COMPETITIVE BUS SERVICES WITH MONOPOLY FARES

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April 1989

Acknowledgements

This work was supported by the Economic and Social Research Council. The author is grateful to bus operators, Gordon Mills, and Jonathan Preston for comments which helped stimulate this paper.

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SUMMARY

This paper extends the author's previous theoretical model of bus competition (Evans, 1987) to consider what happens when competitive bus operators set fares on the presumption that any fare changes they make will be matched by their competitors. This leads to monopoly-level fares and high frequencies. The high frequencies are wasteful, and the economic benefits of such a service are 30 to 50 per cent less than those of the optimal zero-subsidy service. The paper discusses some empirical cases of competition in the light of these results.

potential passenger is assumed to travel, if (s)he travels at all, on that bus for which the sum of the rescheduling cost and the fare is smallest. The demand function for travel is presumed to be exponential; that is, in absence of rescheduling the proportion of the potential passengers who actually do travel is exp(-f/v), where f is the fare, and v is a parameter, assumed in numerical work to be 60 pence per journey. Bus operators are all assumed to have the same costs, which comprise a fixed element F per bus journey, together with a marginal element m per passenger carried. In numerical work F was assumed to be 800 pence per bus journey, and m 10 pence per passenger.

With these assumptions we considered in the previous paper the outcomes of four different operating regimes for the bus services. These were the following.

(1) A regulated regime in which frequencies and fares are chosen by a public authority so as to maximise net economic benefit without restriction. This leads to a large subsidy. This was previously labelled "unconstrained maximum net economic benefit" or "unconstrained MNEB".

(2) A regulated regime in which frequencies and fares are chosen by a public authority so as to maximise net economic benefit, subject to a zero-subsidy constraint. This is a zero-subsidy/zero-profit regime. As usual, we count normal profit as part of costs, so that zero profit means zero superprofit. This regime was previously labelled "breakeven MNEB".

However, the welfare properties of the competitive regime depend on an assumption about the behaviour of operators which is beginning to seem unrealistic in the light of empirical information on competitive practice in Britain. This leads us first to consider an alternative assumption about operator behaviour, and secondly to use our model to look at the welfare implications of the alternative. We do this in the next section. The empirical information leading us to question the previous assumption comes from Tyson (1988), Mackie and Preston (1988), and data collected by the author on competition in Lancaster and Stockton-on-Tees, which are not yet published but which are outlined in section 4 below.

3. THE COMPETITIVE REGIME WITH MONOPOLY FARES

The questionable point in our previous analysis of the competitive regime is the assumption that operators choose their own fares on the presumption that their competitors' fares are fixed. This is the "zero conjectural variation" assumption. There are two reasons for questioning it. First, at the micro level, most operators do not appear to make this assumption. On the contrary, they are more likely to assume that their own fare changes will be matched by their competitors, especially if the changes are in the downward direction. Secondly, the assumption leads theoretically to competitive equilibrium fares that are lower on high-demand routes than on low-demand routes. This is inconsistent with the actual fares in most of the large-scale cases of competition known to the author, where the pre-deregulation fare scales have generally been maintained in spite of sometimes intense competition, and where there is little or no fare discrimination between routes on account of their demand levels. This evidence fare-matching presumption leads to a zero-subsidy/zero-profit service with higher fares and frequencies than the previous competitive equilibrium, which itself has higher-than-optimal fares and frequencies. We now estimate the difference in welfare between the fare-matching competitive regime and the zero-subsidy/zero-profit optimum.

The first step is to obtain the three equations to be satisfied by the fare, f, the headway, h, and passengers per bus, q, in the fare-matching competitive regime. These equations may straightforwardly be derived in a manner analagous to the corresponding equations for the other regimes discussed in Evans (1987). The derivation is a formalisation of the discussion in the previous paragraph. We give the equations here without proof. The symbols were defined in section 2. The equations are:

$$f = m + v, \quad (1)$$

$$q = \frac{2Lv}{c} e^{-f/v}\left(1 - e^{-ch/2v}\right) \quad (2)$$

and

$$(f - m)q - F = 0. \quad (3)$$

These equations may be solved without iteration for f, q, and h, from which the frequency in buses per hour, and net economic benefit per hour or per potential passenger can be calculated. Note that equation (1) shows that the monopoly fare is independent of the demand density, L. We have solved these equations with the buses are allocated to the route is an integer, the frequencies for each regime would rise in jumps with demand density. This possibility was discussed in section 5 of Evans (1987, pp27-31) for the four original regimes. One important consequence of discrete headways is that operators generally make superprofits under competition. They also make superprofits under competition with monopoly fares, but we do not now pursue the details, because this issue does not affect the main conclusions of this paper.

TABLE 2 HERE

Table 2 shows that the adverse welfare consequences of the non-optimal frequency/fare combination under competition with monopoly fares are very serious; the description "wasteful competition" is well justified. The loss in net economic benefit compared with the optimum zero-subsidy regime rises rapidly with demand density from zero at the minimum of 1.070 potential passengers per minute (pp/m) to more than 30 per cent at 2 pp/m, 40 per cent at 3 pp/m and 50 per cent at 8 pp/m. It can be shown that limiting percentage loss as the demand density tends to infinity is 100(1-(1/e)), or 63 per cent. It can also be shown that these levels of percentage loss are invariant with respect to the parameter values, for the same reason as are the percentage losses in the competitive regime with zero conjectural variation. (See Evans, 1987, p24 and Appendix 1 for further discussion.). The only effect of altering the parameters is to change the demand level at which each percentage loss occurs. Since large percentage losses, of the order of 30 to 50 per cent, arise over most of the demand range, we conclude that such losses are the norm in this regime. These figures may be promote such high fares and high frequencies.

4. EXAMPLES OF COMPETITION IN PRACTICE

This section outlines evidence from two current cases of area-wide bus competition studied by the author, Lancaster and Stockton-on-Tees. These cases appear to be not untypical of enduring competition between major operators. They are different from a third case studied by the author, Hereford, (Evans, 1988), where the fare and service patterns seem more in line with the original model of competition. However, Hereford may prove to be exceptional in this respect.

Both Lancaster and Stockton have seen continuous and widespread competition from deregulation day (26 October 1986) until the time of writing. Lancaster is a pure duopoly, the two operators having provided a joint service before deregulation. Knowles (1987) gives a description of Lancaster before and after deregulation. Stockton has three major operators, one of whom is an entrant, together with some minor ones. In both cities frequencies rose greatly in the two years following deregulation, by about 140 per cent in Lancaster and by 60 per cent in Stockton. In both cities the pre-existing distance-related fare scales have been maintained intact by the major operators. In both cities the major operators have implemented fare increases on the same dates and by the same amounts. In both cities fares have been raised by slightly more than inflation. In neither city is there discrimination in fares between routes on account of varying density of demand.

The fare-setting decisions in Lancaster and Stockton seem more long term. If they all feel they need increased revenue in order to finance their competitive services, they could agree on greater fare increases, and, once fares are increased, no major operator is likely to reduce them, for the reason given above. Thus, we could see real fares creeping upwards under competition towards the monopoly level, with a correspondingly high service level.

The author does not have any data on costs and patronage in Lancaster and Stockton by which to estimate the current economic benefits of the bus services in those cities. However, it is fairly clear that the average mainstream user is currently better off than (s)he was before deregulation. This is because real fares have risen only slightly while service levels have risen greatly. This assessment might change if real fares creep up as suggested above. However, it is also fairly clear that the operators must have substantially reduced their costs; otherwise they would not be able to provide the increased service levels for only slightly higher real fares. It follows that the benefits of these reduced costs could alternatively be passed on to passengers in the form of reduced fares. Therefore, although user benefits are now higher than they were before deregulation, they are lower than they could be, given current costs. The only means we have of getting a feel for the welfare losses is by reference to the theoretical model discused above. This suggests that the welfare losses under such competition could be high.

5. CONCLUSIONS

We have extended the theoretical model of bus competition in Evans (1987) to consider the case where bus operators presume that raising fares in real terms in future. Even now, fares and frequencies are likely to be well above the optimum, given current operating costs. The theoretical model suggests that this may be causing a large loss in benefit, although, because fares are probably not now at the monopoly level, this loss is not as large as the 30-50 per cent in the model.

TABLE 1. BUS FREQUENCIES PER HOUR

Demand Level, L (Potential Passengers per Minute)	Zero-Subsidy Maximum Net Economic Benefit	Competition with Zero Conjectural Variation	Competition with Monopoly Fares	Protected Monopoly	Unconstrained Maximum Net Economic Benefit
1.070	0	0	0	0	1.2
1.1	0.4	0.4	0.4	0.3	1.2
1.2	0.6	0.7	0.7	0.4	1.3
2.0	1.3	1.8	2.0	0.8	1.8
3.0	1.9	2.9	3.4	1.2	2.4
4.0	2.4	3.8	4.8	1.5	2.8
5.0	2.8	4.6	6.2	1.7	3.3
6.0	3.2	5.3	7.6	2.0	3.6
7.0	3.5	6.0	9.0	2.2	3.9
8.0	3.8	6.6	10.4	2.4	4.3
9.0	4.1	7.2	11.8	2.5	4.5

TABLE 2. COMPARISONS OF NET ECONOMIC BENEFIT

Demand Level, L (Potential Passengers per Minute)	Difference in Net Economic Benefit per Potential Passenger from that under the Optimal Zero-subsidy Regime			
	Competition with Zero Conjectural Variation	Competition with Monopoly Fares	Protected Monopoly	Unconstrained Maximum Net Economic Benefit
	%	%	%	%
1.1	-3.5	-4.7	-34.2	+174
1.2	-7.8	-12.5	-38.8	+84
2.0	-12.2	-32.0	-38.5	+17.1
3.0	-11.3	-39.8	-36.3	+11.0
4.0	-10.2	-43.7	-34.9	+5.1
5.0	-9.3	-46.2	-33.9	+3.7
6.0	-8.6	-48.0	-33.2	+2.9
7.0	-8.1	-49.3	-32.7	+2.3
8.0	-7.6	-50.3	-32.3	+2.0
9.0	-7.2	-51.1	-31.9	+1.7