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TAXI MARKETS LITERATURE REVIEW

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1. Introduction

OXERA has been commissioned by the Office of Fair Trading (OFT) to undertake two separate but related projects examining the impact of regulation on the UK taxi markets: a study modelling the effects of taxi regulation, and a consumer survey.

The aims of these two projects can be summarised as follows:

- modelling the effects of taxi regulation—to interrogate data available at both the individual and the local authority levels in order to evaluate the impact that regulation of taxi markets has on the factors that influence consumer welfare;

- consumer survey—to investigate and quantify consumers' valuation of the factors that influence consumer welfare.

To inform both projects, OXERA undertook a literature review, the results of which are presented in this paper. As such, this accompanies the two other OXERA papers: 'Modelling the Effects of Taxi Regulation' and 'Consumer Survey Report'.

This literature review covers issues relating to competition, market failure and welfare in relation to taxi markets, with a particular focus on identifying research into the factors that affect consumer welfare. It concludes with a summary of the relationships that can be expected between regulatory measures affecting entry into taxi markets, quality of the taxi services, prices, and waiting times.

2. The Taxi Markets—The Theoretical Framework

2.1 An overview of the taxi markets

This section presents a general overview of the key features of the taxi markets, illustrating the segments of the market, the regulatory characteristics, market failures and the economic justification for regulatory intervention.

2.1.1 Segments of the UK markets

The markets for taxi services can be segmented on the basis of how customers search for the service. Customers can hire a hackney carriage from a rank (the rank segment), hail a hackney carriage in the street (the street-hailed segment), or book a private-hire vehicle (PHV) by phone (the phone-booking segment). Although these three segments of the market are functionally different, there is likely to be some overlap between them.

Regulations in the UK distinguish between two types of taxi: hackney carriages and PHVs. Hackney carriages can ply the streets for business in the rank or hail (or cruising) segments of the market, and in some locations they can also be booked over the phone. Hackney carriages may choose to serve only the rank and hail segments. PHVs can only be booked by phone, or at the offices of the PHV companies. For the purposes of this report, when the term 'taxi' is used, this refers to both hackney carriages and PHVs.

2.1.2 The regulatory environment in the UK

Hackney carriages operated as early as the sixteenth century; their licensing began in London in 1635 and culminated in the London Hackney Carriage Act 1831. With the Town Police Clauses Act of 1847, various powers were granted to local Commissioners (and later the relevant local authorities, or 'LAs'). The 1847 Act established the essentials of the current hackney carriage licensing system, such as the establishment of ranks, fare regulation, driver standards, and the physical/mechanical characteristics of hackney carriages. It also granted local authorities discretion to restrict the number of hackney carriages. PHVs were officially recognised by the Local Government (Miscellaneous Provisions) Act of 1976.

The rest of this section presents a general overview of the various forms of regulation in place in the UK.[1]

2.1.3 Entry regulation

Entry regulation is the policy of restricting the number of hackney carriage licences issued by the licensing authorities, which in most cases is the LA. Under the Transport Act 1985, LAs may refuse an application for a licence for the purpose of limiting the number of hackney carriages, if the licensor is satisfied that there is no significant 'unmet demand' for the services of hackney carriages in that area.[2]

Entry regulation represents a barrier to entry into the rank and hailing segments of the market, and can therefore be expected to confer a degree of market power on those

[1] For an overview of the regulatory environment in the UK, see, for example, Choong-Ho Kang (1998), 'Taxi Deregulation—International Comparison', Institute for Transport Studies, University of Leeds.

[2] Significant unmet demand would be characterised by the presence of passenger delays at off-peak times and evidence of a suppression in demand due to inadequate supply (see, for example, Halcrow (2002), 'Final Report to Bournemouth Borough Council', April).

authorised to operate hackney carriages, which, in the absence of price regulation, would enable them to charge higher prices than in a competitive situation.

Where they exist, entry restrictions are generally justified on the basis that hackney carriage services impose two negative externalities:[3] traffic congestion and air pollution. In a perfectly competitive environment, the price of a ride would cover only the private cost of the service, while the social cost per ride, which includes the externalities, will necessarily exceed the price. Hence, removing entry restrictions, by removing the absolute barriers created by requiring a licence to operate, might lead to oversupply of hackney carriage services, which would have a negative impact on congestion and air pollution. This oversupply could lead to excessive demand for space at ranks and to congestion in town centres.

A further argument that has been used to justify entry regulation is based on the cost structure of the taxi industry, in particular the observation that the majority of costs incurred by hackney carriage providers are fixed and do not vary in relation to the hackney carriage's occupancy rate. An increase in the number of hackney carriages operating will, for a given level of demand, lower the proportion of time that the hackney carriages are occupied (termed 'occupancy rates'). Therefore, in order to cover costs, operators will have to charge higher prices to customers to compensate for the reduced occupancy rate. Restrictions on entry have therefore been justified on the basis that they reduce pressures to raise prices. Section 2.3.1 describes empirical findings from the USA which support this hypothesis.

The Transport Act 1985 allowed for the partial deregulation of entry into the hackney carriage markets in the UK. However, the changes in the Act have not resulted in all LAs removing the restrictions on entry. Indeed, Toner found that, in 1991, only 28% of LAs completely removed entry barriers as a result of the Act.[4] In 2002, the number of hackney carriage licences was restricted in 45% of local authorities in England and Wales outside London. In London there are no entry restrictions on hackney carriages, as hackney carriage driver licences are issued to all applicants who pass the knowledge examination. However, the strictness of the knowledge examination represents a high barrier to entry in the London market.

There are no restrictions on the number of PHV licences. According to the Local Government (Miscellaneous Provisions) Act 1976, operators are required to be licensed by the relevant district council, whether the firm concerned is a single owner–driver or a large operator.

2.1.4 Fare regulation

If price competition is constrained by entry restriction, the setting of maximum fares might be justified to prevent the undue fare increase that could arise from the exploitation of market power. Even in absence of entry restriction, some forms of fare regulation might be warranted if competition on price is not effective in some segments of the market. This could indeed lead to hackney carriage operators competing on quality of service and thus to non-optimal quality of service–price combinations, with customers willing to trade off a decrease in quality of service against lower prices. On the other

[3] A negative externality occurs when the costs to society as a whole ('social costs') are greater than the costs to the individual undertaking the action ('private costs').

[4] Toner, J.P. (1996), 'English Experience of Deregulation of the Taxi Industry', *Transport Reviews*, **16**:1.

hand, fare regulation is subject to the same concerns as price fixing, as regulated fares might not appropriately reflect customers' willingness to pay or the cost of providing the service.

Fare regulation generally takes the form of a prescribed maximum fare. A cap is generally specified for each of the elements of the regulated fare: the fixed charge, the mileage charge and the charge per minute when the hackney carriage is standing still. Different caps are also set for services at peak and off-peak times, often presented in terms of day/night fares. When entry is regulated, fare control generally results in the maximum prescribed fare being adopted as the standard fare by all hackney carriage operators. However, if entry restrictions were lifted, fare regulation would be likely to result in a variety of outcomes other than the standard fare.

The Transport Act 1985 did not address specifically the issue of fare regulation, although it enabled licensed hackney carriages to charge separate fares under certain conditions, such as where the local authority operates a taxi-sharing scheme.[5] In practice, where the Act has triggered deregulatory moves, these have mainly resulted in the lifting of entry restriction, with fare control still in place in almost all the LAs. For example, in London, the government reviews fare increases annually, using a formula based on a range of taxi-specific costs and an index of earnings.

Full-blown deregulation of both the level of fares and entry for hackney carriages has taken place only in the most rural districts, while no LA controls entry without controlling fares.

PHV services are not subject to fare regulation, as the Local Government (Miscellaneous Provisions) Act 1976 did not grant LAs the power to set fares for these services.

Under the Local Government (Miscellaneous Provisions) Act 1976, LAs have discretionary powers to control hackney carriage fares. These powers enable LAs to set schedules of maximum fares which must not be exceeded other than in certain situations. For example, a hackney carriage driver may charge a fare higher than the authorised metered charge if the journey will finish outside of the area where the hackney carriage is licensed to collect passengers, and if a prior contract is made between the driver and the passenger at the time of hiring. Some LAs (eg, Sevenoaks) have the policy that the fares schedules are maximum rates and the drivers are free to charge below this if they wish. Others authorities (eg, in London) have the policy that the fare schedules provide the rates to be charged and that the drivers should not deviate from these rates.

2.1.5 Quality-of-service regulation

Quality-of-service regulation is generally justified on the grounds that it reduces customers' information costs, as it is difficult for passengers to judge the standard of quality of a taxi service before they accept the ride. Minimum quality of service standards are set in relation to consumer safety (eg, roadworthiness test, maximum vehicle ages, and driver training requirement), driver safety (ie, the provisions of protective screens and in-cab cameras) and service quality (ie, tests of drivers' geographical knowledge). Although these prescribed standards are higher for hackney carriages than for PHVs, PHV operators, drivers and vehicles are also required to meet certain minimum standards.

[5] Taxi-sharing schemes allow hackney carriages to transport customers who are not travelling as part of the same group.

An example of quality-of-service regulation related to drivers' fitness-to-drive is the knowledge test of the area that they are required to pass to obtain a hackney carriage licence in some LAs, although the test appears to be much stricter in London than elsewhere. Moreover, in London there are two categories of licence: Green and Yellow Badge Drivers—the former are licensed to drive across all of London, the latter are restricted to suburban areas. This form of quality-of-service regulation may effectively substitute for entry regulations, as appears to be the case in London.

Regulation is also imposed on vehicle quality in relation to both the type of vehicle permitted, and its roadworthiness, cleanliness, availability of luggage storage, etc. The most visible regulations affect the type of vehicle that can be used as a hackney carriage, in particular for London-style Black cabs. Since 1989 all new hackney carriages put forward for licensing in London are required to be wheelchair-accessible. The same gradual introduction of wheelchair accessibility has taken place in other major towns and cities in the UK that have traditionally used Black cabs. Where the specific type of vehicle to be used is not specified by the LA, restrictions can be imposed on the minimum and maximum number of passengers that can be carried by a vehicle registered as a hackney carriage.

In terms of the regulation of quality of service, LAs can impose a variety of measures covering, for example, maximum age of the vehicle and the frequency with which they are tested. The regulation on quality of vehicles broadly applies also to PHVs.

2.1.6 Characteristics of demand for taxi services

Consumer usage of taxis has increased considerably over the past 20 years.[6] By the late 1990s average taxi usage was 12 trips per person per year—nearly twice as high as in the mid-1980s. The incidence of taxi usage also varies geographically: consumers in metropolitan areas use taxis the most, while rural areas have the lowest level of taxi trips.

Women (across all age groups) take taxis more than men, and for men and women the usage is skewed towards younger adults (in the 16–29 age group). As would be expected, those consumers without a car make greatest use of taxis, and, possibly as a result of this, low-income groups have the highest number of taxi trips per household, although these tend to be shorter trips than for consumers in the highest income group. Although, for both men and women, taxis are used mainly for social purposes (with around 20% of trips being for business purposes), there are variations in the type of social journey.

Finally, there is considerable variation in the level of taxi usage by time of day, and day of the week. In particular, there is a significant increase in the number of taxi trips taken between 10pm and midnight compared with the rest of the day. Usage then tails off to an average of virtually no trips per hour around 4am. The average number of trips is relatively stable from 8am to 4pm before dropping again, although it picks up around 7pm.

The nature of demand for taxi services is also highly dependent on economic characteristics. The main factors affecting demand for taxi services are as follows.

[6] The data for the following three paragraphs comes from DETR (2001), 'Transport Statistics: Taxi and PHV Use in GB', March.

- *Fare level*—hackney carriage fares tend to have a fixed fee and a mileage charge. In general, both of these charges are higher for peak demand of hackney carriage services. Modern meters are also adjusted to compensate partly for speed, so that, below a certain limit, slower trips have a somewhat higher price per trip. A fare per minute is usually charged when the hackney carriage's speed falls below a specified threshold.

- *Expected passenger waiting time*—this affects passengers' decision as to whether or not to take a taxi, and thus plays a crucial role in the determination of the demand for taxi services. Expected waiting time is jointly determined by the interaction of demand and supply. This is discussed in section 2.2 below.

- *Time*—in each market segment, demand for taxis is highly variable, depending on the time of the day, the day of the week and the time of the year—demand tends to increase over holidays periods.

- *Climatic factors*—these might also influence demand, which would be expected to be higher on rainy and cold days.

- *Relative availability and the price of alternative transport services*—the availability and price of alternative transport, in particular car, bus, light and heavy rail, or even walking, might have an impact on the demand for taxi services.

- *Economic activity*—demand also depends on the level of economic activity, in particular business, leisure and tourist activities.

There are also imperfections in the market that affect demand. The main feature of the demand for taxi services is that customers face search costs, because of waiting time and imperfect information on price. These are discussed in section 2.2 below.

2.1.7 Characteristics of the supply of taxi services

The supply of taxi services depends on the private costs of providing the service, which include direct operating costs (fuel, lubricants, tyres and variable maintenance) and fixed costs (vehicle capital cost, fixed maintenance, driver salary, licence, taxes and the cost of complying with quality-of-service standards). The costs of providing a taxi service therefore present the following principal features.

- *Negligible marginal costs*—in the taxi industry, the marginal cost of carrying a passenger is negligible, in particular for cruising hackney carriages which are permanently running (with or without passengers). On this basis, for a given length of the operating period, all the direct costs mentioned above should be considered as fixed.

- *Private versus social costs and benefits*—in congested and polluted areas, the private costs of providing the service might be significantly below the social costs, which incorporate the negative externalities relating to congestion and air pollution. However, greater taxi usage can generate social benefits if it leads to reduced use of private cars, thereby reducing congestion and excess demand for limited parking spaces.

The provision of transport services of any type benefits from economies of scale, which can raise the minimum efficient scale of providing network-controlled taxi services (ie, PHV networks). This is because the more drivers there are operating for a single PHV company, the more likely it is that a vacant PHV will be near a point where a customer requires one. While some have argued that this may lead to a concentrated market where price competition is weakened, these arguments have not received widespread support and are not examined further in this report.[7]

2.1.8 Estimating taxi-related elasticities

Price elasticities of demand measure the change in quantity demanded for a given change in price. Where the price elasticity of demand is greater than one, it is less likely that a price rise will be profitable. This is because, as price increases, revenue falls and the less likely it is that operators could raise prices profitably (depending on their profit margin). Knowledge of the elasticity of demand enables an assessment to be made of the ability of operators in the market to raise their prices. Its particular relevance in this research is that it enables consumer welfare to be valued.

The elasticity of demand with respect to the level of fare is likely to depend on several factors, such as the time of the day and the purpose of the trip. The literature that has attempted to estimate taxi-related elasticities has focused primarily on the elasticity of demand with respect to fares. Other relationships have been modelled, including the elasticity of demand with respect to waiting times, the supply response to a change in fares, and, reflecting the relationship between demand and supply, the elasticity of demand responses to changes in the level of supply.[8]

Several studies have based calculations on the assumption, broadly supported by previous research, that the elasticity of demand for taxi services is close to unity—ie, a 5% price increase leads to a 5% fall in demand. However, very few studies have attempted to quantify price elasticities of demand. Toner and Mackie estimate both price and service elasticities (ie, with respect to waiting time, walking time and in-vehicle time) for four cities in the UK.[9] They disregard two of these on the basis of response bias in their survey; their results from the other two cities showed elasticities of demand of –0.8 and –1.0. However, they also concluded that the aggregated results masked two distinct groups of customers: their 'captives' (ie, customers who cannot switch to other forms of transport) exhibited an elasticity of demand of –0.3, while their 'non-captives' had an elasticity of –1.9. The service elasticities estimated showed that demand was much less responsive to changes in waiting time and walking time than to changes in price. Toner and Mackie's welfare calculations are discussed in more detail in section 2.4.

2.1.9 Interaction between demand and supply

Demand and supply are not independently determined, but are inter-related. The mechanism of this relationship is as follows. When demand is a function of fare and expected waiting time and supply is a function of taxi utilisation, trip revenues and costs, an increase in supply can generate an increase in demand through the effect it has on expected waiting times. In particular, given a certain level of demand in one time period,

[7] See, for example, Foerster and Gilbert (1979), 'Taxicab Deregulation: Economic Consequences and Regulatory Choices', *Transportation*, **8**, 371–87.

[8] See, for example, Schaller, B. (1999), 'Elasticities for Taxicab Fares and Service Availability', *Transportation*, **26**:3, 283–97.

[9] Toner, J.P. and Mackie, P.J. (1992), 'The Economics of Taxicab Regulation: A Welfare Assessment', paper presented at the Sixth World Conference on Transport Research, Lyon.

increased supply leads to decreased taxi occupancy rate, which reduces expected waiting times and leads to an increase in demand in subsequent periods.[10]

When demand changes as a result of an increase in price, the net effect will depend on consumers' responsiveness to both price and waiting time. Price rises will initially lead to reduced demand, which, for a given level of supply, will lead to reduced waiting times. This reduced waiting time may in turn spur demand.

This interaction between demand and supply raises theoretical issues in relation to the functioning of the market and the modelling of equilibrium. Several models have been developed which examine the nature of equilibrium in the taxi markets.[11] The direct applicability of most of these theoretical models to an analysis of the UK taxi markets is relatively limited, as they tend to be based on markets where the predominant means of catching a taxi is by hailing in the street. However, in the UK as a whole, hailing represents a minority of demand.

On the other hand, it is important to consider this demand–supply relationship when seeking to generate empirical results in relation to the taxi markets. The impact of the interaction is most readily apparent when examining waiting times. In the UK, waiting times are an important regulatory variable as they can be used to gauge the extent of unmet demand and hence to justify the retention or removal of entry restrictions. However, to look at waiting times alone without reference to the levels of service available in a given area could lead to inappropriate conclusions. This is because waiting times not only depend on the interaction between demand and supply, but are also a factor determining demand. It is therefore possible for the same waiting times to be observed at differing levels of output. For a given waiting time, welfare can be expected to be higher for a higher level of output, provided that level of output is not associated with other costs such as congestion. Policy should therefore not consider waiting times in isolation.

2.2 Market failures in taxi markets

Some of the earlier analysts of taxi markets considered that the level of regulatory intervention apparent in those markets was unjustified. For example, Beesley argued that 'in the absence of intervention, there is little doubt that a taxi industry would approximate the characteristics of perfect competition', also finding no evidence of significant economies of scale and no other significant barriers to entry.[12] However, Beesley recognised that taxi markets cannot be analysed without recognising the distortions that exist in the markets. These distortions arise for a variety of reasons, some economic, others political. The sub-section seeks to explore which of the regulatory restrictions may be economically justified on the basis of market failures. The market failures that have been identified, and which are discussed below, are:

[10] Orr was one of the first commentators to identify that demand is not just a function of prices, but also of waiting time, which depends on capacity as well as on the balance of supply and demand ('equilibrium') for taxi services. Orr, D. (1969), 'The "Taxicab Problem": A Proposed Solution', *Journal of Political Economy*, **77**:1, 141–7.

[11] For example, Rometsch and Wolfstetter use the fact that price does not play its usual role of balancing demand and supply, and develop a model of the taxi markets, characterising the equilibrium as a rational expectations equilibrium in consumers' expected waiting time, and cab operators' expected occupancy rate. Rometsch, S. and Wolfstetter, E. (1993), 'The Taxicab Market: An Elementary Model', *Journal of Institutional and Theoretical Economics*, **149**, 531–46.

[12] Beesley, M.E. (1973), 'Regulation of Taxis', *The Economic Journal*, **83**:329, 150–72, March.

- information failures regarding both price and quality of service;
- negative consumption externalities.

2.2.1 Imperfect information

Consumers may suffer from incomplete information with regard to both price and quality of service in their use of taxi services.

In relation to prices, consumers would be most likely to suffer from imperfect information in the street-hailing segment, were prices to be unregulated. This results from their inability to purchase taxi services at fixed locations, which hampers their ability to make price comparisons.[13] It also results from their inability to know whether the first vacant hackney carriage that passes them would charge a high price or a low price for their journey. Better information on price could be obtained by incurring search costs, either by waiting for the next vacant hackney carriage to pass, which would increase the waiting time involved, or by incurring the hassle factor of negotiating a lower price with the driver. Even if the consumer decides to wait for the next vacant hackney carriage to pass in order to improve the information available, it is not certain that this will lead to a lower price for their journey. The consumer has to factor in the chance that the first price was lower, by which time it would be too late, as that hackney carriage would have moved on.

In the rank segment of the market, information on price might also be difficult to obtain if the 'first-in, first-out' scheme is applied—ie, the first hackney carriage arriving at the rank has the right to pick up the first passenger waiting. Certain institutional arrangements could be established to improve the information available to customers waiting at ranks, for example by making price lists available at the rank. However, at particularly heavily used ranks, such as those at airports, any arrangements which disrupted the flow of vehicles through the rank could create significant congestion costs.

In the phone-booked segment of the market, price information is easier to obtain, as customers are easily able to call a number of companies in order to compare prices.

Imperfect information with regard to quality of service was discussed in section 2.1.5 in relation to the justification for quality-of-service regulation. Market imperfections arise in relation to quality of service because consumers will have imperfect information about quality of service prior to a taxi journey. Each individual taxi journey is an 'experience service', the quality of which can only be judged once the journey has been completed.

2.2.2 Negative externalities

The taxi industry is also characterised by negative demand externalities. These arise from the fact that one consumer's demand for a taxi increases the waiting time of other customers.[14] As waiting times play an important role in consumers' demand, that increase in expected waiting times will reduce the demand of other potential consumers. Expected passenger waiting time is generally considered to be an important value or quality of the services received by passengers. This variable affects passengers' decision as to whether

[13] See Schreiber, C. (1975), 'The Economic Reasons for Price and Entry Regulation of Taxicabs', *Journal of Transport Economics and Policy*, **9**:3, 268–79, September.

[14] Similar negative consumption externalities can be observed in other service sectors, such as hairdressing. However, services, such as haircuts, are less time-specific than a taxi journey, therefore demand for haircuts will be more elastic as consumers can respond to high waiting times by shifting their demand to a later time. In contrast, a taxi journey is likely to be time-specific, and demand much less elastic, giving suppliers pricing power.

to take a taxi, and thus plays a crucial role in the determination of the price level and the resulting equilibrium of the market.[15]

These negative externalities have a similar impact to that outlined above on the relationship between supply and demand. An individual's demand will not only be a function of price, but also of waiting time. Waiting time in turn depends not only on supply but also on expectations of others' demand. The impact of regulation therefore depends on consumers' immediate reactions to changes in price, but also on their expectations of others' demand. The effects of regulation on consumer welfare depend on a combination of these factors.

2.3 Nature of competition in taxi markets

The market failures highlighted above contribute to a market which may not function effectively and which can generate outcomes that may warrant regulation in order to protect consumers.

Where the predominant form of catching a taxi is street hailing, consumers face uncertainty as to how long they might have to wait before vacant hackney carriages pass any particular location. When prices are unregulated, they will face similar uncertainties about price. Their behaviour will depend on their expectations of both price and waiting time. Provided consumers' valuation of expected waiting time exceeds the savings they expect to make by waiting for a vacant, low-price hackney carriage to pass, they will have incentives to hail the first available hackney carriage that passes them.[16] In the presence of high search costs (ie, customers prefer to minimise waiting time and there is imperfect information on price), price competition might be difficult to sustain. A fare reduction might be unprofitable if customers are unwilling to search out offers from multiple drivers before accepting a ride. A unilateral price cut would be unlikely to generate extra demand if customers are unable to identify the location of the hackney carriage offering this lowest fare.

Schreiber's characterisation of the limited incentives for hackney carriage operators to compete on price has been widely criticised.[17] In particular, fleet operators would be able to distinguish themselves from competitors and to advertise the fares they charge, thereby raising their opportunity to obtain repeat business and limiting the incentives not to reduce prices. The applicability of the model has also been criticised on the grounds that it is based on an unrealistic representation of how the hackney carriage markets work. In many hackney carriage markets, a minority of consumers hail taxis, and there are other mechanisms by which price information can be transmitted to consumers, such as posting price lists at ranks.[18]

[15] See, for example, Cairns, R.D. and Liston-Heyes, C. (1996), 'Competition and Regulation in the Taxi Industry', *Journal of Public Economics*, **59**, 1–15; Häckner, J. and Nyberg, S. (1995), 'Deregulating Taxi Services—A Word of Caution', *Journal of Transport Economics and Policy*, May. Yang, H., Lau, Y.W., Wong, S.C. and Lo, H.K. (2000), 'A Macroscopic Taxi Model for Passenger Demand, Taxi Utilization and Level of Services', *Transportation*, **27**, 317–40.

[16] This reasoning is based on Schreiber (1975), op. cit.

[17] See, for example, Coffman, R.B. (1977), 'The Economic Reasons for Price and Entry Regulation of Taxicabs: A Comment', *Journal of Transport Economics and Policy*, **11**, 288–97, September. Williams, D.J. (1980), 'Information and Price Determination in Taxi Markets', *Quarterly Review of Economics and Business*, **20**:4, Winter, 36–43. Soon, J. (1999), 'Taxi!! Reinvigorating Competition in the Taxi Market', *Issue Analysis*, no. 7, The Centre for Independent Studies, May 5th.

[18] Soon (1999), op. cit.

Incentives to compete on price may also be limited by the cost structure of taxi services. When prices are not controlled, they may even be expected to rise in response to an increase in supply.[19] As noted above, as the majority of the costs involved in supplying taxi services are fixed, the marginal costs of carrying an additional passenger are virtually zero. For a given level of demand, the amount of time that a taxi is vacant will be lower the more hackney carriages there are (and vice versa). Therefore, when the occupancy rate falls following an increase in supply, prices would have to rise in order for the operators to cover their costs.

In some theoretical models of the cruising market, there is no equilibrium in either peak or off-peak hours.[20] Equilibrium can only be reached if price is regulated. However, that position of equilibrium is associated with too much entry from the perspective of social welfare. This leads to the conclusion that deregulation of fares and entry is not optimal, that regulation of price improves welfare compared with the deregulated position, but that regulation of both price and entry improves the position further. If the relationships described are valid, and prices neither fulfil the equilibriating function that they would in a well-functioning market, nor respond as expected to an increase in supply, this might provide theoretical support for regulatory measures addressing price, entry or both. However, the conclusions drawn from these models are limited due to their focus on a pure cruising market, which leads to criticisms similar to those made in relation to Schreiber's model described above.

Finally, competition can be expected to be more sustainable in the phone-booking segment of the industry, where prices are more transparent and customers can easily gather and compare information about different PHV operators' prices. Given that the regulatory regime neither limits entry into, nor controls prices in, the PHV segment of the taxi market, this report does not examine the effectiveness of competition in the PHV market in its own right.

2.3.1 Comparisons of outcomes in regulated and deregulated regimes

Some of the empirical work in this area (eg, Teal and Berglund, 1987) compares outcomes in the same markets before and after deregulation; others make comparisons between different cities where the regulatory regimes differ (eg, Coe and Jackson, 1983).[21]

The theoretical arguments that cast doubt on the effectiveness of price competition in taxi markets have to some extent been supported in empirical work examining the effects of deregulation in the USA. Most notably, Teal and Berglund (1987) studied the impact of price and entry deregulation in six US cities that had deregulated before 1985. In each of these markets, telephone bookings accounted for at least 70–80% of the total taxi market. The authors compared the number of taxi firms in operation, taxi fares, and productivity. They also tried to gauge the impact on the level of service in terms of response times and no-show rates (although there was very limited information on the latter). The Teal and Berglund study assimilated information that was available before and after deregulation, in order to provide static comparisons and to draw conclusions about the effects of deregulation.

[19] Teal, R. and Berglund, M. (1987), 'The Impacts of Taxicab Deregulation in the USA', *Journal of Transport Economics and Policy*, 37–56, January.

[20] See, for example, the model developed by Cairns and Liston-Heyes (1994), op. cit.

[21] Coe, G.A. and Jackson, R.L. (1983), 'Some New Evidence Relating to Quantity Control in the Taxi Industry', *Transport and Road Research Laboratory*, Supplementary Report 797.

They concluded that deregulation has not generated the benefits that could have been expected, on the grounds that, due to market imperfections, deregulation is unable by itself to address the oligopolistic nature (ie, the tendency for there to be only a few operators) of the radio dispatch sector (in operation, equivalent to the UK PHV) of the taxi market, which limits its potential benefits.

Coe and Jackson also aimed to identify factors that may result from differences in regulatory regimes. They used information available on several attributes related to outcomes in taxi markets in a number of city-pairs, including vehicles used as hackney carriages, the number of complaints, rank provision, fares, the number of drivers for each hackney carriage, and the ratio of PHVs to hackney carriages. They concluded that quantity control resulted in higher-value vehicles being used and lower rates of licence-ownership turnover. However, neither of these factors was reflected in a reduction in passenger complaints. One significant result was that the degree of quantity control had no significant effect on fare levels; the authors surmised that this could be due to better utilisation of licensed vehicles in areas where regulation was relatively strict, as well as proportionately greater influence from the PHV sector of the market.

The most recent research to address hackney carriage markets in England was published by Toner (1996) in a paper which set out to review the effects of the Transport Act 1985, which still applies in the UK. In terms of the number of vehicles on the roads, Toner found that the greatest growth in hackney carriage numbers between 1986 and 1991 had been in areas that were unregulated throughout that period (+114%), with those that had been deregulated not far behind (+111%). The greatest growth in the number of PHVs had been in those districts where no new hackney carriage plates had been issued.

Some regression analysis was undertaken to establish whether deregulation had affected the regulated hackney carriage fares. Fare data from rate-cards provided by the LAs was used (two people, travelling two miles; two people, four miles; and four people, four miles at night). Toner found some support for his expectation that, other things equal, higher fares would be needed in districts with more hackney carriages per head of population, since drivers need a higher fare per hiring to compensate for lower occupancy rate. However, prices were also found to have risen in regulated areas, hence no strong evidence was found to support the argument that deregulation would lead to significant price increases. Toner therefore concludes that 'the argument in favour of maintaining quantity restrictions to avoid fare rises has little validity.' Looking at non-price factors, Toner finds that, in areas where regulation has continued, licence values have risen significantly, while in deregulated areas, there is evidence of lower standards of quality-of-service enforcement and severe shortages of rank capacity.

2.4 Previous estimates of the welfare impact of taxi regulation

There are relatively few examples of either empirical or theoretical work that has sought to examine consumer welfare in relation to taxi services. Toner and Mackie (1992) used a model first presented by Douglas[22] to model the welfare impact of price and quantity regulation. In the theoretical model, consumer welfare is modelled as a function of price and waiting times. In their empirical work, Toner and Mackie explicitly recognise that wider measures of welfare may be appropriate, and have used the surveys they undertook

[22] Douglas, G.W. (1972), 'Price Regulation and Optimal Service Standards', *Journal of Transport Economics and Policy*, **iv**, 116–27.

to calculate valuations and service elasticities of walking time and in-vehicle time, as well as those for waiting time.

In order to calculate the welfare impacts, knowledge of the relevant price and service elasticities (ie, the responsiveness of demand in respect of waiting time and walking time) and consumers' valuations of service were needed. The principal dimension of service in this market is related to time, and therefore time is one of the prime determinants of optimal regulatory behaviour. If consumers' values of waiting time are low, the regulator can best serve the interests of the public by keeping fares down, thereby allowing longer queues and waiting time. Toner and Mackie set out to address a gap in the literature related to the values of time or price for hackney carriage users and service elasticities.

Toner and Mackie highlight that, due to the range of consumers serviced by hackney carriages, estimates of consumers' elasticities and values of time are likely to depend on the time of day the journeys are taken, and their purpose. The data used in the modelling was collated by means of stated-preference surveys of individuals and transfer-price experiments. For the stated-preference work, individuals were presented with choices based on hypothetical scenarios and their responses were analysed to reveal information about the preferences underlying their choices. Transfer-price methods seek to identify by how much the value of a particular attribute would have to change in order to cause a change in behaviour.

The results found high values of walking and waiting time, and extremely low values of in-vehicle time. The study also examined people's preferences in relation to vehicle type—for example, Black cabs compared with saloon cars, with some evidence of preference for Black cabs and for the larger saloon cars.

Using these estimates of elasticity from the theoretical model that they outline, Toner and Mackie simulated the effects of adopting different licensing strategies through their impact on fares, vehicle numbers and waiting times. They did this in relation to two districts: one where the licence plates sell for £30,000, and the other £20,000. Their table of results is reproduced below. The scenarios are calculated by imposing different restrictions on the model, as follows:

- scenarios A and B maintain the licence premiums[23] ('π') at their current levels;
- scenarios C, D, E, F and G are based on eliminating the licence premium, π, through reductions in fares, increases in vehicle numbers, or both;
- scenarios B and E maximise the occupancy rates of the taxis ('max. ridership');
- in scenario D, service quality (ie, waiting time) is maintained.

Changes in price and waiting time are the main factors underlying consumer welfare, while producer surplus is measured in relation to the prices paid and costs incurred (estimated in relation to occupancy rates).

[23] The price over and above that charged by the LA.

Table 2.1: Effects of different licensing strategies

	District (iii)				District (iv)			
	% inc. fares	No. of cabs	% inc. in CS	% inc. welfare	% inc. fares	No. of cabs	% inc. ir CS	% inc. welfare
A Current case	–	262	–	–	–	120	–	–
B π=current, max ridership	–5.8	251	+2.6	+1.9	–19.4	112	+26.4	+19.6
C π=0, current fares	–	365	+13.3	–18.2	–	156	+6.5	–21.0
D π=0, maintain quality	–26.2	307	+48.2	+7.0	–25.3	140	+55.2	+15.2
E π=0, max. ridership	–27.0	305	+48.6	+7.3	–33.2	129	+64.3	+21.9
F π=0, fare ↓, same cabs	–33.3	262	+32.1	–4.6	–37.1	120	+59.7	+18.4
G π=0, complete deregulation	+18.7	374	–15.1	–38.7	–	156	+6.5	–21.0

Note: CS, consumer surplus.
Source: Reproduced from Table 2 of Toner and Mackie (1992).

In Scenario C, entry control is abolished, but fares control was maintained at the current level. This leads to an increase in consumer surplus in both districts as taxi numbers increase substantially; however, overall welfare is reduced, as producer surplus falls due to cost increases resulting from that same increase in taxi numbers. Open entry at current fares was therefore rejected as a good strategy. Open entry with unregulated fares was found to be worse in district (iii), with both consumer welfare and total welfare lower.

From a finding that waiting-time elasticities are low, and price elasticities close to unity, the authors conclude that the regulators should focus more attention on tariff regulation than on entry control. This does not fit with the requirements of the Transport Act 1985, which, with its focus on unmet demand, unduly concentrates regulators' attention on hackney carriage numbers.

2.5 The theoretical impact of regulation

In light of the above, fare level and waiting time have been identified as key variables driving consumer welfare in the taxi markets. Hence, a sound understanding of the impact of regulation on each of these factors is of paramount importance to inform any change in the regulatory environment in the hackney carriage market.

In addition, it is important to understand consumers' valuation of other aspects of service quality. Some of these other factors are already addressed by regulations, such as vehicle type and drivers' knowledge, but to date, these factors have received little or no attention in the literature.

2.5.1 Impact of regulation on fare level

There are a number of complex and potentially conflicting mechanisms that can influence the relationship between entry regulation and fare levels. Resolution of the net effects of entry regulation on fares is therefore an empirical question which will depend primarily on the strength of the following factors.

- *The effectiveness of price competition*—if deregulation of entry spurs price competition, this could lead to lower fares. If, on the other hand, the effectiveness of price competition is muted by market failures associated with customers' imperfect information on fares, hackney carriages might not have any incentive to

reduce prices and, absent price regulation, entry deregulation may even create incentives for price increases.

- *The effects of entry on costs*—if the increase in supply does not lead to any significant increase in peak or off-peak demand, it might result in a fall in occupancy rates. As the vast majority of costs incurred by hackney carriage operators are fixed, to remain profitable, operators may have to raise prices when their occupancy rates fall, or, where prices are regulated, they may seek to increase the regulated price. Anecdotal evidence suggests that licence premia are higher in areas where entry is restricted. If removal of entry restrictions were to eliminate these excessive premia for hackney carriage licences, this would represent a reduction in fixed costs, thereby lowering pressures for fare increases.

- *The effects of deregulation on demand*—initial downward pressure on the level of fares resulting from entry deregulation, increased supply and reduced waiting time may be mitigated if the increase in supply generates further demand for hackney carriage services, putting upward pressure on fares.

- *The strength of quality of service regulation*—the regulation of quality of service can be expected to have a positive impact on fares through its impact on the costs of supplying hackney carriage services. Such regulation may substitute for regulation of entry (eg, in London), and may also increase costs for those licensed to operate, thereby increasing pressure on the regulator to raise fares.

Further insights into the operation of the hackney carriage markets can be obtained by means of an empirical examination of the determinants of regulated fares. Different relationships can be expected between entry regulation and regulated fares than between entry regulation and market prices, as regulated fares do not reflect market forces, but the outcomes of bargaining between the regulated operators and the LAs. This issue is explored in section 5 of the OXERA study, 'Modelling the Effects of Taxi Regulation'.

2.5.2 Impact of regulation on waiting times

Waiting times are not only significant welfare factors by themselves, they also play an important role in determining the level of demand and the resulting equilibrium in the market. In addition, they depend on capacity, which is in turn a function of the number of hackney carriages in operation, their utilisation rate and the equilibrium demand for hackney carriage services. Waiting times reflect the outcome of interactions between supply and demand, and also influence the level of demand, since an increase in waiting times will reduce the demand of potential consumers.

An empirical assessment of the effect of entry regulations on waiting times will seek to determine the balance between the following two effects.

- *The restrictions on supply imposed by entry regulations*—if entry deregulation increases the supply of hackney carriage services, for a given demand, this will translate into a higher number of hackney carriages in service and lower occupancy rates. Removing restrictions on supply will therefore create a directly negative impact on waiting times (ie, increased supply leads to reduced waiting times).

- *The effects on demand of supply restrictions*—in addition to the direct effects of increased supply generating lower waiting times, those lower waiting times can increase demand, leading to a secondary increase in waiting times, thereby mitigating the initial reduction.

The net effect of entry deregulation on expected waiting time depends on whether the positive supply effect outweighs the negative demand effect. The magnitude of the demand effect depends on the extent to which there was unmet demand before deregulation, as well as on the elasticity of demand with respect to waiting time. If customers are not particularly sensitive to waiting time and unsatisfied demand before deregulation is low, a decrease in waiting time is unlikely to trigger a large increase in demand; thus, deregulating entry would probably lower passenger waiting time.

The impact of regulation on waiting times is explored in section 7 of OXERA's study, 'Modelling the Effects of Taxi Regulation'.

2.5.3 Impact of regulation on quality of service

Quality of service is an important factor in the determination of consumer welfare. Other things equal, consumers would prefer a service of higher quality of service. The results of OXERA's revealed-preference survey shed light on the importance that consumers attach to quality-of-service attributes. This is not an area that has previously received much attention.

To fill this gap in knowledge, consumers' valuations of a variety of quality-of-service attributes have been explored in depth by means of the stated-preference survey. The results of this analysis are discussed in detail in the OXERA 'Consumer Survey Report'. In addition, the following relationships between consumers' perceptions of quality of service and the measures of the regulation of quality of service were explored.

- *The effect of entry regulation on quality of service*—entry regulation can provide incentives for licensed operators to maintain or defend their privileged position by, for example, maintaining investment in their vehicles.[24] Conversely, licensed operators may lower investment levels, as they are protected by the barriers to entry created by the licensing system. Entry regulation can also prevent price competition from introducing incentives for operators to compete by lowering their quality of service.

- *Quality-of-service regulation should improve quality of service*—informational asymmetries may limit the ability of the market to provide proper signals for investment in quality of service. Properly applied quality-of-service regulation should therefore have a positive effect on quality-of-service.

The net impact of entry regulation on quality of service is therefore ambiguous. This is explored empirically in section 8 of OXERA's study, 'Modelling the Effects of Taxi Regulation'.

[24] See, for example, Toner (1996). The argument presented is that hackney carriage licence-holders may seek to raise quality standards in order to raise entry barriers against PHV drivers, so that PHVs could not simply be reclassed as hackney carriages were they to be granted licences.

2.5.4 Impact of regulation on consumer welfare

Given the complex structure of the market for hackney carriage services and the variety of theoretical relationships that exist between the inputs into hackney carriage markets and the outcomes that result, it is difficult to predict unambiguously the net effect of deregulating entry on consumers' welfare. Deregulating entry may have several conflicting effects on welfare, and striking the balance between them is more an empirical matter. Tables 2.2 and 2.3 summarise the anticipated effects of entry and quality-of-service regulation on fares, waiting time, quality of service and, hence, consumer welfare.

Table 2.2: Anticipated impact of entry regulation on factors that influence consumer welfare

	Increase	Decrease	Implied welfare impact of entry regulation
Effects of entry regulation on:			
Fares	If price competition is effective, prices would rise	If price competition is ineffective, prices would fall If efficiency is improved, costs and prices may fall If entry regulation increases waiting time, thereby reducing demand, prices might fall	Ambiguous
Waiting times	If the supply is reduced or constrained, waiting time would rise	Secondary demand effects from increased waiting time would mitigate the initial increase, but would be unlikely to counter it fully	Negative
Quality of service	Quality of service would rise if operators invest more when entry is regulated If entry regulation prevents low-cost/low-quality competition, quality would be higher when entry is regulated	Quality of service may be lower when entry is regulated if operators are protected by the licence system	Ambiguous
Overall consumer welfare impact of entry regulation			**Ambiguous**

Table 2.3: Anticipated impact of quality-of-service regulation on factors that influence consumer welfare

Effects of quality-of-service regulation on:		Implied welfare impact of quality-of-service regulation
Fares	Higher quality of service raises costs and raises prices, leading to an ambiguous effect for consumers	Ambiguous
Quality of service	Quality-of-service regulation should raise observed quality of service	Positive
Overall consumer welfare impact of quality-of-service regulation		**Ambiguous**

Appendix: Estimating Welfare Losses from the Market Values of Taxi Licences

In many taxi markets where entry is regulated, it is possible to observe market values for licence plates that are significantly greater than the administrative cost of issuing a licence. This is viewed by some as *prima facie* evidence that prices are higher than they would be in a competitive market, and that the market value of the licences can be used as a basis for calculating the lost consumer surplus.[25]

The most common technique used to estimate welfare losses created by entry regulation is based on the market value of the licences. A positive value for a taxi licence implies that regulation redistributes income from consumers to producers, and the value of the licence represents (in efficient markets) the present value of the expected excess profits that regulated firms can expect to receive due to their ability to charge prices above cost.

Wayne Taylor's estimates—that, in 1987, prices in the Metropolitan Toronto area were 25% higher than they would be, were the number of licences to be unregulated—provide a good example of this genre of work. His calculations are based on the premise that the number of licences issued is fewer than would pertain in the absence of entry regulations, and therefore prices can be raised above the competitive level, generating a transfer of wealth from consumers to producers. The following approach was used to assess the magnitude of these effects. Using the information on the market value of taxi licences, together with information on the number of licences in existence and information about the number of trips taken, the calculation presented in Table A1 was made. Using simple geometric calculations based on an assumption that the elasticity of demand is unity, Wayne Taylor translates this into a loss of consumer surplus of C$44.1m, or 28% of total spending on taxis in 1987.[26]

Table A1: Direct cost of control of entry—Toronto taxicab industry, 1977 and 1987 (C$)

		1977	1987
A	Average market value of a licence	23,251	95,000
B	No. of licences	2,484	2,943
C	Capital stock in licences	57,755,484	279,585,000
D	Differences in earnings due to control of entry	3,255	13,300
E	Transfer from consumers to producers	8,085,768	39,141,900
F	Average no. of standard trips	7,122	8,221
G	Fare for a standard trip	3.42	6.52
H	Direct cost of entry per standard trip	0.46	1.62
I	Direct cost as % of fare for a standard trip	13.5%	24.8%

Source: Wayne Taylor (1989), Table 3.

Very similar calculations were undertaken by Gaunt and Black in relation to the supply of taxi services in Brisbane, Australia, with the conclusion that the regulated fare is 15.6% higher than that which would prevail in a competitive market, and the number of taxi

[25] See, for example, the summary in Wayne Taylor, D. (1989), 'The Economic Effects of the Direct Taxi Regulation of the Taxicab Industry in Metropolitan Toronto', *Logistics and Transportation Review*, **25**:2, September.

[26] Several studies support a finding that the elasticity of demand for regulated taxis is at or close to unity (eg, Teal and Berglund, 1987).

licences is 228 below that in a competitive market.[27] The significance of the costs of the licences was presented in a different manner by the Australian Productivity Commission, which estimated that, in Sydney, the costs of licences represented 25% of total taxi costs (according to the calculations of the Independent Pricing And Regulatory Tribunal.)[28]

In Toronto and Brisbane, where the above estimates of welfare loss were made, all the taxis were licensed equivalently over the time period of the studies in question. There were not the distinctions between hackney carriages and PHVs that exist in the UK. Where PHVs are allowed to operate, it can be expected that the losses for consumers generated by restrictions on numbers will be mitigated to the extent that PHVs substitute for hackney carriages. To the extent that consumers can substitute between hackney carriages and PHVs, this will be reflected in the value of the licences.

[27] Gaunt, C. and Black, T (1996), 'The Economic Cost of Taxicab Regulation: The Case of Brisbane,' *Economic Analysis and Policy*, **26**:1, 151–70.
[28] Productivity Commission (1999), 'Regulation of the Taxi Industry', Ausinfo, Canberra.