitable for the consideration of the supply side of the car park market. Ultimately it was decided to use an econometric model, two case studies, and an empirical survey in the two countries studied, the UK and Italy.

3.2 The choice of the economic model

The related literature has demonstrated to an extent the fundamental importance of three variables that the operator must take into account, either when they decide to enter into a new car parking market, or when they are already operating. The three variables are location, price and quality. The research in this field of analysis is currently very limited and in any case does not consider these three variables together. It is always concentrated on some one of them, but never all three together.

Another important question is related to the economic analysis of the car parking market. There are very few works that analyse this sector and, in any case, there are none that refer to the off street parking operator sector. The most interesting analyses are related to the demand side of the car park market, but in these works, the supply of parking space is not analysed. Academic literature on the supply side is much more limited and deals almost exclusively with on street car parking.

The behaviour of the operator is not investigated, nor are the three variables considered from their point of view. In particular, the quality of the service has not been investigated until now. Even if the related literature has demonstrated the importance of quality of service, there is no work on this aspect from the car parking operator's point of view.

The choice of the model to use for the simulation of the car park market was decided in relation to the characteristics of the car parking sector analysed by the present thesis, and in view of the first research hypothesis, which explicitly requires an investigation of parking economics. Excluding park and ride, the off street car park structures are almost always located in the city centre. The city centre is a distinct part of the city, normally easily identifiable, where it is also possible to identify the off street car park operators that price their car parking spaces. Even though there are normally also priced on street car parking spaces in the city centre, these are not considered in this thesis, because it is very rare that they are privately owned and/or operated.

The off street car parking market in the city centre is normally formed by a small number of operators. In other word it is an oligopoly. The competition between the operators is the behaviour of one with respect to the other – in other words, a process of action/reaction.

The Hotelling model (Hotelling, 1929) was first used to describe the spatial competition between two firms in a duopoly market. To describe the behaviour of the firms Hotelling introduced a game theoretical solution. In this first model the location and price was the variable considered by the two firms when they decided where locate their activity. Various extensions of this locational model were developed. An interesting use of the model was related to the justification of the spatial agglomeration of firms in industrial clusters (economies of agglomeration). The reduction of the distance between firms was justified by the access to services that companies share (i.e. same labour market, information and expertise, etc.), but was

also found to be the solution for each firm to maintain its competitiveness in the market.

Over time the Hotelling model has "become the natural framework to analyse spatial strategic interaction of oligopolists, especially when they operate in an urban structure" (Baudewyns (2001).Because it is an oligopoly operating in a spatially distinct, identifiable area, the off street car parking market in the city centre meets the conditions for the application of the Hotelling model. The main difference with respect to the original model and its subsequent extension in this thesis is that there has been no previous application using a three game stage; the model was always applied in a two game stage. The related literature in the car parking market highlighted the presence of three variables considered very important for the operator. For this reason the application of the model will considered these three variables, requiring the use of a three stage game process.
The choice of the Hotelling model implies the use of game theory if more than one variable is analysed. Because of the presence of three variables, the model has to be developed in a three stage game. This choice is very important if we consider that there have been no reports in the literature to date of the use of a 3-stage game in the parking sector. As noted in chapter 1, Arnott (2006) has developed a model related to the Hotelling theory utilizing two variables (price and location). The choice of the Hotelling model is related to the possibility it gives to define an appropriate solution in a relatively short time, while in other models use in the literature, such as Anderson, De Palma (2004) or Arnott, Rowse (1999), the use of traditional models permitted the finding of the optimal equilibrium in one stage, using a wider number of variables, but the results did not fit the expected aims, because the models rapidly became very complex.

The simpler model is used in this research. Although on the one had it is to some extent determined by the presence of some simplifying assumptions, on the other hand it provides an opportunity to analyse together three variables considered to be very important for the parking operator, as has been shown in the literature review. The three stage game was developed in the framework of game theory, where every

stage of the model finds the optimum equilibrium for one variable, while the other variables analysed are considered fixed. This is the framework of the oligopolistic Bertrand equilibrium (Philips and Thisse, 1982), where one operator makes his choice, assuming that the other operator does not change his choice. Another framework used in the general public goods sector is that of Stackelberg, where one firm makes its choice and the other simply follows (Fudenberg and Tirole, 1993). This behaviour is less realistic if applied to the car parking sector, because it relates to the presence of an operator who in many ways assumes the role and behaviour of a monopolist.

3.3 The survey: rationale and methodology

The related literature has highlight that car parking sector is very little investigated. There are few data on the car parking market available in both of the countries under consideration, the UK and Italy. Added to this, the behaviour of the car parking operator has not been studied before. The car park is mostly considered as a final destination of the driver, as a static point, and the studies to date have focused on the behaviour of the driver and not on the behaviour of the car park operator, i.e. in term of service offered to the drivers or decision of where to build a new car park.

While location and price is considered only in a very recent work (Arnott, 2006), the quality of the service offered is completely missing as a topic for investigation. Furthermore, there are no works that compare the car parking sector in different countries, while at national level the data available are very limited.For these reasons the research investigated the car park sector in two countries analysing the variables considered important for the operators.

The cities of the UK and Italy are quite typical for Europe in that they tend to have a very old historic city centre, often not designed for the mobility of car, and a more modern periphery, where the typical mobility problems that afflict the city centre are often less acute. The questionnaire was chosen as a research method because the

research hypotheses required that the research obtain information that could be used to describe and analyse the current situation for the sector in the two countries. In terms of the topics covered in the questionnaire and its structure, these were closely related to the research hypotheses and to the knowledge gaps identified in the literature review.

The questionnaire turned out to be an excellent way in which to obtain useful information about the sector. Even before the distribution of the questionnaire, the researcher always phoned the municipality or the private operator to ask the name and e-mail of the person responsible for the car parking sector (for the case of Municipality), or for communication in the case of a private firm. One or two weeks after the delivery of the questionnaire, another call was made to the contact person to verify that they had received the questionnaire, and that they could complete it. The phone call was also an opportunity to talk to the operator and gain from them useful additional information that helped the researcher understand their sector.

The survey was put in the context of the two countries under study, by choosing two typical cities: Edinburgh and Ravenna. The choice was of two typical medium size cities. Smaller cities normally suffer less from the typical problems of mobility, congestion, noise etc. and scarcity of parking space, while bigger cities have a very broad-based structure, where the city is divided into various area and the car park operators do not necessarily consider the city as a whole in terms of market and potential car park competitors, but only the portion of the city where they are located. The sample size was selected to gather a wide selection of responses from different cities in the UK and Italy, as well as from both private and public sectors. In total, some 190 questionnaires were distributed: 160 in the UK, and 30 in Italy. The justification for this sample size was obviously different in the two countries; in the UK, which was not as well known to the author, the aim was to gather a wide range of responses from a reasonably representative sample of public and private operators in a range of cities. In Italy, where many cities are known to the author, and also because of cultural differences in responding to requests for information in the form of a

questionnaire, a more personal approach – involving interviewing the respondent, often in person – had to be taken; for this reason, the sample size is lower.

The decision to use a questionnaire rather than an interview was a result of the considerable amount of information needed, and the large number of cities to be reached, plus the national level of the survey (Adér, Mellenburgh and Hand, 2008); it was a compromise between the amount of data that could be gathered, and geographical reach of data collection. Whilst – due to the researcher's own situation - a background the knowledge of the Italian national and local car park market situation was already in place, in the UK the call pre and post submission of the questionnaire was a critical opportunity to talk with the operator and thus to better understand their business. In addition, it was also decided to interview the main association in the UK that represents the car park sector, the British Parking Association, in order to get a better understanding of the way that the British car parking market operates, the concerns of operators (particularly with regard to government policy), and the Association's views on the future of car parking in Britain. This interview was carried out with Mr Paul O'Brien of the BPA on 24th August 2005.

Another aim of the survey, important in view of the fact that the first research hypothesis has an economic focus, was also to collect financial information from the car park businesses. This aim was very difficult to attain in practice; very few operators provided this data. The reason, apart from the sensitivity of the data, seems to be related to the general practice of the operator (especially the private operator) not to share information, especially financial information, with other people. However, the financial information that was provided was very illuminating and unique in academic research known to this author: empirical car park revenue and cost data have not previously been published.

4. Modelling the competition between car parking operators

4.1 Introduction

In this chapter an economic car parking model has been developed, focusing on the supply side of the market. As discussed previously, there is little existing research in this area, and this makes problematic any attempt to build an analytical framework in which car parking's competition can be rationalized. Consequently, a model inspired by Hotelling's (1929) model is proposed, focusing on the supply side of the market, using as variables, location, price, and quality.

4.2 Literature review

The original Hotelling model (1929) has provided many applications and extensions in the subsequent literature. Some of them deal with demand location uncertainty and product differentiation (Harter, 1996); some others with empirical testing of the Hotelling location model (Young and Ryan, 1996). In some case the author has demonstrated the preference of customers in the service market, such us Stahl (1987, 1995) who showed that the presence of customers with a preference for variety, and the existence of economies of scope in jointly purchasing many commodities on the same site, can induce retailers to agglomerate. For any purpose, a useful extension is found in the work of Philips and Thisse (1982), which applies the model to examine the return for various industries, utilizing aggregate annual price, extraction costs and interest rates in Canada. These authors introduce in a location model a vertical quality differentiation dimension for the suppliers of services. They model firms' competition using a multi-stage game-theoretical approach particularly appropriate to oligopolistic contexts, where competition usually takes place along several dimensions (as is the case in the parking market). In this chapter, we adapt Philip and Thisse's model to a

duopolistic market in which privately owned parking operators are present[21]. The use of a two-dimensional variant of a similar game is presented in Stern (1972), but at the present time there are no extensions of the Hotelling model that have considered three variables. For this reason the application of the model in the car parking sector was developed using a three game stage Nash equilibrium.

4.3 The car parking model

With regard to the model developed in the this section of the thesis, and in relation to existing models about parking markets (see below), some simplifying assumptions have been made (regarding demand, firms' costs, uniformly distributed destinations etc.), for the sake of easier manipulation of the model. This allows us to manage multistage strategic interactions between parking operators more complex than those dealt with by Arnott and Rowse (1999), Calthrop (2000) or Arnott (2006).
In particular, and considering the related literature discussed above, the research analyses the relationship between the 3 variables that together – it is argued – encapsulate the tools used by the car park operator to compete in the city centre car parking market (and the interactions of one with the other): price, location and quality.

The bases of the model are as follows. The context is a city centre described in linear terms, with the presence of two off-street car parks which may differ with respect to the distance from the final destination of the driver, prices and quality (accessibility, accessory services etc.). An adapted version of the Hotelling's (1929) model has been used; in particular Phillips and Thisse's (1982) model will be used to analyse competition between two off-street car parking firms placed at two separate points along a linear city of unit length.

[21] For an alternative application to internet services' markets see Foros and Hansen (2001).

Let introduce the variables used in the model:

A and B = final destination of the driver

0 – 1 = representation of the linear city

C = city centre of the linear city

$\hat{l}$ = final destination of drivers, which are uniformly distributed

$q \in [0, \bar{q}]$ = quality of service, where $\bar{q}$ represent the maximum level of quality

$t \in [0,1]$ = unit cost of walking from the parking to drivers' final destination $\hat{l}$

p_i = price of parking in i car park location

θ = parameter of quality differentiation

n_i^d = demand of parking of drivers i

CT = Total cost of car parking operator i

C' = variable cost of car parking operator i

Π_i = profit of car parking operator i

u_i = utility of driver i

Let "A" and "B" indicate the position of two off-street car parks. The distance of the two car parks from the extreme left of the linear city are respectively a and (1-b) (see Fig.1). Let us assume that there are no congestion problems and the number of free places available in the two car parks should not be less than the number of drivers (clients) that want to park in the city. In this model the parking suppliers must firstly set locations, then they decide the quality of service that they wish to provide, (second stage) and finally supply prices (third stage). As we will see, we can characterise different subgame perfect equilibria (i.e. location, quality and price equilibrium profiles) according to different combinations of the exogenous parameters (i.e. the cost differential between the two off-street parking, as well as the walking cost)[22].

[22] An extended version of the results of the model is attached at Annex 1.

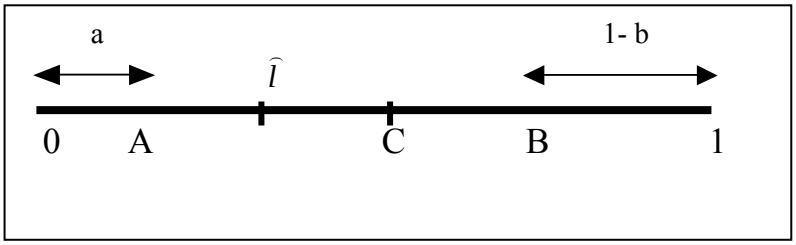

Fig 1 A Linear City: C= city centre, A and B = position of the two off-street car park, $\hat{l}$ = final destination

Assume also that the population of drivers have final destinations (l) uniformly distributed on a unit support and let q be the service quality, where $q \in [0, \bar{q}]$, with $\bar{q}$ is the maximum quality level allowed by existing technology. In what follows, for the sake of simplicity, we suppose that $\bar{q} > 3t$. Drivers' preferences are then represented by the following continuously differentiable utility function:

$$u_l = \begin{cases} q_A - p_A - t|l - a| & \text{if the subject parks in car park A} \\ q_B - p_B - t|l - (1-b)| & \text{if the subject parks in car park B} \end{cases}$$

Where q is service quality, p the price and $t \in [0,1]$ is unit cost of walking from the parking to drivers' final destination $\hat{l}$ (it could also refer to time)[23].

An indifferent destination could be easily identified assuming that: $\exists \hat{l} \quad with \quad a < l < 1-b$

This is given by the following condition

23 The absolute values represent the distance by foot from the car park to the final destination (this idea of destination allows the use of the Hotelling model). As usual, $t|\bullet|$ measures agents' disutility from walking.

$$q_A - p_A - t\left|\hat{l} - a\right| = q_B - p_B - t\left|\hat{l} - (1-b)\right|$$

from which

$$\hat{l} = \frac{1}{2}(1 + a - b) + \frac{1}{2t}(p_b - p_A - \theta) \qquad (1)$$

where $\theta = (q_B - q_A)$ is a vertical quality differentiation parameter.

Traditionally, from (1) the following demand functions can be drawn:

$$d_A^d = \frac{1}{2}(1 + a - b) + \frac{1}{2t}(p_B - p_A - \theta) \qquad (2)$$

$$d_B^d = \frac{1}{2}(1 - a + b) + \frac{1}{2t}(p_A - p_B + \theta) \qquad (3)$$

As it may be noticed, demand decreases with respect to parking price and increases as regards competition prices. Moreover, demand increases with respect to parking space quality. As usual in Hotelling-like models, firms' locations affect parking demand.

On the supply side, car parking variable costs are assumed to be linear and off-street supplier B's marginal costs strictly lower than off-street provider A's, i.e.

$$CT_A = Cn_A^d; \qquad CT_B = C'n_B^d \qquad \text{with } C > C'$$

No fixed costs are considered, on the assumption that construction expenses have been subsidized by the government (or local Municipality). This is a simplification of the model assumed for two main reasons: the first is related to the three stage game applied to the Hotelling model, which in the case where a fourth variable is added, results in an equation that is not solvable. The second reason is the assumption of the variable costs as a differentiator of the quality of service for the operator. The fixed costs are a variable that would need a four stage game to be solved, while even now, three stages are a major innovation for the Hotelling model. Furthermore the differential in marginal costs is assumed to be larger then unit walking costs.

Thus, profits are the following:

$$\Pi_A = \left[\frac{1}{2}(1+a-b)+\frac{1}{2t}(p_B - p_A - \theta)\right](p_A - C) \qquad (4)$$

$$\Pi_B = \left[\frac{1}{2}(1-a+b)+\frac{1}{2t}(p_A - p_B + \theta)\right](p_B - C') \qquad (5)$$

Finally, parking competition is modelled by a three-stage simultaneous game with perfect information. In the first stage, locations are set, then decisions taken about operators' quality of service, and then price decisions are taken. As usual, backward induction techniques are used in order to determine sub game perfect equilibria. As it will be clearer later, since multiple subgame equilibria emerge, action-reaction dynamics are used to select stable solutions[24].

From solving our game, some alternative competitive strategies emerge for car parking operators. These can be rationalised in different ways taking into account different mixtures of our descriptive parameters. The fact that off-street operator A's

[24] Further techniques for refining subgame perfect Nash equilibrium can be found in Osborne and Rubinstein (1994).

marginal cost disadvantage is not very large and walking costs relatively low, choosing locations at the edge of the city and offering qualitatively similar services allows firms to segment the market. On the other hand, in the presence of large cost differentials and low walking costs, parkers are mainly attracted to a car park by using quality of service and the car park's relative position in the city becomes irrelevant. Intermediate solutions are also phased out where neither costs nor the differential in walking costs are relatively large. More precisely, the next propositions allow us to identify three possible competitive scenarios.

Proposition 1 (Edged Location)

Whereas, $C - C' \leq 3t + t(a-b)$ in a stable subgame Nash equilibrium both car parking operators decide to minimize quality of service differentiation. Moreover, extreme locations maximize profits, geographically segmenting the market.

Proof:

Let us start by assuming that $C - C' \leq 3t + t(a-b)$. Maximizing expression (4) and (5) with prices we get the car parks' reaction functions in the 3rd stage of the game. Intersecting these functions, the price of both car parks is obtained:

$$p_A^* = t + \frac{t}{3}(a-b) + \frac{C'+2C-\theta}{3} \qquad (6)$$

$$P_B^* = t - \frac{t}{3}(a-b) + \frac{C+2C'+\theta}{3} \qquad (7)$$

Hence, firstly substituting (6) and (7) in (2) and (3) then in (5) and (4), it is possible to show that equilibrium profits in this stage are :

$$\Pi_A^* = \left[t + \frac{t}{3}(a-b) + \frac{C'-C-\theta}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(a-b) + \frac{C'-C-\theta}{t} \right] \right\} \qquad (8)$$

$$\Pi_B^* = \left[t - \frac{t}{3}(a-b) + \frac{C-C'+\theta}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(b-a) + \frac{C-C'+\theta}{t} \right] \right\} \qquad (9)$$

As usual, these expressions have to be maximized with respect to service quality in order to get second stage reaction functions. These are, respectively for off-street parking A and off-street parking B, equal to:

$$q_A = q_B - 3t - t(a-b) + (C - C') \qquad (10)$$

$$q_B = q_A - 3t - t(b-a) + (C'-C) \qquad (11)$$

Looking at (10) and (11), it may be noticed that the reaction functions at the quality-stage are straight and parallel lines. Thus, an interior Nash equilibrium in quality does not exist. Since car parks are maximizing convex profits over a closed domain, using Weierstrass's Theorem, we must notice that two symmetric corner solutions exist, corresponding to the boundaries of the quality domain. Hence, through action reaction dynamics it is possible to show that the unique stable equilibrium is:

$$q_A^* = q_B^* = 0$$

The following figures illustrate action-reaction dynamics (notice that the reaction lines' relative position may be easily determined using (10) and (11)).

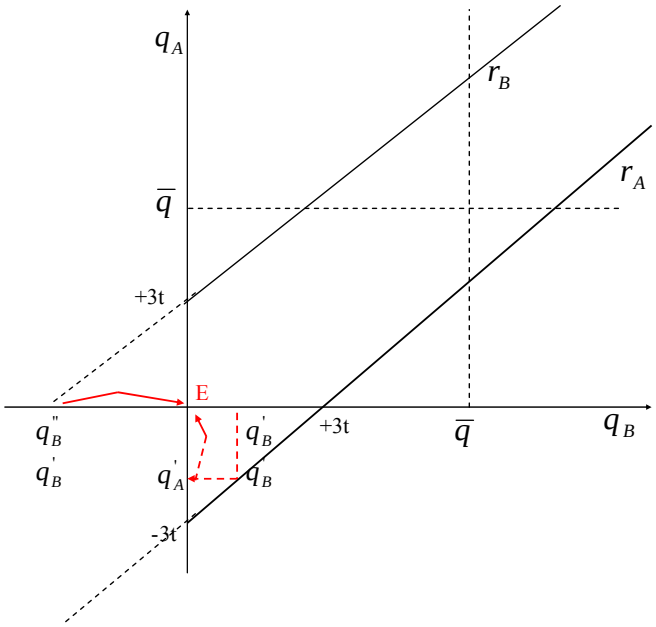

Fig 2. Second Stage Quality Best Reply Dynamics Case 1: h=(C-C')-t(a-b)=0 and $q'_B < 3t$.

Figure 2, Case 1 shows that when q'_B is the starting point , parking operator A's reaction is to try to achieve negative quality (q<0), but this is not possible, so q_A goes in 0. Then, B' reaction is q''_B <0, but this is not possible either, so B also goes to 0. Then, the solution is (0;0).

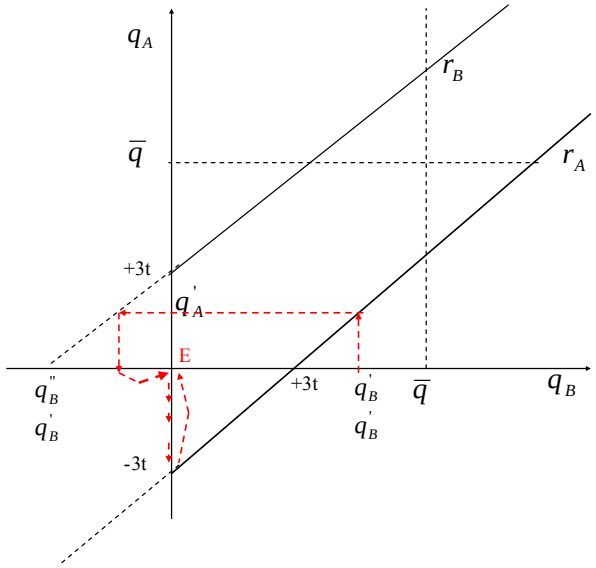

Fig 3. Second Stage. Quality Best Reply Dynamics Case 2: h=0 and $q'_B > 3t$.

Figure 3, Case 2 shows that when q'_B is the starting point, reaction is $q'_A > 0$, thence B sets q''_B<0, but neither is this possible, so q_B goes to zero. Then, A's reaction is negative quality, but this is not possible (q<0), and it goes to 0. The solution is again (0;0)

In the case that h=0 and $q'_B = 3t$, the same solution phases out.

Remaining figures illustrate the same procedure where $h \neq 0$, h<3t .

The next one shows that when q'_B is the starting point, A's reaction is $q'_A > 0$. Then B's reaction is a negative quality $q''_B < 0$, but this is not possible so it goes to 0. The same holds for parking A. Thus, once more, our solution is (0;0).

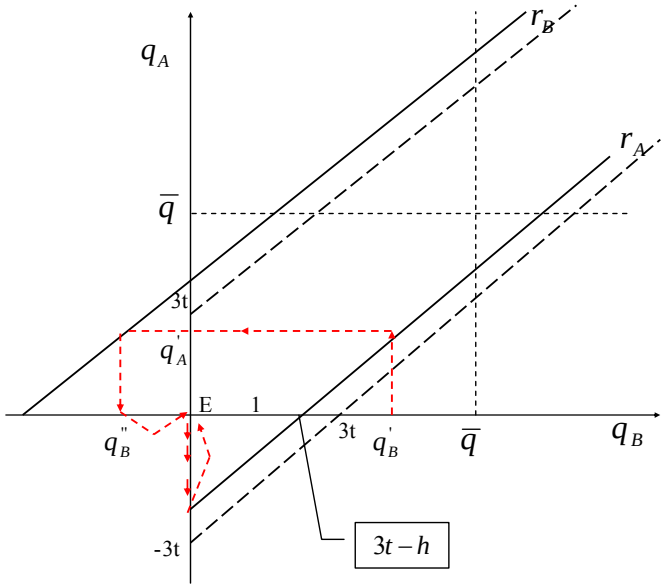

Fig 4 Second Stage Quality Best Reply Dynamics. Case 1: h $\neq$ 0 , h<3t and $q'_B > 3t$

When $q'_B < 3t-h$ is the starting point, A's reaction is q'_A<0, so it goes to 0. Then, B selects q''_B<0, so it also goes to 0. We get ones more (0;0).

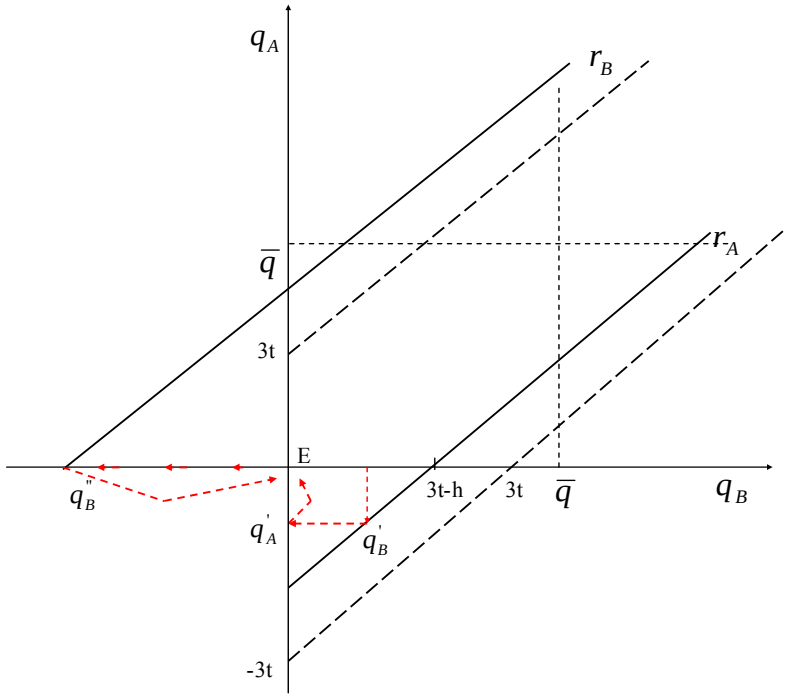

Fig 5 Second Stage Quality Best Reply Dynamics Case 2: $h < 3t, h \neq 0$ and $q'_B < 3t-h$

Finally, also with $q_B^{'} = 3t - h$ the solution is: $(0;0)$. Now, let us move to the third stage of the game. Corresponding to the above solutions, parking profits are given by:

$$\Pi_A = \left[t + \frac{t}{3}(a-b) + \frac{C-C'}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(a-b) + \frac{C-C'}{t} \right] \right\} \qquad (12)$$

$$\Pi_B = \left[t - \frac{t}{3}(a-b) + \frac{C-C'}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(b-a) + \frac{C-C'}{t} \right] \right\} \qquad (13)$$

Maximizing the last expressions with respect to the car parks' locations, we obtain once again straight and parallel reaction functions. These are, respectively for A and B car parking, equal to:

$$a = b + \frac{C-C'}{t} - 3 \qquad (14)$$

$$a = b + \frac{C-C}{t} + 3 \qquad (15)$$

As above, action-reaction dynamics over locations' domains gives the following equilibrium values:

$$a^* = b^* = 0$$

The next figures illustrate these dynamics.

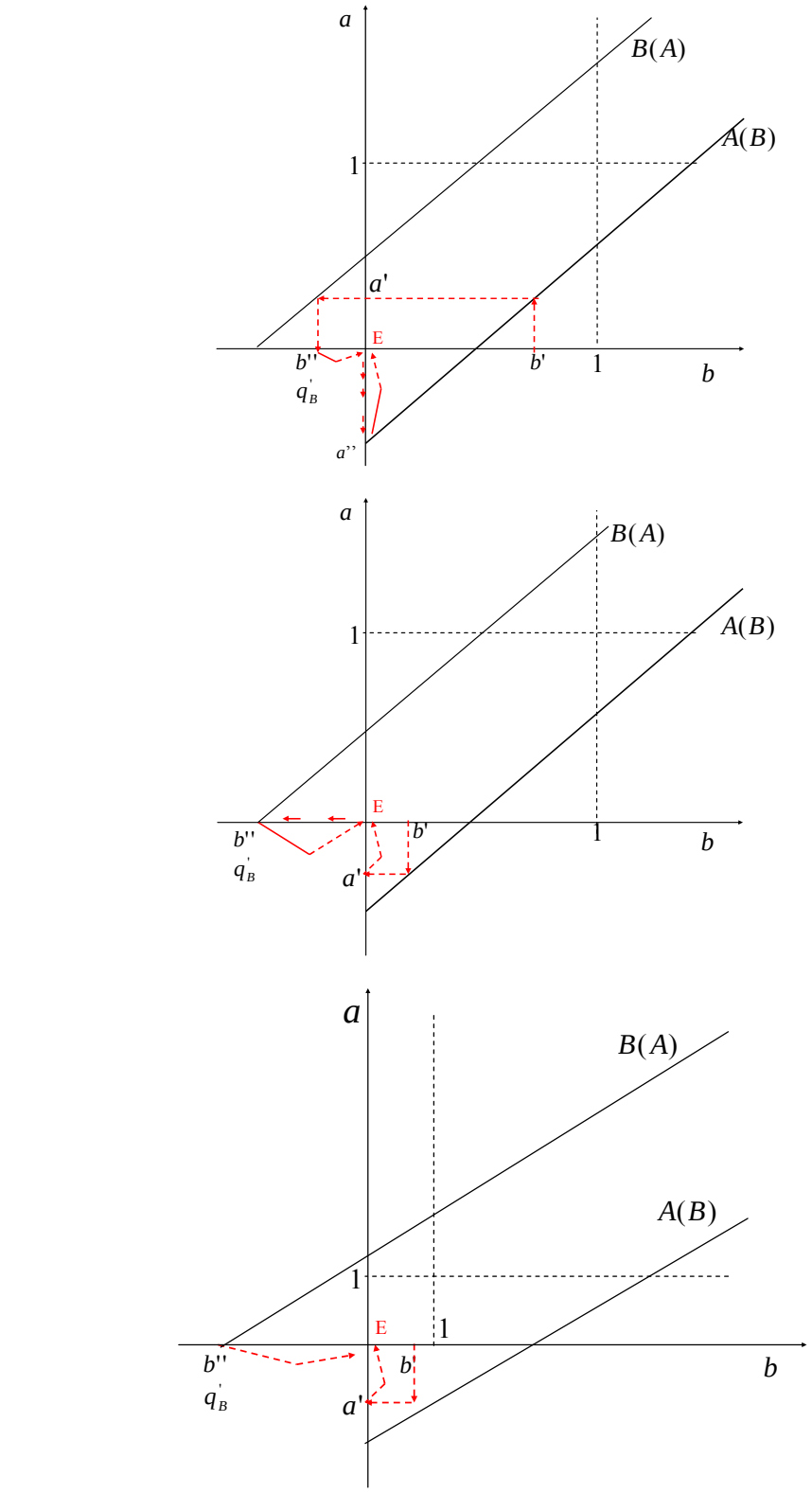

Fig 6 Location action-reaction dynamics (Edged Locations)

The insights of Proposition 1 suggest that where marginal cost differentials are low and walking costs high, no vertical product differentiation and geographical segmentation are the profit maximizing strategies. Since similarities in quality levels are likely to exist, car park owners prefer to keep at minimum service quality using distance as a market-segmenting device. As will be made clear below, if marginal cost differences increase, firms will increase quality differentiation or move themselves closer to the market.

Proposition 2 (Minimal Geographical Differentiation)

Whereas $3t < C - C' < 4t$, in a stable subgame Nash equilibrium off-street parking operator A will move their parking location closer to that of off-street parking operator B. Furthermore, both car park owners keep service quality to a minimum.

Proof:

Using an argument similar to that of the previous proposition, it may be easily shown that, if $C - C' \in (3t;4t)$, in the second stage of the game the best reply dynamics lead us to a stable subgame equilibrium in which no quality differentiation is implemented. Then, following the same reasoning (see figure 5), it is easy to show that in the location stage the following solution does emerge:

$$a^* = \frac{C - C'}{t} - 3 > 0$$

$$b^* = 0$$

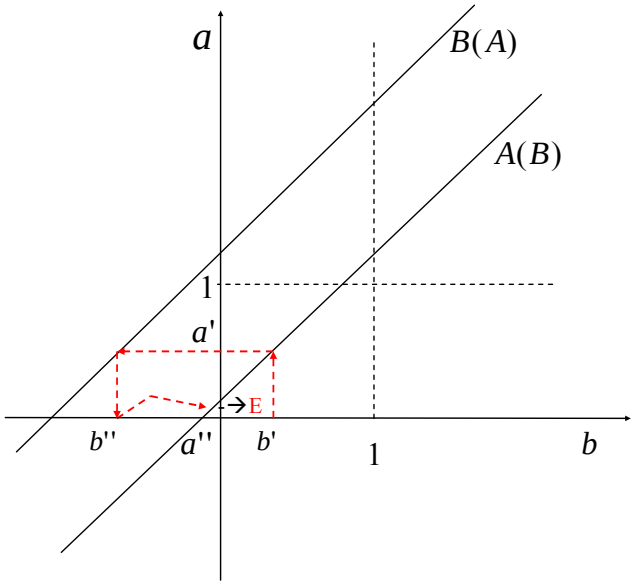

Fig 7 Location action-reaction dynamics (Minimal Geographical Differentiation)

As stated in the previous proposition, where we have a slight increase in differentials in costs, parking firms will maintain qualitatively undifferentiated services. In order to compensate (in term of profits) its relative disadvantage in costs, off-street car parking operator A will reduce its distance from the other firm. The higher its cost disadvantage is, the closer its position will be with respect to the rival's location.

The next proposition shows what happens when cost differentials are very large.

Proposition 3 (Quality Differentiation)

Where off-street parking A owners $C - C' \geq 4t$, in a perfect Nash equilibrium subgame, off-street parking operator A will increase proportionally its service quality in order to get non-negative profit. In this case, services have to be vertically differentiated and locations are irrelevant.

Proof: Let us now suppose that $C - C' \geq 4t \geq 3t + t(a - b)$.

The proof is similar to that in Proposition 1. In this case, maximizing expressions (8) and (9) with respect to service quality we get parallel reaction lines set in a different position with respect to the previous case. Now, action-reaction dynamics lead us to a quality differentiation result as illustrated in Figure 6.

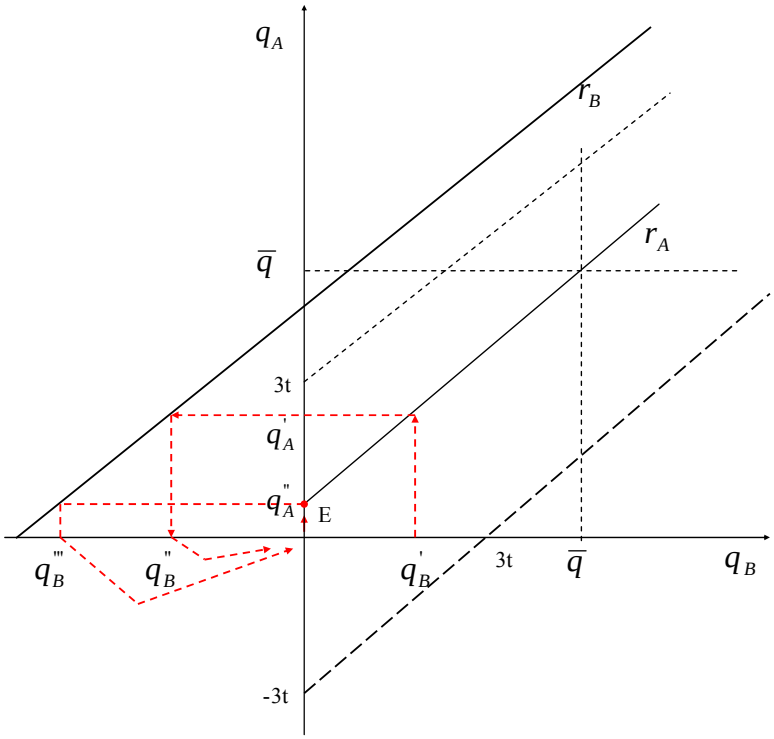

Fig 8 Quality Best Reply Dynamics (Quality Differentiation) $h \neq 0 \quad and \quad h > 3t$

The graph shows that when $q_B^{'}$ is the starting point, the reaction action of A is $q_A^{'} > 0$. The reaction action of B is $q < 0 \ (q_B^{''})$, but it is not possible to have negative quality, so it goes to 0. The reaction action of A is $q_A^{''} > 0$ (equal h-3t), so the reaction action of B is a quality $q < 0 \ (q_B^{'''})$, but neither is this possible, so it goes to 0. The reaction action of A is $q_A^{''} > 0$, and B, again, goes to 0. So we obtain two values, in equilibrium: $E := \begin{cases} q_A = h - 3t \\ q_B = 0 \end{cases}$

Hence, in the second stage Nash equilibrium it is true that:

$q_A^* = h - 3t$

$q_B^* = 0$

Substituting $\theta = 3t - h$ in (12) and (13) we obtain:

$\Pi_A = 0$

$\Pi_B = 2t$

As is straightforward to see, locations do not in this case influence car park operators' profits. The lack of importance of location is emphasized in this case.

Proposition 4 (Prices and Profits)

Finally, in the edged locations equilibrium, both car parks set prices higher than marginal costs and they earn positive profits. Furthermore, car parks' profits increase proportionally with walking cost.

Proof: In order to get the result it is sufficient to put $a = b = 0$ and $\theta = 0$ in (6) and (7). Since in this case $h < 3t$, we know that $p_A^* > C$ and $p_B^* > C'$. Again substituting $\theta = 0$, $a = b = 0$ in (4) and (5), the proposition may be easily proved.

Proposition 5 (Prices and Profits)

In quality differentiation and minimal geographical differentiation equilibria, off-street parking A sets a competitive price. Additionally, off-street parking's A profit is positive and its price-margin on costs increases proportionally with walking cost.

Proof: In order to show the result we have to consider two cases.

CASE I: Minimal Geographical Differentiation:

Substituting $a = \frac{C - C'}{t} - 3$, $b = 0$ and $\theta = 0$ in (6) and (7), off-street car parking operator A's equilibrium price is: $p_A^* = \frac{C - C' + C' + 2C}{3} = \frac{3C}{3} = C \quad \Rightarrow \quad \Pi_A^* = 0$. Similarly, Off-street operator B's equilibrium prices is: $p_B^* = 2t + \frac{C + 2C' - C + C'}{3} - 2t + \frac{3C'}{3} = C' + 2t$ with $\Pi_B^* > 0$

CASE II: Quality Differentiation

As above, putting $\theta = 3t - h$ in (6) and (7), we get $p_A^* = C$ and $p_B^* = C' + 2t$. Thus, $\frac{d(p_B^* - C')}{dt} > 0$. Substituting price and quality equilibrium values in (4) and (5), it is possible to get $\Pi_A^* = o$ and $\Pi_B^* = 2t$. ۱

In conclusion, it may be noted that only in the first solution of the game do both owners get positive profits. With quality or geographical differentiation, off-street car parking operator A must set competitive prices in order to survive. In this case, only off-street operator B is able to apply price margins (with positive profits).

4.4 Results

The model's aim of testing the interaction of the three variables and assisting parking suppliers in maximising profits for their facilities in a competitive market has been dealt with by a linear model representing competition between car park owners.
The analysis has suggested a number of possible competitive strategies for parking suppliers, namely the edged location, minimum geographical differentiation, and quality differentiation equilibrium.

Tab 1: Summary of model results

Strategies **Description**	**Edge location equilibrium Proposition 1**	**Minimum geographical differentiation equilibrium Proposition 4**	**Quality differentiation equilibrium Proposition 5**
Condition	If the marginal cost difference is high and t (walking cost) is low (C-C'>t)	If the difference C-C' is high and t is not very high	If the difference C-C' is very high and t is low
Price choice	The prices are different than the marginal costs (and profits increase as the walking costs increase)	Competitive price for off-street A (p=C). for off-street B p>C'	Off-street A price=C (Π=0) On-street B price >C' (Π>0)
Quality choice	Lowest for both owners	The same	Very high (proposition 5: quality is the only off-street survival solution)
Location choice	Edge	Quite near, but not in the same position (minimal distance)	Irrelevant
Positive profits for owner choice	Both	Off-street B owner only	Off-street B owner only

The first proposition is found by the model to be effective when the marginal cost difference between off-street car parking owners is high and the walking cost is low. In this case, prices are different and greater than marginal costs (and profits increase as walking costs increase). The car park quality is kept low by both owners (off-street A and B) and car parks are located at the edge of the city centre. The two car park

operator can offer the minimum quality of service, with minimum costs, and drivers do not see differences between them. In this case the two operator prefer to segment the car parking market in two sections. The drivers do not have minimum costs for quality service when quality is the same at both car parks. In the second case, the marginal cost difference between the off-street operators is high, and walking cost is not very high. Off-street parking A sets competitive prices, while off-street operator B's prices are higher than marginal cost. The quality of car parking is the same for each owner. The locations of the two car parks are quite close together, but not exactly the same, in order to lower under-pricing. Finally, when the marginal cost difference between off-street car park owners is very high and the walking cost is low, the price charged by off-street operator A car parking is equal to the marginal cost (and profits are equal to zero), while the price of off-street car parking B is greater than its marginal cost (and profits are positive). In this case, relative locations become irrelevant for profit maximization.

4.5 Conclusion

To deepen the knowledge of the city centre car parking market on the supply side, an economic model has been developed. Its aim is to simulate the use of the variables price, quality and location to understand the strategic behaviour of two car park operators in a city centre context. The analysis has suggested a number of possible competitive strategies for parking suppliers. These are the edged location, minimum geographical differentiation, and quality differentiation equilibrium.

The first one is effective when the marginal cost difference between off-street car parking owners is high and the walking cost is low. In this case the prices are different and greater than marginal costs (and profits increase as the walking costs increase). The car park quality is the lowest for both owners (off-street A and B) and both parks are located at the edge of the city. This is the case of two car parking operator who prefer to segment the car parking market of the city centre in two size.

Because of the relative low distance of both car park respect to the final destination, the driver will chose the cheaper car park, considering that for both quality is the lowest and not a variable who can differ one to the other. Because of the increasing of price respect to the increasing of distance to the final destination make the choice to locate at the edge of the city the more profitable.

In the second case, the marginal cost difference between off-street car parking is high and walking cost is not very high. Off-street parking A sets competitive prices while in the car park B prices are greater than marginal cost. The quality of car parking stays the same for each owner. The location needs to be quite close, but not exactly the same in order to lower under pricing. An identical location is in any case impossible.

Finally when the marginal cost difference between the two off-street car parking owners is very high and the walking cost is low, off-street A car parking's price is equal to the marginal cost (and profits are equal to zero), while the off-street B car parking's price is greater than its marginal cost (and profits are positive). Relative locations become irrelevant for profit maximization.

In the three equilibrium strategies indicated above, only the edged location equilibrium is profitable for both parking owners, whilst minimum geographical and quality differentiation generally involve zero profit for off-street parking operator A.

The model developed for this thesis has formalized the strategic behaviour of the car parking operator in the city centre. It can be considered innovative because it gives the possibility to use simultaneously three variables in a competitive market. In term of policy it can predict the behaviour of the operator, for example in a case in which local authorities rule on minimum standard of service quality. The model shows that if there is an improvement in quality required, the tendency of the operators will be towards the quality differentiation equilibrium, or (if the operators are quite close to one another) the minimum geographical differentiation situation,. In general the

model provides a reasonable approximation of the behaviour of operators under certain circumstances, although it is necessarily limited by its assumptions – in particular, that capital costs are paid by the state. This is a limitation of the model that must be taken into account. The exclusion of the fixed costs is adequate in the case of an existing operator in the market, while if an operator must decide whether or not to enter the market, in reality he must consider these costs and consequently the necessity to reach high profits to cover them. In this case, the cost for the construction of a new structure can be internalized within the variable costs as amortization rates, but in this case it becomes very important that the solution implies the duration of the amortization plan.

The main assumptions and limits of the model are the linear city context, the presence of two operators (and no more), and the exclusion of fixed costs. Together these provide the level of simplicity necessary to find the market equilibrium where the three variables price, quality and location are analysed together. The game theory is the method used to find the solution in the case of the Hotelling model when more then one variable is analyzed. In this case the variables analyzed using this model are three. This thesis therefore represents the first case of the use of three variables together in the parking sector . These assumptions have also allowed the author to overcome the limit of the model developed in the literature where the complexity of the assumptions has often led to a very high level of complexity within the model, reducing the relevance of the results (Anderson and De Palma, 2004).

A model that could take into account more contextual factors and more accurately reflect the impacts of changing local authority policies would need to be able to simultaneously elaborate more data. At the present time (late 2008) in Italy, new research is starting about a simulation using a specific scaling algorithm capable of reducing a high dimensional space (that is, one with a high number of variables) to a target space with fewer dimensions (typically 2 or 3). This new algorithm, called Topological Weight Centroid, is developed by the Semeion research centre in Rome[25], and will be suitable for applications which can deal with more data simultaneously,

[25] http://www.semeion.it/index.php?option=com_frontpage&Itemid=1&lang=english

obtaining further and more sophisticated simulation of car parking operators' behaviour.

5. Survey

5.1 Introduction

As shown in the previous chapters, the literature discusses the car parking sector from several standpoints but most usually considers it in terms of the final destination of journeys. Moreover, car parking has been considered much less as a sector of the economy at the micro and macro level, and then only for the revenue it can raise to help municipalities' financial problems. Little attention is given to the private operator. The previous chapter has tried to model the behaviour of the car park operators in a competitive city centre car parking market. The survey carried out during the second part of the research aims to extend the findings of the literature review and the economic model. In particular, it focuses on how, firstly, location, and then price and quality are important and managed by the operators.

5.2 Objectives of the survey

This survey of the strategic behaviour of the car parking operator has two main objectives. The first one is to deepen the knowledge of the car parking sector from the operator's point of view. The survey is useful in helping us to understand how they compete with one another in this market. The survey is also designed to help us understand whether the variables of price, quality and location are indeed important to the car park operator. In addition, the survey is intended to help to corroborate the results of the economic model and its relevance to the situation of parking operators. Does the model reflect the actual behaviour of the parking operator? What is their behaviour with respect to the three variables, and/or other variables that they identify?

Finally, the survey gathers other information about the car parking context in which they operate and the level of importance that operators give to some quality variables. The survey is an important piece of research: to the knowledge of the author, it is the first piece of empirical academic research addressing the behaviour of car parking operators carried out in the UK and Italy in the last decade, and possibly ever.

5.3 Description of the survey

The survey was designed to assess the behaviour of car parking operators in the UK and Italy and was administered as a self-completion questionnaire. The main issues investigated by the survey were the variables considered important by the operator in selecting the type of car parking to be provided; along with the location and services they deem necessary in attracting users. The survey also asked operators to give their opinion about past, present and future trends in the city centre car parking market.

In addition, the survey requested information about the operators and the car parks they managed under the following headings:

- General information concerning type of owner (public, private, PPP)
- Type of parking management (profit orientated, social benefit orientated)
- Location
- Number of parking spaces
- Price per parking space
- Annual costs
- Revenue and profit
- Technical equipment and tools available for efficient parking management.

Annex 2 shows a sample of the questionnaire.

The choice of information gathered was based on the results of the literature review and also on the suggestions of Mr. O'Brian, Manager of British Parking Association, who was interviewed during the research period.

The main objectives in identifying the operators chosen to participate in the survey were:

- To achieve as broad a spectrum as possible of different types of operator
- To achieve as large a sample size as possible within a manageable number of cities
- To achieve a widespread variation of locations in both countries

The majority chosen were public operators because of their tendency to manage many car parks and their resulting knowledge and expertise in the sector and the context in which they operate. However, private operators were also chosen, due to their strong profit-motivation, in spite of the "public service" aspect of car parking, especially in city centres where the number of spaces available is often less than demand.

5.4 Results of the data collection

The data gathered came mainly from first part of the questionnaire; namely the strategic choices made by operator as well as their view on market trends in parking and the need for new infrastructure. The second part of the questionnaire in most cases was not completed, because this required a lot of time (i.e. the table of the parking charges), or the provision of confidential of data (i.e. annual income, profit) However, this gap in information is somewhat compensated for thanks to the policy review and analysis of market trends provided in Chapter 2. Moreover, Section One of the questionnaire provides the key information required to understand the working framework of the operators, and to compare it with the results of the literature and the economic model.

5.5 Administration of the survey

Once designed, the survey was piloted in Italy and the UK, using personal contacts responsible for parking in the City of Edinburgh Council and the Municipality of the City of Udine. This was to ensure that questions were comprehensible and that the contacts understood how to complete the questionnaire.

A sample of cities was then selected from both countries. In the main, these were medium sized cities, with a few larger cities, such as Rome and Naples in Italy or Edinburgh and Glasgow in the UK. The choice of the cities chosen to survey was in part dependent on the willingness of car parking operators to participate. Both in UK and Italy a preliminary contact with the single operator (private or municipality managers) was carried out to introduce the questionnaire sent and gauge their interest. After that, the questionnaires were sent firstly to Councils and private operators in the United Kingdom. For various reasons (travel costs, time available etc.) contact was made with 160 organisations in total (municipalities and private operators). After the questionnaire had been sent, a follow up phone call was made to ensure that it had been received. If a questionnaire was not returned, a further phone call was made to the contact person to encourage them to complete the questionnaire. In this way, 30 questionnaires were returned with section A completed, while, as noted before, section B was returned empty in most cases. Some 27 questionnaires were completed by managers of municipal operations, and 3 from private operators. Of these three, two were private owners and managers of car parks, while the other was a private company operating a publicly owned car park in Edinburgh.

In Italy, the questionnaire was sent to 30 operators. Some 15 of them returned it: 6 public car park managers and 9 private operators. The percentage of questionnaires completed from Italy was greater than in the case of the UK because of the author's ability to speak the language as a native in the former country, and also because some operators had already been contacted through previous work in Italy. For this reason, in Italy it was also possible to deliver the questionnaire in person and, in some cases,

to complete it in real time with the respondent. For language reasons but, more importantly, resource limitations (the author being based in Italy) this approach was unfortunately not possible in the UK.

Table 1: Number of respondents in each category (private and public) - UK

United Kingdom	
1. Lincoln Council	16. Bracknell Council
2. Midlothian Council	17. West Dunbarton Council
3. Eden District Council	18. Scottish Borders Council
4. Nottingham Victoria Centre	19. Caerphilly Council
5. Nottingham Royal Moat House	20. North Lincolnshire Council
6. Gwynedd Council	21. Dundee Council
7. York Council	22. Herefordshire Council
8. Newcastle Council	23. Rutland County Council
9. Wokingham D Council	24. Clackmannanshire Council
10. East Ayrshire Council	25. Sunderland Council
11. C.P.S. Edinburgh	26. Bedford Council
12. Borough of Poole	27. Windsor & Maidenhead Borough
13. Sheffield Council - Fitzwilliam	28. Isle of Wight Council
14. Sheffield Council - Moorfoot	29. Edinburgh Council
15. Angus Council	30. Calderdale Council

Legend

PRIVATE
PUBLIC
Public, managed by Private

Figure 1: Map of respondent UK cities

Table 2: Number of respondents in each category (private and public) - Italy

Italy	
1. Ravenna	9. Naples
2. Cesena	10. Ancona
3. Bologna	11. Rovigo
4. Siena	12. Mestre/Venice
5. Udine	13. Ferrara
6. Rome	14. Forlì
7. Vicenza	15. Ferrara
8. Brescia	

Legend

PRIVATE
PUBLIC
Public, managed by Private

Figure 2: Map of respondent Italian cities

Parking context in sample respondent cities

In order to put the survey results into context it is useful at this point to describe the parking situation and market in two of the respondent cities, one in the UK and one in Italy.

The UK example is Edinburgh, capital of Scotland. It is located in southeast Scotland, about 700 km north of London. It is the location of the Scottish Parliament, has a strong financial industry, and is also famous for its ancient and cultural heritage city centre. The city of Edinburgh has about 450,000 inhabitants. More than 1,000,000 vehicles enter the city centre every day. Over 94,000 people work in the city centre. Of the parking that is subject to controls, there are 7,100 resident parking spaces, over 5,200 pay and display spaces, and about 4,000 parking spaces in private off-street car parks.[26]

Edinburgh is a typical example of a city with parking problems due to demand exceeding supply at certain times and in certain places. One of the City's main transport objectives is to try to reduce the amount of congestion on its roads by shifting car trips onto other modes of transport. In order to achieve this, Edinburgh has implemented a parking management strategy. This involves limiting city centre parking, residential parking schemes, maximising parking standards for new development and measures which restrict the number of parking spaces available to certain users (especially commuters). Limiting parking encourages private vehicle users who cannot find a parking space to find alternatives (i.e. public transport, cycle and walking) to travel into and around the city. These aims are also included in the Edinburgh Local Transport Strategy (2004-2007)[27]. To achieve its objectives the City of Edinburgh has highlighted some policies:

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[26] http://www.edinburgh.gov.uk/internet/Transport/Parking/Parking%20in%20Edinburgh/Parking_facts_and_figures/CEC_did_you_know

[27] Scottish Local Authorities, like their English and Welsh counterparts, have the power to create Local Transport Strategies - LTS. These strategies are official reports, which outline local transport policies and objectives and how they are to be achieved. Once created, the LTS becomes a document which support improvements needed in an authority and which the public has access too. All forms of transport are covered in a LTS, including parking.

"P1 – reallocate road space to pedestrian, cyclists and public transport replacing on-street parking by off-street parking provision in the city centre, but retaining approximately the same level of parking available;

P2 – park and Ride sites will be provided at the edge of the urban area on main radial routes to encourage long stay parking, and especially commuter parking, to locate there and hence help support the city economy by providing for short stay parking in the central areas;

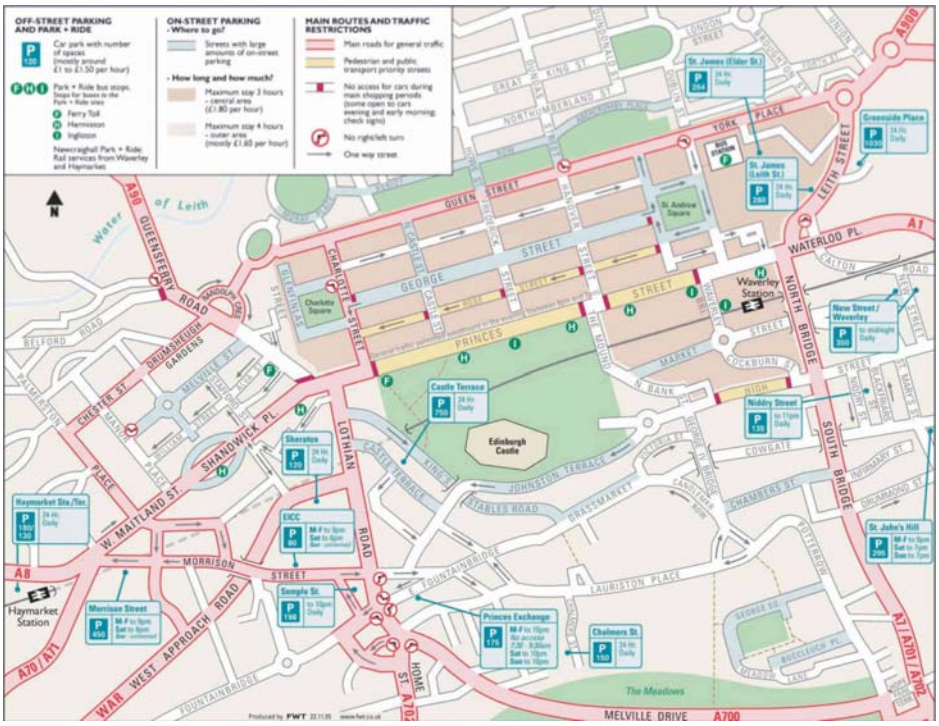
P6 – the Council will provide clear and easily accessible information on where parking is available for the public to reduce city centre congestion through minimising circulating traffic."

The existing parking situation in Edinburgh consists of four types of on-street parking (pay and display, resident permit, shared use bays and kerb space with no charge) and two types of off-street parking (public and private). In the City of Edinburgh, the highest demand for parking is located in the city centre. As stated in its LTS, the Council's car parking policy is primarily concerned with maintaining and enhancing on-street parking controls, and with off-street public car parks, managed by private companies (Edinburgh LTS 2004-2007), in two cases for Council-owned car parks.

The on-street parking controls come under the umbrella of Controlled Parking Zones (CPZs), areas of the city where the local authority allows local residents to apply and pay for a parking permit. The CPZ allows residents and short-term visitors to park but it makes it difficult for commuters to park on the street during the day. In Edinburgh, there are two main CPZs, a central zone (City Centre) and a peripheral zone (communities adjacent to the city centre). The latter is currently (2007) being extended. The charge for a visitor to park on the street in the CPZs varies according to location, generally decreasing with distance from the city centre, whilst maximum lengths of stay increase. To park in George Street in the city centre costs £1.80 per hour for a maximum of two hours. As will be seen below, this is more expensive than in any of the off-street car parks.

As mentioned earlier, the off-street car parks in Edinburgh are managed by private companies. The majority of these facilities are located in the city centre, where there are 14 (one of the fifteen shown in the figure below is actually out of order). There are only two publicly-owned car parks, but these are leased to and operated by a private company.

Figure 3: Edinburgh city centre map: Off-street location



Most of the car parks operate 24 hours per day. The price range depends on a number of variables. If the car park has the minimum required level of service, the price increases from the periphery to the city centre, based on the distance from the city centre in terms of walking time. Analysing the ticket price for the first hour and the services available, and moving from the periphery to the city centre on a west-east axis, the following car parks are available:

- Haymarket: £6 a day, no hourly pricing available, surface parking, cash only payment and no personnel available
- Morrison-street: £1.20 per hour surface parking, cash only payment but with personnel available

- Edinburgh International Conference Centre: £1.20 per hour, surface parking, cash only payment but with personnel available
- Princes Exchange: £1.50 per hour - underground, no personnel in attendance, only pay and display system but credit cards accepted
- Chalmers Street: £2.50 for each two hour time period, surface parking, pay and display (cash only);
- Niddry Street: £3 for every 2 hours, surface parking, pay and display

Considering the car parks with more facilities, there is the same increase in price with respect to the distance from the city centre, and the service quality of the car park. We can compare these examples with the lower quality car parks described earlier:

- The Sheraton and Semple Street car parks cost respectively £3 for 2 hours and £1.50 for 1 hour. They are close to EICC, but have a good level of quality, with several services: pay and display system, cash payment system also with credit card, access control, disabled facilities, tourist information (maps, brochure), security control, and a drinks and food machine
- St. John's Hill: £1.70 for 2 hours: it is a multi-storey car park of lower-medium quality: there is a pay and display system accepting only cash, access control, drink and food machine, and tourist information. Like New Street car park, it is within walking distance of the city centre, but unlike New Street it provides only a minimum quality of service (surface parking with a pay and display system) costing £1.50 for 2 hours. However, this may be because this car park is temporary and about to be redeveloped
- St. James Centre and Leith Street: these are two car parks located close one to each other and very close to the prime shops in Edinburgh, with the same medium-level of quality, and the same price too, of £1.70 for every two hours

In Edinburgh at present, a number of off-street car parks are being redeveloped as buildings and the off-street parking is not being replaced. One car park near EICC – an "off-centre" location – closed in 2005 because its revenues were insufficient. The Italian company Trevipark has applied for permission to build an automatic parking "silo" on the south side of the city centre but, other than that, there appears to be little

demand from operators to provide new public off-street facilities in the city centre. This may be due to the lack of suitable locations and the cost of land which makes investment in other land uses more profitable. The Council's transport policy is perceived to make it more difficult for drivers to enter and find their way around the city centre, which increases risks for developers and operators of potential new car parks. This is the context in which the responses to the survey from Edinburgh were provided.

Parking context in an Italian city: Ravenna

An example of an Italian city is Ravenna. Ravenna, an important town in the region of Emilia-Romagna, stands in the north-east plain of Romagna, bordering on the provinces of Forlì and Cesena to the south, and Bologna and Ferrara to the north. It is an ancient town, situated on the Adriatic Sea. There are 147.000 inhabitants and 95,000 vehicles (0.64 vehicles per inhabitant, while 0.63 is the national figure).
The city of Ravenna is like Edinburgh, a typical example of a city where, at certain times and in certain places, demand for car parking outstrips supply. One of the main issues for the Municipality of Ravenna is to reduce the number of cars in the city centre, particularly because of pollution, congestion, and noise, but in general, to enhance the quality of life of the citizens. For these reasons the Municipality implemented the "Piano Urbano del Traffico – PUT" (General Master Plan for Urban Traffic) in 2002. The main objectives of the Plan are to improve traffic circulation, reduce road accidents and, in general, to mitigate the negative impacts of the car on the city's mobility. In the meantime, the Municipality has introduced the "Zona a Traffico Limitato - ZTL" (Limited Traffic Zone), an area where residents need a parking permit to park on-street.

Ravenna's PUT also includes a specific programme named "Piano Urbano Parcheggi – PUP" (Urban Parking Programme). This programme plans for the construction of new parking infrastructure based on periodic monitoring of demand and supply of car parking spaces in the city. If there is the need for a new car park in a specific area of the city, the Municipality provides a specification of the locations, capacities, legal

and contractual conditions, financial procedures and scheduling of works etc. Recently, the Municipality has introduced the possibility of constructing new car parks using the project financing procedure. This new financial support permits the provision of new car parking infrastructure using private funding. In 2007, the Municipality of Ravenna drew up the procedure for a new car park infrastructure.

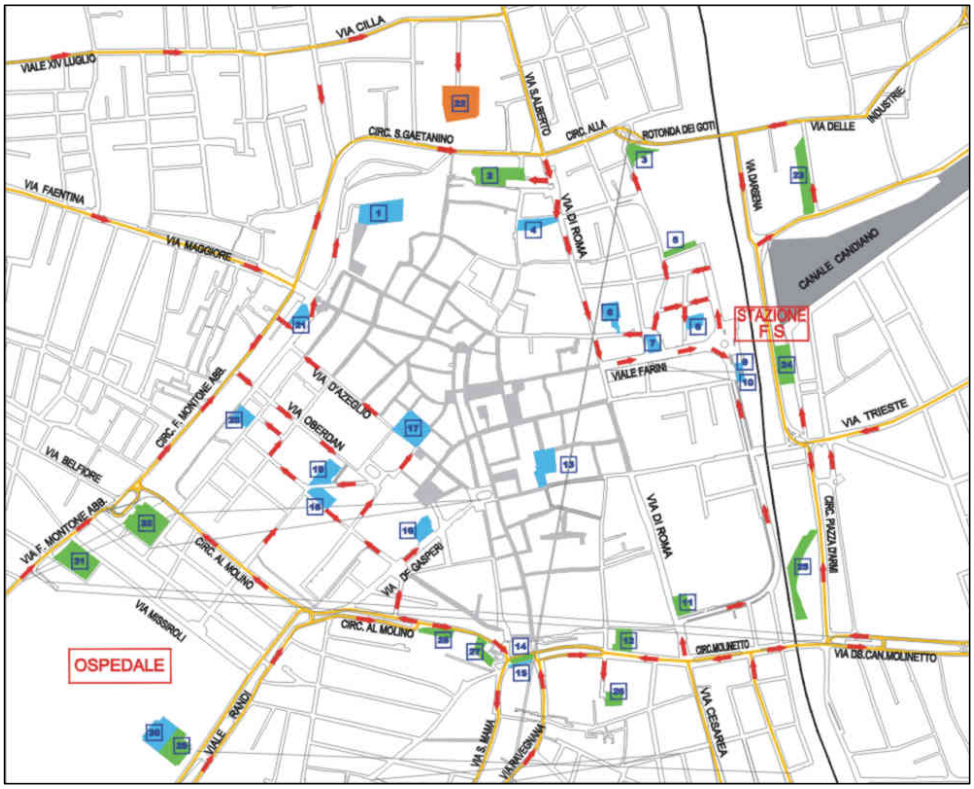
At the present, the city of Ravenna has 7,459 on-street car park bays, 3,181 of which are in the city centre. The off-street car parking spaces in the city centre total 1,842.

Table 3: Off-street car parks in the city centre of Ravenna

Owner	Management	Number	n° parking bays
public	Public	9	889
public	Private	5	543
private	private	4	410
TOTAL		18	1842

All the off-street car parks located in the city centre are priced. The median cost of the first hour is €1,30/hour (£0.80). For almost all of them there is short long-term rate: €2 for the first 2 hours (£1.40). The four private car parks in the city centre offer a medium level of quality: access control, the possibility to pay by cash or credit card, information about tourist attractions, a parking guidance system and the possibility to reserve a parking bay.

Figure 4: Ravenna city centre map: Off-street location. Priced car parks are shown in blue; free of charge car parks are shown in green; the new car park construction is shown in orange. Grey indicates the Limited Traffic Zone.



The other car parks provide a medium level of services, tending to reduce the further away they are from the city centre.

Ravenna is also similar to Edinburgh in respect of ticket prices, which tend to decrease moving from the city centre to the periphery. The two car parks closest to the city centre have the highest ticket price per hour: Largo Firenze and Piazza Kennedy. The three car parks near the city centre are priced a little lower: Piazza Mameli, R. Ricci and Piazza Baracca. The other car parks have a price lower than all the previously mentioned car parks.

It is notable that the first two car parks have the same price (€1.5/hour) and the same level of service, while the three car parks near the city centre have different charges. Piazza Mameli and R. Ricci car parks have the same price (€1.2/hour) and services

(pay and display, cashless payment system), while the Piazza Baracca car park charges a little more (€1.3/hour), but also offers more client services: pay and display, cashless payment system and tourist information.

Currently, the Municipality is building a new car park, close to the city centre using a particular method of procedure to access the fund for new car park constructions. The project is financed through a public private partnership, the land is publicly owned, while the construction is private, and the operation has been granted as a concession for a minimum of 99 years to the same private operator. Obviously, the way in which the price of car parking is decided is very important. The Municipality of Ravenna gives the concession to operate the car park to the private operator. The concession stipulates a range of prices that the private operator must respect, if it wants to operate the car park. This procedure is typical of other Italian Municipalities as well. In this way, the Municipality in Italy can control a public car park managed by a private operator. However, in the case of a private car park managed by a private operator, the Municipality can intervene only indirectly, for example by changing the routes available to the private car, and consequently the ease of access to the car park. It must be remembered that the private operator is subject to the competition of other on and off-street parking; also that in the case of the Municipality of Ravenna, other factors as well as profitability are taken into account when determining prices – for example the needs of special interest groups such as city centre businesses. On the other hand, increased parking charges and the lack of parking space available during the day, are encouraging the private operator to establish new car parks, in particular in city centres. The Municipality of Ravenna has announced the availability of new car parking construction in 2008.

Having considered these two examples of respondent cities, Edinburgh and Ravenna, the thesis now goes on to present the results and analysis of the survey data.

5.6 Analysis of the data

The survey has two sections. The first section consists of questions that aim to deepen knowledge of the car park operator's point of view, and to understand if the economic model results are supported. This first section relates to the main aims of the survey, whilst the second section aimed to be a simple collection of data relating to the surveyed operators' own business. Since in a number of cases Section 2 was not completed, it was decided not to utilize this data, and instead try to assemble similar data from the literature at national level in both countries (UK and Italy). These results could then be used to compare with the results of Section One. Summaries of the data collected are in Annex 3.

The first question of the **First Section** relates to the choice between different car parks with respect to a hypothetical new car park operating in the city centre context. The introduction of the section presents the scenario in which the operator makes his choices. The city is of medium size: in the UK, it is 250,000-400,000 inhabitants, while in Italy it is 150,000-300,000 inhabitants, these being equivalent to typical medium sized cities of the two countries. A medium sized city was chosen because it is rare for small towns to have parking problems, whilst although large cities obviously do, there are not enough of them to produce sufficient survey data.

5.6.1 First question

In the **first question** the operator has to choose from a range of options: the best combination of price, quality and location for a new car park construction, in order to be able to compete with an existing car park, located in the city centre, with a high level of service quality and price. The number of parking bays in this car park is 1.500 for the UK and 1.000 for Italy. As with the differing number of inhabitants, the number of car park spaces reflects a reasonable size for a new car park, but one that is not the same for both countries.

For this question, in particular, the aim is only to provide a sufficiently realistic scenario so the operator will be able to give a realistic response, but not to influence the choices made by the operator when they answer the questionnaire. The car park characteristics are explained with respect to the three variables that the first part of the research has found to be very important for a competitive management of this field of services:

The price, often depending both in the UK and Italy on the duration of the parking and the distance from the city centre, is described as belonging to one of the 5 categories, from very low (1) to very high (5).

The "distance"' categories are "centre", "outskirts" and "semi-peripheral". This factor increases in importance as one approaches the city centre, where parking spaces are often fewer compared to demand. The quality of the parking is categorised as low, medium and high, referring to a number of facilities such as the presence of security systems, lighting, accessibility, signage and payment methods. Operating costs are important too as they are then driving other choices relating to the management of the car park, such as services provided.

Table 4: Three variables

Price: refers to cost of parking to customer per hour (on a scale of 5 = very high to 1 = very low)
Quality: refers to overall quality in terms of secure parking facilities, lighting, access etc (good, medium, bad)
Location: refers to either Central (city/town centre), Peripheral (city/town outskirts), or Semi-peripheral (in-between).

Table 5: Existing car park

EXISTING CAR PARK	Price	Quality	Location
	4 (High)	High	Central

Of the wide range of possible combinations of variables, respondents are presented with only five from which to make their choice. The choice of these combinations included in the question is explained in the table below (Table 6).

Table 6: Description of possible combination of the variables

	PRICE	QUALITY	LOCATION	Reason of the choice
Car Park-Option 1	5	High	Central	This option is abandoned due to non-competitiveness with the given scenario.
Car Park-Option 2	4	High	Central	The existing car park in the scenario has a very high level of the three variables, so the operator is asked to find a competitive alternative.
Car Park-Option 3	3	High	Central	This is a redundant choice, with respect to the scenario, because a moderate price is unlikely to be charged in a centrally located car park in which there has been investment in quality facilities.
Car Park Option 4	2	High	Central	This option is abandoned due to non-competitiveness in the given scenario. The price is not high enough to sustain high quality costs.
Car Park-Option 5	1	High	Central	This option is abandoned due to non-competitiveness in the given scenario. The price is not high enough to sustain high quality costs.
Car Park-Option 6	5	Medium	Central	This option is abandoned due to non competitiveness in the given scenario.
Car Park-Option 7	4	Medium	Central	This option is abandoned due to non competitiveness in the given scenario.
Car Park-Option 8	3	Medium	Central	Option choice.
Car Park-Option 9	2	Medium	Central	Option 8 is more realistic than this one, because the position in the central area would be bound to require a reasonable return of the investments.
Car Park-Option 10	1	Medium	Central	This option is abandoned due to non-competitiveness to the given scenario. The price is not high enough to sustain medium quality costs.
Car Park-Option 11	5	Low	Central	This option is abandoned due to non competitiveness in the given scenario.
Car Park-Option 12	4	Low	Central	This option is abandoned due to non competitiveness in the given scenario.
Car Park-Option 13	3	Low	Central	Option choice.
Car Park-Option 14	2	Low	Central	This option is abandoned due to non-competitiveness in the given scenario.

Car Park-Option 15	**1**	**Low**	**Central**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 16	**5**	**High**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 17	**4**	**High**	**Semi-peripheral**	Option choice.
Car Park-Option 18	**3**	**High**	**Semi-peripheral**	Option 17 is better than this one, because the position in the semi-periphery requires a reasonable return on the investment.
Car Park-Option 19	**2**	**High**	**Semi-peripheral**	This option is abandoned due to non- competitiveness in the given scenario.
Car Park-Option 20	**1**	**High**	**Semi-peripheral**	This option is abandoned due to non-competitiveness to the given scenario.
Car Park-Option 21	**5**	**Medium**	**Semi-peripheral**	This option is abandoned due to non- competitiveness in the given scenario.
Car Park-Option 22	**4**	**Medium**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 23	**3**	**Medium**	**Semi-peripheral**	This option is abandoned as it is less competitive than option 24.
Car Park-Option 24	**2**	**Medium**	**Semi-peripheral**	Option choice.
Car Park-Option 25	**1**	**Medium**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario. Option 24 is obviously better.
Car Park-Option 26	**5**	**Low**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario. Price is much too high.
Car Park-Option 27	**4**	**Low**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario. Price is much too high.
Car Park-Option 28	**3**	**Low**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario. Price is much too high.
Car Park-Option 29	**2**	**Low**	**Semi-peripheral**	This option is abandoned due to its non-competitiveness compared with option 24.
Car Park-Option 30	**1**	**Low**	**Semi-peripheral**	This option is abandoned due to non-competitiveness in the given scenario. Price is much too high.

Car Park-Option 31	**5**	**High**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 32	**4**	**High**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 33	**3**	**High**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 34	**2**	**High**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 35	**1**	**High**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 36	**5**	**Medium**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 37	**4**	**Medium**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 38	**3**	**Medium**	**Peripheral**	This option is abandoned due to its non-competitiveness compared with option 44.
Car Park-Option 39	**2**	**Medium**	**Peripheral**	Charges too low, so this option is abandoned due to non competitiveness in the given scenario.
Car Park-Option 40	**1**	**Medium**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 41	**5**	**Low**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 42	**4**	**Low**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 43	**3**	**Low**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.
Car Park-Option 44	**2**	**Low**	**Peripheral**	Option choice.
Car Park-Option 45	**1**	**Low**	**Peripheral**	This option is abandoned due to non-competitiveness in the given scenario.

At the end of this selection the car park options choice for the questionnaire were 5 different combinations of the three variables. These were the only logical combinations of choices that could be offered to respondents.

The question asked to the respondent, in the case of UK cities was:

In this section we are interested in understanding your strategic behaviour in making decisions about how to enter a local parking market where you currently have no existing presence.

To achieve this we have presented you with a hypothetical situation in which:

A medium-sized city (250,000-400,000 inhabitants) has only one car parking operator managing one 1,500-space car park, with the following attributes:

	Price	Quality	Location
EXISTING CAR PARK	4 (High)	High	Central

N.B.

- Price refers to cost of parking to customer per hour (on a scale of 5 = very high to 1 = very low)
- Quality refers to overall quality in terms of secure parking facilities, lighting, access etc (good, medium, bad)
- Location refers to either Central (city/town centre), Peripheral (city/town outskirts), or Semi-peripheral (in between)

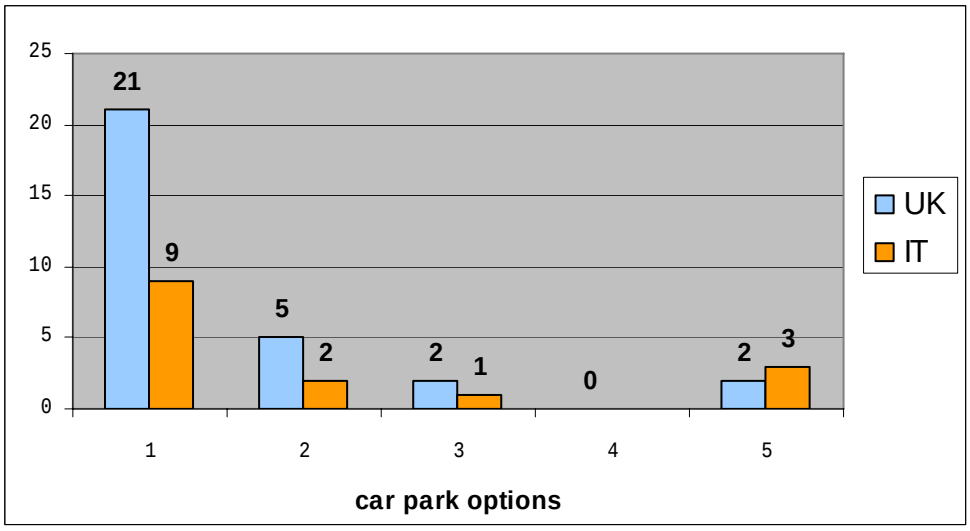
A number of possible new car parks options are described below. Please indicate from the five options provided the car park that you would choose to open first as a competitor to the existing car park.

Table 7: Range of car parking options offered in the questionnaire

	PRICE	QUALITY	LOCATION
Car Park-Option 1	**3**	**Medium**	**Central**
Car Park-Option 2	**4**	**High**	**Semi-Peripheral**
Car Park-Option 3	**3**	**Low**	**Central**
Car Park Option 4	**2**	**Low**	**Peripheral**
Car Park-Option 5	**2**	**Medium**	**Semi-Peripheral**

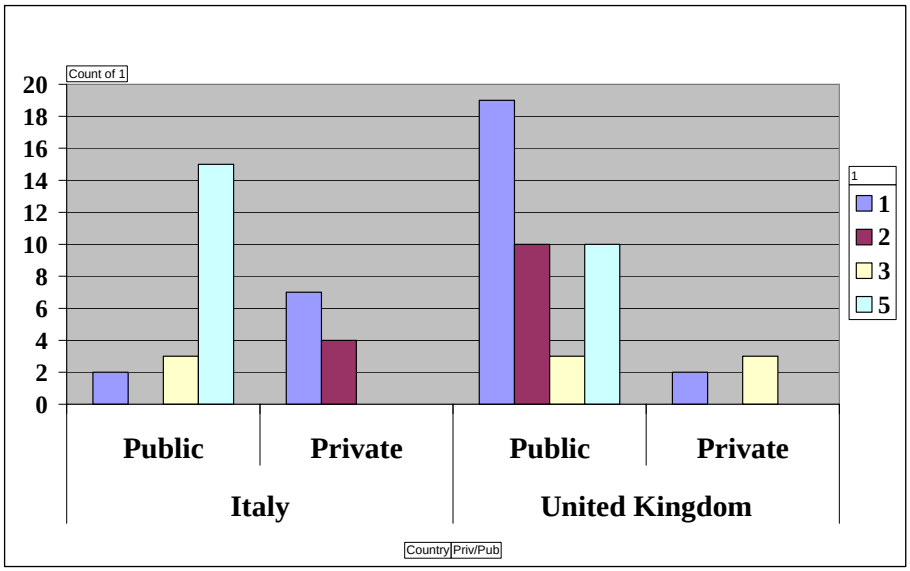
The restricted number of combinations was very useful also because it required a low level of effort of the interviewee, and a higher possibility of return of the questionnaires compiled. The results of the **first question** are shown in the tables below.

Figure 5: Choice between various car parks: UK and IT results.



Legend: 1, 2, 3, 4, and 5 refers to the 5 kind of car parks described in Table 4

Figure 6: Choice between various car parks: public and private results



Legend: 1, 2, 3, 4, and 5 refers to the 5 kind of car parks described in Table 4

The first response shows that the car park number 1 is most important for both the countries. That is to say, the operator prefers to compete with the current car park in the same area of the city, reducing price and quality in order to be competitive. This operator rejects the option of operating in other locations because it predicts that yields would be lower. Car park 2 is the second choice for the UK operator, while the Italian prefers the option of reduced price and quality in a semi-peripheral location. No respondent selects option 4, because even if the price is low and quality is moderate, there is no possibility to compete with the existing operator.

Summarising the results of the hypothetical locational game, there is a great preference amongst respondents for parking in city centres and for quality in facilities when prices and position are comparable. Even with low prices, parking in the outskirts of a city is always a low-priority option, whilst under the same price and distance conditions, the presence of 'quality' facilities is the determinant factor.

5.6.1 Second set of questions

The **second set of questions** was intended to extend current knowledge of operators' behaviour, and compare this with the results of the economic model described in the previous chapter. The three hypothetical scenarios represent the choice between two car parks present in the city. They differ in terms of operating costs, location, price, and quality. Each scenario represents a possible solution from the model and the alternative. The questionnaire does not exactly reflect the model, because the latter has continuous differentiability. In spite of this, the questionnaire offers interesting results that can be compared to the empirical solutions of the model; as will be shown, there are important commonalities.

The **first scenario** "edged location equilibrium" refers to the first results of the economic model, when the marginal costs difference between the two off-street car parking owners is high and the walking cost is low. In this case, there is a significant price differential, and prices are greater than marginal costs. The car park quality is low in both cases, and both car parks are located at either side of the city centre.

The question asked of the respondent, in the case of UK cities was:

To further explore your strategic behaviour in making decisions we have presented you with three further hypothetical situations whereby:

Two car parks exist in a city, but vary in terms of

- Operating costs
- Location
- Price
- Quality

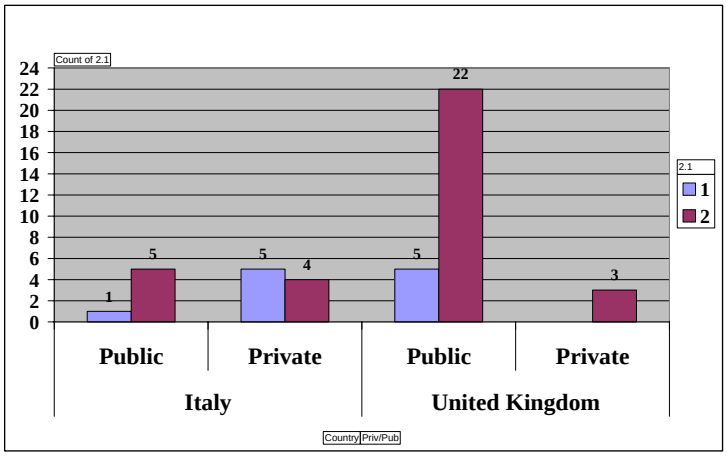
For each of the following scenarios please indicate which one of the two car parks you would prefer to own and operate?

Scenario 1

	Operating costs	Location	Price	Quality	Preferred choice (tick one option below)
Car park 1	Medium	Semi Periphery	High	Low	
Car park 2	Low	Semi Periphery	Medium	Low	

The **result of the first question** shows that the second option is preferred by both the countries. When the car park is not in the city centre, the price must be reasonable - charging a high price is impossible. However, the preference of the Italian operators is less clear cut than that of the UK operators, particularly in regard to the choice of the private sector in the first question, where almost half the operators opted for semi periphery, with high quality and price.

Figure 7: Choice between two car parks: UK and IT results.



This could be seen as confirmation of the effect of the Italian policy on car parking sector, which is tending to shift new construction far from the city centre, raising in the meantime the price of bays in the city centre.

The **second scenario** describes the second solution of the model: "minimum geographical differentiation equilibrium". In this case, the marginal cost difference between the two car parks is high and walking cost is not very high. One of the two off-street facilities sets competitive prices while for the other car park, the price is greater than marginal cost. The quality of car parks is the same for each owner. The

location needs to be quite close, but not exactly the same in order to minimise under-pricing. An identical location is in any case impossible.

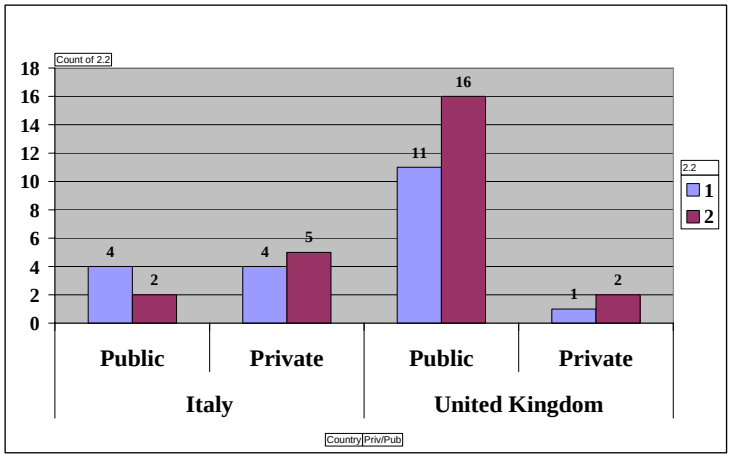
The scenario of the two car parks in the city was described as follows, and respondents were asked to select the option that they would be most interested in owning and operating:

Scenario 2

	Operating costs	Location	Price	Quality
Car park 1	High	Centre	High	Low
Car park 2	Medium	Semi periphery	High	Low

The **results of the second question** show that the options are quite similar for both the countries. In the UK, more operators in both private and public sectors chose option 2, as did the Italian private sector, but more public sector operators in Italy chose option 1.

Figure 8: Choice between two car parks: UK and IT results.



The operating cost differences between the two options convinced the private operator to choose to run a car park in an area of the city with lower costs, not the city centre, in contrast to the first question. It appears that operating costs play an important role

in their decision. For the Italian private operator the choice is the same as for the UK operators, due to their profit-orientated behaviour.

However, the choice of the Italian public operators makes an interesting contrast to the UK and Italian private operators: in this case, the first option is choice, in contradicting the results of the economic model, probably because this is also the general trend of parking policy in Italy: fewer car parks, with increasing prices, even if this means that profits may be reduced. In addition, in this case, if we consider the influence of the policy, the result of the model is confirmed. The choice of the public operator is a little more orientated to the first car park, because the choice was influenced by other factors that play a role in determining Italian public sector, for example special interest groups such as city centre businesses and voters.

5.6.1 Third set of questions

Finally, the **third scenario** describes the third solution to the model: "quality differentiation equilibrium". In this case, the marginal cost difference between the two off-street car parks is very high and the walking cost is low. For one off-street car park the price is equal to the marginal cost (and profits are equal to zero), while for the other one, the price is greater than its marginal cost (and profits are positive). In this case, relative locations become irrelevant for profit maximization.

The choice of existing car parks in the city was described as:

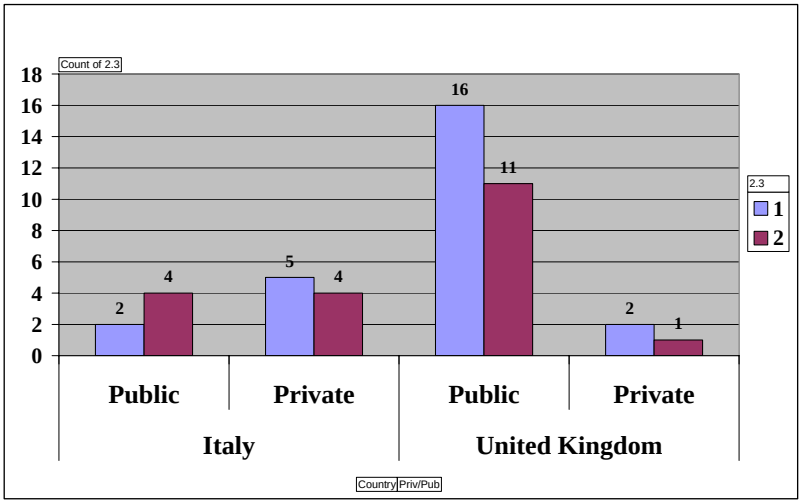
Scenario 3

	Operating costs	Location	Price	Quality
Car park 1	High	Centre	High	High
Car park 2	Low	Centre	Medium	Low

The **results of the third question** show that the choices are quite similar for both the countries, although there are some differences. The main difference in relation to the model results is the response of the UK public operator. The reason may be the need

to discourage parking in the city centre, leading to a preference for high price and high quality car parks.

Figure 9: Choice between two car parks: UK and IT results.



The results of the model are confirmed by the Italian operator, in particular the public ones, while for the private operator, quality standards are considered important even if expensive.

The **third section** of the questionnaire deals with factors determining the competitiveness of the car parks. Historically, analysis of quality services in the literature has been based on industry. Some useful literature exists from this perspective, while for the car parking sector I have used the personal contacts made in the course of my own job. I have worked with both public and private operators, including those involved in the evaluation of service quality for the annual Award given by the Italian Parking Association (AIPARK), the British Parking Association (BPA) and the European Parking Association (EPA). Other sources of information are local parking policies, sector publications, studies such as that of the RAC Foundation and interviews with the managers of the BPA and AIPARK.

As said before, quality is a very important variable for the car parking sector. These conclusions were reached thanks to a number of examples gathered from the sources analysed. However, which elements go to make up "quality", and how much they are

really considered by the operator is not defined anywhere in the academic or commercial literature.

The factors considered can be categorised as

1. Proximity to attractive area
2. Local policy
3. Security related
4. Information related
5. Payment related

The first group of factors strictly speaking does not relate to quality. They are location factors, but they could be considered very important and related to the other groups of quality factors. The elements selected for the questions result from the investigation of the sources of information referred to above, remembering in general the lack of information regarding this aspect of the car park sector.

Table 8: Factors determining the competitiveness of the car park

Group	Factor
1°	Location close to commercial area
	Location close to employment area
2°	Parking policy of the Municipality/Council
3°	Access control
	Overnight security
	Theft prevention
4°	Providing information for clients
	Parking guidance systems
	Parking space reservation systems
	Disabled facilities
	Occupancy information via Internet
5°	Cashless payment
	Parking payment by mobile phone
	Short and long term rates

For each factor, the car park operator could choose from a range of five levels of importance in the questionnaire:

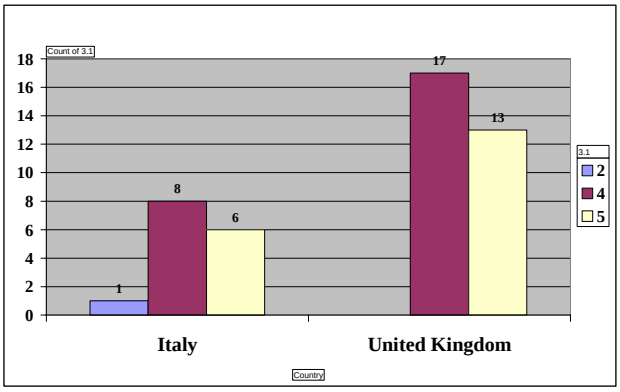
5 Very important
4 Important
3 Neither important nor unimportant
2 Not important
1 Not important at all

The results of the survey for each group of factors, as indicated above, are now presented.

The first group of factors is related to the proximity of an attractive area: locations close to either a commercial area or an area of employment. These variables are not exactly quality variables, because they are much more connected with location. Hence, this helps to show that location is much more important than quality, as well as helping to order the importance of the quality variables.

Location close to commercial area

Figure 10a: Location close to a commercial area: UK and IT results.

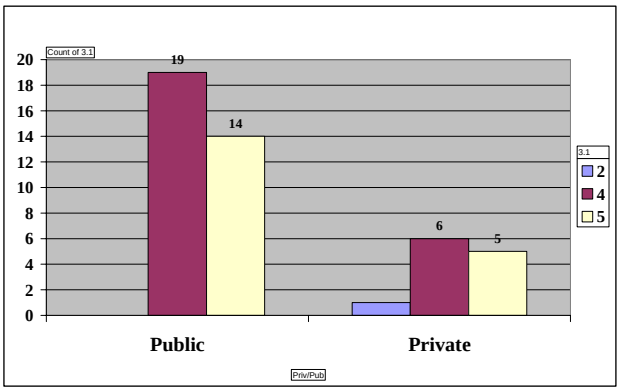


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant, (2) Not important, (1) Not important at all

In the UK this factor is very important. No one interviewee made a choice less than "important". The need to obtain the maximum possible revenue from the client has

primary importance. Also for the Italian operator, the commercial areas are those with potential clients.

Figure 10b: Location close to a commercial area: public and private results.

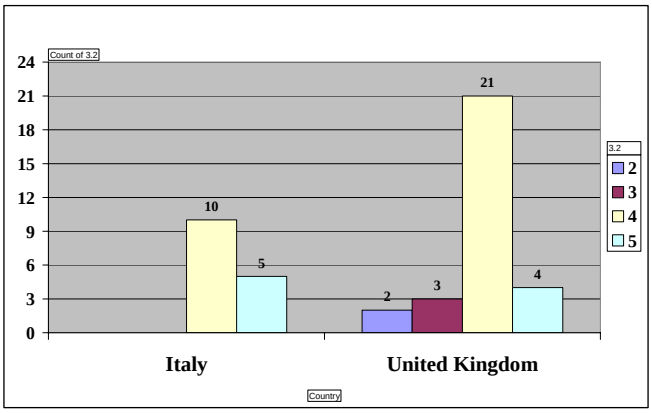


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

In the table above, the results are confirmed for both private and public operators.

Location close to area of employment

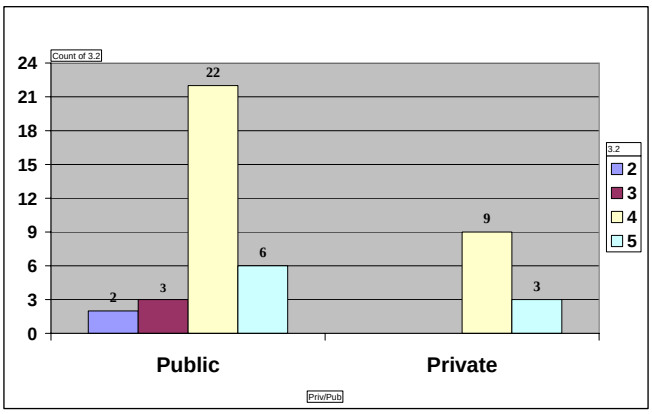
Figure 11a: Location close to the Employment area: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Also in this case, the presence of employees is considered an important factor for the choice of the location of the car park, usually concentrated mostly in the city centre area, at least in the cities of these two countries. Italy gives great importance to this factor, more then in the UK. This could be considered the consequence of the tardiness of Italy to develop alternative modes of transport.

Figure 11b: Location close to areas of employment: public and private results

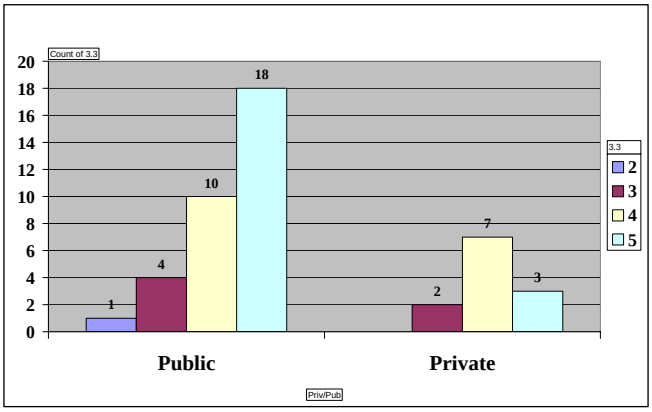


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

The public sector affords a little less importance to a location close to an area of employment than does the private sector. This could be related to the policy objective to shift people from car to public transport as much as possible.

The second factor is the parking policy of the municipality/council

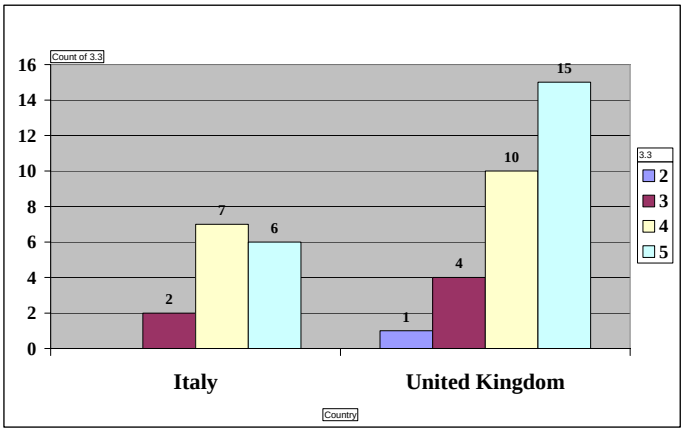
Figure 12a: parking policy of the municipality/council: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

While this factor is obviously important for the public sector, it is interesting to observe that the private sector also considers it moderately important. This bears out the suggestion made earlier, that private operators are often passive receptors of the parking and mobility policies applied by the Public Authority and have to take them into consideration.

Figure 12b: Parking Policy of the municipality/council: public and private results.



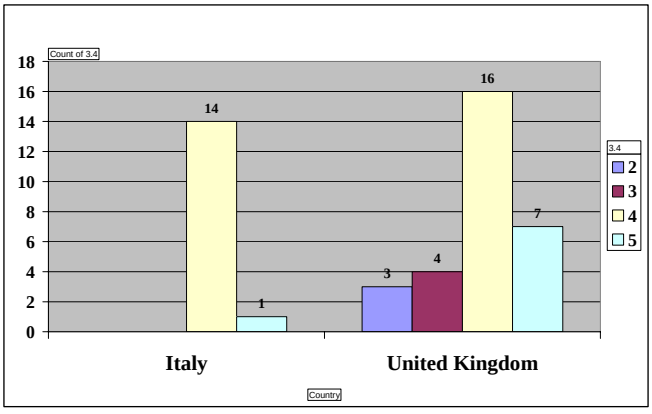
Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Nevertheless, the importance of this factor, but also the range of responses in both countries shows the significance of the gap in communication between policy makers and car park operators that this thesis seeks to begin to remedy.

The third group of factors is security related: access control, overnight security and theft prevention.

Access control

Figure 13a: Access control: UK and IT results

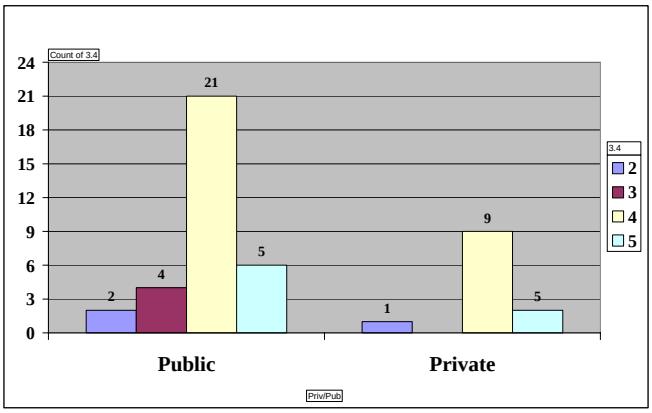


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

In Italy this factor is considered a basic tool of service, usually related to the perception of risks in the community. In the UK it is also important, although not

necessarily of primary importance, because it also requires additional costs (personnel, CCTV etc).

Figure 13b: Access control: public and private results

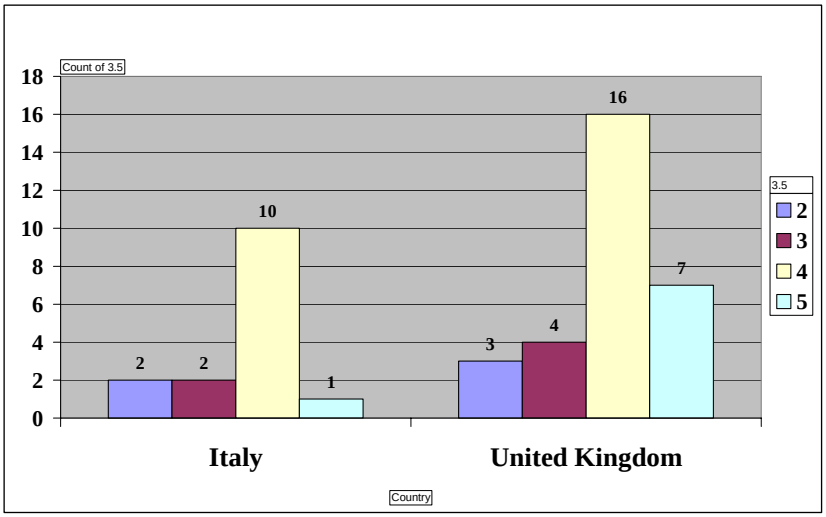


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Both private and public sectors declare this to be of minor importance in the UK.

Overnight security

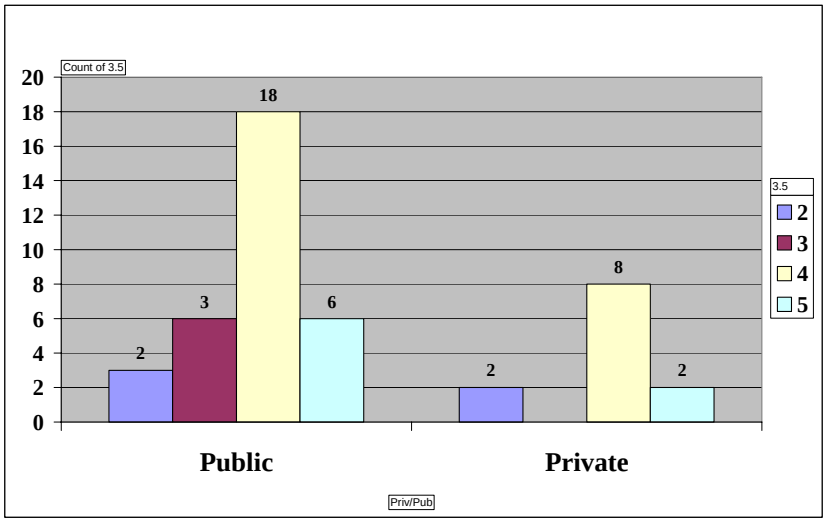
Figure 14a: Overnight security: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

This factor is more important in the UK than in Italy, perhaps reflecting the high standard of service already achieved in Italy.

Figure 14b: Overnight security: public and private results.

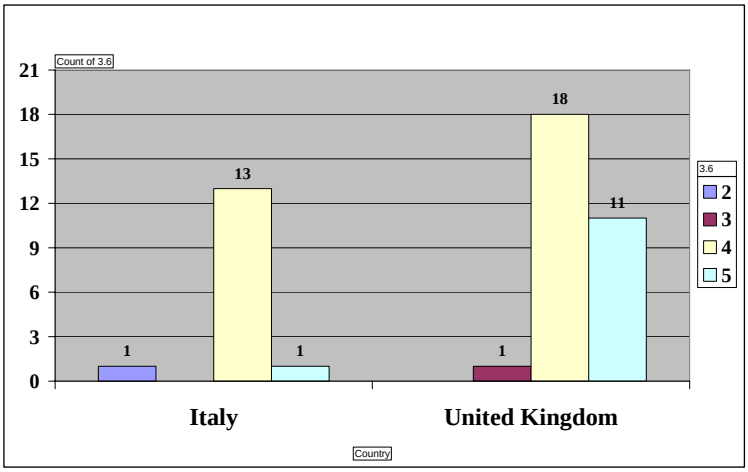


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

The evidence changes when we differentiate between public and private, possibly because for private operators it is an investment related to the service quality offered to their customers. Whilst for public operators, it is also related to the general security policies of the Municipality, and the needs of the community.

Theft prevention

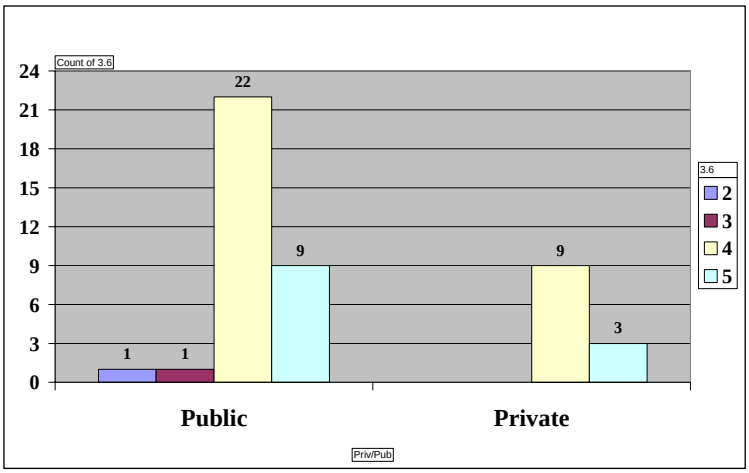
Figure 15a: Theft prevention: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

This factor is one of the most important. The attractiveness of the car park is related to the security services. The data confirm this conclusion, for both countries.

Figure 15b: Theft prevention: public and private results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

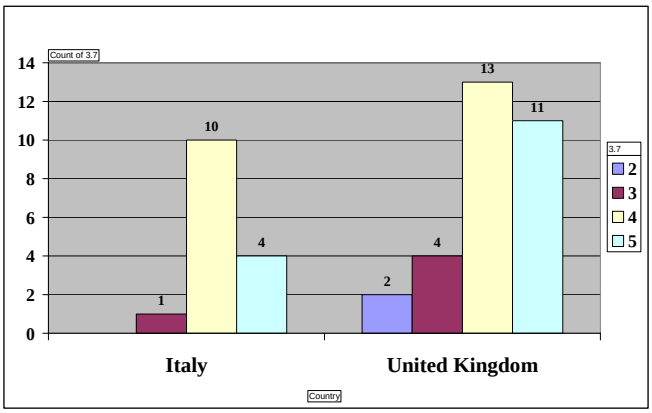
Private and public operators' preferences coincide when rating the importance of this factor.

5.6.1 Fourth set of questions

The fourth group of factors is related to the information provided to the clients: tourist and visitor information, parking guidance systems, parking space reservation systems, disabled facilities and occupancy information via Internet.

Providing information for clients

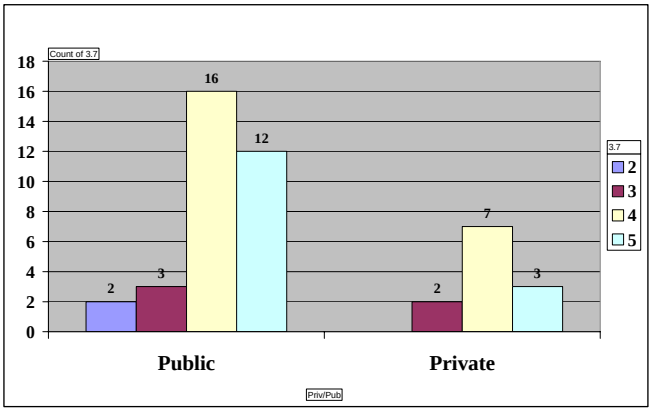
Figure 16a: Information: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

This factor, as stated by several respondents, is very important for both countries, even if it is related much more to the operators who have direct contact with the client, rather than to the development of a particular information system, such as a video display, presence of a map with itinerary or a touch screen.

Figure 16b: Information: public and private results.

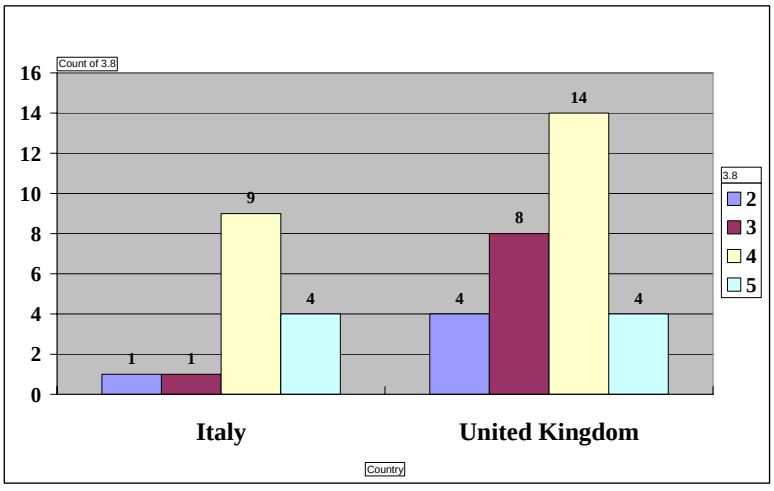


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Public and private operators place similar emphasis on the importance of this factor.

Parking guidance systems

Figure 17a: Parking guidance systems: UK and IT results.

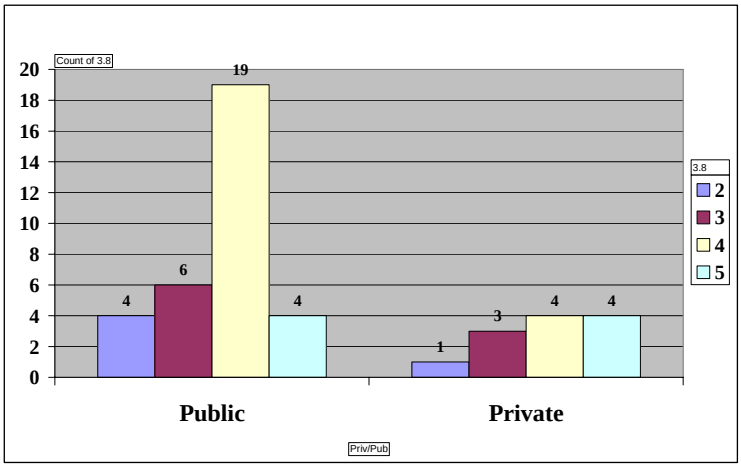


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Surprisingly, this tool, even if studied to some considerable extent in the literature as it relates to the behaviour of the driver, seemed in both countries to be less important than the other factors. It is interesting that this case underlines the different point of

view of the supply side of the city centre car parking market, in comparison to the demand side or the research field itself.

Figure 17b: Parking guidance systems: public and private results.

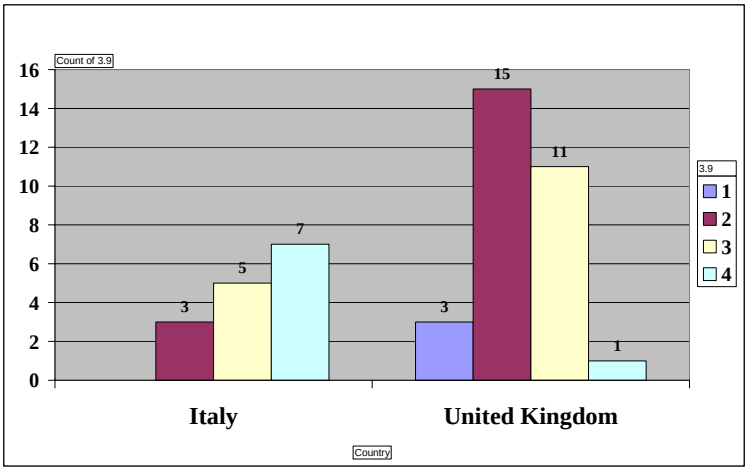


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

The different level of interest shown by public operators compared to those in the private sector underlines the relative insignificance of this factor for operators' perceptions of a car park's competitiveness.

Parking space reservation systems

Figure 18a: Parking guidance systems: UK and IT results.

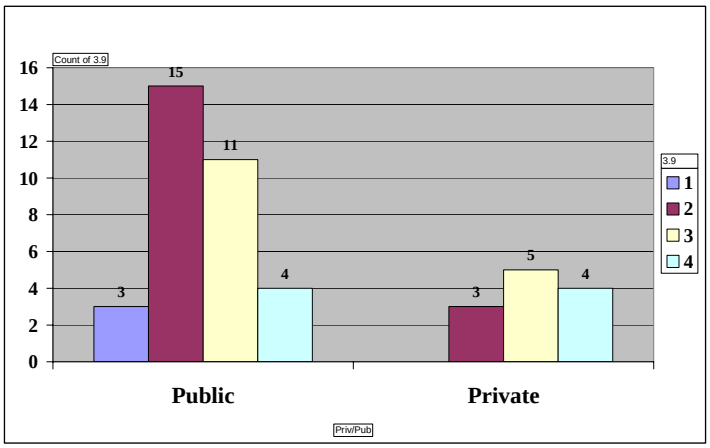


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

This factor has a very low importance for the operators, in both the countries, in particular for the UK. This implies that they as yet do not see information technology

as an instrument of use to the driver, and consider therefore that it fails to add value to the service.

Figure 18b: Parking guidance systems: public and private results.

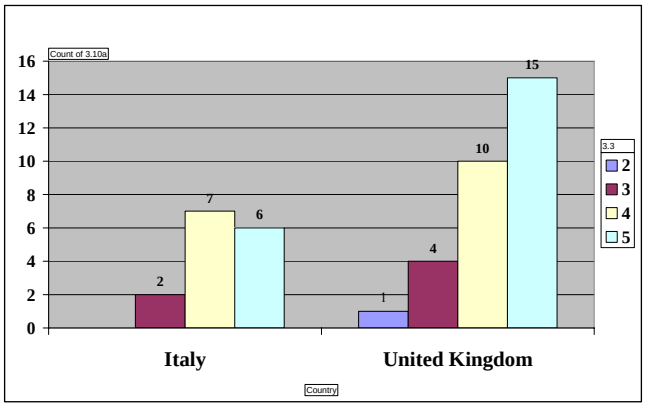


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

The private sector is much more aware of the new tools at its disposal to make its car parks more attractive. Possibly, the cost of this kind of measure for the public sector is still perceived to outweigh its potential benefit to drivers.

Disabled facilities

Figure 19a: Disabled facilities: UK and IT results.

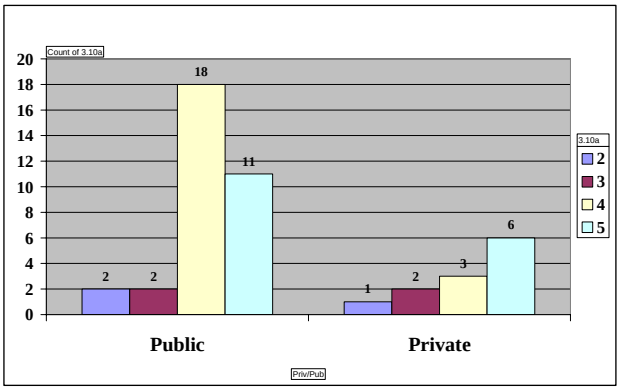


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

This is absolutely one of the most important factors taken into account for both countries. Even if not related to a wide number of clients, it should be an important means of marketing: the presence of disabled facilities is an indicator of high quality

customer service. In addition, there are legal reasons why operators have to incorporate such facilities in their car parks.

Figure 19b: Disabled facilities: public and private results.

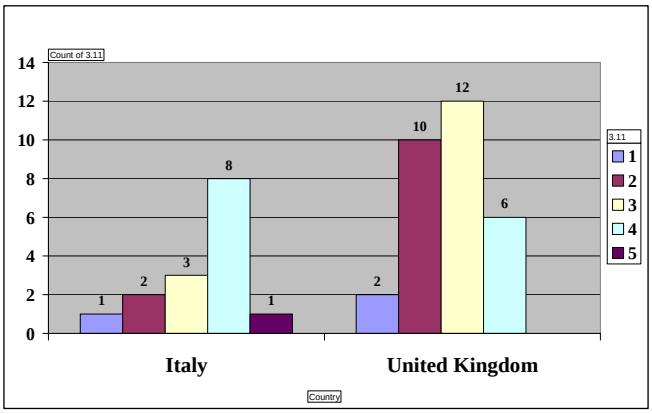


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

The differentiation here may be accounted for by the reason mentioned above: that the public operator has to respect the general aims of the community, and may recently have become much more sensitive to this particular issue. In the UK, public organisations have particular duties to provide accessible facilities.

Occupancy information via Internet

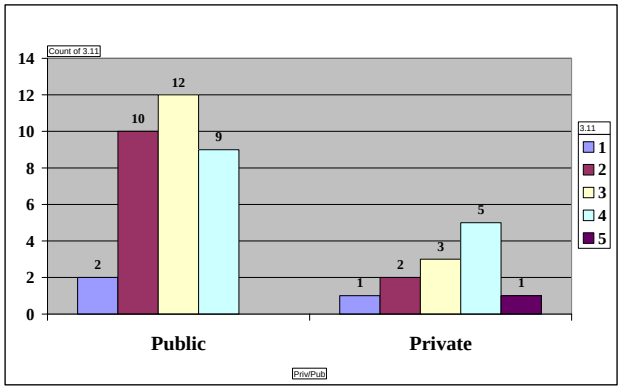
Figure 20a: Occupancy information via Internet: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Another IT related factor, this has not yet attracted the interest of the car park operator. This outcome may be the consequence of the low demand for such a service from drivers.

Figure 20b: Occupancy information via Internet: public and private results.



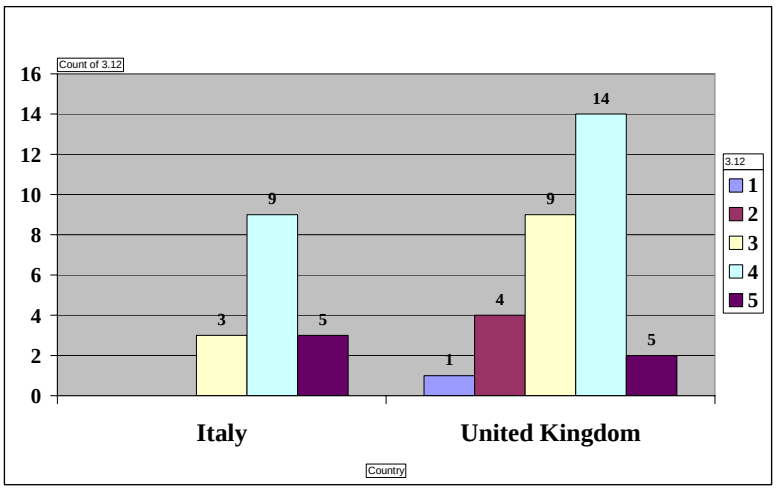
Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Private operators are more sensitive to the ability of this new instrument to improve their level of service, but also for them it appears that it is not yet the time to add this tool to their range of services.

The fifth group of factors is related to the payment system provided to the clients: cashless payment, parking payment by mobile phone and short/long-term rates.

Cashless payment

Figure 21a: Cashless payment: UK and IT results.

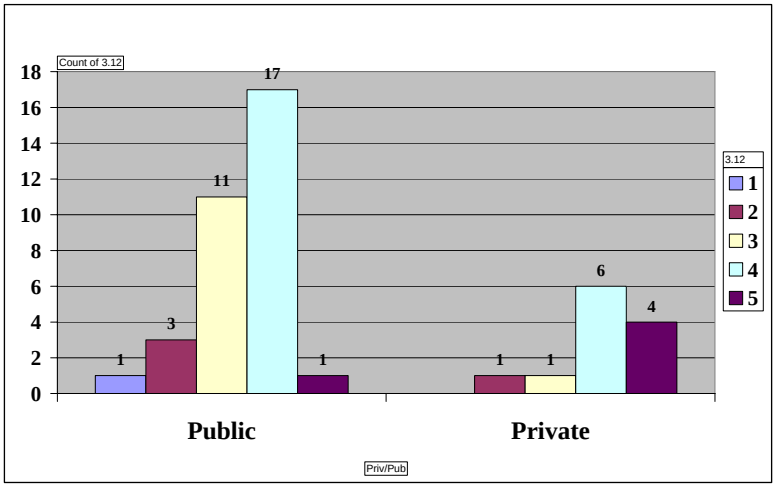


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

These results need clarification. The low importance for the cashless payment should be related to the fact that it requires habitual clients, using the same car park for

several times, during the week, month or year. In this case the car park operators prefer use other systems, such as short-term and long-term rates, which avoid cashless payment, but which at the same time increase customer loyalty.

Figure 21b: Cashless payment: public and private results.

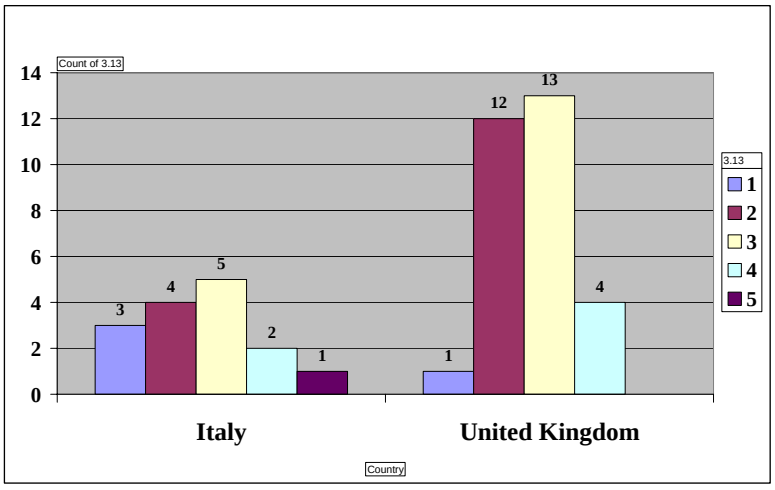


Legend: (5) Very important, (4) Important, (3) Neither, (2) Not important, (1) Not important at all

The private operators are much more interested in this tool, for the obvious possibility of increasing customer loyalty.

Parking payment by mobile phone

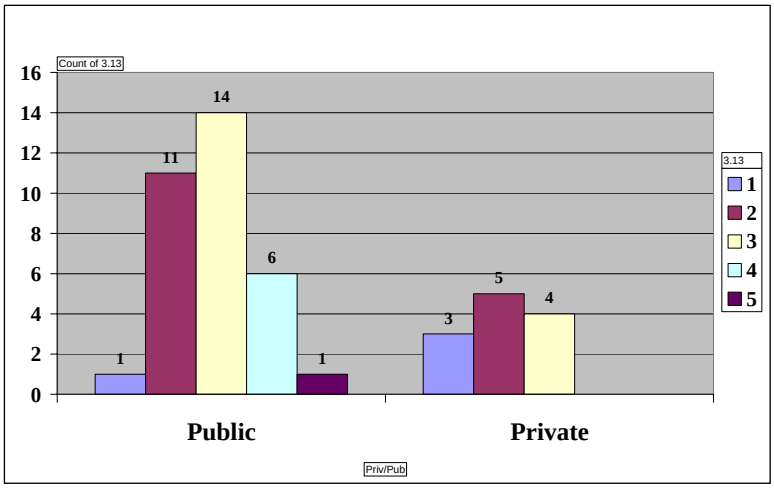
Figure 22a: Parking payment by mobile phone: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Somewhat strangely – in view of the advances in the use of this method for on-street parking – in neither country in the survey was this tool perceived to be important in the off-street sector. Even though the mobile phone is very widespread, it is not as yet generally used as a method of payment and the off-street car park sector appears to be included in this.

Figure 22b: Parking payment by mobile phone: public and private results.

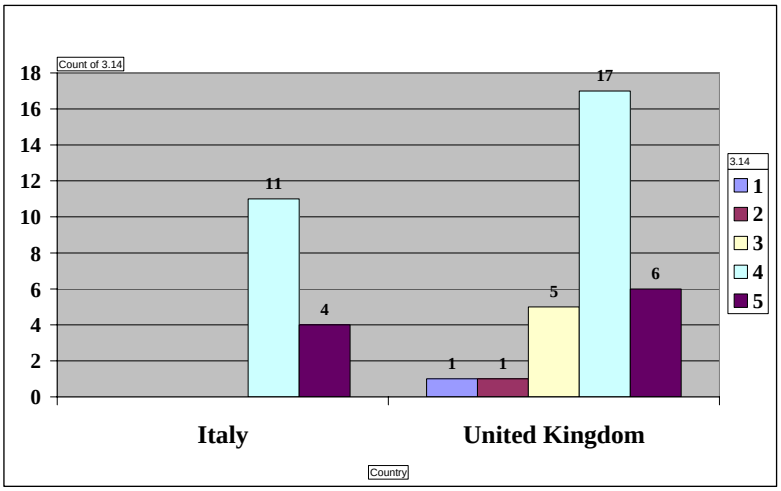


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

Private operators are more reluctant to consider this as a possibility to add value to their service, perhaps because of the complexity of the feature.

Short and long term rates

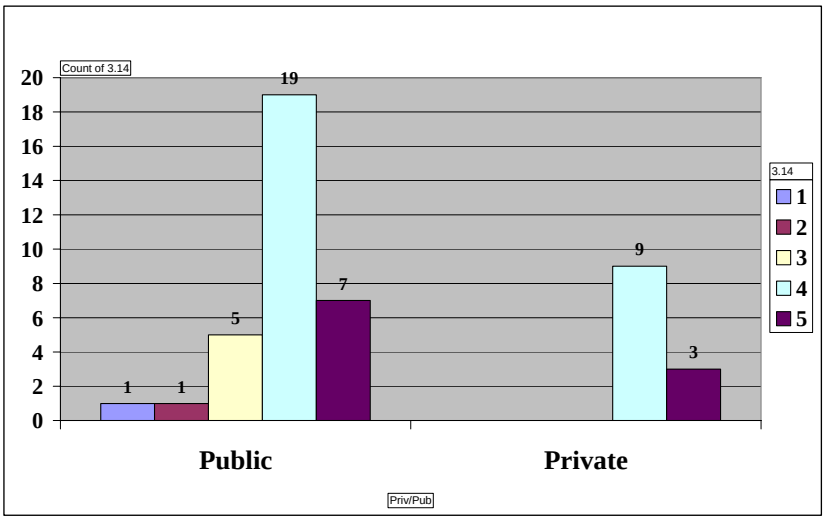
Figure 23a: Short and long term rates: UK and IT results.



Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

For the Italian operator this is a very important payment system. The importance afforded it is probably related to the fact it has only recently become generally used in the car park sector, both off-street and on-street, while in the UK it is a more common tool, probably due to the more profit-orientated mentality in this country.

Figure 23b: Short and long term rates: public and private results.

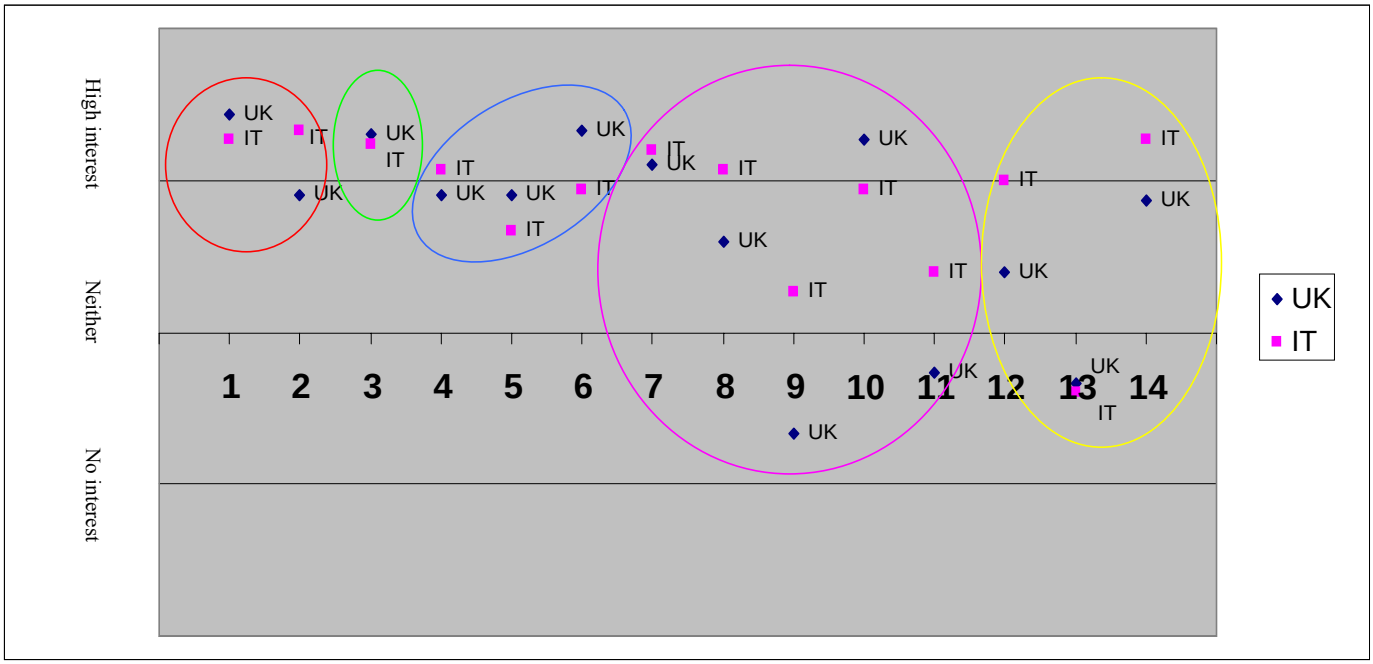


Legend: (5) Very important, (4) Important, (3) Neither important nor unimportant (2) Not important, (1) Not important at all

The fact that all private car park operators selected this tool as important confirms its significance as a means of adding value to the car park service, even if with possibly different aims. The public operator, as stated in the previous chapter, also considers this payment system as a tool to reduce the time spent parked in the city centre and to target specific users to use car parks.

Summarising the third set of questions, relating to the main factors relating to the quality of the service of the car park operator, Figure 24 shows the results.

Figure 24: Factors determining the competitiveness of car parking: UK results.



Legend: Set of factors determining the competitiveness of car parking:

Group	Factor
1° (red circle)	1. Location close to commercial area 2. Location close to employment area
2° (green circle)	3. Parking policy of the municipality
3° (blue circle)	4. Access control 5. Overnight security 6. Theft prevention
4° (pink circle)	7. Providing information for clients 8. Parking guidance systems 9. Parking space reservation systems 10. Disabled facilities 11. Occupancy information via internet
5° (yellow circle)	12. Cashless payment 13. Parking payment by mobile phone 14. Short and long term rates

In general, as is shown in Figure 24 above, the "variable quality of service" as a set of possible tools, was considered very important by all the operators in both the countries. This result is very important and new, because quality in the car park

sector has previously been considered as a tool to influence the behaviour drivers when they have to choose a parking location, but not one that influences the behaviour of the car park operator. Added to this, when the quality of car park service is referred to in the field of research, it is always discussed in terms of single tools, for example "the use of information technology to reserve a parking bay, but not as a whole.

The second result shows less of a difference between Italian and UK choices, in particular for the first three set of variables: proximity to an attractive area (red circle), parking policy and finally security (blue circle). The other set of responses have exhibited some differences. Below we tried to summarise the general results with respect to the two countries and the type of operator (public, private).

Table 9: Description of possible combinations of the variables

Factors	Totals	Total Ranking	UK Totals	UK Ranking	IT total	IT Ranking
Location close to commercial area	197	1	133	1	64	2
Location close to employment area	182	6	117	6	65	1
Parking policy of the municipality	193	2	129	3	64	2
Access control	178	8	117	6	61	7
Overnight security	172	9	117	6	55	11
Theft prevention	189	4	130	2	59	10
Providing information for clients	186	5	123	5	63	6
Parking guidance systems	169	10	108	10	61	7
Parking space reservation systems	119	13	70	14	49	13
Disabled facilities	193	2	129	3	64	2
Occupancy information via Internet	133	12	82	12	51	12
Cashless payment	162	11	102	11	60	9
Parking payment by mobile phone	119	13	80	13	39	14
Short and long-term rates	180	7	116	9	64	2

If we consider the ranking of the factors in Italy and in the UK, we can see that there are some similarities. In particular, location close to a commercial area, parking policy and provision of disabled facilities rate in the top 5 main factors for both the countries. The differences are in the other factors. While UK operators focus their attention on the factors that try to create a relationship between the car park and the

client, such as giving information and making the driver feel secure about his car, the Italian ones are more interested in the choice of the location near an employment area, or diversifying their tariffs. A variance test of the total scores for Italian and UK respondents calculates a result of 7.2, a result which indicates that the two samples are significantly different in their responses, with a 95% probability.

Table 10: Description of possible combinations of the variables

Factors	Public Totals	Public Ranking	Private total	Private Ranking
Location close to commercial area	51	1	146	1
Location close to employment area	51	1	131	6
Parking policy of the Municipality	49	6	144	2
Access control	47	9	125	9
Overnight security	46	11	126	8
Theft prevention	51	1	138	3
Providing information for clients	49	6	137	4
Parking guidance systems	47	9	122	10
Parking space reservation systems	37	13	82	14
Disabled facilities	50	5	137	4
Occupancy information via Internet	39	12	94	12
Cashless payment	49	6	113	11
Parking payment by mobile phone	25	14	94	12
Short and long-term rates	51	1	129	7

The table above shows that the choice of the location is very important for the public operator, because of the "public service" needs for the community. This also helps to explain the importance of the disabled facilities factor. In this case, for the private operator it can be seen as a means of providing client orientated services, to attract more drivers. For the public operator the short and long-term rates are also important, as they are linked to the need to control mobility and access in congested streets in the city centre, and the need to increase the share of car parking bays available to drivers who go into the centre for shopping and use of various services. A variance test of the total scores for public and private sector respondents also shows a result of 7.2, indicating that the two samples are significantly different in their responses, with a 95% probability.

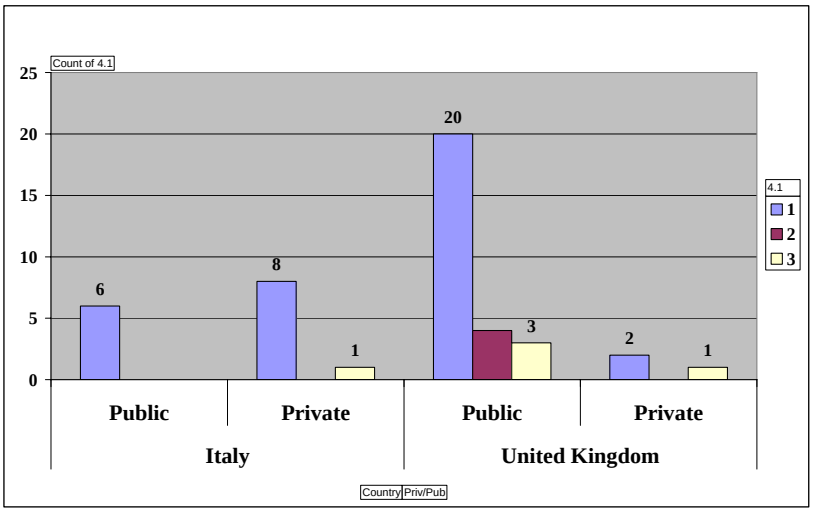
From the private sector point of view, parking policy attained second position, and this is very important, because it underlines the gap in communication between the policy maker and the sector operators.

The fourth section of the questionnaire is related to the operators' perceptions of market trends in off-street parking demand and supply.

The first set of questions asked respondents how demand for car parking has/may have changed in the city during the past five years; what they perceive the current situation to be and what trend they predict for the next three years. The second question investigates how the level of off-street car park construction has changed in the city during the past five years, what the current situation is, and what are the likely trends over the next three years. For each of the three options the operator could choose from a range of three possible alternatives: increasing, constant, decreasing.

The results of the first questions relating to parking demand are shown in the tables below.

Figure 25a: Past 5 years' car park demand trends: UK/IT and public/private results.

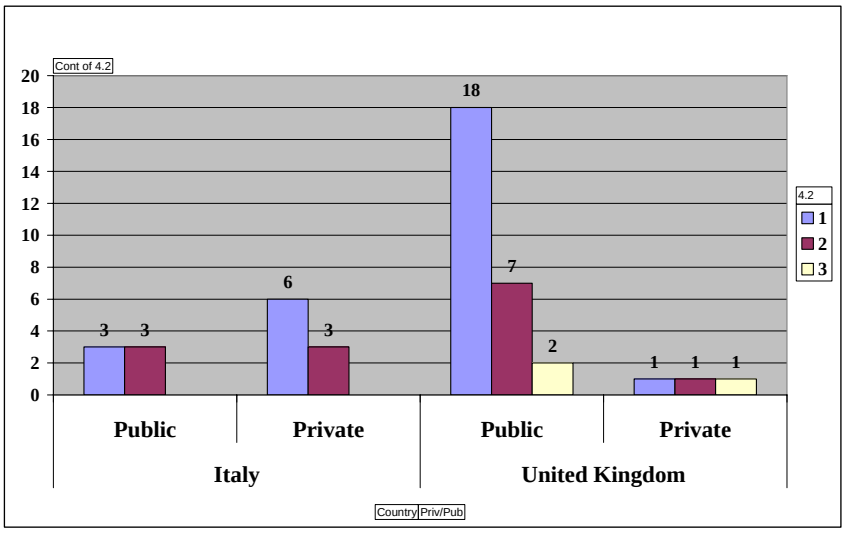


Legend: (1) increasing, (2) constant, (3) decreasing

The perception of the operators is of a general increase in demand over the past 5 years. The negative response of some of the private operators could be related to the

mobility and parking policies applied at national and local level, to control the effect of traffic congestion in city centres with access limitations for the private car in some cases (for example, the institution of the ZTL in Italy).

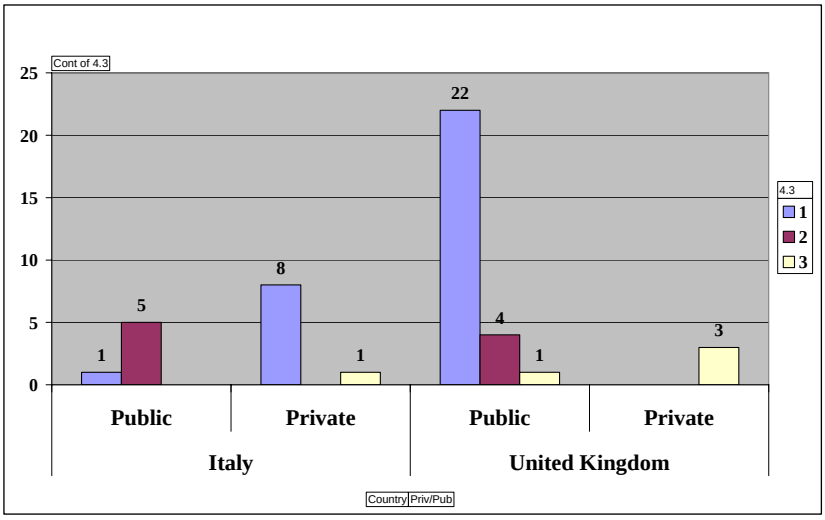
Figure 25b: Actual car park demand trends: UK/IT and public/private results.



Legend: (1) increasing, (2) constant, (3) decreasing

At the present time, the trends in demand maintain an upward direction, even if the number of operators that declare the situation to be stable has increased, both in the public and private sectors.

Figure 25c: Future car park demand trends: UK/IT and public/private results.

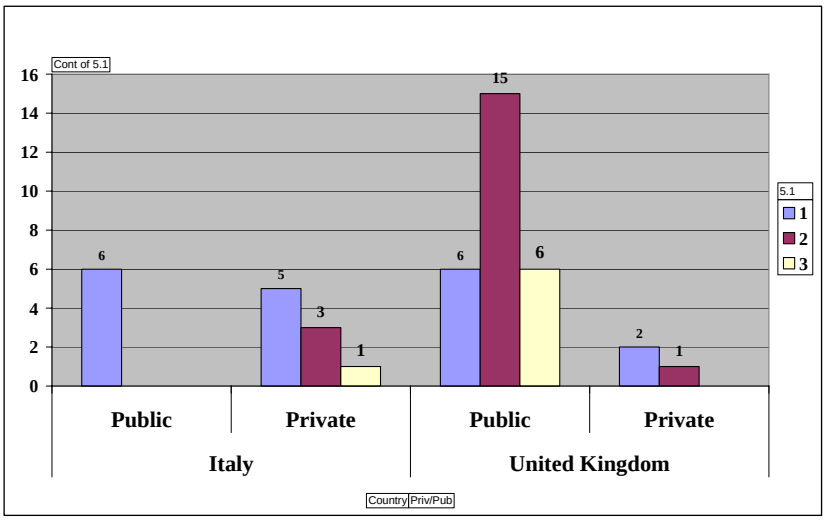


Legend: (1) increasing, (2) constant, (3) decreasing

The trends in demand over the next three years are seen on aggregate to be generally increasing, but with substantial differences between the UK and Italy. While in Italy the private operators foresee an increase in demand and, alongside this, the public sector predicts general stability in demand, in the UK the opposite is the case. The cause of these pessimistic predictions from the private operators in the UK may be the consequence of policies that tend to use parking as a restraint tool in order to reduce congestion and mobility problems in the city centre. The same argument was put to the author by Mr O'Brian of the British Parking Association, when he was interviewed for this research.

The results of the second set of questions, relating to car park construction, are shown in the tables below.

Figure 26a: Past 5 years' car park construction trends: UK/IT and public/private results.

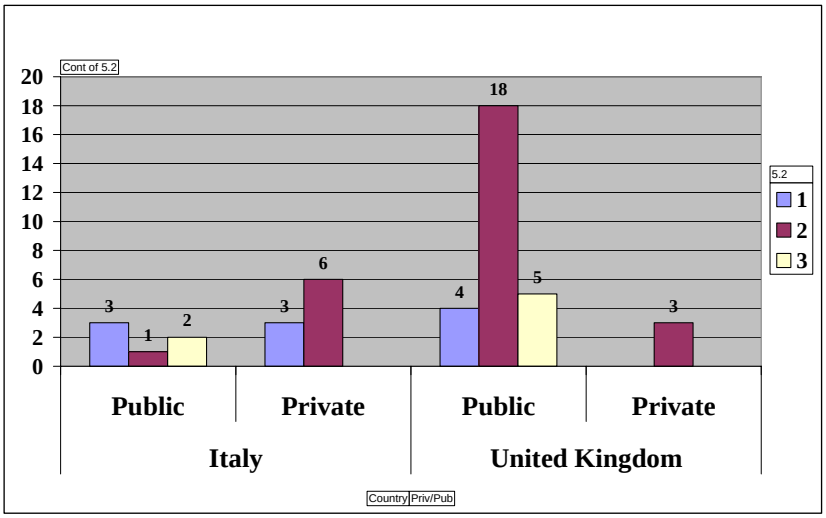


Legend: (1) increasing, (2) constant, (3) decreasing

The trends in car park construction in the past five years also show important differences between the UK and Italy. While the Italian public and private operators have both registered an increase in the number of their car parks, thanks to the Legge Tonioli Law (see Legge Tonioli in Italian policy chapter) which has supported them, in the UK the trend tends to be seen as one of stability, at least in city centres. Once again, in the UK, local government policies on mobility have played an important role: a (perception of) a general reduction of access by car to the city centre, with the

consequence of a reduction of the number of cars, which discourages the construction of new car parks.

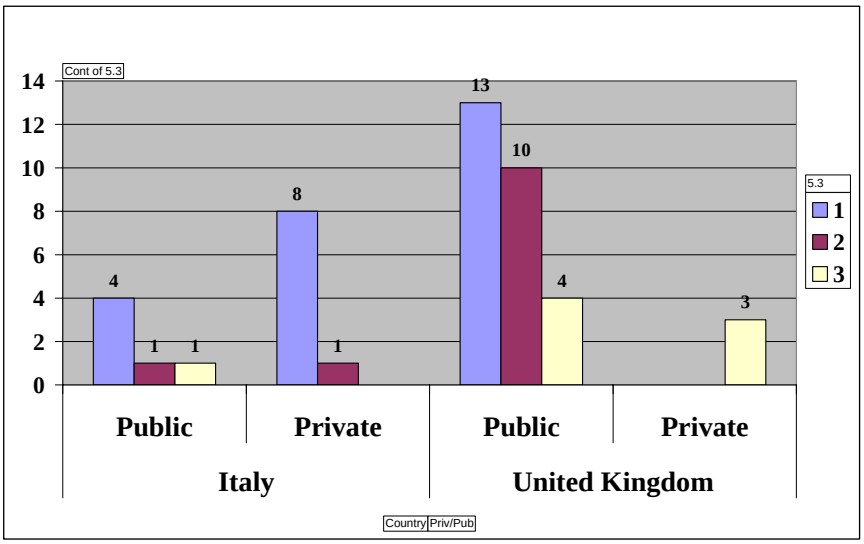
Figure 26b: Actual car park construction trends: UK/IT and public/private results.



Legend: (1) increasing, (2) constant, (3) decreasing

At the present time the trend in parking construction is generally stable for both the countries, even though in Italy there is still public finance support for new developments.

Figure 26c: Future car park construction trends: UK/IT and public/private results.



Legend: (1) increasing, (2) constant, (3) decreasing

Regarding the future three years, the public operators in both countries share an optimistic vision, although this is somewhat less marked in the UK. This confirms the tendency of public policy to support new construction in Italy, while in the UK there is the need to shift cars from on-street to off-street car parks. The vision of the private sector in the UK is very pessimistic, albeit it being the response of only three operators. This demonstrates the difficult situation in which private operators work. If the public operators are right in their predictions of growth, why do the private operators not share their vision? The reason is probably that private operators are excluded from the policy planning process. They are not active players, responding to new market demand with increased investment or improved quality of service, but rather passive recipients of new rules, procedures and policies of which they are unaware until published in the public domain.

Summarising the results of the fourth section of the survey, both in the UK and in Italy, the demand for parking spaces is steadily growing. Whilst there has been an increase in parking spaces in the past, the situation is currently consistent, but forecast to grow again in the future, and over the next three years. For Italy, we have a constant growth in supply over the years, which is rather more evident than in the UK. One reason for this may be the gap in information available to the private operator about the future trends of the car park market. The private operator tends to be, as argued earlier in this thesis, only a follower of the parking and mobility policies of local and national authorities, and is not pro active.

These results show on one hand a market where the increasing demand prompts a continuous increase in the number and size of car parks supplied. It also shows the potential in economic terms of this market, a potential which is highlighted by answers to questions relating to annual income.

A medium-size parking lot in the city centre, whether in the UK or Italy, is a very remunerative proposition. In one major UK city, 500 parking bays in the city centre generate income of £775,000 per year, with costs of merely £35,000 and therefore

profits of £740,000. In the same city, a car park with 2,694 bays earns £2,850,000 per year with costs of only £750,000 and profits of £1,500,000[28].

From the scarce quantitative information available, it appears however that this level of profitability is not common to all parking lots: for example, a medium-sized town in the South East, has a car park in the town centre with 205 bays and an income of £164,000 with £20,000 spent in running costs[29].

Even when capital costs are added to the costs of operation, managing parking lots is still a very remunerative activity. A council of a medium-sized city (around 160,000 people), with 16 parking lots, generates an annual income of £2,151,757, with running costs of £1,225,736 and profits of £503,256 (with annualised capital costs of £422,765)[30].

In Italy there are some differences. Without considering capital costs, a 212 bay parking lot in a medium-sized city in the North East of the country, earns £44,800 per year with running costs of £18,000 and thus profits of £26,800[31]. For a private owner in a smaller town, a parking lot with 706 bays earns £170,000 with running costs of £144,000 and capital costs of £124,000. Therefore, the returns will pay off the initial investment only after some years[32].

This apparent incongruence is due to the competitiveness of a market where public administrations offer on-street parking at low prices and thus force the private owner to offer parking at lower prices than the market prices would imply.

It is often the case in Italy that public administrations are oblivious to the normative framework stating that parking lots should have priority over on-street parking because of the impact of the latter on traffic circulation and environment. In the same city, for example, an on-street parking area with 94 bays earns £190,000 with running

[28] City of Nottingham, private operator
[29] City of Wokingam, City Council operator
[30] City of Dundee, City Council operator
[31] City of Forlì, City Council operator
[32] City of Cesena

costs of only £8,000. Even if costs declared are only running costs, the evidence points to this being a highly profitable business.

5.7 Conclusion

The results of the survey has permitted an in-depth and realistic analysis of the car parking sector. The first question has improved our understanding of car park operator choices with respect to a city centre situation. Location is a very important variable in the choice of strategies for the operator. When they have to select where to locate their car park in respect to another operator who operates in the city centre they prefer to build a new car park in the city centre (i.e. in the same area as the existing the car park operator) reducing price and quality. The semi-periphery is the second choice and only in this case is the competition increased in terms of quality and price as a consequence. This choice is also seen in the range of 3 alternative scenarios chosen in the second question (assessment of the economic model), in particular in the first and third scenarios. Some differences occur, but they depend on the different point of view of the UK and Italian public operators. In Italy other factors, such as the presence of special interest groups (i.e. city centre businesses, voters etc.) have a strong influence in determining policy, while in the UK, the public operator is more business orientated and functions more like a private operator.

The importance of location is confirmed also in the third set of questions. Commercial areas are normally located in the city centre. Italian operators are more likely than their UK counterparts to locate in or near an area of employment. This is probably because Italy does not have policies which provide for or control parking space for employees. The second most important variable is the parking policy of municipalities or local councils. The results confirm the influence of this variable in the business of the operators and, as a consequence, the importance of their involvement in the policy decision-making process of the local authority.

Security related variables are considered important for both countries, more then technology tools. This result is very interesting if we consider the extended literature related to the behaviour of drivers using these tools (parking guidance systems, parking reservation systems etc.). Interest in facilities for the disabled was demonstrated by operators in both countries. Another important variable is the possibility to equate the cost of parking with respect to the time of parking, in particular in Italy for the public operator (cross-referencing the data of Tables 5a and 5b).

The fourth set of questions is very interesting if related to the literature review. While for both countries over the last 5 years the trend of demand for car parking has increased; the future trend differs. While the private operators in Italy predict a further increase, the UK operators express a pessimistic vision. This vision is the opposite in the case of the public operators. This response reflects UK policy, which sees car parking as a tool for reducing access into the city centre, while in Italy the policy is to increase the construction of car parks, especially by private operators with public subsidies. This vision is confirmed if we consider the trend of new car park constructions. Again, the Italian operators have an optimistic vision, while in the public sector in UK the tendency is to shift cars from on to off-street construction. Private operators, however, have a very pessimistic vision in respect to new business opportunities.

In general, the results of the survey confirm the importance of location, mediated by price. The survey also confirmed the importance of the collection of variables under the quality heading for operators who make the strategic choice to become more competitive in their business. Finally, the pessimistic vision of private car park operator in UK, compared with the more buoyant attitude of the public sector, underlines the difficulties of the car park market, despite its potential to be, as shown by the data collected on the economics of the market, a highly remunerative business.

6. Conclusion, Discussion and Recommendations

General conclusion and significance of the results

In this dissertation, an analysis of the car parking sector as a market was undertaken, focusing on the car park operators' point of view. The study of the literature about the sector showed the knowledge gap which exists about it, and therefore the possibility of making an important contribution by means of this research. The research has permitted the development of an economic model to describe the strategic behaviour of car park operators asked to make development choices using various combinations of key variables. Furthermore, the dissertation has presented an analysis of the sector by means of a questionnaire submitted to a significant number of operators. This includes an important comparative analysis of the car park sector in two countries, UK and Italy.

The literature review demonstrated that the economics of car parking is a field of analysis that has been little explored. Only a very few recent works have been focused on the off-street car park market, and almost none have considered the car parking operators' point of view. There are no studies that consider the competition between car park operators. They always consider the final destination of the driver, but not the car park facility *per se*. For this reason there are no studies which consider the choices of car park operator in the choice of their business activities. For example, the services offered by the car park operator have been completely overlooked in the literature, and there is no analysis in terms of the variables which comprise those services. The location of a car park is seen as a consequence of the analysis of driver behaviour and destination and not as a strategic choice of the car park operator to gain a profitable activity. Likewise, price is considered as a tool to control and influence the behaviour of drivers rather than an element used by the operator to market his particular car park.

The second Research Hypothesis assumed that "the needs and views of car parking operators are not taken into account by local and national authorities when they draw up their mobility and parking policy". For the assessment of this hypothesis we focused on two countries where car transport and parking are of major importance, but who have very different attitudes towards car parking: the UK and Italy.

Local and national government transport policy shows a tendency in the UK to stop new car parking construction in the city centre, using alternative mobility services there instead. The low importance of this sector is highlighted if we consider that car parking tends to be considered by public authorities largely as a demand management tool (although also as a revenue raiser, where they control it). In drawing up Local Transport Plans (LTPs) there appeared to be no consideration given as to how these plans might affect the car park operators' business. In some cases, LTPs even predict the closure of existing private car parks in the city centre. This situation was confirmed in the survey, when we asked operators to predict future trends in demand for car parks and new car park constructions; their predictions for UK city centres were quite gloomy. For this reason, the market is exploring new opportunities, such as airports and railway stations.

In Italy, the opposite is true: here, the trend in the car parking market is towards increased new construction, both private and public, thanks to major financial contributions from the state, and also thanks to new instruments used in project financing. On the other hand, the trend towards public control of the operator's business in terms of, for example, range of price, time of working, is affecting the profitability of the business operators. In both countries, therefore, there is only marginal consideration of the needs of car park operators, although from different perspectives in each case.

The first hypothesis stated that "when a parking operator chooses whether or not to enter a new parking market, he considers the location of his car park and those of his competitors as the key variable in his decision, followed by price and quality". The literature review has show that location is a very important variable for car park

profitability. It is clear that city centres are (or were) the most profitable area for car park operators to locate because these are the areas with the highest potential demand for car parking. This conclusion is also confirmed by the economic modelling and the survey completed by car park operators in the UK and Italy. The problems faced by car park operators are car driver access to the city centre, the high price of land and planning and development restrictions in the city centre, especially in the UK where policy tends to reduce new development; or in Italy where the subsidy for new constructions conflicts with the strong public control of car park management.

Price is the second most important variable, because, as shown in the literature, price levels encourage or discourage the use of a car park. In several cases in the UK, increasing the price of a car park is used as a way of discouraging long-stay and encouraging short-stay parking in the city centre. On the other hand, the price of on-street parking, if not in line with the market price, can negatively affect the profitability of the off-street car park.

The third variable is quality. It is noteworthy that even though we are talking about a service industry, considerations of quality have been completely overlooked in research, even though some trade literature has shown its importance (e.g. national and international prizes for car park quality). The economic model showed the interaction of quality with location and price when we want to understand the competitive behaviour of the operators, while the survey in Italy and in the UK has demonstrated the importance of the quality variable. It is interesting that the elements considered important by the operator are different from the elements focused upon in the research (parking guidance system, parking reservation systems etc.). We can conclude that competition between car park operators is based on a mix of the following factors: location, quality and price. We can also conclude that neither policy makers nor researchers have paid sufficient attention to the issue of car parking.

Original contributions

The research has investigated the gap in the literature on the car parking sector. Research to date has mainly considered the car park as the final destination of a vehicle trip, analysing driver behaviour in various ways. Far fewer and only more recent studies have considered car parking as an economic sector. The investigation of the car park sector described in this thesis has enabled an investigation of the supply side of the car park market to be carried out in two countries, UK and Italy, where policy makers and operators have differing points of view and approaches to its regulation, control, support and development.

Comparing Italy and UK we do not know the effects of policy but we can see different approaches. In Italy more parking spaces are being developed, while in the UK policy is focused on modifying the demand side of the market, although the problem of creating enough parking spaces remains.

The research has permitted an evaluation of the importance of this sector, as well as highlighting a surprising lack of understanding by the operators of the policy making process. The effect of this misunderstanding is that the operators have a different perception of their future business opportunities. On the other hand, the research has investigated the most relevant variables taken into account by the operators when establishing a new car parking facility and in the course of their work in the city centre car parking market.

Specifically, location is considered the most important variable in the choice of off-street car park operators, followed by price. Quality is important as well, and the research has investigated the components of the quality factor, which has thrown up important questions for a new field of research.

This research has modelled the strategic behaviour of car park operators in the car park market, showing that in the city centre, good quality of service can be accompanied by high pricing. The Hotelling model is apply in this sector for the first

time, giving original solution. Ad to this has been developed for the first time in the analysis of parking a three stage game model.

The survey suggests conclusions that are similar to the econometric models and confirm the importance of these three variables.

The research has generated suggestions for future work in this field, deepening the knowledge of the car park market. We would also suggest to the policy maker that they consider the operators' point of view, if they do not want to risk losing some existing car parks in city centres, thus reducing the availability of parking space, with possible negative economic consequences for local retailing, for example.

As shown in the survey this could change the pessimistic vision of private operators for the future, in particular in the UK, where the operators agree on the growth in demand, but feel that there is not space in the market for new initiatives, or for the survival of the existing car parks. In Italy, the tendency to support the construction of new car parks must be accompanied by a more liberalised market, if the policy maker wants to avoid having a negative influence on the operators' businesses.

Future Work

There is a great deal of further research that could be done:

- Finding out what parking operators actually want from mobility policies of local authorities.
- How local authorities and parking operators could be better "connected" – brought together to discuss matters that are of interest to both parties.
- Finding out more about the economics of parking. Is it realistic to expect more parking to be provided completely by the private sector in city centres, given the cost of constructing it? What could local and national authorities do to improve the economics of parking in city centres?

- Consider the competition between on-street and of street car parking. It is an important extension of the research, also because on street car parking sector is often publicly-owned and managed, so the competition with the private off-street sector must be considered in the context of different aims, i.e. the public sector can reach more result other then profitability, such as social benefit, control of mobility by car, restricting the availability of parking space in some area of the city centre, etc.
- How can the model be extended? Can it be extended to be made more realistic? In the field of modelling analysis, new research on simulation is beginning. This will use a specific scaling algorithm capable of reducing a high dimensional space (equivalent to a high number of variables) to a target space with fewer dimensions (typically 2 or 3). This new algorithm, called the Topological Weight Centroid, is being developed by the Semeion research centre in Rome[33], and will be applied to the analysis of a great number of data simultaneously, obtaining further simulation of the car parking operators behaviour.
- Consider the asymmetry of information between public and private car park operators. This point is very important to investigate with further research because, as show by the survey, the information of the operator on the policy applied and their involvement in the decision making process of such policy is neglected.
- Consider the possibility of using information technology tools for a more efficient and effective control and management of car parking space in the city centre, giving information (in real time) to drivers about the available parking space in the city centre
- Consider the use of video camera access control (CCTV) into the city centre as an alternative to managing transport demand
- Extend the knowledge of facilities for the improvement of car park services: the quality of service of the car parking sector has for the first time considered and analysed with this research. The results obtained suggest the extension of this aspect.

[33] http://www.semeion.it/index.php?option=com_frontpage&Itemid=1&lang=english

- Develop new financial solutions to support the high cost of construction, considering the high cost of the land in the city centre, the need to maintain the vitality in the city centre, and the need, in some cases, to shift parked cars from on street to off street parking, and so on.

Appendices

Annex 1

THE GAME

Multi stage game: Sub game perfect equilibrium
1° stage: localization
2° stage: quality
3° stage: price

SET UP

Nash equilibrium 3° stage

Condition

$$\begin{cases} \dfrac{\delta \Pi^A}{\delta p_A} = 0 \\ \dfrac{\delta \Pi^B}{\delta p_B} = 0 \end{cases}$$

Now we find the reaction function:

$$\frac{\delta \Pi^A}{\delta p_A} = 0$$

$$\frac{1}{2}(1 + a - b) + \frac{1}{2t}(p_B - 2p_A - \theta) + \frac{C}{2t} = 0$$

$$t(1 + a - b) + (p_B - 2p_A - \theta) + C = 0$$

$$p_A = \frac{p_B + C - \theta}{2} + \frac{t}{2}(1 + a - b) \qquad \textbf{(6)}$$

reaction function of A

$$\frac{\delta \Pi^B}{\delta p_B} = 0$$

$$\frac{1}{2}(1 - a + b) + \frac{1}{2t}(p_A - 2p_B + \theta) + \frac{C'}{2t} = 0$$

$$p_B = \frac{p_A + c' + \theta}{2} + \frac{1}{t}(1 - a + b) \qquad \textbf{(7)}$$

reaction function of B

Now we shall intersect the reaction functions (8 and 9) and obtain the equilibrium price:

(7) → (6)

$$p_A = \left[\frac{1}{2}p_A + \frac{1}{2}C' + \frac{\theta}{2} + \frac{t}{2}(1 - a + b) + C - \theta\right] + \frac{t}{2}(1 + a - b)$$

$$2p_A = \frac{1}{2}p_A + \frac{1}{2}C' + C - \frac{\theta}{2} + \frac{t}{2} - \frac{ta}{2} + \frac{tb}{2} + t + ta - tb$$

$$4p_A = p_A + C' + 2C - \theta + t - ta + tb + 2t + 2ta - 2tb$$

$$3p_A = 3t + ta - tb + C' + 2C - \theta$$

$$p_A^* = t + \frac{t}{3}(a - b) + \frac{C' + 2C - \theta}{3} \qquad \textbf{(8)}$$

$$p_B^* = \frac{1}{2}\left[t + \frac{t}{3}(a - b) + \frac{C' + 2C - \theta}{3} + C' + \theta\right] + \frac{t}{2}(1 - a + b)$$

$$2p_B^* = t + \frac{t}{3}(a - b) + \frac{C' + 2C - \theta}{3} + C' + \theta + t - t(a - b)$$

$$6p_B^* = 3t + t(a - b) + C' + 2C - \theta + 3C' + 3\theta + 3t - 3t(a - b)$$

$$p_B^* = \frac{6t - 2t(a - b) + 4C' + 2C + 2\theta}{6}$$

$$P_B^* = t - \frac{t}{3}(a-b) + \frac{C + 2C' + \theta}{3} \qquad \textbf{(9)}$$

Section of equation

$$p_B^* - p_A^* = ?$$

$$t - \frac{t}{3}(a-b) + \frac{C + 2C' + \theta}{3} - t - \frac{t}{3}(a-b) - \frac{C' + 2C - \theta}{3} =$$

$$-\frac{2t}{3}(a-b) + \frac{C + 2C' + \theta - C' - 2C + \theta}{3} =$$

$$-\frac{2t}{3}(a-b) + \frac{C' - C + 2\theta}{3} = p_B^* - p_A^*$$

We shall find the equilibrium demand which are the following expressions 10 and 11:

$$t \quad > \quad \frac{C \quad - \quad C \quad '}{3} \ \sin \qquad ce$$

$$d_A^* = \frac{1}{2}(1 + a - b) - \frac{1}{3}(a-b) + \frac{1}{2t}\left(\frac{C' - C - \theta}{3}\right)$$

$$\frac{1}{2} + \frac{1}{2}(a-b) - \frac{1}{3}(a-b)$$

$$d_A^* = \frac{1}{2} + \frac{1}{6}\left[(a-b) + \frac{C' - C - \theta}{t}\right] \qquad \textbf{(10)}$$

$$d_B^* \Rightarrow \qquad p_A^* - p_B^* = t + \frac{t}{3}(a-b) + \frac{C' + 2C - \theta}{3} - t + \frac{t}{3}(a-b) - \frac{C + 2C' + \theta}{3}$$

$$p_A^* - p_B^* = \frac{2t}{3}(a-b) + \frac{C' + 2C - \theta - C - 2C' - \theta}{3} = \frac{2t}{3}(a-b) + \frac{C - C' - 2\theta}{3}$$

$$d_B^* = \frac{1}{2}(1 - a + b) + \frac{1}{2t}\left[\frac{2t}{3}(a-b) + \frac{C - C' - 2\theta}{3} + \theta\right]$$

$$d_B^* = \frac{1}{2} - \frac{1}{2}(a-b) + \frac{1}{3}(a-b) + \frac{1}{6}\left(\frac{C - C' + \theta}{t}\right)$$

$$d_B^* = \frac{1}{2} + \frac{1}{6}\left[(b-a) + \frac{C - C' + \theta}{t}\right] \qquad \textbf{(11)}$$

Thus the profits of equilibrium are as follows:

$$\Pi_A^* = \left[t + \frac{t}{3}(a-b) + \frac{C' + 2C - \theta}{3} - C\right]\left\{\frac{1}{2} + \frac{1}{6}\left[(a-b) + \frac{C' - C - \theta}{t}\right]\right\}$$

$$\Pi_A^* = \left[t + \frac{t}{3}(a-b) + \frac{C' - C - \theta}{3}\right]\left\{\frac{1}{2} + \frac{1}{6}\left[(a-b) + \frac{C' - C - \theta}{t}\right]\right\} \qquad \textbf{(12)}$$

with $t + \frac{t}{3}(a-b) + \frac{C' - C - \theta}{3} \geq 0$

$$\frac{\theta}{3} \leq t + \frac{t}{3}(a-b) + \frac{C' - C}{3}$$

$$\theta \leq t(a-b) + 3t + (C' - C)$$

$\left(t + \frac{C - C'}{3}\right)\left(\frac{1}{2} + \frac{C - C'}{t}\right)$

and

$C - C' > 0$

$$\Pi_B^* = \left[t - \frac{t}{3}(a-b) + \frac{C + 2C' + \theta}{3} - C'\right]\left\{\frac{1}{2} + \frac{1}{6}\left[(b-a) + \frac{C - C' + \theta}{t}\right]\right\}$$

$$\Pi_B^* = \left[t - \frac{t}{3}(a-b) + \frac{C - C' + \theta}{3}\right]\left\{\frac{1}{2} + \frac{1}{6}\left[(b-a) + \frac{C - C' + \theta}{t}\right]\right\} \qquad \textbf{(13)}$$

with $t - \frac{t}{3}(a-b) + \frac{C - C' + \theta}{3} \geq 0$

$$\frac{\theta}{3} \geq -t + \frac{t}{3}(a-b) - \frac{C - C' + \theta}{3}$$

$$\theta \geq t(a-b) - 3t - (C - C')$$

The expression 14 is a synthesis of the expressions 8 and 9. They express the possibility of negative price. So too, the expressions 8 and 9 could be too different in terms of quality.

Condition of expression (8)

$$t + \frac{t}{3}(a-b) + \frac{C' + 2C - \theta}{3} \geq 0 \qquad ; \qquad \theta \leq 3t + t(a-b) + (C' + 2C)$$

Condition of expression (9)

$$t - \frac{t}{3}(a-b) + \frac{C' + 2C + \theta}{3} \geq 0 \qquad ; \qquad \theta \geq -3t + t(a-b) - (C + 2C')$$

or these conditions can be expressed thus:

$$\underset{A}{-3t + t(a-b) - (C - C')} \leq \theta \leq \underset{B}{3t + t(a-b) + (C' - C)}$$

$$t(a-b)-3t-(C-C')\le\theta\le t(a-b)+3t+(C'-C)$$
$$t(a-b)-(C-C')-3t\le\theta\le t(a-b)-(C-C')+3t \qquad \textbf{(14)}$$

this is the condition of not negative price equilibrium.

Nash equilibrium 2° stage

Including price equilibrium in the expressions 4 and 5 we find the profits of the game's second stage.

In this phase of the game the two car parker's reaction functions are the following expressions 15 and 16:

Expression 15 (for all)

$$\Pi_A=\left[t+\frac{t}{3}(a-b)+\frac{C'-C-\delta(q_B-q_A)}{3}\right]\left\{\frac{1}{2}+\frac{1}{6}\left[(a-b)+\frac{C'-C-\delta(q_B-q_A)}{t}\right]\right\}$$

$$\frac{\delta\Pi_A}{\delta q_A}=0$$

$$\frac{\delta\Pi_A}{\delta q_A}=\frac{\delta}{6}+\frac{\delta}{18}(a-b)+\frac{\delta}{18}\left(\frac{C'-C-\delta q_B}{t}\right)+\frac{2\delta^2 q_A}{18t}+\frac{\delta}{6t}\left[t+\frac{t}{3}(a-b)+\frac{C'-C-\delta q_B}{3}\right]=0$$

$$1+\frac{1}{3}(a-b)+\frac{C'-C}{3t}-\frac{\delta}{3t}q_B+\frac{2\delta}{3t}q_A+1+\frac{1}{3}(a-b)+\frac{C'-C}{3t}-\frac{\delta q_B}{3t}=0$$

$$3t+t(a-b)+(C'-C)-\delta q_B+2\delta q_A+3t+t(a-b)+(C'-C)-\delta q_B=0$$

$$2\delta q_A=2\delta q_B-6t-2t(a-b)+2(C-C')$$

$$q_A=q_B-3t-t(a-b)+(C-C') \qquad \textbf{(15)}$$

$q_B=q_A$.....

$q_A=q_A$.....

$$\frac{\delta}{6}+\frac{\delta}{18}(b-a)+\frac{\delta}{18}\left(\frac{C-C'-\delta q_B}{t}\right)+\frac{2\delta^2 q_B}{18t}+\frac{\delta}{6t}\left[t-\frac{t}{3}(a-b)+\frac{C-C'-\delta q_A}{3}\right]=0$$

$$3t + t(b-a) + (C - C') - \delta q_A + 2\delta q_B + 3t - t(a-b) + (C - C') - \delta q_A = 0$$

$$2\delta q_B = 2\delta q_A - 6t - 2t(b-a) + (C'-C)$$

$$q_B = q_A - 3t - t(b-a) + (C'-C) \qquad \textbf{(16)}$$

$$q_A = q_B - \frac{3t}{2} - t(a-b) + C - C'$$

$$q_B = q_A - \frac{3t}{2} - t(b-a) + C'-C \qquad \Rightarrow \qquad q_A = q_B + \frac{3t}{2} - t(a-b) + C - C'$$

The two reaction functions are parallel, so they must be studied. See below the three figures, each for all the possible cases. We shall determine the possible Nash equilibrium in the restricted domain's case (from 0 to q).
Applying the theorem of Kakutany we determine the Nash equilibrium in the restricted domain by dynamic strategy of action-reaction.

FIGURE

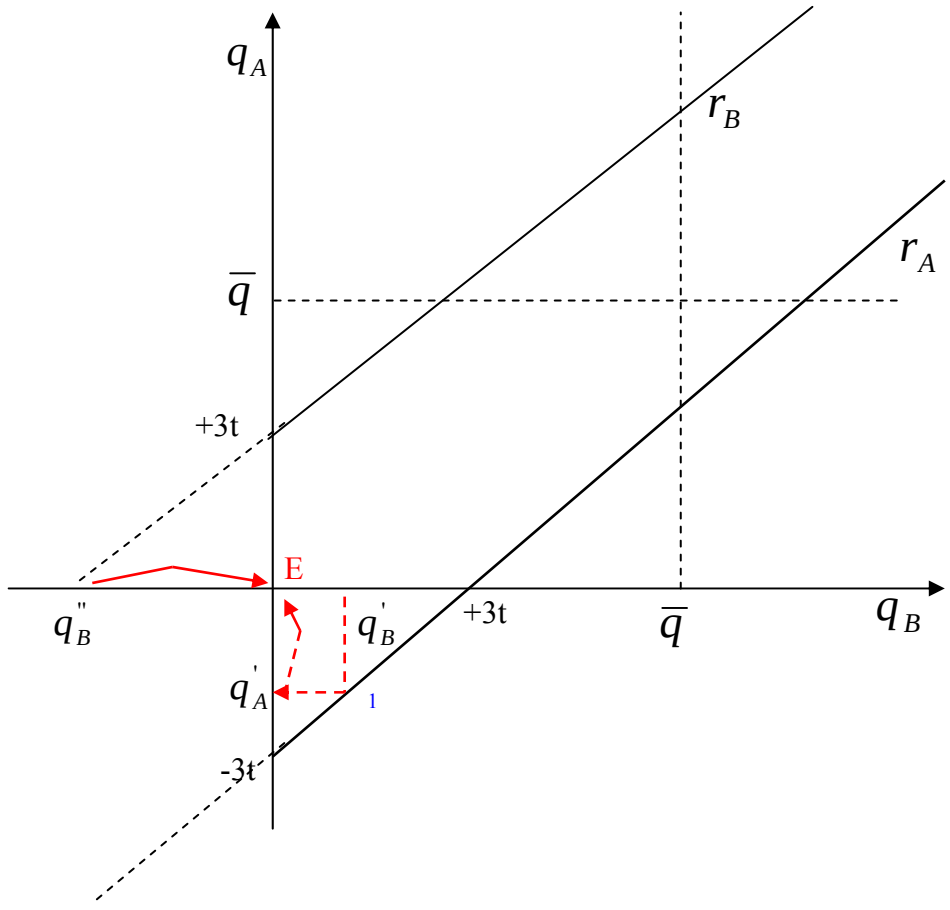
if $\begin{matrix} C - C' > t \\ C - C' - t > 0 \end{matrix}$ $\underbrace{h = (C - C') - t(a - b) > 0}_{\text{h}}$

$q_A = q_B - 3t + h \qquad (\underline{r_A}(q_B))$

$q_A = q_B + 3t + h \qquad (\underline{r_B}(q_A))$

Second Stage
Quality Best Reply Dynamics
Fig. 1 **Case 1**

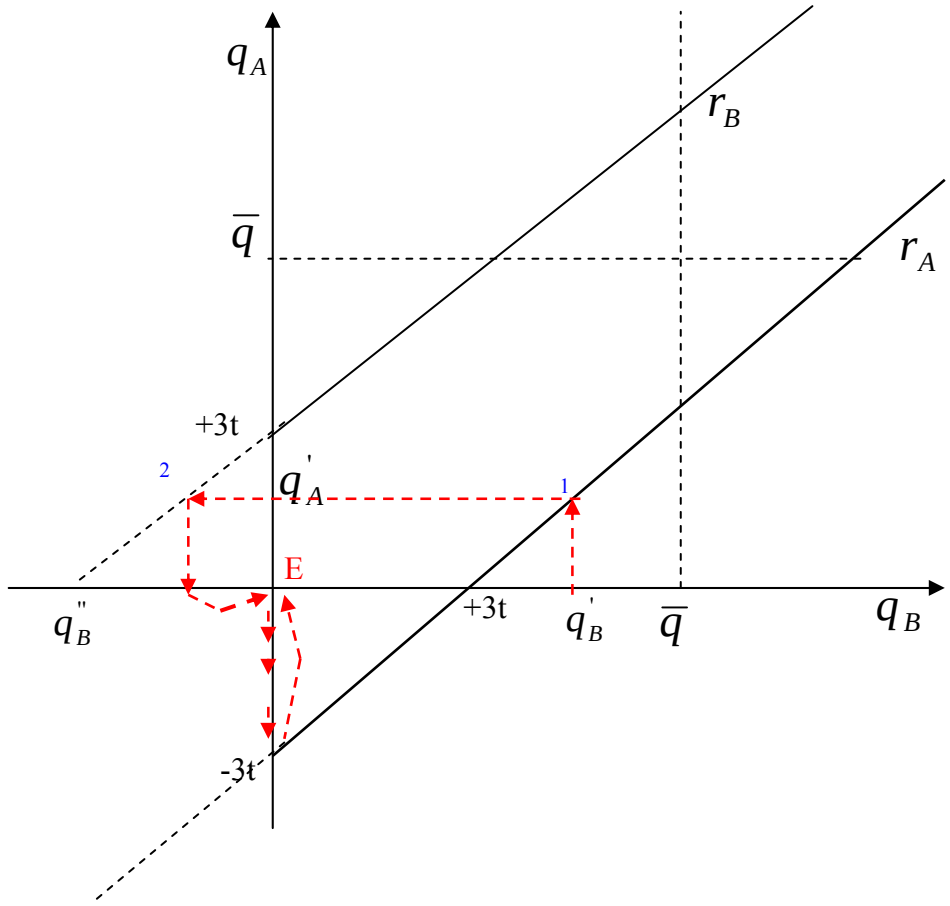
$$E(q_A^*; q_B^*) = (0;0)$$



The graph shows that when $q_B^{'}$ is the starting point , the reaction action of A is a negative quality (q<0), but this is not possible, so it goes in 0. Then the reaction action of B is q<0 ($q_B^{''}$), but this is not possible either, so B also goes to 0. Then the equilibrium is E(0;0).

Second Stage
Quality Best Reply Dynamics
Fig. 1 **Case 2**

$$E(q_A^*; q_B^*) = (0;0)$$



h=0

$q_B^{'} > 3t$ *but* $< \overline{q}$. On the right side of 3t

The graph shows that when $q_B^{'}$ is the starting point, the reaction action is $q_A^{'}$>0, and the reaction action of B is q<0 ($q_B^{''}$), but neither this is possible (qualitative level <0), so it goes to 0. The reaction of A is negative, but this is not possible (q<0), and it goes to 0. The equilibrium is E (0;0)

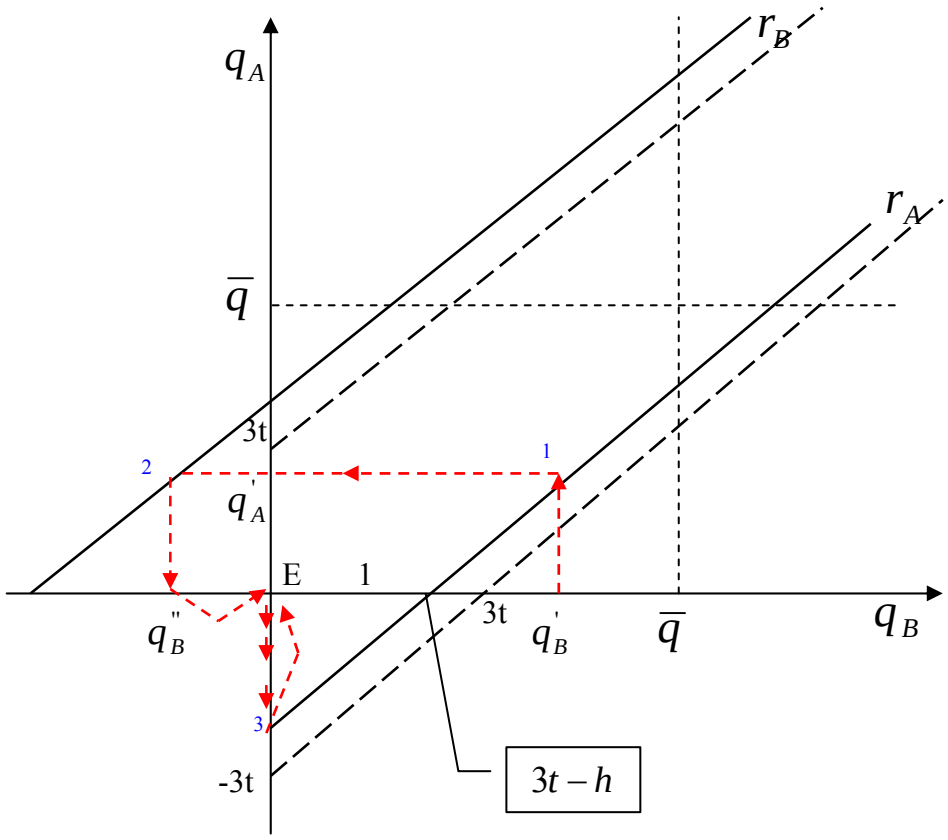
Second Stage
Quality Best Reply Dynamics
Fig. 1 **Case 3**

Also for this case with h=0 and $q_B^{'} = 3t$ the equilibrium is:

$$E(q_A^*; q_B^*) = (0;0)$$

Second Stage
Quality Best Reply Dynamics
Fig.2 **Case 1**

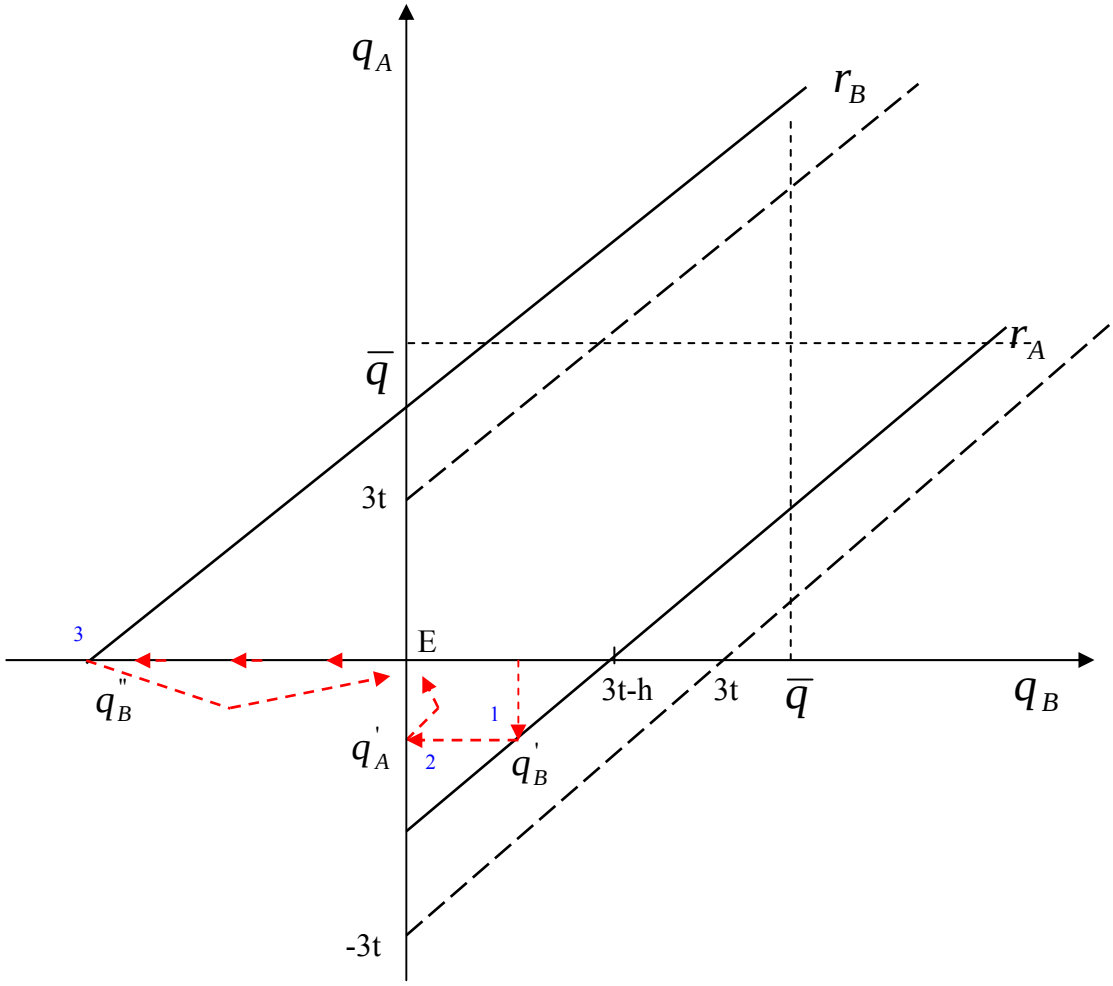
$$E(q_A^*; q_B^*) = (0;0)$$



h # 0
h<3t

The graph shows that when $q_B^{'}$ is the starting point, the reaction action of A is $q_A^{'} > 0$. The reaction action of b is a negative quality <0 ($q_B^{''}$), but this is not possible so it goes to 0. The reaction action of A is <0, so it goes to 0. The equilibrium is E(0;0).

Second Stage
Quality Best Reply Dynamics
Fig.2 **Case 2**



$h < 3t$ *and* $h \# 0$

$q_B' < 3t - h$ with $h < 3t$ *and* $h \# 0$

The graph shows that when q_B' is the starting point, the reaction action of A is q_A'<0, so it goes to 0. The reaction action of B is q_B''<0, so it also goes to 0. The equilibrium is E(0;0).

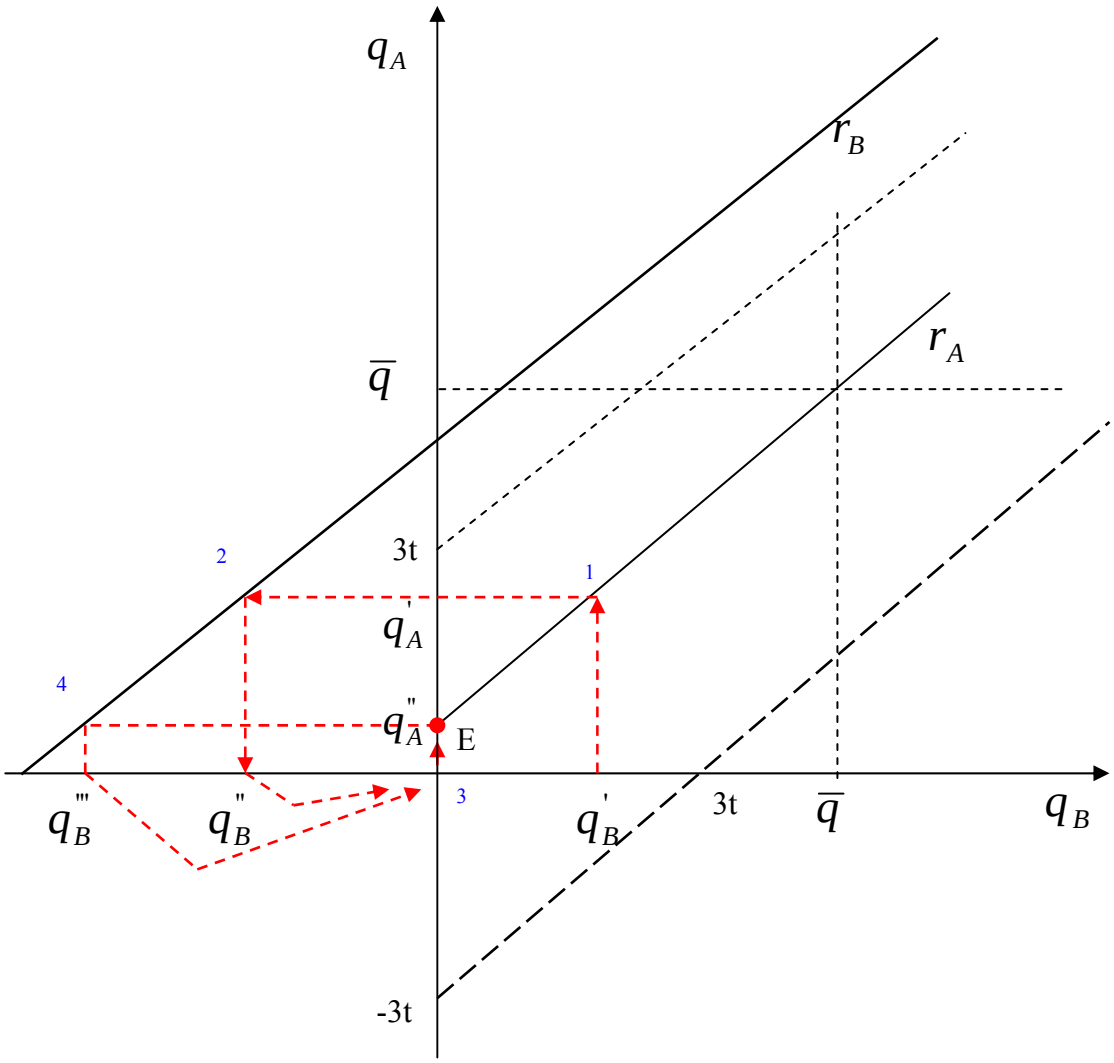
Second Stage
Quality Best Reply Dynamics
Fig.2 **Case 3**

Also for this case with $q_B' = 3t - h$ the equilibrium is:

$$E(q_A^*; q_B^*) = (0;0)$$

Second Stage
Quality Best Reply Dynamics
Fig.3

$$E(q_A^*; q_B^*) = (h - 3t; 0)$$



$h \# 0 \quad and \quad h > 3t$

The graph shows that when $q_B^{'}$ is the starting point, the reaction action of A is $q_A^{'} > 0$. The reaction action of B is $q < 0$ ($q_B^{''}$), but this is not possible with a negative quality, so it goes to 0. The reaction action of A is $q_A^{''} > 0$ (equal *h-3t*), so the reaction action of B is a quality $q < 0$ ($q_B^{'''}$), but neither this is possible, so it

goes to 0. The reaction action of A is $q_A^{"} > 0$, and B, again, goes to 0. So we obtain two values, in equilibrium: $E \begin{cases} q_A = h - 3t \\ q_B = 0 \end{cases}$

if $+h - 3t > 0$ $\quad h > 3t$ $\quad \theta = 3t - h$ $\quad q_A^* = h - 3t$ $\quad q_B^* = 0$

$\theta = 3t - (C - C') + t(a - b)$

$\theta = 3t - C + C' + t(a - b)$ condition (14) is verified.

Solution:

$h < 3t$ $\quad (0;0) = (q_A^*; q_B^*)$ $\quad \Rightarrow \theta = 0$

$h > 3t$ $\quad (q_A^*; q_B^*) = (h - 3t; 0)$

Nash equilibrium 1° stage:

Including the qa and qb in equilibrium in the 4 and 5 expressions 4 and 5 we find the profits of the third stage of the game. The function of reaction this first case are 17 and 18. In Nash perfect equilibrium, number 17,the car parks are in the extreme opposite of the city. In case 19 we find an indifferent profit to the position. So the choice of where to place the car parking is indifferent from the strategic elements.

I) First case

Whit $\theta = 0$

$$\Pi_A = \left[t + \frac{t}{3}(a - b) + \frac{C' - C}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(a - b) + \frac{C' - C}{t} \right] \right\} \quad \textbf{(*)}$$

$$\Pi_B = \left[t - \frac{t}{3}(a - b) + \frac{C - C'}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(b - a) + \frac{C - C'}{t} \right] \right\} \quad \textbf{(**)}$$

$$\frac{\delta \Pi_A}{\delta_a} = 0 \Rightarrow \frac{t}{6} + \frac{t}{18}2a - \frac{t}{18}b + \frac{t}{18}\left(\frac{C'-C}{t}\right) + \frac{t}{6} + \frac{C'-C}{18} - \frac{t}{18}b = 0$$

$$\frac{\delta \Pi_B}{\delta_a} = 0 \Rightarrow \frac{t}{6} - \frac{t}{18}a + \frac{t}{18}\left(\frac{C-C'}{t}\right) + \frac{t}{6} + \frac{C-C'}{18} - \frac{t}{18}a + \frac{t}{18}2b = 0$$

$$3t + 2at - tb + (C'-C) + 3t + (C'-C) - tb = 0$$

$$3t - ta + (C-C') + 3t + (C-C') - ta + 2tb = 0$$

$$2at = 2tb - 6t - 2(C'-C) \Rightarrow a = b - 3 + \frac{C-C'}{t} \quad \textbf{(17)}$$

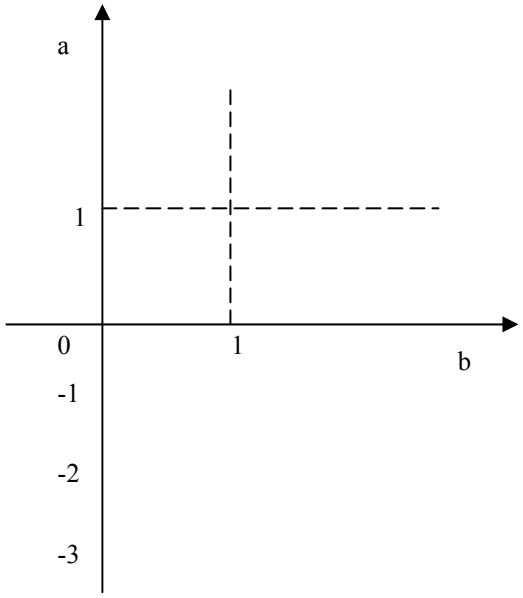
$$2bt = 2ta - 6t - 2(C-C') \Rightarrow b = a - 3 - \frac{C-C'}{t} \quad \textbf{(18)}$$

The reaction action function, relatively the position, are:

$$a = b - 3 + \frac{C - C'}{t} \qquad p_A(p_B)$$

$$a = b + 3 + \frac{C - C'}{t} \qquad p_B(p_A)$$

Figure 2:



With $\theta = 0$ if $h < 3t$, than $h = C - C' - t(a - b)$

and

$$C - C' - t(a - b) < 3t$$
$$C - C' < 3t + t(a - b)$$
$$\frac{C - C'}{t} < 3 + (a - b) \qquad \Rightarrow \qquad \overline{q} \quad \text{=(3+1(because a-b<1 and >0))}$$

So there are two cases with $\theta = 0$:

I) CASE 1 : Edge location

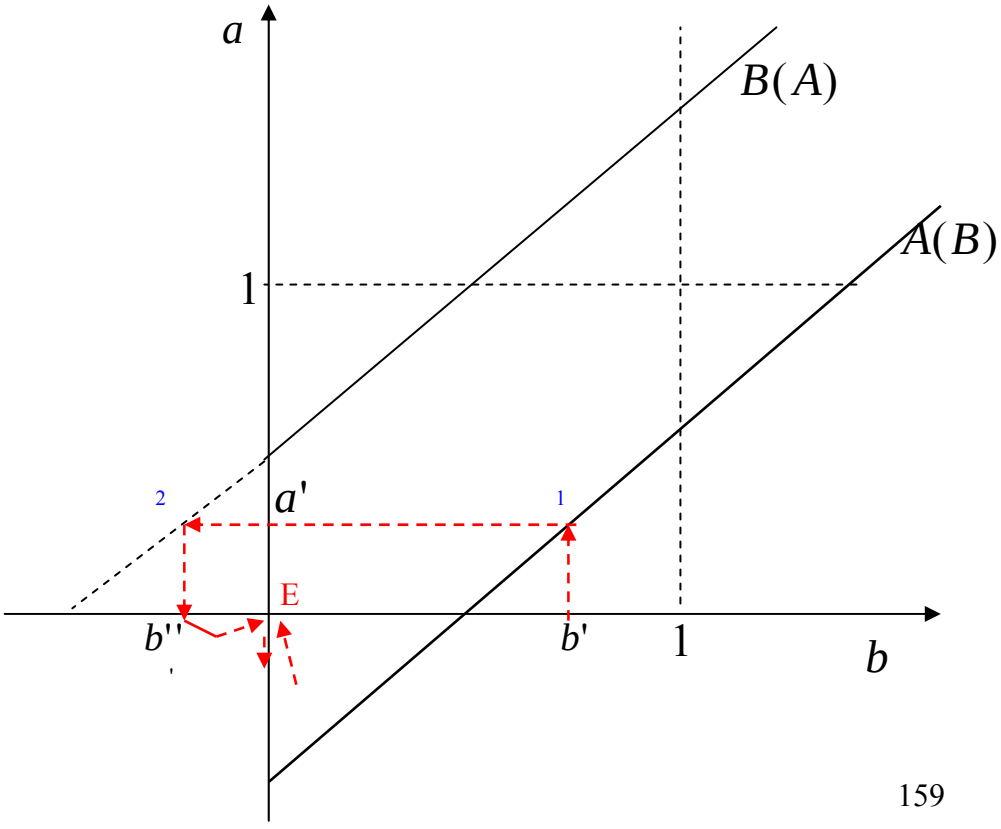
The position of the reaction action function regarding the advanced limit of the dominion of localizations is:

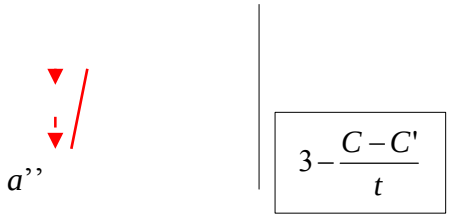
$-\frac{C-C'}{t}+3<1 \quad \Rightarrow \quad \frac{C-C'}{t}<2$ In this case the reaction action function of A has an intercepts less than 1, with the axis of the abscissas. In the case of $\frac{C-C'}{t}\geq 2$ the intercept is ≥ 1.

$\frac{C-C'}{t}+3<1 \quad \Rightarrow \quad \frac{C-C'}{t}<-2$ always true, so the reaction action function of B has the intercepts with the axis of the formers (?) always greater of one

First Stage
Location Best Reply Dynamics
Fig.4 **Case 1.1**

q A





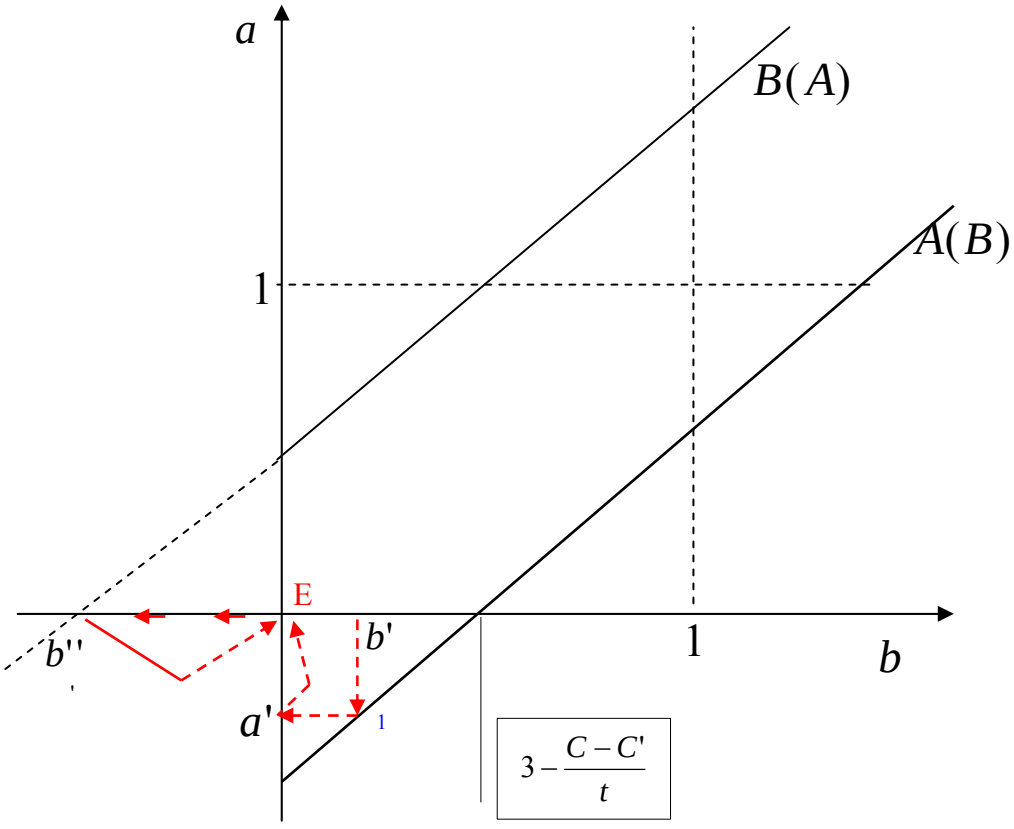
$$h = 0 \quad or \quad h < 3t$$

$$\frac{C - C'}{t} < 2$$

The graph shows that when b' is the starting point, the reaction action of A is positive (a'). The reaction action of B to a' is negative (b''), so B goes to 0. The reaction action of A to B is also negative, so this too goes to 0.

First Stage
Location Best Reply Dynamics
Fig.4 **Case 1.2**

$$E(a^*;b^*) = (0;0)$$



The graph shows that when b' is the starting point, the reaction action of A is negative (a'). The reaction action of B to a' is also negative (b''), so B goes to 0. The equilibrium is E(0;0)

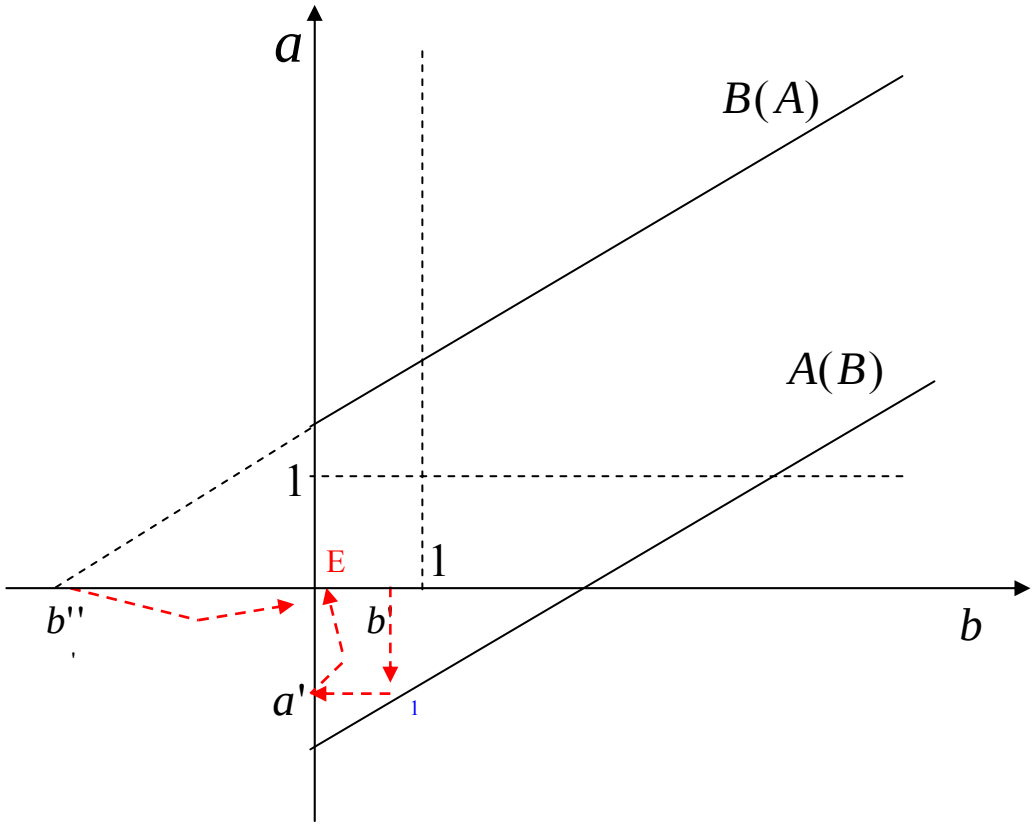
First Stage
Location Best Reply Dynamics
Fig.4 **Case 1.3**

Also for this case with $b' = 3 - \frac{C - C'}{t}$ the equilibrium is:

$$E(0;0)$$

First Stage
Location Best Reply Dynamics
Fig.5 **Case 2**

$$E(a^*;b^*) = (0;0)$$



$$h = 0$$

$$h < 3t$$

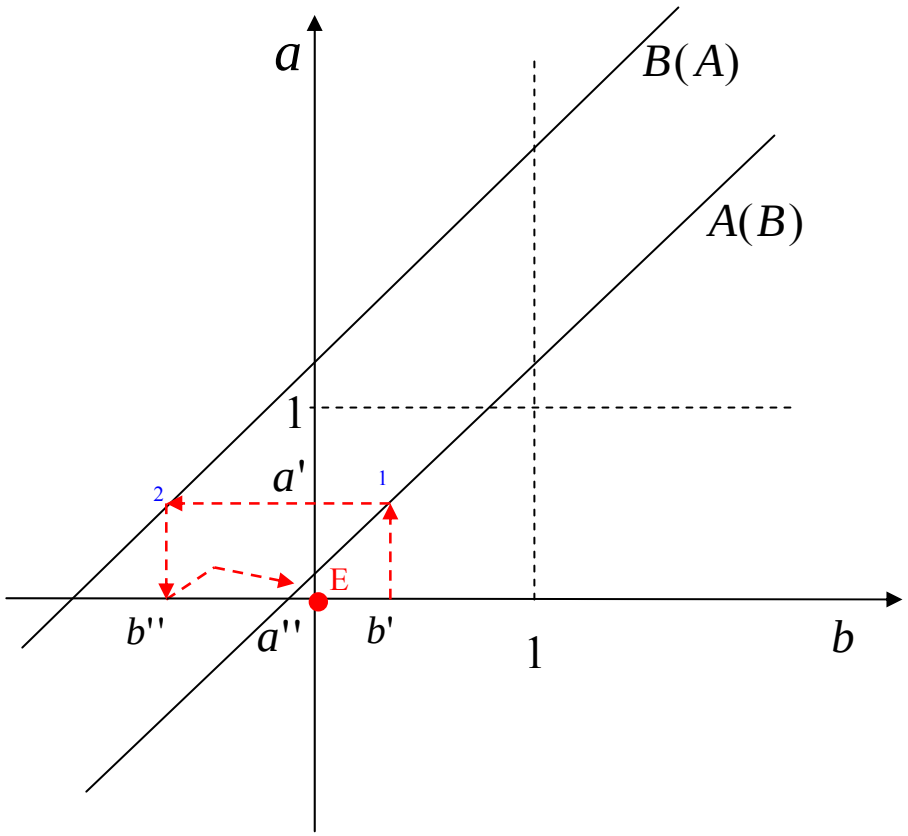
$$3 \geq \frac{C - C'}{t} \geq 2$$

The graph shows that when b' is the starting point, the reaction action of A is negative (a'). The reaction action of B to a' is also negative (b''), so B goes to 0. The equilibrium is E(0;0)

I) CASE 2 : Minimal Geographical differentiation

First Stage
Location Best Reply Dynamics
Fig. 6

$$E(a^*;b^*)=\left(\frac{C-C'}{t}-3;0\right)$$



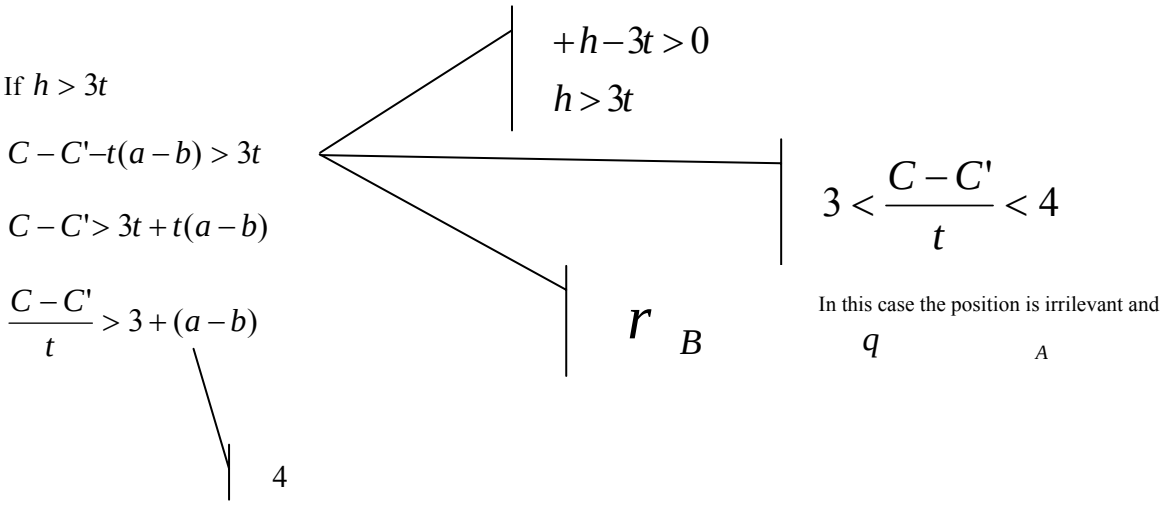
$$h>3t$$

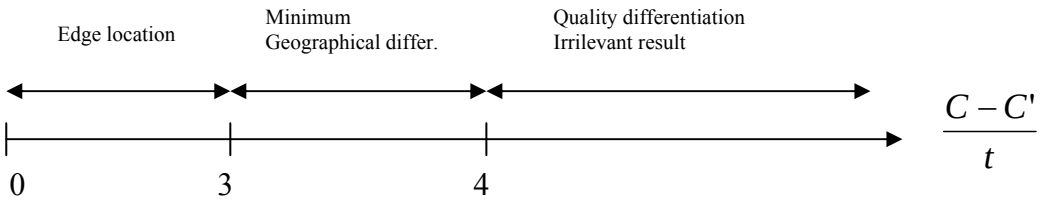
$$4>\frac{C-C'}{t}>3$$

The graph shows that when a' is the starting point, the reaction action of A is positive (a'). The reaction action of B to a' is negative (b''), so B goes to 0. The reaction action of A to b'' is a positive value (a''). Then the reaction action of A is a negative value etc. This forms a sort of cyclic continuum between the two values. So the equilibrium is made of these two values

$$E\begin{cases} q_A=\frac{C-C'}{t}-3 \\ q_b=0 \end{cases}$$

II) Second Case $\theta = 3t - h$: Quality Differentiation





$$\Pi_A = \left[t + \frac{t}{3}(a-b) + \frac{C'-C-3t+C-C'-t(a-b)}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(a-b) + \frac{C'-C-3t+C-C'-t(a-b)}{t} \right] \right\}$$

$$= 0$$

$$\frac{1}{2} + \frac{1}{6}\left[(a-b) - 3 - (a-b)\right] = \frac{1}{3}(a-b)$$

$$\Pi_A^* = 0$$

$$\Pi_B = \left[t - \frac{t}{3}(a-b) + \frac{C - C' + 3t - C + C' + t(a-b)}{3} \right] \left\{ \frac{1}{2} + \frac{1}{6} \left[(b-a) + \frac{C - C' + 3t - C + C' + t(a-b)}{t} \right] \right\}$$

2t

q A

$$\Pi_B^* = 2t$$

Annex 2

Car Park Operations Survey 2006

Car parking is a fundamental element of car mobility in any city. Previous research has typically studied car parkers' behaviour, focussing predominantly on satisfying drivers' demands in terms of routing, time searching for parking etc.

Likewise, UK government and local authority transport policies have increasingly focussed on influencing mobility and accessibility by car. Some times this can affect car parking operators, because changes in accessibility can reduce the number of cars in some city areas, and hence parking demand.

In both instances there is a risk that the views and interests of car parking operators have been ignored.

Additionally, research has focused primarily on the demand side of the car parking market, or indirectly, considered car parks as the final destination of drivers' trips.

This research intends to redress the balance somewhat by examining current UK car parking operations and the views and expectations of car park operators/managers. The results of this survey may help car parking operators to optimise their current car park operations and help make future choices in different local parking markets.

All responses will be treated with the strictest confidence.

Please return your completed questionnaire in the pre-paid envelope provided by 30 April 2006. If you would prefer an electronic version of this questionnaire, please email g.ferilli@napier.ac.uk

SECTION A: STRATEGIC PARKING BEHAVIOUR: Only one copy to be completed.

In this section we are interested to understand your strategic behaviour in making decisions about how to enter a local parking market where you currently have no existing presence.

To achieve this we have presented you with a hypothetical situation in which:

A medium-sized city (250,000-400,000 inhabitants) has only one car parking operator managing one 1500-space car park, with the following attributes

	Price	Quality	Location
EXISTING CAR PARK	4 (High)	High	Central

N.B.

- Price refers to cost of parking to customer per hour (on a scale of 5 = very high to 1 = very low)
- Quality refers to overall quality in terms of secure parking facilities, lighting, access etc (good, medium, bad)
- Location refers to either Central (city/town centre), Peripheral (city/town outskirts), or Semi-peripheral (in-between)

A number of possible new car parks options are described below. Please indicate from the five options provided the car park that you would choose to open first as a competitor to the existing car park.

	PRICE	QUALITY	LOCATION	Preferred option (please tick one)
Car Park-Option 1	3	Medium	Central	
Car Park-Option 2	4	High	Semi-Peripheral	
Car Park-Option 3	3	Low	Central	
Car Park Option 4	2	Low	Outskirts	
Car Park-Option 5	2	Medium	Semi-Peripheral	

To further explore your strategic behaviour in making decisions we have presented you with three further hypothetical situations whereby:

Two car parks exist in a city, but vary in terms of

- Operating costs
- Location
- Price
- Quality

For each of the following scenarios please indicate which one of the two car parks you would prefer to own and operate? (Question continues on the following page.)

Scenario 1

	Operating costs	Location	Price	Quality	Preferred choice (tick one option below)
Car park 1	Medium	Semi Periphery	High	Low	
Car park 2	Low	Semi Periphery	Medium	Low	

Scenario 2

	Operating costs	Location	Price	Quality	Preferred choice (tick one option below)
Car park 1	High	Centre	High	Low	
Car park 2	Medium	Semi periphery	High	Low	

Scenario 3

	Operating costs	Location	Price	Quality	Preferred choice (tick one option below)
Car park 1	High	Centre	High	High	
Car park 2	Low	Centre	Medium	Low	

Factors determining the competitiveness of your car parking. In this section we are interested to learn about all the factors you consider relevant to increase the competitiveness of your car parking. Please indicate the level of importance you attach to each of the factors listed below (tick one box per row).

	Very important	Important	Neither important nor unimportant	Not important	Not important at all
Location close to commercial area					
Location close to employment area					
Parking policy of the Municipality/Council					
Access control					
Overnight security					
Theft prevention					
Providing information for clients					
Parking guidance systems					
Parking space reservation systems					
Disabled facilities					
Occupancy information via Internet					
Cashless payment					
Parking payment by mobile phone					
Short and long term rates					
Other factors (please state and indicate importance attached)					

Demand for car parking: these questions investigate how demand for car parking has changed/may change in the city in which you currently operate your car park[s]. Please tick the relevant boxes below to indicate how.

Previous trend: During the past five years demand for car parking has

Increased ☐
Remained constant ☐
Decreased ☐

Current trend: At the present time demand for car parking is

Increasing ☐
Constant ☐
Decreasing ☐

Future trends: Over the next three years demand for car parking is likely to

Increase ☐
Remain constant ☐
Decrease ☐

Level of off-street car parking construction. This question investigates how the level of off-street car parking construction has changed in the city in which you currently operate your car park[s]. Please tick the relevant boxes below to indicate how.

Previous trend: During the past five years the level of off-street car parking construction has

Increased ☐
Remained constant ☐
Decreased ☐

Current trend: At the present time the level of off-street car parking construction is

Increasing ☐
Remained constant ☐
Decreasing ☐

Future trends: Over the next three years the level of off-street car parking construction is likely to

Increase ☐
Remain constant ☐
Decrease ☐

SECTION B: GENERAL INFORMATION. Please complete one copy for each car park you operate/manage.

This section concerns general information about the car park you operate/manage.

Local authority name: _____

Car park name: _____

City location: _____

Location of car park. Please tick one box, which best describes where your car park is located.

City/town centre ☐

Peripheral (City/town outskirts) ☐

Semi-peripheral (In-between) ☐

Type of car parking facility. Please tick one box, which best describes the type of parking facility you operate/manage.

On-street parking ☐

Off-street parking ☐

Multi-storey car park ☐

Underground car park ☐

Park & Ride facility ☐

Number of parking spaces. Please enter the number of parking spaces available at this site

_____

Ownership of car park.

Public ☐

Private ☐

Public/private partnership ☐

Type of management

Public ☐

Private ☐

Public/private partnership ☐

Parking charges. Please state the current car parking charges that apply to the car park you operate/manage.

Cost of parking	Standard rate £/p	Residential rate (if applicable) £/p	Contract/business) rate (if applicable) £/p
1 hour			
2 hours			
3 hours			
4 hours			
5 hours			
6 hours			
Daily charge			
Monthly charge			
Other charging options (please state)			

Car park payment options. Please tick all payment options that are available

Cash ☐

Credit card ☐

Voucher ☐

Mobile phone ☐

Web/internet ☐

Other (Please state) _____

Average occupancy rates. Please indicate the average occupancy rates of your car park.

Daily % _____%

Monthly % _____%

Annual % _____%

Number of employees. Please indicate the number of employees employed at your car park.

_____Full time

_____Part time

Costs. Please indicate the costs involved in running your car park

Annual operating costs £_____

Capital costs £_____

Income. Please indicate the annual income generated from your car park. This information will be treated in the strictest confidence.

Annual income £_____

Profit. Please indicate the annual profits generated from your car park. This information will be treated in the strictest confidence.

Annual profit £_____

Technical equipment used for the management of the car park. Please indicate all measures that are currently in place at the car park you operate/manage

Type of technical equipment	**Tick all that apply**
Variable message signs on-street	
Occupancy information via internet	
Parking guidance systems (within car park)	
Multi-use of parking facilities	
Contactless access	
Contactless exit	
Other measures (please state below)	

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Annex 3

Data collected in both the countries.

ID	Country	Priv/Pub	1	2,1	2,2	2,3	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	3.10	3,11	3,12	3,13	3,14	4,1	4,2	4,3	5,1	5,2	5,3
1	United Kingdom	Public	1	1	1	1	4	4	4	3	3	4	4	2	2	4	3	4	2	5	1	1	1	3	3	1
2	United Kingdom	Public	3	2	1	2	4	4	3	4	4	4	5	5	3	3	4	5	3	4	1	1	1	2	2	1
3	United Kingdom	Public	1	2	2	2	4	4	5	3	4	4	5	4	3	5	3	3	3	4	1	1	1	3	2	2
4	United Kingdom	Private	1	2	1	1	5	4	4	5	5	5	4	3	3	5	2	5	2	4	1	2	3	1	2	3
5	United Kingdom	Private	1	2	2	1	5	5	4	5	5	5	3	2	2	4	3	4	2	5	3	3	3	2	2	3
6	United Kingdom	Public	1	2	1	1	4	4	4	5	3	5	4	5	1	5	2	3	2	4	2	1	1	2	2	1
7	United Kingdom	Public	1	2	2	2	4	3	5	4	2	3	2	2	1	2	1	4	4	3	3	3	3	3	3	3
8	United Kingdom	Public	1	2	1	1	5	5	5	5	5	5	4	4	4	5	4	4	4	4	1	1	1	1	1	1
9	United Kingdom	Public	1	2	2	1	5	5	4	4	4	4	3	3	3	4	2	4	3	5	2	2	2	2	2	3
10	United Kingdom	Public	1	2	1	2	5	4	4	4	5	5	4	5	1	4	1	4	3	5	1	1	1	2	2	2
11	United Kingdom	Private	3	2	2	2	5	4	4	2	4	4	3	3	3	3	2	2	2	4	1	1	3	1	2	3
12	United Kingdom	Public	1	1	1	1	4	3	4	4	4	4	3	4	3	4	3	4	3	3	2	2	1	2	2	2
13	United Kingdom	Public	5	2	1	2	5	4	5	4	4	4	5	4	2	4	2	3	3	4	1	1	1	1	1	1
14	United Kingdom	Public	1	2	2	1	5	4	5	4	4	4	5	4	2	4	2	3	3	4	1	1	1	3	3	3
15	United Kingdom	Public	1	2	1	1	4	4	2	2	4	4	4	4	2	4	2	1	1	1	1	1	1	1	2	2
16	United Kingdom	Public	2	2	2	2	4	4	5	5	4	5	5	4	2	5	3	4	3	4	3	2	2	2	2	1
17	United Kingdom	Public	5	2	2	1	4	4	5	4	4	4	5	4	3	5	3	3	3	4	1	1	1	1	1	1
18	United Kingdom	Public	1	2	1	1	4	4	3	5	4	4	4	3	2	5	3	4	3	5	1	1	1	2	2	2
19	United Kingdom	Public	2	2	1	1	5	4	5	4	2	4	4	3	3	5	3	3	3	4	1	1	1	2	2	1
20	United Kingdom	Public	1	2	2	1	5	5	3	4	4	5	5	4	2	4	3	3	2	4	1	2	1	2	2	3
21	United Kingdom	Public	1	2	1	1	5	4	5	4	4	5	5	5	2	5	4	4	4	5	1	1	1	1	1	1
22	United Kingdom	Public	1	2	2	2	4	2	4	4	4	4	5	4	2	4	4	2	2	2	1	2	1	2	2	2
23	United Kingdom	Public	1	1	2	2	4	4	5	2	2	4	2	2	2	4	2	4	4	4	1	2	1	1	2	2
24	United Kingdom	Public	1	2	2	1	4	4	5	4	3	4	4	4	3	5	4	4	3	4	1	1	1	2	2	1
25	United Kingdom	Public	1	1	1	1	5	3	5	4	5	5	4	4	3	5	4	3	2	3	1	1	1	2	2	1
26	United Kingdom	Public	2	2	1	1	4	4	3	5	5	5	4	3	3	4	3	3	2	4	1	1	2	2	3	2
27	United Kingdom	Public	2	2	2	1	4	2	4	4	4	4	4	4	2	4	2	4	2	4	2	2	2	2	2	2
28	United Kingdom	Public	1	2	2	1	4	4	5	3	4	4	4	3	2	4	3	2	2	4	1	1	1	3	2	2
29	United Kingdom	Public	1	1	2	2	5	4	5	4	5	5	5	3	2	5	3	4	3	3	3	3	1	3	3	1
30	United Kingdom	Public	2	2	2	2	4	4	5	3	3	4	5	4	2	4	2	2	2	3	1	1	1	2	2	1
1	*Italy*	Public	3	2	1	2	4	5	4	4	5	4	3	2	3	2	2	3	2	5	1	2	2	1	1	1
2	*Italy*	Private	1	2	2	1	4	4	5	4	4	5	5	5	2	5	3	5	2	5	1	1	1	1	2	1
3	*Italy*	Private	1	1	1	2	4	4	4	4	4	4	4	4	4	4	4	4	3	4	1	1	1	1	1	1
4	*Italy*	Private	2	1	2	2	5	4	5	4	2	4	4	3	3	5	3	3	3	4	1	1	1	2	2	1
5	*Italy*	Private	1	2	2	1	4	4	3	4	4	4	5	5	3	3	4	5	3	4	1	1	1	2	2	1
6	*Italy*	Public	5	2	1	2	5	4	4	3	4	4	4	4	4	4	4	4	5	4	1	1	2	1	2	1
7	*Italy*	Public	1	2	1	2	5	5	4	5	4	4	4	4	2	3	2	4	2	4	1	1	1	1	1	1
8	*Italy*	Public	1	2	1	2	5	5	5	4	3	4	4	4	3	4	3	4	3	4	1	2	2	1	1	2
9	*Italy*	Public	5	2	2	1	5	4	5	4	4	4	5	4	4	4	4	3	4	5	1	1	2	1	3	3
10	*Italy*	Private	1	2	1	2	4	4	4	4	4	4	4	5	4	5	4	5	1	5	3	2	1	3	2	1
11	*Italy*	Private	1	1	1	1	4	5	3	4	4	4	5	5	4	5	4	4	2	4	1	1	1	1	1	1
12	*Italy*	Private	1	2	1	2	5	5	4	4	2	4	4	4	2	2	1	4	1	4	1	1	1	2	1	1
13	*Italy*	Private	2	1	2	1	2	4	4	4	4	4	4	4	3	4	4	4	3	4	1	2	3	1	2	2
14	*Italy*	Public	5	1	2	1	4	4	5	4	4	2	4	4	4	4	4	4	4	4	1	2	2	1	3	1
15	*Italy*	Private	1	1	2	1	4	4	5	4	4	4	4	4	4	5	5	4	1	4	1	2	1	1	2	1

Question 1 and 2:

Count of 1	Priv/Pub														
Country	Public	Private	Grand Total	0	public										
Italy	6	9	15												
United Kingdom	27	3	30												
Grand Total	33	12	45												

Count of 1		1						Count of 1		1				
Country	Priv/Pub	1	2	3	5	Grand Total		Country	Priv/Pub	1	2	3	5	Grand Total
Italy	Public	2		1	3	6		United Kingdom	Public	19	5	1	2	27
	Private	7	2			9			Private	2		1		3
Italy Total		9	2	1	3	15		United Kingdom Total		21	5	2	2	30
Grand Total		9	2	1	3	15		Grand Total		21	5	2	2	30

Count of 1		1											
Country	Priv/Pub	1	2	3	5	Totale complessivo		Priv/Pub	1	2	3	5	Grand Total
Italy	Public	2		3	15	20		Public	21	5	2	5	33
	Private	7	4			11		Private	9	2	1	0	12
Italy Totale		9	4	3	15	31		Grand Total	30	7	3	5	45
United Kingdom	Public	19	10	3	10	42							
	Private	2		3		5							
United Kingdom Totale		21	10	6	10	47							
Totale complessivo		30	14	9	25	78							

Count of 2.1		2.1											
Country	Priv/Pub	1	2	Grand Total									
Italy	Public	1	5	6									
	Private	5	4	9									
Italy Total		6	9	15									
United Kingdom	Public	5	22	27									
	Private		3	3									
United Kingdom Total		5	25	30									
Grand Total		11	34	45									

Count of 2.2		2.2											
Country	Priv/Pub	1	2	Grand Total									
Italy	Public	4	2	6									
	Private	4	5	9									
Italy Total		8	7	15									
United Kingdom	Public	11	16	27									
	Private	1	2	3									
United Kingdom Total		12	18	30									
Grand Total		20	25	45									

Count of 2.3		2.3											
Country	Priv/Pub	1	2	Grand Total									
Italy	Public	2	4	6									
	Private	5	4	9									
Italy Total		7	8	15									
United Kingdom	Public	16	11	27									
	Private	2	1	3									
United Kingdom Total		18	12	30									
Grand Total		25	20	45									

Question 3:

Count of 3.1		3.1			
Country	Priv/Pub	2	4	5	Grand Total
Italy	Public		2	4	6
	Private	1	6	2	9
Italy Total		1	8	6	15
United Kingdom	Public		17	10	27
	Private			3	3
United Kingdom Total			17	13	30
Grand Total		1	25	19	45

Count of 3.1	3.1			
Priv/Pub	2	4	5	Grand Total
Public		19	14	33
Private	1	6	5	12
Grand Total	1	25	19	45

Count of 3.1	3.1			
Country	2	4	5	Grand Total
Italy	1	8	6	15
United Kingdom		17	13	30
Grand Total	1	25	19	45

Priv/Pub	2	4	5	Grand Total
Public	0	76	70	146
Private	2	24	25	51
Grand Total	2	100	95	197

country	2	4	5	Grand Total
Italy	2	32	30	64
United Kingdom	0	68	65	133
Grand Total	2	100	95	197

Count of 3.2		3.2				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public			3	3	6
	Private			7	2	9
Italy Total				10	5	15
United Kingdom	Public	2	3	19	3	27
	Private			2	1	3
United Kingdom Total		2	3	21	4	30
Grand Total		2	3	31	9	45

Count of 3.2	3.2				
Priv/Pub	2	3	4	5	Grand Total
Public	2	3	22	6	33
Private			9	3	12
Grand Total	2	3	31	9	45

Count of 3.2	3.2				
Country	2	3	4	5	Grand Total
Italy			10	5	15
United Kingdom	2	3	21	4	30
Grand Total	2	3	31	9	45

Priv/Pub	2	3	4	5	Grand Total
Public	4	9	88	30	131
Private	0	0	36	15	51
Grand Total	4	9	124	45	182

country	2	3	4	5	Grand Total
Italy	0	0	40	25	65
United Kingdom	4	9	84	20	117
Grand Total	4	9	124	45	182

Count of 3.3		3.3				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public			3	3	6
	Private		2	4	3	9
Italy Total			2	7	6	15
United Kingdom	Public	1	4	7	15	27
	Private			3		3
United Kingdom Total		1	4	10	15	30
Grand Total		1	6	17	21	45

Count of 3.3	3.3				
Priv/Pub	2	3	4	5	Grand Total
Public	1	4	10	18	33
Private		2	7	3	12
Grand Total	1	6	17	21	45

Count of 3.3	3.3				
Country	2	3	4	5	Grand Total
Italy		2	7	6	15
United Kingdom	1	4	10	15	30
Grand Total	1	6	17	21	45

Priv/Pub	2	3	4	5	Grand Total
Public	2	12	40	90	144
Private	0	6	28	15	49
Grand Total	2	18	68	105	193

country	2	3	4	5	Grand Total
Italy	0	6	28	30	64
United Kingdom	2	12	40	75	129
Grand Total	2	18	68	105	193

Count of 3.4		3.4				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public			5	1	6
	Private			9		9
Italy Total				14	1	15
United Kingdom	Public	2	4	16	5	27
	Private	1			2	3
United Kingdom Total		3	4	16	7	30
Grand Total		3	4	30	8	45

Count of 3.4	3.4				
Priv/Pub	2	3	4	5	Grand Total
Public	2	4	21	6	33
Private	1		9	2	12
Grand Total	3	4	30	8	45

Count of 3.4	3.4				
Country	2	3	4	5	Grand Total
Italy			14	1	15
United Kingdom	3	4	16	7	30
Grand Total	3	4	30	8	45

Priv/Pub	2	3	4	5	Grand Total
Public	4	12	84	30	130
Private	2	0	36	10	48
Grand Total	6	12	120	40	178

country	2	3	4	5	Grand Total
Italy	0	0	56	5	61
United Kingdom	6	12	64	35	117
Grand Total	6	12	120	40	178

Count of 3.5		3.5				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public		2	3	1	6
	Private	2		7		9
Italy Total		2	2	10	1	15
United Kingdom	Public	3	4	15	5	27
	Private			1	2	3
United Kingdom Total		3	4	16	7	30
Grand Total		5	6	26	8	45

Count of 3.5	3.5				
Priv/Pub	2	3	4	5	Grand Total
Public	3	6	18	6	33
Private	2		8	2	12
Grand Total	5	6	26	8	45

Priv/Pub	2	3	4	5	Grand Total
Public	6	18	72	30	126
Private	4	0	32	10	46
Grand Total	10	18	104	40	172

Count of 3.5	3.5				
Country	2	3	4	5	Grand Total
Italy	2	2	10	1	15
United Kingdom	3	4	16	7	30
Grand Total	5	6	26	8	45

country	2	3	4	5	Grand Total
Italy	4	6	40	5	55
United Kingdom	6	12	64	35	117
Grand Total	10	18	104	40	172

Count of 3.6		3.6				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public	1		5		6
	Private			8	1	9
Italy Total		1		13	1	15
United Kingdom	Public		1	17	9	27
	Private			1	2	3
United Kingdom Total			1	18	11	30
Grand Total		1	1	31	12	45

Count of 3.6	3.6				
Priv/Pub	2	3	4	5	Grand Total
Public	1	1	22	9	33
Private			9	3	12
Grand Total	1	1	31	12	45

Priv/Pub	2	3	4	5	Grand Total
Public	2	3	88	45	138
Private	0	0	36	15	51
Grand Total	2	3	124	60	189

Count of 3.6	3.6				
Country	2	3	4	5	Grand Total
Italy	1		13	1	15
United Kingdom		1	18	11	30
Grand Total	1	1	31	12	45

country	2	3	4	5	Grand Total
Italy	2	0	52	5	59
United Kingdom	0	3	72	55	130
Grand Total	2	3	124	60	189

Count of 3.7		3.7				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public		1	4	1	6
	Private			6	3	9
Italy Total			1	10	4	15
United Kingdom	Public	2	2	12	11	27
	Private		2	1		3
United Kingdom Total		2	4	13	11	30
Grand Total		2	5	23	15	45

Count of 3.7	3.7				
Priv/Pub	2	3	4	5	Grand Total
Public	2	3	16	12	33
Private		2	7	3	12
Grand Total	2	5	23	15	45

Priv/Pub	2	3	4	5	Grand Total
Public	4	9	64	60	137
Private	0	6	28	15	49
Grand Total	4	15	92	75	186

Count of 3.7	3.7				
Country	2	3	4	5	Grand Total
Italy		1	10	4	15
United Kingdom	2	4	13	11	30
Grand Total	2	5	23	15	45

country	2	3	4	5	Grand Total
Italy	0	3	40	20	63
United Kingdom	4	12	52	55	123
Grand Total	4	15	92	75	186

Count of 3.8		3.8				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public	1		5		6
	Private		1	4	4	9
Italy Total		1	1	9	4	15
United Kingdom	Public	3	6	14	4	27
	Private	1	2			3
United Kingdom Total		4	8	14	4	30
Grand Total		5	9	23	8	45

Count of 3.8	3.8				
Priv/Pub	2	3	4	5	Grand Total
Public	4	6	19	4	33
Private	1	3	4	4	12
Grand Total	5	9	23	8	45

Priv/Pub	2	3	4	5	Grand Total
Public	8	18	76	20	122
Private	2	9	16	20	47
Grand Total	10	27	92	40	169

Count of 3.8	3.8				
Country	2	3	4	5	Grand Total
Italy	1	1	9	4	15
United Kingdom	4	8	14	4	30
Grand Total	5	9	23	8	45

country	2	3	4	5	Grand Total
Italy	2	3	36	20	61
United Kingdom	8	24	56	20	108
Grand Total	10	27	92	40	169

Count of 3.9		3.9				
Country	Priv/Pub	1	2	3	4	Grand Total
Italy	Public		1	2	3	6
	Private		2	3	4	9
Italy Total			3	5	7	15
United Kingdom	Public	3	14	9	1	27
	Private		1	2		3
United Kingdom Total		3	15	11	1	30
Grand Total		3	18	16	8	45

Count of 3.9	3.9				
Priv/Pub	1	2	3	4	Grand Total
Public	3	15	11	4	33
Private		3	5	4	12
Grand Total	3	18	16	8	45

Priv/Pub	1	2	3	4	Grand Total
Public	3	30	33	16	82
Private	0	6	15	16	37
Grand Total	3	36	48	32	119

Count of 3.9	3.9				
Country	1	2	3	4	Grand Total
Italy		3	5	7	15
United Kingdom	3	15	11	1	30
Grand Total	3	18	16	8	45

country	1	2	3	4	Grand Total
Italy	0	6	15	28	49
United Kingdom	3	30	33	4	70
Grand Total	3	36	48	32	119

Count of 3.10a		3.10a				
Country	Priv/Pub	2	3	4	5	Grand Total
Italy	Public	1	1	4		6
	Private	1	1	2	5	9
Italy Total		2	2	6	5	15
United Kingdom	Public	1	1	14	11	27
	Private		1	1	1	3
United Kingdom Total		1	2	15	12	30
Grand Total		3	4	21	17	45

Count of 3.10a	3.10a				
Priv/Pub	2	3	4	5	Grand Total
Public	2	2	18	11	33
Private	1	2	3	6	12
Grand Total	3	4	21	17	45

Priv/Pub	2	3	4	5	Grand Total
Public	4	6	72	55	137
Private	2	6	12	30	50
Grand Total	6	12	84	85	187

Count of 3.10a	3.3				
Country	2	3	4	5	Grand Total
Italy		2	7	6	15
United Kingdom	1	4	10	15	30
Grand Total	1	6	17	21	45

country	2	3	4	5	Grand Total
Italy	0	6	28	30	64
United Kingdom	2	12	40	75	129
Grand Total	2	18	68	105	193

Count of 3.11		3.11					
Country	Priv/Pub	1	2	3	4	5	Grand Total
Italy	Public		2	1	3		6
	Private	1		2	5	1	9
Italy Total		1	2	3	8	1	15
United Kingdom	Public	2	8	11	6		27
	Private		2	1			3
United Kingdom Total		2	10	12	6		30
Grand Total		3	12	15	14	1	45

Count of 3.11	3.11					
Priv/Pub	1	2	3	4	5	Grand Total
Public	2	10	12	9		33
Private	1	2	3	5	1	12
Grand Total	3	12	15	14	1	45

Priv/Pub	1	2	3	4	5	Grand Total
Public	2	20	36	36	0	94
Private	1	4	9	20	5	39
Grand Total	3	24	45	56	5	133

Count of 3.11	3.11					
Country	1	2	3	4	5	Grand Total
Italy	1	2	3	8	1	15
United Kingdom	2	10	12	6		30
Grand Total	3	12	15	14	1	45

country	1	2	3	4	5	Grand Total
Italy	1	4	9	32	5	51
United Kingdom	2	20	36	24	0	82
Grand Total	3	24	45	56	5	133

Count of 3.12		3.12					
Country	Priv/Pub	1	2	3	4	5	Grand Total
Italy	Public			2	4		6
	Private			1	5	3	9
Italy Total				3	9	3	15
United Kingdom	Public	1	3	9	13	1	27
	Private		1		1	1	3
United Kingdom Total		1	4	9	14	2	30
Grand Total		1	4	12	23	5	45

Count of 3.12	3.12					
Priv/Pub	1	2	3	4	5	Grand Total
Public	1	3	11	17	1	33
Private		1	1	6	4	12
Grand Total	1	4	12	23	5	45

Priv/Pub	1	2	3	4	5	Grand Total
Public	1	6	33	68	5	113
Private	0	2	3	24	20	49
Grand Total	1	8	36	92	25	162

Count of 3.12	3.12					
Country	1	2	3	4	5	Grand Total
Italy			3	9	3	15
United Kingdom	1	4	9	14	2	30
Grand Total	1	4	12	23	5	45

country	1	2	3	4	5	Grand Total
Italy	0	0	9	36	15	60
United Kingdom	1	8	27	56	10	102
Grand Total	1	8	36	92	25	162

Count of 3.13		3.13					
Country	Priv/Pub	1	2	3	4	5	Grand Total
Italy	Public		2	1	2	1	6
	Private	3	2	4			9
Italy Total		3	4	5	2	1	15
United Kingdom	Public	1	9	13	4		27
	Private		3				3
United Kingdom Total		1	12	13	4		30
Grand Total		4	16	18	6	1	45

Count of 3.13	3.13						
Priv/Pub	1	2	3	4	5	Grand Total	
Public	1	11	14	6	1	33	
Private	3	5	4			12	
Grand Total	4	16	18	6	1	45	

Count of 3.13	3.13					
Country	1	2	3	4	5	Grand Total
Italy	3	4	5	2	1	15
United Kingdom	1	12	13	4		30
Grand Total	4	16	18	6	1	45

Priv/Pub	1	2	3	4	5	Grand Total
Public	1	22	42	24	5	94
Private	3	10	12	0	0	25
Grand Total	4	32	54	24	5	119

country	1	2	3	4	5	Grand Total
Italy	3	8	15	8	5	39
United Kingdom	1	24	39	16	0	80
Grand Total	4	32	54	24	5	119

Count of 3.14		3.14					
Country	Priv/Pub	1	2	3	4	5	Grand Total
Italy	Public				4	2	6
	Private				7	2	9
Italy Total					11	4	15
United Kingdom	Public	1	1	5	15	5	27
	Private				2	1	3
United Kingdom Total		1	1	5	17	6	30
Grand Total		1	1	5	28	10	45

Count of 3.14	3.14						
Priv/Pub	1	2	3	4	5	Grand Total	
Public	1	1	5	19	7	33	
Private				9	3	12	
Grand Total	1	1	5	28	10	45	

Count of 3.14	3.14					
Country	1	2	3	4	5	Grand Total
Italy				11	4	15
United Kingdom	1	1	5	17	6	30
Grand Total	1	1	5	28	10	45

Priv/Pub	1	2	3	4	5	Grand Total
Public	1	2	15	76	35	129
Private	0	0	0	36	15	51
Grand Total	1	2	15	112	50	180

country	1	2	3	4	5	Grand Total
Italy	0	0	0	44	20	64
United Kingdom	1	2	15	68	30	116
Grand Total	1	2	15	112	50	180

Question 4:

Count of 4.1		4.1			
Country	Priv/Pub	1	2	3	Grand Total
Italy	Public	6			6
	Private	8		1	9
Italy Total		14		1	15
United Kingdom	Public	20	4	3	27
	Private	2		1	3
United Kingdom Total		22	4	4	30
Grand Total		36	4	5	45
Cont of 4.2		4.2			
Country	Priv/Pub	1	2	3	Grand Total
Italy	Public	3	3		6
	Private	6	3		9
Italy Total		9	6		15
United Kingdom	Public	18	7	2	27
	Private	1	1	1	3
United Kingdom Total		19	8	3	30
Grand Total		28	14	3	45
Cont of 4.3		4.3			
Country	Priv/Pub	1	2	3	Grand Total
Italy	Public	1	5		6
	Private	8		1	9
Italy Total		9	5	1	15
United Kingdom	Public	22	4	1	27
	Private			3	3
United Kingdom Total		22	4	4	30
Grand Total		31	9	5	45

Question 4:

Cont of 5.1		5.1			
Country	Priv/Pub	1	2	3	Grand Total
Italy	Public	6			6
	Private	5	3	1	9
Italy Total		11	3	1	15
United Kingdom	Public	6	15	6	27
	Private	2	1		3
United Kingdom Total		8	16	6	30
Grand Total		19	19	7	45
Cont of 5.2		5.2			
Country	Priv/Pub	1	2	3	Grand Total
Italy	Public	3	1	2	6
	Private	3	6		9
Italy Total		6	7	2	15
United Kingdom	Public	4	18	5	27
	Private		3		3
United Kingdom Total		4	21	5	30
Grand Total		10	28	7	45
Cont of 5.3		5.3			
Country	Priv/Pub	1	2	3	Grand Total
Italy	Public	4	1	1	6
	Private	8	1		9
Italy Total		12	2	1	15
United Kingdom	Public	13	10	4	27
	Private			3	3
United Kingdom Total		13	10	7	30
Grand Total		25	12	8	45

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