An Application of the Economic Modelling Approach to the Investigation of Predation

By J. S. Dodgson*, Y. Katsoulacos†, and C. R. Newton*

1. Introduction

This paper is concerned with the issue of the identification of predatory behaviour. In particular, it is concerned with a comparison of a specific application of the conventional rule-of-reason approach adopted by certain competition agencies in the United Kingdom (namely, the Office of Fair Trading (OFT) and the Monopolies and Mergers Commission (MMC)), with an Economic Modelling Approach which we have developed (Dodgson, Katsoulacos and Newton, 1992) following a proposal by Philips (1987) on the appropriate way to identify predatory behaviour. The use of a particular case study generates data (of a sort that is normally commercially confidential) and enables us to assess both the limitations of a modelling approach and the light it casts on the more conventional rule-of-reason approach.

The case study we are concerned with is that of competition between bus operators in Inverness. This is one of the five allegations involving predatory behaviour in the British bus industry that were investigated formally by the OFT (see Office of Fair Trading, 1989a/b/c, 1990 and 1992). The OFT is concerned only with the issue of whether action is anti-competitive. If action is judged to be anti-competitive, the Director-General of Competition (the head of the OFT) has the power to refer the matter to the Monopolies and Mergers Commission. The MMC must also judge whether action is anti-competitive and, in addition, whether it operates against the public interest. Of the five formal bus industry investigations, three were judged to involve predatory/anti-competitive action, and two of these were referred to the MMC. In this paper we draw on information in the published reports of the Office of Fair Trading (1989b) and the Monopolies and Mergers Commission (1990), together with supplementary material from our own discussions with some of the participants and from additional sources of information (for example, on service levels).

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† Department of Economics, University of Liverpool, and Athens University of Economics and Business. This paper presents some of the results of a study on the identification of predatory behaviour in the bus industry funded jointly by the Economic and Social Research Council (grant number WD08250021) and the Department of Transport. The authors are grateful for their assistance, but neither organisation bears any responsibility for the content of this paper. The authors also thank the participants in the Inverness bus competition case for discussing the case and providing supplementary information. The views expressed in this paper are, however, the authors' own.
The Economic Modelling Approach considers the question of whether there is a profitable entry opportunity in the market where predation is alleged. If there is, but the entrant actually makes losses, then the approach considers whether action by the incumbent might have denied the entrant its profitable entry opportunity. The Economic Modelling Approach considers the opportunities available to both firms and the actions they take. While the results may in some circumstances be model-specific, the paper shows how the approach can be used both to provide general insights into the process of identifying predatory behaviour and to investigate particular cases.

2. Bus Competition in Inverness:
The Office of Fair Trading and Monopolies and Mergers Commission Investigations

On 21 March 1989 the Director-General of Fair Trading gave notice that his office would carry out an investigation under Section 3 of the 1980 Competition Act in order to establish whether Highland Scottish Omnibuses (HSO) had been or were pursuing a course of conduct which amounted to an anti-competitive practice. The matters to be investigated were:

(1) The conduct of the company in respect of its operation of local bus services in the Inverness area with particular regard to the use of additional vehicles on registered services and the reduction of fares to a level similar to those of a competitor, Inverness Traction Ltd. (ITL).

(2) Whether that conduct restricts, distorts or prevents competition in connection with the supply of local bus services in the Inverness area (Office of Fair Trading, 1989c, p. 1).

Inverness is the major town in the Scottish Highlands. The town itself has a population of some 42,600, and the surrounding district another 18,000. HSO was one of the eleven bus-operating subsidiaries of the nationalised Scottish Bus Group, itself a subsidiary of the Scottish Transport Group. HSO’s network of local bus routes operating in Inverness in 1988 accounted for some 30 per cent of its total revenue from local bus services and for 21 per cent of its overall turnover.

In May 1988 a new company, Inverness Traction Ltd., commenced operations in Inverness with eight minibus routes. It was formed by 19 owner-directors, most of whom had previously worked for HSO. In August 1988 the company expanded its operations by introducing a further seven minibus routes in Inverness. Inverness Traction went into receivership in March 1989, but its operations were taken over in April by Alexanders (North East) Ltd., a bus operator set up in 1988 and based in Aberdeen. The Inverness Traction name was retained, but Alexanders themselves were to go into receivership in November 1989. ITL operations were then taken over by Magicbus (Scotland) Ltd., a subsidiary of Stagecoach (Holdings) Ltd., the largest British bus operator. Competition in the town continued until September 1991.

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Highland Scottish was privatised in August 1991. In September the company imposed a new set of conditions on its workforce. Many of its drivers resigned and joined Inverness Traction, and after briefly attempting to continue operation of its services in Inverness, HSO withdrew from the town on 13 September (MacDonald, 1991).

In investigating allegations of predatory behaviour in Inverness the OFT adopted an approach that was common with their other investigations of predation in the bus industry. They defined predatory behaviour as follows:

"Predatory behaviour of the sort alleged involves the deliberate acceptance of losses in the short run with the intention of eliminating competition, so that enhanced profits can be earned in the longer term by raising prices above the competitive level" (Office of Fair Trading, 1989c, p.37).

The Office adopted a three-stage process in assessing whether behaviour was predatory. The first stage considered whether predation was feasible in the market under investigation. The second stage considered the relationship between the incumbent's costs and revenue, and in particular whether the incumbent's actual profits were negative (that is, \( \pi_m < 0 \)). If the incumbent did make losses in the market where predation was alleged, the third stage of investigation considered evidence of intent.

In all its formal investigations the Office believed that predation was a feasible strategy in the bus industry. Competition from cars and walking is limited. Asymmetries of information give existing operators an incentive to build up a reputation for toughness in the face of competition in order to deter future entry. Firms are free to vary fares as they wish, so that fares can be reduced once entry occurs (as happened in Inverness on the day that ITL entered the market) rather than in anticipation of possible entry. In contrast, service levels have to be notified 42 days in advance, so that incumbents have prior warning of entry. Incumbents may also have greater resources to finance losses.

The OFT’s Inverness report was published on 22 September 1989. HSO’s actions had clearly not prevented competition, but the Office believed that the actions had restricted competition and constituted an anti-competitive practice. The OFT judged that Highland’s actions had gone beyond a legitimate competitive response and constituted a significant restriction on ITL’s ability to compete. HSO had not earned enough revenue to cover total costs including overheads on their Inverness town services. The OFT (Office of Fair Trading, 1989b, p.43) identified five features which, it believed, indicated evidence of predatory intent rather than simply the short-run consequences of competition in a previously uncontested environment. These were:

(i) the 60 per cent increase in bus-miles operated by HSO, from the pre-entry first five months of 1988 to the first five months of 1989;
(ii) the increase in HSO’s costs by one third despite a fall in unit costs, as a result of the increased bus-mileage operated;
(iii) the continued operation of duplicate services on one route (route 12);
(iv) the undercutting of ITL’s fares on one route;
(v) the fact that Highland’s business plan indicated a willingness to accept losses over a period of time in the expectation that competition would cease.
The Office also considered that HSO’s actions would be likely to restrict competition because it was better able to sustain losses than were the entrants. It should be noted that the Office did not cite the matching of fares (a feature of the original reference) as evidence of predatory intent.

The Office sought undertakings from Highland Scottish regarding its future behaviour, but the company was not prepared to provide acceptable undertakings. As a result on 14 December 1989 the Director-General of Fair Trading referred the case to the Monopolies and Mergers Commission under Section 5 of the 1980 Competition Act. The MMC report was published in July 1990. It covered the period of competition from 15 December 1988 to 14 December 1989, so there was some overlap with the period covered by the OFT’s investigation. The MMC was required to consider: (a) whether HSO was engaging in an anti-competitive practice and, if it was, whether that practice operated, or might be expected to operate, against the public interest; (b) what adverse effects might result; and (c) what actions (if any) should be taken to remedy or prevent such adverse effects.

The MMC did find that HSO had acted in an anti-competitive manner:

“We are clear that in providing a grossly excessive volume of services, whilst incurring substantial losses, HSO pursued a course of conduct in relation to ITL that was likely to drive it out of the market and hence to have the effect of restricting competition ... HSO’s behaviour towards A(NE) [Alexanders] ... was no less anti-competitive than it was towards ITL” (Monopolies and Mergers Commission, 1990, pp. 50-51).

HSO “went too far: its provision of new services and of duplicates was grossly excessive, incurring losses that were unjustified...” (Monopolies and Mergers Commission, 1990, p.1).

The MMC’s conclusions were based entirely on HSO’s actions with regard to services operated, rather than with regard to fares. The MMC concluded that the matching of the entrant’s fares was a reasonable commercial response, even though the entrant’s initial fare may not have been commercially viable for the entrant. They argued that the fare undercutting on route 12 cited by the OFT as evidence of intent may not have been as significant as it first appeared. The incumbent had incorrectly anticipated that the entrant would charge its standard fare of 30p on a route extension and so lowered its own fare accordingly: the entrant then announced a fare of 50p, but in practice both operators charged 30p. Moreover, HSO continued to charge 30p for five months after the entrant had abandoned the service. On bus service levels, HSO was found to have breached the spirit of its parent Scottish Transport Group guidelines on overbussing, but both operators were believed to have operated extra services without regard to profitability:

“... both HSO and ITL put on as many duplicate services as they could with no regard to the demand, and little for the cost” (Monopolies and Mergers Commission, 1990, p. 50).

The MMC believed that HSO’s anti-competitive practices might have been expected to operate against the public interest, since the takeover of Inverness Traction by
Alexanders had been unlikely: in the absence of competition Highland Scottish would probably have adopted lower service levels and higher fares. As it turned out, the takeover of Alexanders by Magicbus meant that Highland Scottish had not been able to do this. The MMC identified two other effects likely to be adverse to the public interest. The first was that the experience of Inverness might have a general effect in inhibiting small newcomers from challenging established operators in the bus industry. Secondly, the experience of the owner-workers of Inverness Traction in losing the capital they invested in the company might discourage workers from participating in management and employee buy-outs when the nationalised Scottish Transport Group was privatised.

Nevertheless, the MMC did not propose any remedial or preventive measures. Their argument was that the Magicbus takeover of Inverness Traction meant that there was now no need for them to constrain Highland Scottish's actions. With regard to loss of entrepreneurial confidence, the Commission thought that its best short-term remedy would be "to make it clear to the bus industry that this Commission would normally expect to recommend briskly effective remedial action in any case referred to them in which they found the public interest adversely affected by an anti-competitive practice" (Monopolies and Mergers Commission, 1990, p.53). While the MMC has no powers to impose fines, the Commission also considered that the possibility of fines (under European Commission competition laws) might have "punitive and deterrent merits".

3. The Economic Modelling Approach

Philips (1987) argued that predation involves the conversion of a profitable entry opportunity into an unprofitable one. Thus, proof of predation should involve a rule-of-reason approach in which evidence is provided

"to the effect that an alleged predatory price cut turned a positive entry value into a negative one for the alleged victim. It should be shown that the present value of future profits is larger than the fixed sunk entry costs of the victim under normal competition and that the price cut made this value smaller than the fixed sunk entry cost. In simple words, this amounts to showing that without the price cut, there was room in the market for an additional firm under normal competition, that is, in a non-cooperative Nash equilibrium. And that, as a result of the price cutting, the price went below the non-cooperative Nash equilibrium price" (Philips, 1987, pp.67-68).

Our Economic Modelling Approach (EMA) is intended to make this proposed method operational. To do this we require a model which predicts the non-cooperative Nash equilibrium (or "normal competitive" equilibrium) in the market under investigation. We have set out such a model in Dodgson, Katsoulacos and Newton (1992).

If the model predicts that there is no positive entry value, that is, the equilibrium profits of the entrant \( \pi_e^* \) are negative, so that there is not room in the market for two firms, then either the entrant has entered by mistake, or alternatively the entrant is aware of the potential profitability of the market and is hoping to displace the existing incumbent. If, on the other hand, the model predicts that there is a positive entry value but the entrant actually makes losses, that is, the actual profits of the entrant \( \pi_e \) are negative, then
predation is a possibility. However, it is necessary to be careful to distinguish predation from other possibilities that are also consistent with positive equilibrium (\(\pi_{c}^{*} > 0\)) and negative actual (\(\pi_{c} < 0\)) profits for the entrant. One such possibility is that the entrant chooses the wrong level of entry, in terms of prices and/or service level, by mistake. Another is that the entrant deliberately chooses a price/service level combination which is not its own best response to the incumbent’s combination, in order to influence the incumbent’s behaviour: in the extreme, the entrant might choose a combination which denies the incumbent any profitable response. Such deliberate responses on the entrant’s part prove to be an important consideration in the competitive situation we analyse in Section 4 of this paper.

Our model of bus competition involves two firms competing on both price (fare) and service level. We measure service level in terms of the total bus-miles operated by each firm on the particular route (or in the particular town) being modelled. Bus operating costs are a function of both bus-miles and patronage, so that:

\[
C_i = F_i + m_i B_i + \hat{h}_i q_i
\]  

(1)

where

- \(C_i\) = total costs of firm \(i\),
- \(F_i\) = fixed costs,
- \(B_i\) = bus-miles,
- \(q_i\) = patronage (passenger journeys, or passenger-miles).

It is worth noting that most of the marginal costs are associated with bus-miles, so that marginal costs per journey or per passenger-mile (\(\hat{h}_i\)) are low in relation to marginal costs per bus-mile (\(m_i\)).

We have used both constant elasticity and non-constant elasticity formulations of demand. The constant elasticity demand function is:

\[
q_i = \alpha_i f_i^{-\eta_i} f_j \hat{h}_i B_i \hat{\epsilon}_i B_j \hat{\epsilon}_j
\]

(2)

where \(f_i\) is the fare of operator \(i\), and the elasticity parameters \(\eta_i, \hat{\eta}_i, \hat{\epsilon}_i\) are all positive.

We refer to the constant \(\alpha_i\) as a “strength of demand” parameter.

The non-constant elasticity of demand function is:

\[
q_i = \beta_i e^{-(\nu_i f_i + \hat{\nu}_i f_i^{-1} + \zeta_i B_i^{-1} + \hat{\zeta}_i B_i)}
\]

(3)

where \(\beta_i, \nu_i, \hat{\nu}_i, \zeta_i\) and \(\hat{\zeta}_i\) are all positive, and are related to their respective elasticities, for example,

\[
\eta_i = \nu_i f_i
\]

(4)

so the absolute value of fare elasticity rises with the fare.

Ideally one would wish to estimate the demand function using data on fares, service levels and patronage in a competitive situation. So far this has not proved to be possible. Generally in competitive situations firms are unwilling to release patronage data for reasons of commercial confidentiality. In the particular case study of competition in Inverness which we model in Section 4, data on patronage were published by the Monopolies and Mergers Commission for 21 four-week periods. However, we were unable to estimate demand function parameters satisfactorily for either model using these
data because (a) the two competing firms charged the same prices in each period, so it was not possible to estimate the separate effect of each firm's price on their own and their rival's demand, and (b) there were insufficient data to correct for the influence of seasonal factors on demand.

Our demand function has therefore been calibrated by using separate estimates of the own- and cross-price and service elasticities, and then solving for the parameters $\alpha_r$ or $\beta_r$ with data on actual patronage, fares and bus miles for the particular operator on the route under consideration. We have generated demand elasticity estimates using a generalised cost-of-travel framework. Potential bus passengers are viewed as having a preferred time of departure within a Hotelling-type framework. Their decision to travel by bus then depends on the generalised cost of travel, which is a linear function of the fare, the in-vehicle travel time, walking time and (if they have to choose a bus departure time which differs from their preferred time) "re-scheduling time". Potential travellers choose the bus that minimises their generalised cost of travel, and the decision as to whether to travel or not then depends on this value of generalised cost.

For any particular route it is possible to estimate generalised costs at different times of day, and hence patronage levels, using data on existing fares and the two operators' timetables, together with data from empirical studies of bus passengers' time valuations. Proportional changes in demand, and hence elasticities, can then be estimated by simulating changes in one operator's fares or his timetable and measuring the proportional effect on estimated demand. This is a second best to the actual estimation of the demand parameters, specifically because we cannot apply normal goodness-of-fit criteria to judge the demand model being used.

Nash equilibria for the constant demand elasticity version of the model are derived in Dodgson, Katsoulacos and Newton (1992), and derivations for the non-constant demand elasticity version are available from the authors on request. One advantage of the constant elasticity version over the non-constant elasticity version is that the former provides analytical, closed-form solutions for both firms' fares and both firms' bus-miles, whereas the latter provides analytical solutions for fares, but bus-miles have to be solved numerically from reaction functions. Both forms of the model permit derivation of Nash-equilibrium fares, bus-miles, patronage, revenue, costs and profits from estimates for both firms of fixed costs, the cost function parameters ($m_m$, $h_m$, $m_e$ and $h_e$), the own- and cross-price and bus-miles elasticities, and the demand constant parameters. The resulting Nash equilibrium profits $\pi_m^*$ and $\pi_e^*$ can then be compared with actual profits $\pi_m$ and $\pi_e$ estimated from observed fares, patronage, fixed costs and bus-miles, and the cost function parameters.

Consider the case where the model derives a positive entry opportunity for the entrant ($\pi_e^* > 0$) but the entrant actually makes losses ($\pi_e < 0$). This situation is necessary for predation, but not sufficient, since we need to check that the entrant is actually forced by the incumbent's behaviour to make losses, rather than being in a situation where either deliberately or in error it forgoes the prospect of profitability. To do this we can use bus-miles reaction curves derived from the model. These bus-miles reaction functions show the optimal (that is, profit-maximising) bus-miles for each firm given the bus-miles (and associated optimal fare) chosen by its rival.
In Figure 1 the entrant’s bus-miles are shown on the vertical axis and the incumbent’s on the horizontal. The curve $EE'$ shows the entrant’s reaction function, that is, profit-maximising bus-miles for the entrant given the incumbent’s bus-miles, the incumbent’s optimal fare and its own optimal fare; while the curve $II'$ shows the incumbent’s reaction function. The point $NE$ where the two reaction functions intersect is the Nash equilibrium, $B_m^* B_e^*$. If the incumbent produced more bus-miles than its $NE$ value, $B_m^*$, then this would reduce the profits of the entrant. If positive profits could be earned by both firms at the $NE$ ($\pi_m^* > 0$ and $\pi_e^* > 0$), then an increase in the incumbent’s bus-miles could eventually reduce the entrant’s best-response profits to zero. This is shown in the diagram by the point $X$, which lies on the entrant’s zero isoprofit curve $\pi_0$. Now, if the entrant actually made losses ($\pi_e < 0$) but the incumbent’s bus-miles lay below $B_m^X$, then the entrant would be able to earn profits if it changed its own bus-miles to a level which lay along its reaction curve $EE'$. In this latter case, the incumbent’s actions have not therefore denied the entrant a profitable entry opportunity and the entrant could survive in the market. Therefore, the incumbent’s actions have not prevented competition, though by reducing the profitability of entry in this market the incumbent may have slowed down or deterred entry into subsequent markets.

The entrant may also choose a level of bus-miles so high that the incumbent is denied a profitable opportunity, but we defer discussion of this possibility until our analysis of the case study evidence from Inverness.
4. Modelling Bus Competition in Inverness

4.1 Data used in the modelling exercise

The MMC report on Inverness contains patronage data for both Highland Scottish Omnibuses (the incumbent) and Inverness Traction (the entrant) for the 21 four-week periods from May 1988 when entry occurred. The report also contains bus-mileage data for HSO for the same period, and average fare data for both operators combined. Annual cost data for HSO's Inverness town services (with a breakdown into different categories of cost) are also reported for the years 1987, 1988 and 1989. We also had data on the entrant's bus-miles over the same 21 four-week periods. We constructed cost data for ITL from unit cost data published in the OFT and MMC reports and in a national study of minibus costs (Turner and White, 1990).

Table 1 summarises key data for both incumbent and entrant in the first full period after entry and in the last period modelled, a full year after entry. Competition was modelled separately for each of the twelve four-week periods starting on 20 June 1988, three weeks after entry, and finishing on 21 May 1989.

In order to derive elasticity values for the calibration of the demand functions, service timetables for all the different routes in the town for the two operators were combined in order to simulate a "representative" timetable to capture the structure of the timetabling on a "typical" route on a "typical" day in the periods modelled. This was done by calculating the total number of departures on all the operator's routes for each four-week period and dividing by the number of routes operated and the number of days in that period. Having obtained the average number of departures per day on an average route for both operators, the "representative" timetable for each period was created by presuming that the departures for each of the two operators were timed evenly throughout the day. We regard our use of a representative route in this fashion as justified since Highland Scottish was challenged by Inverness Traction on all its urban routes, and competition and frequency levels were high throughout the network.

Unit values of in-vehicle time and walking time were taken from estimates of time values for British urban bus travellers in MVA Consultancy et al. (1987), adjusted by means of an index of average earnings to May 1988 prices. The same source was used to proxy schedule delay time by using estimates of the values of bus passengers' waiting time. We estimated average waiting time for bus passengers in Inverness at six minutes and average in-bus time (calculated from route length and bus speed data) at seven minutes. Together with average bus-fare values, these estimates provided us with levels of generalised costs per bus trip on our representative route.

Generalised cost elasticity can be estimated as equal to the overall bus-fare elasticity (which we took to be -0.3) multiplied by the inverse of fare as a proportion of overall generalised cost. We then used the resulting generalised cost elasticity, together with the constant-elasticity-of-generalised-cost-of-travel demand function proposed by Goodwin (1984) to simulate the effects of a proportionate change of either fare or bus-miles on both firms in order to derive firm-specific elasticities.

The resulting own-fare elasticity values present a problem for the constant elasticity demand model because they are less than one in absolute terms, and thus inconsistent with
### Table 1

**Competition in the Inverness Bus Markets: Key Data for Competitors**

<table>
<thead>
<tr>
<th></th>
<th>One month after entry&lt;sup&gt;a&lt;/sup&gt;</th>
<th>One year after entry&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incumbent</td>
<td>Entrant</td>
</tr>
<tr>
<td></td>
<td>HSO</td>
<td>ITL</td>
</tr>
<tr>
<td>Fare per passenger journey (pence)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>25.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Bus-miles operated</td>
<td>71,700</td>
<td>48,400</td>
</tr>
<tr>
<td>Patronage (number of journeys)</td>
<td>198,700</td>
<td>82,300</td>
</tr>
<tr>
<td>Cost per bus-mile (pence)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>90.0</td>
<td>77.5</td>
</tr>
<tr>
<td>Profit/loss (£)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-29,700</td>
<td>-20,400</td>
</tr>
</tbody>
</table>

<sup>a</sup> The period one month after entry is the four weeks 20 June - 17 July 1988.

<sup>b</sup> The period one year after entry is the four weeks 24 April - 21 May 1989.

<sup>c</sup> All financial figures have been converted to constant (May 1988) prices.

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A (profit-maximising) Nash equilibrium. To deal with this difficult problem we had to use a separate entry condition (see Klepper, 1989) to derive the own-fare elasticities. Our entry condition presumes that an entrant could break even if it operated only one single bus journey, and from this the implied own-fare elasticity is derived.

In our empirical work we have found it convenient to average elasticities across operators. To give time-invariant parameters, all the elasticities were also averaged across the sample period. The resulting (constant) elasticities used in Inverness are:

- Own-fare: \(\eta_0\) = -1.02
- Cross-fare: \(\eta_1\) = +0.13
- Own-service: \(\varepsilon_0\) = +0.43
- Cross-service: \(\varepsilon_1\) = -0.21

These elasticity parameters, along with observed values of fares, bus-miles and patronage, were then used to solve for the constants in the demand equations for each period. These were not averaged across operators, in order to allow for the possibility of different strengths of demand for different operators, but they were averaged over time. The value of this constant parameter for the incumbent was 67 per cent greater than that for the entrant in both models, indicating that with equal fares and bus-miles the incumbent would capture 62.5 per cent of the market and the entrant 37.5 per cent. This clearly gives a considerable competitive advantage to the incumbent. One possible explanation for this phenomenon, which we also found in our other detailed case study of competition between an entrant and an incumbent (see Dodgson, Katsoulacos and Newton, 1992), is that there is a "loyalty" effect among passengers acting in the incumbent's favour. This might result from the existence of pre-paid travel passes, reliability or quality of services, or from the
inertia of existing passengers who choose not to try a new operator. A second possibility is that, although competition occurred on all the major corridors within the town, the entrant’s particular route configuration was inferior to that of the incumbent’s in terms of coverage, perhaps because the entrant’s managers had less experience in designing optimal networks to meet passenger demand.

4.2 Modelling results
Figure 2 shows our estimated Nash equilibrium and actual profits for the constant elasticity demand model in the first period modelled (20 June - 17 July 1988), while Figure 3 shows the situation in the last period modelled (24 April - 21 May 1989). The Figures show that both operators made losses, but that there was a profitable Nash equilibrium for both firms. As competition proceeded, the asymmetry in the Nash equilibrium became more pronounced as the incumbent’s comparative disadvantage (in unit cost levels) was reduced by cost-cutting measures while its comparative advantage (in terms of the strength of the demand for its services) remained. Both Figures, and the results for all the intervening periods, suggest a situation consistent with predation, and not inconsistent with the OFT’s and MMC’s findings.

However, as indicated in Section 3 above, we need to consider whether the combatants’ actual losses were avoidable. This is exactly what the EMA allows us to do. Figure 4 shows the firms’ bus-miles reaction functions in the first period modelled and Figure 5 in the last. To convert the profitable entry opportunity for the entrant identified in Figure 2 into an unprofitable one, the incumbent would have had to operate bus-miles to the right of CC’. Since the actual bus-mile combination is shown by point A, the entrant could have earned profits by reducing (considerably) its own bus-miles. Such an option was not open to the incumbent in the short run, since in the initial period point A lies above the line BB’. Thus no reduction in bus-mileage could restore the incumbent to profitability given the service levels operated by the entrant. However, as competition proceeded and the incumbent reduced its costs, so the line BB’ shifted upwards and the incumbent would be able to break even at higher and higher levels of service produced by its rival.

By the later stages of competition, as Figure 5 shows for the final period modelled, both firms had the opportunity to eliminate their own losses by moving onto their reaction functions, but chose not to do so. One explanation of such behaviour is that both operators made mistakes, but this becomes less likely as time goes by and the firms learn from experience. Another possibility is that they were engaging in Stackelberg warfare, with both firms attempting to obtain dominance in the market by expanding bus-miles in order to secure a more favourable market position in the future (see Katsoulacos, 1991). The incumbent was producing more output than in a competitive equilibrium and in doing so was forgoing some of its profits. The main plank of the OFT and MMC cases against HSO was that the company expanded output in the face of competitive entry, and so some of its losses were avoidable. However, the other side of the coin, which is revealed by the EMA’s emphasis on the actions of both firms, is that the entrant entered with a level of output which was also above the competitive level (and in the initial phase of the competition so high as to deny the incumbent the possibility of a profitable response in the
Figure 2

*Actual and Nash Equilibrium Profits in Inverness One Month After Entry*

Key: $\Pi_I$: Incumbent’s profit; $\Pi_E$: Entrant’s profit; $A$: Actual; $E$: Estimated

<table>
<thead>
<tr>
<th>Data</th>
<th>Actual Outcome (A)</th>
<th>Nash Equilibrium (E)</th>
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<tbody>
<tr>
<td></td>
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<td></td>
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<tr>
<td>Fare (pence)</td>
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<tr>
<td>Bus-miles</td>
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</tr>
<tr>
<td>Patronage</td>
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<td>82,000</td>
</tr>
<tr>
<td>Profit/loss (£)</td>
<td>-30,000</td>
<td>-20,000</td>
</tr>
</tbody>
</table>

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Figure 3

Actual and Nash Equilibrium Profits in Inverness One Year After Entry

Key: $\Pi_i$: Incumbent’s profit; $\Pi_e$: Entrant’s profit; $A$: Actual; $E$: Estimated

Data

<table>
<thead>
<tr>
<th></th>
<th>Actual Outcome (A)</th>
<th>Nash Equilibrium (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incumbent HSO</td>
<td>Entrant ITL</td>
</tr>
<tr>
<td>Fare (pence)</td>
<td>27.7</td>
<td>27.7</td>
</tr>
<tr>
<td>Bus-miles</td>
<td>102,000</td>
<td>72,000</td>
</tr>
<tr>
<td>Patronage</td>
<td>227,000</td>
<td>113,000</td>
</tr>
<tr>
<td>Profit/Loss (£)</td>
<td>-26,000</td>
<td>-24,000</td>
</tr>
</tbody>
</table>
short run). It seems unreasonable to penalise only one of the combatants in this competitive battle, that is, to expect an incumbent to acquiesce when faced by very aggressive entry and not to fight back with a similarly aggressive response. This conclusion is strengthened by the fact that, as again the EMA reveals, the entrant could have avoided losses by a different response to the incumbent’s post-entry bus-mile choice.

In the event, the incumbent did have an advantage in the form of a longer purse. The entrant did not respond by retreating to the much lower, but profitable, output level which our model has identified, but instead continued its Stackelberg-type warfare until it went bankrupt.

So far the analysis of the model indicates that the incumbent was not preying in the sense of seeking to eliminate competition. This is consistent with the OFT/MMC conclusion, in the sense that the OFT/MMC found that competition had not been
eliminated in Inverness simply as a matter of fact. HSO’s actions might deter future entry because they had made life very difficult for entrants, and HSO had forgone some of its own short-run profits in order to reduce the entrant’s profits. In apportioning blame to HSO’s actions we believe that due allowance should be made for the fact that the entrant was also behaving in a similarly aggressive manner and that the entrant could have avoided its losses by alternative responses to the incumbent’s actions. Further, account must be taken of the fact that, throughout this period of warfare, consumers have benefited from better services than would otherwise have been provided.

However, one problem with the Economic Modelling Approach is that results may be specific to the particular form of model chosen. In the Inverness case the results differ between the constant elasticity and non-constant elasticity variants. While both models suggest that both firms could have performed better in Nash equilibrium than they did in
practice, the non-constant elasticity version denies the possibility of a profitable entry opportunity (and hence of predation).

Although this raises the possibility that there was not a profitable entry opportunity after all, we think that the balance of evidence supports the counter view. In choosing between the models a powerful argument in favour of the constant elasticity model in this case is the fact that entry did continue in Inverness, with ITL replaced first by Alexanders and then by Magicbus/Stagecoach (itself a sophisticated operator likely to be able to assess profitability prospects). Two operators served the town from May 1988 to September 1991, a period of over three years. In its evidence to the OFT the Highland Regional Council also believed there was room for two operators in Inverness (Office of Fair Trading, 1989b), as did the Managing Director of Magicbus in his evidence to the MMC (Monopolies and Mergers Commission, 1990).

If, on the other hand, there had been no profitable entry opportunity, the entrant must have entered by mistake unless it expected to displace the incumbent completely. HSO certainly claimed in its evidence both to the OFT and to the MMC that this is what it believed ITL’s objective to be (Office of Fair Trading, 1989b; Monopolies and Mergers Commission, 1990). Faced with an entrant in such circumstances an incumbent which was informed about market profitability might reasonably be expected to defend its position staunchly, especially in the period when it was reducing its costs.

5. Conclusions

This paper has compared the Economic Modelling Approach to the identification of predatory behaviour with a more conventional rule-of-reason approach. The major problem with the EMA is in choosing the particular form of model to use in order to model competition in a particular market, and in deriving the parameter estimates to be used in practice with this model. There is always the problem that results may be model-specific. The EMA involves a particular view of what constitutes “normal” competitive equilibrium, and it requires specific forms for the demand and cost functions. In our present study we have not been able to estimate the parameters of these functions statistically, though we have derived empirical values through an alternative process. Consequently we have not been able to distinguish between alternative forms of the model statistically, though this could be done in the future if suitable data became available.

The usefulness of the EMA can be viewed in two main ways. First, it provides general insights into the process of identifying predatory behaviour. Secondly, it provides a more complete picture of the various alternatives open to the competing firms in the investigation of particular cases. The early OFT/MMC investigations were primarily concerned with the incumbent’s profits, and whether they were positive or (avoidably) negative. The EMA shifts the focus of attention to the entrant’s profits, and whether they could be positive in the circumstances under investigation. The conventional approach seems to overlook the possibility that there may not have been a profitable entry opportunity in the first place. If this were so, then an incumbent might be falsely accused of predatory
behaviour when it had no choice but to make losses if it wished to stay in this (natural monopoly) market. The EMA also focuses attention on the actions of both firms in the market. Incumbents may be accused of aggressive behaviour, but the behaviour of the entrant is also relevant: it is possible that aggressive behaviour by the incumbent may be a response to aggressive entry, and both firms may be trying to eliminate or discipline the other. (Later OFT investigations did concentrate on the actions of the entrant. See Office of Fair Trading, 1992.) The "rationality" of the entrant is also relevant: an inexperienced entrant who makes mistakes could impose losses on the incumbent (and on itself), and might be particularly difficult to counter since the incumbent cannot be sure that the entrant will respond in a profitable manner to changes in the incumbent's fares and service levels.

Finally we must consider the practicality of the EMA as a means of identifying predation in particular circumstances. Developing models to analyse competition in specific markets is a complex process. However, for the bus industry, we have developed software which has enabled the EMA to be applied to particular investigations. The model can be used to test the sensitivity of the results to changes in the form of the model or the parameter estimates. Hence, elasticity values or cost parameters, or both, can be varied to see how far this affects the results in a particular competitive situation. Where results are not particularly sensitive to changes in model specification or parameter estimates, the regulator can be reasonably confident about the results of the model, and the EMA is then a very valuable adjunct to the more conventional approach. In the Inverness case we conclude that the actions of the incumbent did, as the OFT and MMC believed, reduce the profit potential of the entrant, but we also conclude that the incumbent faced a very serious competitive threat from an entrant which was also forgoing profit in order to eliminate its rival.

References


Monopolies and Mergers Commission (1990): Highland Scottish Omnibuses Ltd. HMSO.


Transport and Road Research Laboratory (1980): The Demand for Public Transport. TRRL, Crowthorne.

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