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"Explaining Competitive Practices in the Bus Industry:
The British Experience"

by

Dr Jonathon Preston

Institute for Transport Studies
University of Leeds
Leeds, UK.

EXPLAINING COMPETITIVE PRACTICES IN THE BUS INDUSTRY: THE BRITISH
EXPERIENCE

J. Preston

Institute for Transport Studies, University of Leeds

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ABSTRACT

This paper examines the effects of the 1985 Transport Act on the local bus industry in Great Britain. An immediate distinction is made between the bulk of the market that is run without subsidy (the 'commercial sector') and the socially necessary services that receive subsidy administered by a system of competitive tendering (the 'tendered sector').

Competition in the commercial market is briefly reviewed. It is argued that the theory of contestable markets does not appear useful in explaining all aspects of competition in the commercial market. Instead, some form of oligopoly model might be more useful. Simple models of this type are developed based on game theory. They are shown to help explain entry deterrence strategies, predatory behaviour, the trend to mergers/acquisitions, the tendency for competition to lead to high frequency/fare combinations and the pressures towards collusion.

Competition in the tendered market is also briefly reviewed. Competition in the tendered market appears to be more widespread than in the commercial market. Although there are some imperfections, it is argued that the tendered market is inherently more contestable than the commercial sector. The main problem is the interface between the commercial and tendered sectors, which is shown to be substantial and leads to distortions.

It is concluded that there are important lessons to be learnt from British experience, particularly for regulators and legislators. Possible improvements might be either to loosen or to tighten up the existing regulatory framework. An alternative might be to develop a system of comprehensive tendering or franchising.

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1. INTRODUCTION

This paper attempts to develop ideas first presented to the University Transport Studies Group earlier this year (Preston, 1989). It is partly a product of a two year monitoring study that the Institute for Transport Studies carried out for the Economic and Social Research Council, entitled 'The Impact of Stage Bus Deregulation in Urban Area'.

The 1985 Transport Act led to the creation, outside London, of two separate, but inter-related, bus markets.

1. The 'commercial sector', which does not receive any revenue support, although it does receive subsidy through concessionary fare repayment schemes, fuel tax rebate and rural bus grants. The 1985 Act removed quantity regulation for this sector (the 1980 Transport Act had effectively removed price regulation) but all services have to be registered with the Traffic Commissioners. 42 days notice has to be given before a service can be introduced, altered or withdrawn. By contrast, fares do not need to be registered and can be changed immediately.
2. The 'tendered sector' constitutes socially necessary services that are, however, unprofitable and require revenue support. Such services are identified and the system administered by the Passenger Transport Executives (PTEs) in the seven main provincial conurbations and by Shire/Regional Councils elsewhere. Although there is scope for input from operators, most tenders, in terms of service levels and maximum fares that can be charged, are specified by the administering bodies. Tenders are awarded by a system of sealed bids.

Initially, around 85% of bus miles were registered as commercial and only 15% as tendered (Balcombe et al., 1988), although there are signs that the tendered share of the market is increasing. Hence, the tendered share is relatively small in terms of mileage but it is dominant in certain areas (e.g. rural areas) and in certain time periods (early morning, late evening, Sundays).

In the rest of this section the theory of contestable markets will be briefly examined and two hypotheses concerning the contestability of the commercial and tendered bus markets will be set up. In section 2 some of the competitive practices that have emerged in the commercial sector will be reviewed and their implications for contestability theory assessed. In section 3 an attempt will be made to explain why a number of practices, such as predatory behaviour, strategic entry deterrence, the tendency for competition to lead to high frequency/fare combinations, mergers/acquisitions and collusion, have emerged. This is done by considering the competition that has resulted from bus deregulation as a game. This is not a novel idea and may be seen as being related to earlier work in the same vein, for example, the deregulation training game 'Pirates' (Buchanan and Lewis, 1985) and some work by Evans (1985). A more recent example is the work of Dodgson and Katsoulacos (1988A). In section 4 the competitive practices that have emerged in the tendered sector will be reviewed and the importance of the overlap with the commercial sector is stressed. In section 5, the competition for

tenders is also studied within a game theoretic framework. In the final section, some conclusions are drawn with respect to the contestability of Britain's local bus industry and the theoretical and practical implications are discussed.

1.1 Contestability and the Local Bus Industry

The Government's White Paper 'Buses' (Cmd 9300) took the view that consideration of market structure (but not ownership) is irrelevant because the bus industry is contestable. Contestability theory is normally associated with the work of Baumol, Panzar and Willig (1982) and, expressed simply, suggests conditions under which firms will be efficient in their production method, output mix and price irrespective of the number of firms in the market. The main conditions are as follows:

- (i) All potential producers have access to the same technology.
- (ii) There are no barriers to entry or exit and hence no sunk costs.
- (iii) Consumers respond quickly to price changes.
- (iv) Incumbent firms can not respond quickly to an entrant by reducing prices and/or increasing output.

The White Paper argued that quantity regulation was the main barrier to entry. If this was removed the market would be contestable, particularly as the main capital investment in the industry (vehicles) does not represent a sunk cost but an asset that can be either redeployed ("capital on wheels") or resold. Increased actual and potential competition would ensure contestability.

However, unpublished quantitative analysis of commercial competition in Hereford over a period of six years (based on Evans, 1988) suggests that fare may be a function of market structure. Elsewhere, for example, Preston, there is qualitative evidence that frequency may also be a function of market structure (Mackie and Preston, 1988). By contrast, a small scale study of tender prices in West Yorkshire (again unpublished) failed to establish a relationship between price and the number of bidders. This evidence leads to two hypotheses being set up:

- i) The commercial bus market is not contestable.
- ii) The tendered bus market is contestable.

It is the aim of this paper to establish the validity of these two hypotheses.

2. COMPETITION IN THE COMMERCIAL BUS MARKET

2.1 Review of the Competitive Process

It is not the aim of this paper to provide a comprehensive review of events in Britain. This will be done by other papers presented at this conference. However, in this section we will briefly review some of the main competitive practices that have emerged in the commercial sector.

The first point to make is that major actual competition has not

been universal. It has been estimated that significant competition has occurred in over a quarter of the towns and cities in Great Britain with a population of 40,000 or more, with competition also occurring in smaller towns and rural areas (Preston, 1988). Minor competition has occurred in virtually every urban area. However, competition has not affected all routes. TRRL estimate that only 10% of services have been affected by major competition (Balcombe et al., 1988). Competition is most common in northern England and Scotland and least common in southern England. This is related to the structure of the local industry (in particular, local government owned operators are more predominant in the northern part of Britain) and market conditions, both in terms of demand and supply (particularly labour). Where competition does occur predatory behaviour is often witnessed. Such behaviour includes 'swamping' routes with vehicles and, less commonly, fares cuts. This is discussed in 3.1. The limited extent of actual competition is, in part, related to the success of the entry deterrence strategies deployed by incumbent firms. This will be examined in section 3.2.

Why does competition occur? It seems that competition is not a purely random event but has some systematic features (Preston, 1988). These are related to the characteristics of the incumbent (typically a local government owned operator perceived as a high cost/low quality operator) and the entrant (typically a newly privatised firm that was previously part of the National Bus Company (NBC) or independent companies who perceive themselves to have cost and/or quality of service advantages). Personal factors are often important. The entrant firm's management often have knowledge of the area being entered. In many cases, entrants have former employees of the incumbent working for them, with the most extreme example being the workers' co-operatives that provide a particularly stubborn form of competition for existing operators.

Where competition does occur it can take a number of forms. The most common form is probably frequency competition and fares matching, with the incumbent acting as the price leader. Some explanations for this are given in Mackie and Preston (1988), with the main factor being the reaction period phenomenon; competition is harder to match in frequency than price. The result of this competition is that fares and frequencies may be higher than the optimum. This is examined in section 3.3. Fares competition is less common. The main examples include the trial area of Hereford (Evans, 1988) and high density, low income corridors (e.g. Liverpool). Similarly, quality competition has been limited. The minibus has been the main innovation but only very rarely have minibus services charged higher fares than the lower quality, conventional bus services. This suggests that the quality competition models of Dodgson and Katsoulacos (1988B) and Glaister (1985) may not be appropriate for examining competition within the bus market, although they may explain inter modal competition.

An important trend in the bus industry is that of mergers and acquisitions. The 1985 Transport Act fragmented the NBC into a number of smaller units. However, new groupings have emerged (e.g. the AJS, Badgerline, Drawlane and Stagecoach groups), whilst large bus companies have been buying out smaller

companies. This is discussed in section 3.4.

Lastly, it has been felt by some observers that collusion has been a feature of the commercial bus market. This is discussed in section 3.5.

2.2 Contestability and the Competitive Process

The competitive processes that have emerged might be viewed within the following framework: incumbents will attempt to reduce the contestability of the industry, whilst entrants will attempt to increase its contestability. Examples of the former include incumbents attempting to erect 'strategic' barriers to entry by developing branded ticketing and limiting access to bus stations and key central area stops. Examples of the latter include entering an area of which existing management have good local knowledge in order to reduce sunk costs and livery matching in order to reduce brand loyalty (which may be thought of as an 'innocent' barrier) (Salop, 1979).

The key way that incumbents limit the contestability of the commercial sector is by matching almost immediately any increase in frequency or reduction in fares. However, if there are always potential competitors threatening entry and entry can be profitable for a certain time period (no matter how short), this should not matter, perfect contestability should still result. This assumes that the other conditions for contestability are met. However, some violations have been identified. For example, there are some sunk costs, associated with 'economies of experience' and there may be opportunity costs associated with waiting to enter the market. These violations, in combination, are likely to mean that the theory of contestable markets does not provide a thorough explanation of events in the commercial bus market. Hence, in the next section, the applicability of oligopoly models and, in particular game theory, will be examined.

3. EXPLAINING COMPETITION IN THE COMMERCIAL BUS MARKET

It was noted in section 2 that competition is fairly widespread if considered on a city by city basis, but more limited if considered on a route by route basis. Hence, for most bus routes there is still only one bus operator and hence some form of monopoly model, modified to take into account inter modal competition and potential entry may be appropriate. However, where there is competition there will be more than one operator on a route but the number of operators is likely to be a small number (rarely more than four). Hence, oligopoly models (and in most cases duopoly models) may be appropriate. If bus users are homogeneous in terms of tastes, there are some fixed costs associated with entry and unit costs rise only slowly with increases in quality the bus market may exhibit some features of a natural oligopoly (Shaked and Sutton, 1983). However, the main cause of oligopoly may be that on routes where demand dictates a frequency such that knowledge of the timetable is essential (e.g. headways greater than 10 minutes), it is necessary to achieve public awareness of your services and this may represent an important fixed cost/scale economy. Given economies of scope, in most urban areas, route configurations are such that only a small

number of operators result in serving the area.

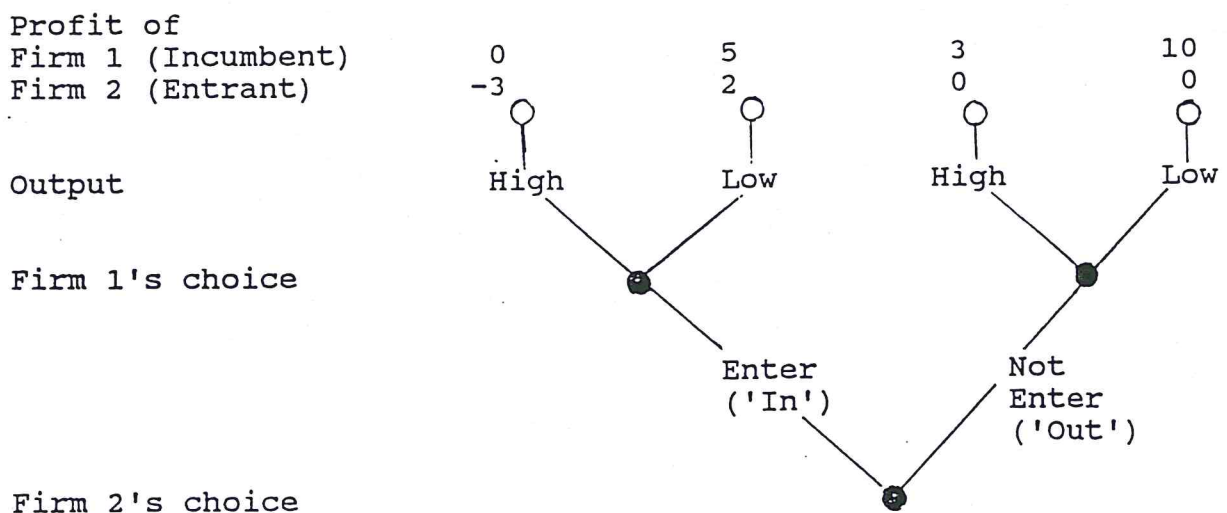
Thus, a competed bus route may be characterised as an oligopoly, whilst in most urban areas the commercial bus market will have an oligopolistic structure. That is, it is a market having few firms (but more than one) on the supply side and a very large number of buyers on the demand side. The key feature of an oligopoly is that firms are strategically linked to each other. One approach that provides useful insights into these interactions is the theory of games. The first systematic study of this type was the work of Von Neumann and Morgenstern (1944) and an early proponent has been Shubik (1959). As with many economic theories, game theory has developed so as to be quite complex mathematically (see for example Vorob'ev, 1977, or Friedman, 1986). However, this paper is only interested in the basic concepts and their applicability to the urban bus market. It is not the aim of this paper to review the essential features of game theory, this is adequately covered in text books (see, for example, Ordeshook, 1986). However, a review of this literature would suggest that the commercial bus market may be viewed as as a non co-operative, n-person (where n often equals two), variable sum game. It is such a game that is the focus of the rest of this section.

3.1 Predatory Behaviour

Figure 1 illustrates the situation where a route is currently being served by one operator (firm 1) but another operator (firm 2) is considering entry. Suppose, initially, that the game is a one-off (i.e. static) and the entrant first chooses whether to enter or not, and the incumbent then responds with either high output (=fight) or low output (=acquiesce). Given this sequence of moves, two non co-operative equilibria are possible:

- (1) The entrant chooses 'out' (i.e. not to enter) and the incumbent chooses low but threatens high if the entrant chooses 'in' in an attempt to deter the entrant.
- (2) The entrant chooses 'in' and the incumbent chooses low output whatever the entrant chooses.

Figure 1 A Game Involving Predatory Behaviour



There are two equilibria because each firm gets his maximum pay-off given the choice of the other. However, equilibrium 1 has an undesirable feature that can be interpreted as a non credible threat (or a bogus ploy). If the entrant chose 'in' it would be irrational for the incumbent to choose high because its profit would be greater if it chose low (5 as against 0 in our example). Hence, only equilibrium 2 can be said to be a perfect non co-operative equilibrium, because looking at any intermediate point that might be reached by the players in the game, the strategies that are being followed are a non co-operative equilibrium for the subgame. This condition is violated by equilibrium 1. What this result suggests is that predatory behaviour, such as swamping, is irrational and hence unlikely.

This 'unique' perfect equilibrium appears intuitively unreasonable (Selten (1978) refers to it as the chain store paradox) and does not accord well with the evidence presented in section 2. This is because initially a single shot game has been considered whereas, in reality, a multi-period (dynamic) game in which entry can occur repeatedly over time and/or place (i.e. sequential entry) should be considered. If faced with entry in an early period, the incumbent plays high. This forces the entrant out of the market and then, in subsequent periods, the incumbent can play low in the knowledge that other entrants will have been deterred by its initial tough stance. This suggests that, in most cases, initial competition will be met by strong re-action from the incumbent and that predatory behaviour will be endemic. A counter argument is that the last entrant knows that the incumbent's threat is non credible and will choose 'in'. By backward induction, all other firms will choose 'in' and hence predation will be unsuccessful. However, this assumes that the game is finite and the players have complete and perfect information. Kreps and Wilson (1982) relax the information conditions and assume that the incumbent plays high in the face of entry either because it is a strong firm and this is its dominant strategy or it is a weak firm mimicking the behaviour of a strong firm. If the entrant(s) attach a probability of the incumbent being weak of less than 0.5 when in fact the incumbent is weak, then the incumbent's non credible threat becomes credible. Such reputation building appears to have been important in the bus industry.

Given the hypothesis set up in 1.1, it is assumed in Figure 1 that the market is not truly contestable; if the entrant chooses 'in' its pay-off is always lower than the incumbent's (by 3 units). As a result the incumbent can always increase output to such a level at which it just breaks even but the entrant makes a loss and is forced out of the market. Moreover, in the bus industry, the incumbent can switch relatively quickly and costlessly from one strategy to another and hence enjoys a first mover advantage over the entrant (Brock, 1983). In extreme examples, it might be possible for the incumbent to cross subsidise its activities in contested periods or routes. This has been termed the long purse hypothesis and this investment in entry deterrence might be thought of as a sunk cost to be recuperated in the medium to long term. Losses may also be sustained by sale of assets and deferral of vehicle replacement and may contribute to the problems of transitional disequilibrium

observed by Button (1988). Furthermore, certain firms may have weaker bankruptcy constraints than others. This is related to ownership (current and historic) and capital structures. It may explain the survival, in the face of major entry, of some publicly owned firms and the success of workers' co-operatives.

The above strategy would only be effective if all entrants acted rationally and stayed out of the market. The often vigorous reaction of an incumbent to entry, no matter how small scale, may be thought of as pre-play posturing in that it aims to discourage other firms entering subsequent rounds of the game. However, if there are a large number of firms prepared to enter the market whatever the consequences (i.e. they are prepared to call the incumbent's bluff), the strategy would have to be re-considered. This partly explains the tendency for independents to enter an area collectively in the belief that the incumbent is unable to respond vigorously to all cases of competition. This 'vulture effect' is particularly evident where the incumbent has had operational difficulties (e.g. Manchester, Sheffield).

3.2 Strategic Entry Deterrence

In addition to predation, the incumbent may develop a policy of strategic entry deterrence. In order to effect such a policy, the incumbent must commit himself to a policy that has a lasting effect on demand or cost to the detriment of an entrant. This involves a binding pre-commitment on the part of the incumbent. The main example of such a policy is of incumbents increasing their capacity by expanding their fleet (for example, through the purchase of minibuses). The extra vehicles will be used to increase frequencies and introduce new routes in an attempt to fill all gaps in the market. This has been termed the 'scorched earth' policy. The high percentage of commercial registrations by many urban bus companies may be seen as an extension of this policy. Although not totally irreversible, policies of this type might be thought of as being similar to brand proliferation, which has been shown to deter entry (Schmalensee, 1978).

In addition, entry deterrence strategies might include attempting to raise rival's costs (Salop and Scheffman, 1985). This has been tried by 'poaching' the rival's trained staff and by attempting to distort the second hand vehicle market. In some instances, strategic advertising may also deter entry. However, these examples are relatively minor; output seems to be the key variable in entry deterrence strategies.

The likely result of most entry deterrence strategies is that frequencies are higher than optimal. Monopoly rents are earned surreptitiously in order to avoid the interest of others and avoid losing customer goodwill. This may be seen as an attempt to introduce information asymmetries. One way that monopoly rents are earned is through the use of a standard fare scale rather than the use of market based fares. Market based fares only seem to have occurred where actual competition has taken place (e.g. Harrogate).

3.3 Frequency/Fare Combinations

The above has explained why competition may be limited. However,

clearly entry deterrence strategies are not always successful. It may be that there are some markets where, whatever the incumbent's strategy, the entrant can come into the market with a profitable fare/frequency mix because the entrant has a cost and/or quality advantage over the incumbent which negates the effects of sunk costs and barriers to entry. Moreover, in some markets there were two or more incumbents pre-deregulation. Some of the earliest examples of competition were in markets previously served by two operators under a joint agreement (e.g. Lancaster).

Interviews we have carried out with bus operators in and around West Yorkshire suggest that firms are satisficers rather than optimisers. Given that competition has emerged, the following rules/decision making procedures are often applied:

- (1) Fare reductions are ruled out as being a high risk strategy (i.e. an easy way of losing money). An exception may be for routes serving low income areas where high frequencies and high fare elasticities reduce the tendency to board the first bus that arrives, when a cheaper alternative is available.
- (2) Firms have a preference for increasing output (particularly firms with only partially commercial objectives). Reducing frequencies are seen as a sign that you are losing the game.
- (3) Decisions are based on rules of thumb. Because of limited recall of past events and other factors, firms do not have perfect or complete information. However, most large companies believe that they know the market elasticities and key demand characteristics. Smaller companies may not have this knowledge but acquire it by default by mimicking the large companies. If expanding output, large companies tend to assume that overheads have already been covered. Small companies tend to assume that their overheads are near zero.

In Figure 2 it is assumed that two operators can change either fare or frequency upwards, downwards or not at all. Hence we assume that, other than entry/withdrawal, changes are only made on an incremental basis. This gives a potential 9 x 9 pay-off matrix. This may appear to be unrealistically cumbersome but can be easily handled with a microcomputer spreadsheet package such as LOGISTIX. However, assumptions (1) and (2) reduce this matrix to a 4 x 4 form. Although the results for all 81 cells of the matrix have been calculated, for simplicity's sake, in Figure 2, only the 16 most likely combinations are presented. The non co-operative equilibrium is the same for both matrices.

A hypothetical 5 mile (round trip) route is considered that is operated for simplicity, over a ten hour day, by two operators each with a 30 minute frequency. It is assumed, for the moment, that services are equally spaced. Demand is 1000 passengers per day, the mean fare charged is 25 pence and costs are £1 per mile. As a result in the base situation both companies are making £25 per day profit. An increase in fare would result in a mean fare of 30 pence. An increase in frequency would be from 30 minutes to 20 minutes, but the additional mileage would be costed at 75

pence per mile as no contribution to overheads is assumed. Both firms assume a fare elasticity of -0.3 and a service elasticity of 0.4. Knowledge of cross effects are limited to the belief (based on survey results) that only 1 in 10 passengers will switch to using the lower fare bus. These decision rules might be thought of as a simplified version of the type of modelling that some big bus companies have developed.

Figure 2 A Game of Competition that Leads to a High Fare / High Frequency Combination

		Firm 2				Firm 1's minimum return
		YES	YES	NO	NO	
Firm 1	Fare Increase	YES	NO	YES	NO	
	Frequency Increase	YES	NO	YES	NO	
	Fare Increase					
	Frequency Increase					
YES	YES	(34, 34)	(50, 25)	(20, 23)	(36, 23)	20
YES	NO	(25, 50)	(41, 41)	(16, 34)	(31, 33)	16
NO	YES	(23, 20)	(34, 16)	(13, 13)	(28, 10)	13
NO	NO	(23, 36)	(33, 31)	(10, 28)	(25, 25)	10
Firm 2's minimum return		20	16	13	10	

Our interviews suggest that operators are risk averse. Hence, their likely strategy will be to maximise the minimum possible pay off (i.e. a maximin strategy). In this example, for both firms the maximum minimum pay-off is £20 and the most likely outcome would be a high fare, high frequency outcome. This result is similar to that of the spatial competition models of Foster and Golay (1986) and Evans (1987). Both firms' pay offs would be slightly higher than the arbitrary starting point and would be considerably higher than the most competitive outcome achieved (in which both firms increase frequency but maintain fare at their base levels) where pay offs of 13 are achieved (i.e. about a 10% return on costs, which might constitute a normal profit).

Clearly, our results are determined by our assumptions concerning the decision rules (in particular, the perceived market elasticities and cross effects and the 'live and let live' strategies adopted), the single period nature of the game, the arbitrary incremental changes studied and the number of firms involved. If the number of firms involved is greater than two, it is likely that the results would be more akin to the competitive results.

The game presented in Figure 2 (and its full matrix form) is, however, dominance solvable and hence if both firms were, for example, to maximise their maximum pay-offs (i.e. they are risk takers) the same result of higher fares and frequency would be

achieved. However, if firm 1 is considered the incumbent and firm 2 the recent entrant, firm 1 might adopt a strategy that minimised firm 2's maximum return. This might be seen as abandoning a strategy of 'live and let live', which itself is related to the concept of modified zero conjectural variation (Novshek, 1980), in order to 'fight'. For both the full and partial matrix such an approach would involve firm 1 keeping fares at the same level and increasing frequencies. Firm 2 would still increase both fares and frequencies. The result would be that firm 1's pay off would be 23 and firm 2's 20. If firm 2's entry involved sunk costs of at least £20 per day then firm 1's strategy would force firm 2 out of the market, in the same way as was discussed in section 3.1. Alternatively, if at least 160 passengers (i.e. 16% of base demand) exhibit brand loyalty to firm 1, over the range of fare and frequency changes examined, the same policy of increasing frequency but not fares would force firm 2 to exit. It seems likely that in many instances of head-on competition such policies of attempting to drive the competitor out of the market (even if it means sustaining temporary losses) are attempted.

An alternative decision criterion is minimax regret (Ferejohn and Fiorina, 1974). Each player examines the difference between the maximum and minimum payoffs of each strategy (the regret) and then chooses the strategy that minimises the regret. In the partial matrix, given in Figure 2, both firms would increase frequency but not fares giving a pay-off of 13, which might be thought of as approaching a competitive result. However, if the full matrix is considered and both firms pursued a minimax regret decision criterion then they would both reduce fares and increase frequencies, with a pay-off of -12 each. This is clearly not a policy that could be sustained in the long term.

So far, analysis has been limited to the effect of competition on only one route. If the market was expressed in terms of a network of routes two main points would need to be considered. Firstly, the increased size of the market is more likely to support two or more firms. Secondly, and counter-balancing the first point, the existence of a network of routes is likely to increase the scope for entry deterrence strategies such as the 'scorched earth' policy as well as developing strategic barriers, such as branded ticketing.

The assumption that there is an unwritten agreement to ensure that services are equally spaced means that a mixed policy of collusion with respect to sticking to the timetable, equal spacing etc but non co-operation with respect to fares and frequency exists. The assumption about equal spacing seems particularly prone to being violated. One firm may either timetable buses just ahead of the other firm (head running) or encourage drivers to hang back in order to produce the same effect. A game involving headrunning is illustrated by Figure 3. It is assumed where one firm headruns and the other does not, then head running captures all the market. If both firms head run the market is shared equally. Whenever headrunning occurs, frequency effectively falls by 50% and, applying a service elasticity of 0.4, revenue falls by 20% relative to equal spacing.

Figure 3 A Game Involving Headrunning

Firm 1	Firm 2		Firm 1's minimum return
	Headrun	Don't Headrun	
Headrun	(0, 0)	(100, -100)	0
Don't headrun	(-100, 100)	(25, 25)	-100
Firm 2's minimum return	0	-100	

This is an example of the prisoner's dilemma game. The dominant strategy is for both firms to headrun, resulting in a zero pay off each. However, a preferable result for both operators and for society as whole would be for neither firm to headrun (i.e. equal spacing). Given that this game is repeated over time and that operators will attach probabilities to each strategy succeeding or failing, it will be shown in 3.5 that quasi co-operation is possible. The fact that collusion is more likely in terms of equal spacing than fare/frequency combinations may be related to a more explicit probabilistic treatment on the part of operators of the former strategy than the latter. However, if one firm is trying to drive the rival out, headrunning would seem likely.

3.4 Merger/Acquisition

Contestability theory would suggest mergers are irrelevant because the structure of a contestable market does not affect its performance. The recent trend towards merger in the British bus industry suggests that either the industry is not contestable or that there are some other reasons for merger related, perhaps, to economies of scope or managerial tendencies for empire building. Sheperd's (1988) analysis of mergers in the US airline industry concluded that the trend indicated non contestability. A similar conclusion could be drawn for the British bus industry, with mergers having three main impacts. Firstly, mergers may be more effective than predatory behaviour in achieving area monopolies (McGee, 1958, 1980). Secondly, larger firms will be better able to sustain losses and, hence, in the short term have a weaker bankruptcy constraint. Thirdly, mergers may occur in order to expand capacity and hence strategically deter entry. This is related to the Top Dog effect described by Fudenberg and Tirole (1984).

3.5 Collusion

McElroy and Siegfried (1984) have identified some market characteristics that facilitate collusion, several of which appear to apply to the bus industry. Homogeneous products, consumer insensitivity to price, relatively static demand and dispersion of buyers are characteristics that the urban bus market exhibits. Barriers to entry are not strongly characteristic, whilst the absence of a fringe of small sellers (or potential entrants), a high ratio of fixed to variable costs and frequency of depressed conditions are not really appropriate to the urban bus market. This suggests that collusion is likely to occur in the bus industry. A cursory examination of Figure 2 would confirm this as, with collusion, both firms can increase

their pay-offs from 34 to 41.

Figure 4 A Game of Competition that Leads to Collusion

		Firm 2 Frequency Increase		Firm 1's minimum return
		YES	NO	
Firm 1 Frequency Increase	YES	(13,13)	(28,10)	13
	NO	(10,28)	(25,25)	10
Firm 2's minimum return		13	10	

The 1985 Transport Act recognised that collusion was likely and hence restrictive practices legislation was invoked to limit the scope for co-operative behaviour such as price-fixing. However, the game described by Figure 4 (which is itself a sub set of Figure 2) may be thought of as another version of the prisoner's dilemma game. Suppose (after Vickers, 1985) that there is an infinite supergame (a repeated game) in which firms discount the future by attaching weights W (where $W=1/(1+r)$ and r =firm's discount rate). Unless W is very small, non co-operative collusion will occur ('quasi co-operation' or 'tacit collusion'). For example, suppose that firm 2 decides to play a trigger strategy which, in this case, is to maintain frequency at the existing level, provided that firm 1 does not increase frequencies, but firm 2 will choose a higher frequency forever should firm 1 introduce higher frequencies. From this example if there are no defections a firm's profit flow would be;

$$25 + 25W + 25W^2 + \dots = 25/(1-W)$$

If a firm defects, its return in period 1 will be 28 and in all subsequent periods it will be 13 and hence the profit flow would be:

$$28 + 13W + 13W^2 + \dots = 15 + 13/(1-W)$$

Comparing the two payoffs, it is better not to defect so long as:

$$W > 0.2.$$

It is likely that most operators would not be short sighted and would tend to have values of W closer to 1 than zero. Hence, if this example is typical we might expect collusion to be common place in the bus industry. However, the assumption of an infinitely repeated game seems unrealistic. Similar results can, though, be shown to result from a finitely repeated game (Krepps et al, 1982) provided it can be assumed that firm 1 attaches a probability, p , to firm 2 preferring, or being committed to, the trigger strategy. What will then happen is that even if p is very small, the players will collude until some point towards the end of the game. This analysis thus suggests that there will be strong pressure towards collusion in the commercial bus market. It should be stressed that in this application collusion implies no realistic threat of entry from firms 3, 4 etc. (i.e. our assumption of a 2 player game is important). The question of

whether tacit collusion and blockaded entry are compatible strategies needs empirical investigation. In addition, the above assumes that neither operator is pursuing a policy of driving the other out of the market. Collusion is most likely to occur between firms that perceive each other as business equals and are unable to deal each other knock out blows.

4. COMPETITION IN THE TENDERED BUS MARKET

There are three methods by which tenders have been awarded and they have influenced the competitive practices that have emerged in the tendered market.

- (1) Full cost method. The operator is paid for the full cost of operating the service and the tendering authority receives all revenue that accrues. The main disadvantage of this method is that it does not give the operator an incentive to develop patronage. In some instances, the tenderer may (as the sole buyer of services) be able to exert a form of monopsonistic exploitation. Advantages include that it reduces commercial risk, reduces problems of competition for revenue and may make it easier to maintain integrated ticketing.
- (2) Net subsidy method. The operator is allowed to keep the revenue that accrues and receives subsidy to cover the deficit on costs. In initial rounds of tendering this method gave an advantage to incumbents as they possessed the revenue information. However, the successful tender price is published and from this, after making assumptions about the incumbent's costs, rival firms can assess revenue. However, the problem would have been reduced if tendering authorities had supplied revenue data from the outset.
- (3) Resource based tenders. In these tenders the authority specifies a number of vehicles required for a certain amount of work, such as peak services, normally on a full cost basis.

Resource based tenders attract the lowest price, in terms of subsidy (often a price of zero (nil tender)) because of the potential interaction with commercial services. However, they are not very common (except in Tyne and Wear). By and large, full cost tenders attract lower prices (or more precisely require less total subsidy) than net subsidy tenders. Unpublished evidence suggests that for the former prices are generally increasing and for the latter prices are generally decreasing. There is some evidence that tenders for long periods of time attract lower prices than tenders for shorter periods (e.g. West Midlands).

Apart from the phenomenon of nil tenders, at least two competitive practices have been detected which are largely internal to the tender market. Firstly, there has been a policy for big bus companies to submit block bids for a number of tenders in order to exploit economies of scope and/or economies of scale or to act as an entry deterrence strategy. Secondly, in the initial round of tenders there was some evidence of large bus companies in certain areas tacitly colluding. The resultant high prices were likely to attract entry but were probably seen as a

one-off gain as existing operators exploited experience advantages over new operators. The need to submit lower prices in subsequent rounds was one of the main incentives for the large local government owned operators (for example, in South and West Yorkshire) to reduce costs, particularly of labour, although this would also be advantageous in the commercial market.

4.1 Interaction between the Commercial and Tendered Markets

In reality the British local bus market is currently neither purely commercial nor purely tendered. For example, in West Yorkshire 571 out of 705 commercial services (80%) have a tendered element (Tyson, 1988). This fact has been ignored by the theoretical models that have been developed so far. This is non-trivial because, the tendered market effects the commercial market and vice-versa. To use game theory jargon, a situation of closed-loop strategies exists in which knowledge of previous moves effects outcomes. This feedback might be either positive (away from equilibrium) or negative (towards equilibrium). The interactions occur at five stages.

1. The nature of the tendered market was initially determined by the commercial services registered by operators by February 26th 1986. Because they possessed revenue information, these operators might be thought of as having a first mover advantage over operators who joined the game later on. Operators involved in the game from the initial stages adopted one of three main types of strategy:

(i) Commercially register as much as possible of the existing network. For example, many municipal operators registered 90% plus of their existing services. This would seem to imply cross-subsidy but operators adopting this strategy appear to have taken the view that the commercial market was not contestable and hence cross subsidy could be maintained, whilst by contrast, the tendered market was both contested and contestable and services could be lost.

(ii) Shut down operations completely at certain times of the day/week (e.g before 07.00 hours and after 21.00 and on Sundays). Such a policy was based on aggregate data and average costs and largely determined by shift patterns. It was often based on the view that the services put out to tender could be easily won back.

(iii) Re-cast the network to maintain coverage throughout the day/week whilst ensuring a commercial return. This was based on disaggregate data and marginal costs and involved reductions in frequency except, possibly, for the inter peak and Saturdays. This strategy was devised so as to develop a core of commercial services.

2. Once the commercial services were registered, the tendering authority considers social need and then determines what additional services should require subsidy. These services should not inhibit competition (which is difficult if operators adopted commercial registration policy iii). Although many tendering authorities claim to have sophisticated methods of assessing social need, due in part

to time constraints, most adopted a simple policy of buying back lost mileage. This strategy has been identified by operators and hence after January 26th 1987 operators could de-register services in the safe knowledge that they would be, by and large, put back out to tender. Hence operators have modified their strategies, given their knowledge of the likely response by the tendering authorities. For example, an operator may only de-register certain bus runs, confident that he can win the tender back because staff and vehicles are already in place. In West Yorkshire this practice was rapidly adopted by both large and small operators suggesting the importance of the learning process. In response, tendering authorities have begun to vary their policy on services that should be put out to tender.

3. Once a tender is specified, operators decide to bid. If no bids are received the tendering authority can either (after consultation with operators, including possible changes to commercial services) re-specify the tender, re-advertise the existing tender (which will alert small companies that the large operators are not interested) or withdraw the tender.
4. In initial rounds, some operators did put in high prices because they had information advantages over new entrants. Others put in low prices (including nil tenders) in order to deter entry both to the tendered (and more particularly) the commercial market. It seems likely that the tendered market as it currently exists may best be described by asymmetric information games (AIG), which have been used to explain other forms of contracting (Milgrom and Roberts, 1987). The kernel of such games is that a variable (for example, revenue) is of interest to one operator (the 'receiver') but is not directly observed. However, another firm (for example, the incumbent) has knowledge of revenue (and is denoted the 'signaler' or 'sender'). The bids that the sender then makes will influence the inferences that the receiver makes about the amount of revenue that exists on a route. However, given that, by passenger counts etc., the receiver can find out the approximate level of revenue at only minimal cost, this is probably not a serious problem in the long term. However, the signals that firms send out about their cost structure and overall financial viability via the bids they make, their stance in the commercial market and informal information channels, may be more important examples of AIG. The reluctance of operators to make available any information on patronage, revenue and costs pertaining to both commercial and tendered routes might be seen as confirming the significance of AIG.
5. If the incumbent wins the tender the status quo is normally maintained. If an entrant wins the tender, the incumbent may then decide to register the service commercially to run just before the tendered service. This may happen because the incumbent put in a too high (or 'rogue') bid in the first place or is concerned about the implications of the entrant's success on the rest of the tendered and commercial markets. The tendering authority will normally, in due course, withdraw the tender. Alternatively, it might try to ensure that the two services are equally spaced, although this requires the

co-operation of the commercial operator. An entrant might also decide to register commercial services that complement the tender work gained and, in extreme cases, this might de-stabilise existing commercial services.

5. EXPLAINING COMPETITION IN THE TENDERED MARKET

The above might suggest that game theory also has an application to the tendered market. However, the tendered market involves a large number of players. For example, in West Yorkshire over 100 firms requested tender documents, with around 40 submitting bids and some 25 being successful, although in initial rounds the maximum number of bids per tender was only 4. By contrast, there are only around 15 operators in the commercial market in West Yorkshire and only around 12 routes are being actively contested. Nationally, independents have a 13% share of the commercial market but a 24% share of the tendered market (Balcombe et al., 1988). Initially, only 10% of commercial routes have been contested but the corresponding figure for tenders in the major conurbations was around 50% (Tyson, 1987). This indicates that the tendered market has been contested to a greater degree than the commercial market.

In addition, the tendered market has proved more contestable. This is because the incumbent can never be sure of the number of players bidding for a route until after a commitment to a particular strategy has been made. If an incumbent loses a tendered route it is unable to react (at least internally to the tendered market) until the tender is renewed, which may be a period of up to five years. It is the length of this reaction period, combined with lower sunk costs (because the tendering authority normally designs the route and publicises it, hence reducing the effects of economies of experience), that makes the tendered market inherently more contestable than the commercial market. 'Hit and Run' entry is more feasible (and profitable) in the tendered market than in the commercial market.

Figure 5 Games Theory Framework for the Tendered Market

Firm 1 Tender price	Firm 2 Tender price	High	Low	Minimum return
High		(H, H)	(0, 2L)	0
Low		(2L, 0)	(L, L)	L
Minimum return		0	L	

Although game theory helps explain the iterative process by which competitive prices are reached (if incomplete information etc. is taken into account) it may be of limited use thereafter for a comprehensive tendering/franchising system. However, a possible game theory framework is given by Figure 5. Firms can bid either high or low resulting, if the tender is won, in a return of H and L respectively (where $H > L$), but if the tender is lost the return is 0 (although firms also have the option of registering commercially). In this example, it is assumed that there are 2 tenders and if both firms bid the same price the tenders are shared. It can be seen that the maximin solution is for both

firms to bid low. In fact, if one firm had a strategy of continuing operating its traditional services (i.e. it has a decision criterion akin to minimax regret), there may well be strong pressures on even normal profits. Collusion is less likely than in the commercial market because of the larger number of players and the lack of suitable entry deterrence strategies.

6. CONCLUSIONS

Conclusions with respect to three main headings can be made: firstly, the contestability of the bus industry, secondly, the applicability of game theory to the bus industry and, thirdly, policy implications.

6.1 Is the Bus Industry Contestable?

Returning to the hypotheses set at the beginning of the paper, our conclusions are as follows:

- (i) The commercial bus market is not perfectly contestable.
- (ii) The tendered bus market, as it currently exists, is not perfectly contestable either.
- (iii) The tendered market, as it currently exists, is more contestable than the commercial market.
- (iv) A comprehensive tendering or franchising system is potentially more contestable than the current regime.

In part, it may be argued that what is being observed is a transitional disequilibrium, caused by the effects of experience goods and economies of experience which will diminish over time (Button, 1988). Clearly, the bus market is still undergoing a transition, but from our analysis it does appear that incumbent firms have some first mover advantages that will exist in perpetuity, unless the incumbent makes a strategic mistake and loses the initiative.

Although potential competition appears to have had some effect on the bus industry in Britain, it does not seem to have had the same effect over all routes over all periods of time, nor has it had as strong an effect as actual competition. A study by Morrison and Winston (1987) of the US airline industry suggests that three potential competitors have approximately the same effect on welfare as one actual competitor. A broadly similar result, if it could be empirically tested, might be found for the bus industry and hence, to use Morrison and Winston's term, the industry may be 'imperfectly contestable'.

6.2 How Useful is Game Theory to Understanding the Bus Industry?

Game theory does have some disadvantages in that it can be fairly cumbersome analytically and does have a large amount of jargon which would make it difficult to be understood by many bus managers. On the other hand, most bus managers are aware that they may have to fight 'wars of attrition' and that they need to know the 'rules of the game' and develop suitable 'strategies'. Hence, without knowing it, bus managers are behaving in a game theoretic manner. It has been shown that game theory can help explain a number of outcomes in the commercial bus market. It is less useful in explaining behaviour in a comprehensive tendering

system, but does provide some useful insights into the current tendered system, particularly with respect to its over-lap with the commercial sector.

One advantage of game theory is that it can help explain why things go wrong as well as why they go right. Two examples will suffice:

- (i) A feature, so far, of the bus industry is its instability. (This fact, of course, means that assessments such as ours can be criticised for being premature). The average lifespan of a commercial registration is reportedly only nine months (Balcombe et al., 1988). In part, this instability might be seen as an attempt by operators to familiarise themselves with their pay-off matrices on a trial and error basis.
- (ii) Game theory may help explain erroneous entry. Our analysis of major entry in Preston (Mackie and Preston, 1988) suggests that the entrant misjudged the incumbent's response and over-estimated the effect on demand of high frequency minibuses (e.g. they assumed a service elasticity of at least 0.4, but, in the short term, the actual elasticity only turned out to be 0.1). Similar analysis may be relevant to cases where major entry has failed either completely (Poole, Salisbury, Scunthorpe) or partially (Glasgow, Manchester, Plymouth). Conversely, the theory can also be used to explain examples of successful major entry in terms, for example, of strategic mistakes by the incumbent, strategic advantages possessed by the entrant and favourable demand conditions.

6.3 What are the Policy Implications?

At least three policy implications could be drawn from our analysis. These are that competition and/or contestability could be encouraged by decreasing regulation, by increasing regulation or by adopting a new regime completely.

- (i) Given that actual competition does have a definite effect on the bus market, it may be desirable to ensure that there is more competition. If all markets are contested the use of contestability theory as a 'benchmark' is largely irrelevant. One view holds that competition is inhibited because there is still too much government interference. There have been calls for commercial registrations to be scrapped completely, for the powers of the Office of Fair Trading (OFT) to be reduced (or removed completely), for all remaining firms in public ownership to be broken up into smaller units and privatised and for the functions of the PTEs and the County Councils in administering tenders to be moved into the private sector and other public transport modes (in particular, rail and its variants) put on an equal footing.

But would such a policy prescription produce the desired result? From our analysis, it may be expected that firms would quickly regroup (either through merger or collusion) and that predatory behaviour would be endemic. Moreover, even where strategic entry deterrence strategies fail and

there is actual competition, there is no guarantee that the resultant fare/frequency mix will be optimal and there seems to be a very good chance that it will be sub optimal.

- (ii) Given the above, although it may seem paradoxical, there may be a need to increase regulation to ensure effective competition. If a game is to be played properly, good referees are needed. The Monopolies and Mergers Commission would have to be given more powers to ensure that the bus industry can not re-agglomerate, whilst the OFT would need more powers to prevent predatory behaviour. The registration process might be changed so that fares as well as services have to be registered and adhered to for a fixed period of time. Although such regulation would be difficult to implement in the case of bankruptcies and would reduce firms' flexibility, it could increase stability and make hit and run entry feasible.

However, in considering the option of increasing existing regulatory controls the following maxim, that goes something as follows, may be appropriate:

"It is the business of government to legislate for competition. It is the business of businesses to ensure that this doesn't happen". (Or if it does happen, to ensure it doesn't work).

- (iii) Hence a third option, that of developing a comprehensive system of tendering or franchising, needs to be considered. In part, this is because, even with distortions it appears that the tendered market, as it currently exists, is more contestable than the commercial market. The experience of London is also salutary. Here, one third of routes have been put out to tender, reducing costs by 20% whilst overall bus usage (in contrast to the rest of the country) has risen. Critics would argue that the problem with tendering is that the planner is even more imperfect than the market. If that is the case, franchising might be a suitable middle way. The advantages of comprehensive tendering/franchising are that it can lead to cost reductions, whilst avoiding wasteful competition and maintaining integration and stability. It would remove the distortions caused by the current 'mixed' system of commercial and tendered markets. Disadvantages include the increased administration costs, the difficulty of assessing quality in such a system, the reduced scope for innovation and the possibility of regulatory capture. It is interesting that in Australia and the US the consensus seems to be that the advantages outweigh the disadvantages but in Britain this does not seem to be the view of either government or the industry. It is to be hoped that other papers at this conference will help shed more light on the advantages and disadvantages of such a regime.

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