COMPETITION ON AN URBAN BUS ROUTE

A Comment

By C. A. Nash*

Dr. Glaister (1985) has presented a very interesting model of the effects of allowing minibuses to compete with standard buses on an urban bus route. One might simply welcome it as a contribution to the debate, if it were not that the Buses White Paper (Department of Transport, 1984) cites it as an important piece of evidence in favour of the proposed policy of unrestricted competition in Britain. The current policy significance of Glaister's work requires us to examine both the model itself and the data inputs for a degree of realism which we would not otherwise necessarily require of an exploratory paper on an under-researched topic.

THE MODEL

Any simulation model is bound to contain unrealistic assumptions and short cuts to make the problem manageable. Unfortunately, it is not always easy to tell whether or not these affect the results seriously. However, in this case, it is our view that both the predictions themselves and the estimates of the resulting benefits to passengers are so inherently implausible that the performance of the model is likely to suffer severely from the following shortcomings.

Firstly, there is a serious difficulty in making any forecast of the outcome of free competition in the bus industry. This is that it is possible for the industry as a whole to break even, and for the marginal revenue of placing one extra bus on the road to equal the marginal cost, at a wide range of combinations of fares and output (see Appendix). Glaister overcomes this problem by a simple device. He pegs the load factor for each type of vehicles at a given level, and sets the fare so as to break even at that load factor. This produces a unique equilibrium, but it is an arbitrary one. Moreover, it affects the predictions in two ways:

(a) The base position, and the adjustments in fares and services occasioned by a reduction in subsidy without deregulation, are determined in an arbitrary fashion, rather than in accordance with optimising procedures. This is very important. The assumed mean bus load of 40 is very high, and has the result that in the base — even with high frequencies — so many buses are full that waiting times in the centre are very long. If

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the base position is unrealistically sub-optimal, this will naturally strengthen the case for deregulation.

It may be argued that, for the peak at least, 40 is not unreasonable. However, this brings in another problem. There is apparently no allowance in the costing for "peak only" operations. These would inflate the costs of any type of operation, but the marginal cost of coping with the peak is presumably lower for big buses than for small. Thus it seems likely that the fares are understated both for big buses and for minibuses, unless he is assuming that extra peak services will cease to be provided. Certainly, the big bus fares are very low indeed.

(b) Glaister gives no reason why, after deregulation, the market should not settle down with lower fares and higher load factors (lower frequencies) or vice versa, rather than with those forecast. Indeed, he himself suggests that minibuses may well be higher, permitting lower fares but giving longer waiting times. It should also be noted that no buses are permitted to turn short of the suburban terminus. This seems unlikely in practice, in view of the higher load factors to be obtained closer in to the city centre — it seems likely that under free competition the combination of fares and frequencies at the suburban terminal would, other things being equal, be considerably poorer than is suggested by this assumption.

Some examples may be worth giving of the way in which these unrealistic assumptions lead to the conclusion that passengers, by and large, would prefer a service with a high frequency and very high fares to what they have at present. For instance, in the high flow case, after the cut in subsidy but before deregulation, it appears that in the suburbs — with 7.4 buses per hour — average waiting time is 4 minutes. Towards the centre, even with 44 buses per hour, this rises to a maximum of 13.8 minutes! What must be happening is that a large proportion of the big buses are running full, thus providing ample opportunity for savings in waiting time to be achieved by large numbers of minibuses. But it seems most unlikely that these waiting times on high frequency routes are typical in practice: faced with such problems, most operators would supplement the service over the busier part of the route.

For low frequency routes too, some of the waiting times appear to be unreasonably long. For instance, with 2.6 buses per hour in the suburbs, the typical waiting time is 10.8 minutes. This clearly assumes a random arrival of passengers: at such low frequencies, many passengers would in fact know the timetable and arrive accordingly.

COST SAVINGS

One of the interesting points in Glaister's paper is that it gives us some indication of how the Department of Transport expects the predicted cost savings to occur as a result of competition. The White Paper asserts that the differences in operating cost between Passenger Transport Executives and the National Bus Company, and between the NBC and private operators, suggests that there is potential for a cost saving of 30% to 40%. This ignores differences in the nature of the services
operated. When we examined a sample of one PTE, one municipal operator and two NBC subsidiaries, we found that differences in cost per mile were almost entirely explained by differences in operating conditions (Mackie and Nash, 1982).

But the Department's non-competitive and competitive costings here are instructive. For big buses, it apparently assumes that crew will work 14% more driving time per hour paid, for 29% lower wages. There are also big reductions in capital and maintenance costs, presumably for similar reasons. Thus it is clear that workers in the bus industry are expected to pay much of the cost of deregulation. On the other hand, it must be said that the predicted minibus operations would generate very large numbers of low-paid jobs. To debate whether this is the best way of overcoming the current high levels of unemployment in British cities would take us far beyond the scope of this note!

It should also be noted that, in the case where minibus entry occurs but the competitive cost reduction is not secured, Glaister's paper assumes a very large increase in absolute subsidies. The reason is that a subsidy of one-ninth of costs after minibus entry is more than twice as much as in the base. Without that increase in subsidy, the effects of minibus entry would be much less favourable to the passengers.

THE BENEFITS OF MINIBUSES

Let us examine the case for minibuses, using reasonable assumptions about existing fares.

Glaister's paper suggests the following typical (non-competitive) costs for big and small buses on medium flow routes:

**Big** (88 capacity at 6.88 m.p.h.)

- £2.1297 per vehicle mile
- (£1.3296 after competition)

**Small** (15 capacity at 7.74 m.p.h.)

- £1.2957 per vehicle mile
- (£0.8377 after competition)

Thus, small bus costs per seat mile are

\[
\frac{1.2957}{2.1297} \times \frac{88}{15} = 3.57 \times \text{big bus costs per seat mile}
\]

(or

\[
\frac{0.8377}{1.3296} \times \frac{88}{15} = 3.70 \text{ after competition}
\]

If, as Glaister assumes, load factors and proportionate subsidies are similar for big and small buses, then fares will also be in a similar ratio.

Suppose that a typical big bus fare is 20p for a two-mile journey. The small bus fare would be 71p. In-vehicle time savings would be slightly under 2 minutes. Thus, for each of Glaister's three categories of passengers, the saving that must be made in waiting time, if passengers are to be better off using a minibus rather than
the existing bus, is given by \((51/2V) - 2\), where \(V\) is the value of time of this group and waiting time is given double weight. The results are:

<table>
<thead>
<tr>
<th>Type of Time</th>
<th>Value (p/min)</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High value of time</td>
<td>2.40</td>
<td>8.6</td>
</tr>
<tr>
<td>Medium value of time</td>
<td>1.35</td>
<td>16.9</td>
</tr>
<tr>
<td>Low value of time</td>
<td>0.57</td>
<td>42.7</td>
</tr>
</tbody>
</table>

On a typical busy urban bus route, there would seem to be little chance of the savings in waiting time that would be necessary to make minibuses attractive, even to users with high value of time. Thus we conclude that, running as Glaister assumes, minibuses would be neither profitable nor socially desirable.

The only way for minibuses to become commercially attractive would be to achieve much higher load factors than conventional buses. For instance, if they achieved a load factor twice as high, the cost ratio would be reduced to 1.8. If we rework the calculations, the fare on minibuses would be 36p and the necessary time savings \((16/2V) - 2\), or for the three categories of passengers:

<table>
<thead>
<tr>
<th>Type</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1.33</td>
</tr>
<tr>
<td>Medium</td>
<td>3.93</td>
</tr>
<tr>
<td>Low</td>
<td>12.04</td>
</tr>
</tbody>
</table>

It would now seem likely that passengers with high value of time would prefer the minibus, though low-value passengers would certainly still prefer conventional buses. However, we must ask what sort of policy minibus operators would need to follow to achieve such an increase in load factors. Probably it would involve:

1. Reducing peak capacity to the level justified by off-peak patronage, unless part-time crew could be found for peak extra work.
2. Shuttling on the more heavily used parts of the route, with few or no buses proceeding to the extremities.
3. Operating few or no services in the early morning and evening and on Sundays.

But big bus operators too could achieve much higher load factors if they adopted the same tactics. It is likely that they would then again present a more attractive marketing mix than small buses. We therefore conclude that:

The presence of cross-subsidy in big bus operations does present the possibility that minibuses could operate profitably at very high load factors by "creamming" the best traffic.

But either

This cross-subsidy is undesirable, so it could end, and big buses could then defeat the minibus competition,

or

The cross-subsidy is desirable, so minibus entry to undermine it should be prevented.

In neither circumstance, therefore, do we see a case for minibus operation on busy urban bus routes.

**CONCLUSIONS**

Enough has been said in this note to suggest that the model presented in Glaister's paper is so unrealistic that its predictions should not be taken seriously. Thus it cannot be regarded as evidence for or against the policies advocated in the White
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paper. We do believe that there is a prospect of minibus entry, but that the consequences in terms of fares and service levels, particularly for poorer users of public transport, will be very much less favourable than Glaister supposes.

APPENDIX

Breakeven Levels of Fares and Output

If \( C = C(F) \) and \( Q = Q(P,F) \)

where

\[
\begin{align*}
C & = \text{total cost} \\
F & = \text{frequency} \\
Q & = \text{no. of passengers carried} \\
P & = \text{fare per trip}
\end{align*}
\]

then breakeven is given by

\[
C(F) = P.Q(P,F).
\]

Generally, this will represent a whole locus of possible combinations of price and frequency at which the industry may break even.

At any point on this locus, an operator who placed one extra bus on the road would expect to gain \( [B \cdot P.Q(P,F)]/F \) in revenue (where \( [P.Q(P,F)]/F \) is the average revenue per trip and \( B \) is the number of trips made per bus). On the assumption of constant costs per trip he will incur costs of \( [C(F)/F] \) \( B \) which must be equal to \( [B \cdot P.Q(P,F)]/F \) to just break even; or, in other words, \( C(F) = P.Q(P,F) \) as stated above.

Thus at no point on this locus is there any incentive for entry to or exit from the industry.

A Rejoinder

By Stephen Glaister †

It is self-evident that a single simulation study can do no more than explore and illustrate points of principle, and assist the development of intuition. This is the spirit in which my work was cited in an appendix to the Buses White Paper (Department of Transport, 1984). Different readers will draw different conclusions from this kind of exercise; that is why I was keen that an account of it

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should be publicly available. The aim is to concentrate on the important issues, so an exercise of this kind is bound to be unrealistic in some respects, and it cannot represent all the varied circumstances to be found in the real world. Dr. Nash's comments are helpful in improving understanding of the limitations. The debate would be advanced further if he and others were to present modelling work which illustrated their own propositions.

The particular route chosen for analysis was certainly not typical of urban bus routes in general. Patronage and bus load factors were high, especially in the peak. A reason for the choice was simply that, in the two months that were available to complete the work, there was little prospect of obtaining sufficiently detailed data on an alternative route. In addition, the case of London is of obvious special interest. By using the data to hand I was at least able to base my study on observed data. The modifications to the observed situation - notably the geographical imbalance in demand - were intended to add features which had been claimed to favour the big bus over the small bus. I agree that this may have led to exaggerated waiting times at one or two points under regulation. However, it is part of the case against regulation that the practice of cross subsidy often involves the sub-optimal "starving" of heavily patronised routes such as these. The average big bus load of 40 assumed for the peak cases may seem high; but the observed average was 58 for the central section alone, and the assumed load was reduced to 29 for the low flow case that I considered. (I would draw attention to the footnote to my paper, on page 71: the extreme waiting time quoted by Nash was a case that occurred at a particular instant, and was probably caused by bunching of vehicles. It was not an average or a typical situation.)

The observation that an equilibrium can be achieved at each of a range of fare levels (the substance of Nash's Appendix) is a familiar one - for instance, it was made in this Journal by George W. Douglas (1972). How this ambiguity might be resolved in real markets in the absence of fares regulation is open to debate. That is why I chose to "close" the model by fixing average load factors, which - with given costs and the zero profit condition - is equivalent to fixing fares. Nash is correct in saying that I did not consider whether the particular resulting equilibria were any more plausible than alternatives. Nash's illustrative calculations serve to show that, with the particular level of fares that he hypothesises (not mine), the load factors I assumed would be unlikely to be consistent with an equilibrium covering both large and small buses. But this only suggests that the small buses should try an alternative strategy. The particular fares that I hypothesised in the base were simply those which would be consistent with the assumed costs, subsidy and load factors, and zero profit. Because the load factors were untypically high, the fares were untypically low.

In recognition of the preliminary nature of the work, I have since carried out a much more detailed study of the main bus services in a provincial city. Individual routes and stops were modelled, and considerable care was taken in the representation of the base situation. Experiments were carried out with a wide variety of pricing (load factor) strategies to investigate a range of possible competitive outcomes. Large variations in costs, boarding times and small-vehicle sizes were also tried. The passenger flows were lower than those in the London study, and so the effects of deregulation tended to be muted by comparison. However,
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the conclusions were generally similar. In brief, providing that costs and boarding times were not too different from those assumed, it seemed that the very big bus was fundamentally uncompetitive with vehicles no bigger than 45 seats. The dense routes enjoyed a substantial expansion. Some of the remainder, which received cross subsidy under regulation, expanded a little, and some contracted somewhat. On the denser routes minibuses often operated in competition with larger vehicles, offering a faster service at a premium of something of the order of 50%. On thinner routes it was more likely that minibuses alone would operate. I would be happy to supply a copy of this study on request.

REFERENCES