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DEREGULATING THE BUS INDUSTRY

by

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ABSTRACT

Deregulating the Bus Industry

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In its Buses White Paper, the British Government sets out its proposals for abandoning quantitative control of entry to and provision of local bus services. The logic on which the proposals are based can be reduced to four propositions:-

(i) Deregulation will produce a competitive market.
(ii) Competition will substantially reduce costs.
(iii) A competitive market will improve resource allocation.
(iv) A competitive market will not cause any significant undesirable spin-off effects.

Each of these propositions is suspect.

If there is any competition on bus routes, it will tend to be small group rather than large group. Active rivalry involving schedule matching and price wars may occur, as may collusion. Neither will produce efficient results.

Even if a competitive result were to obtain, the resulting resource allocation would not be socially efficient. A first best optimum requires subsidies because the market is subject to external economies (the Mohring effect). If Government budget constraints operate, the second-best solution then requires cross-subsidies. Competition is not compatible with social efficiency in either of these cases. Nor will the competitive market solution optimise load factors. Quality competition, in the form of minibuses 'creaming' the best traffics, may also be socially undesirable.

The White Paper authors underplay the significance of these resource allocation arguments, while exaggerating the likely impact of deregulation on cost efficiency. Even though some cost savings may be available they could be obtained anyway under a regime of competitive tendering for profitable as well as unprofitable routes. Competition for the market rather than competition in the market is required.

DEREGULATING THE BUS INDUSTRY

In its White Paper "Buses", [1] the British government sets out its proposals for creation of a freer local bus service sector than exists in any developed industrial economy in the world. The purpose of this paper is to examine the basis and nature of the proposals, and particularly to assess the validity of the analysis that has been presented in support of them.

The White Paper diagnosis of the bus industry is that a potentially virile sector is being stifled to such an extent by regulation that the variety and quality of service is poor, demand is unnecessarily low, and costs unnecessarily high. The prescription is for a heavy dose of free competition on the road between commercially motivated, financially autonomous companies, supported (lest the cure be worse than the disease) by tighter quality regulation, fair competition protections, and direct support of socially desirable unremunerative services. The prognosis is the elimination of cross-subsidy, the introduction of new types of service, and the establishment, essentially through market pressures, of the best attainable price/frequency/quality combination consistent with the external finances available.

The essence of the White Paper can be reduced to four propositions.*

1. Deregulation will produce a competitive market.
2. Competition will substantially reduce costs.
3. A competitive market will improve resource allocation.
4. A competitive market will not cause any significant undesirable spin off effects.

We shall examine each of these propositions in turn.

1. THE WHITE PAPER PROPOSALS AND MARKET STRUCTURE

The White Paper makes the simple assumption that the market is effectively contestable, so that either there will be competition, or at least, operators will have to behave as if the market is highly competitive in order to forestall entry. Either way, the outcome would be competitive prices, costs and services. In section 3 we shall examine whether such an outcome would be socially efficient. But now, we must question the validity of the assumption that local bus service is an effectively contestable market. We do so on two grounds.

The first is that some markets are too small to sustain many operators. The unit of capacity (the bus) will be large in relation to the market, so that effective entry barriers will then exist. The second is that we do not start with a clean

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* We do not discuss here the proposals for the ownership structure of National Bus Company or the PTEs and Municipal operators.

sheet. In many markets, one at least of the incumbents will be a large operator which for historical reasons has achieved a position of market dominance. Even with the necessary measures in the White Paper requiring equal access to the concessionary pool, bus stations and so on, the network operator may retain a variety of advantages. These include demand-side factors such as the ability to offer a range of connections and forms of ticketing which enhance customer loyalty. They also include the sheer financial strength of large operators and their control over the second-hand bus market, which is itself by no means perfect. All of these factors may leave entrants at a disadvantage.

If these arguments have any force, then the implications for market structure need to be considered. One likely outcome is active small-group competition. The relevant model may then be that of oligopolistic rivalry.

Consider the case in which new entry by a small operator against a large incumbent occurs. Both logic and experience suggest that he is likely to run just ahead of the existing operator, probably at lower fares. The likely response of the existing operator is to match the schedules and fares of the newcomer in an attempt to drive him out of the market, and at the same time offer a demonstration to other potential entrants of the likely consequences.

The White Paper argues "this is not what will probably happen with totally free entry. If two competitors were to behave like that, the profitability of both would be at risk."

This rests on the article of faith that entry barriers are so low that incumbents will face such a strong threat of entry in all their profitable markets simultaneously, that they will lack the power, and the incentive, to engage in fighting tactics.

In practice, the evidence is that tactics of this kind have occurred. The best example comes from the Hereford and Worcester Trial Area, where free entry on profitable urban routes has seen both free buses and simultaneous departures as competitive tactics. The TRRL monitoring exercise concluded that average revenues, at 51p per service mile had fallen to unsustainable levels. "It appears that the present situation in Hereford must be unstable, although the eventual outcome is unpredictable ...... Under present conditions, deregulation in itself may not be sufficient to allow small operators, however efficient, to compete successfully with established operators with greater resources." [2].

Other evidence is slightly less persuasive, because it relates to cases of regulated competition under the 1980 Transport Act stage licensing procedures, rather than to a regime of unregulated competition. Here, a number of cases have featured schedule matching, including Erewash Travel (Nottingham) and Tally Ho Coaches Limited (South Devon). In the case of CK Coaches of

Cardiff and Cardiff City Transport, public safety aspects surfaced, and both parties were warned by the Traffic Commissioners against unruly driving practices. In each of these cases schedule matching lasted for a considerable time, and it can be shown [3] that even if the low cost operator emerges victorious, a lengthy payback period is typically required to recoup the costs involved.

A noteworthy feature of this type of case has been the role of the relevant regulatory bodies. In the Erewash and Tally Ho cases, pressure from the County Councils helped to end the schedule matching phase, while in another case (Felixstowe Omnibus), the Traffic Commissioner imposed licensing conditions, which prevented this type of behaviour. With the removal of these regulatory powers, the schedule matching phase may be further prolonged.

As evidence of the effects of competition following from deregulation frequent reference is made in the White Paper to the experience of express deregulation under the 1980 Act. It is very doubtful, however, whether the experience of deregulation of the express business can teach us anything about what to expect from deregulation of stage carriage for three main reasons.

Firstly, the express sector was, and is, unsubsidised and largely financially viable. Thus it presented a much more attractive market for new entry than the stage carriage business, where a much more limited part of the network remains profitable.

Secondly, a major feature of regulation in the express sector was the protection of rail services from competition. Thus there was a large market awaiting coach invasion immediately regulation was lifted. Whether this effect of deregulation was desirable is open to question. Indeed, the evidence quoted on P.74 of the White Paper in respect of long distance commuter coaching suggest that it has cost other public transport operators a loss of £7.4m p.a. in revenue in return for a saving to commuters of £3m. p.a. If we assume that commuter coach operators are just breaking even, this would require a combination of net non-financial benefits to users and cost savings to established public transport operators to total £4.4m if commuter coach services were to be judged desirable. On balance, there is probably a net disbenefit to users when fares are excluded. Allowing for the effects on congestion and accidents would make the comparison even less favourable to commuter coaches.

Thirdly, partly because of the presence of a close substitute and partly because of other factors, such as the mix of journey purposes, the express business is far more sensitive to price and quality changes than is the stage carriage. For the latter, mean price and mileage elasticities appear to be of the order of -0.3, +0.3. For express, Douglas [4] has estimated mean elasticities of -1.1 and +0.6 respectively. Consider the effect of new entry, which eliminates a 10% surplus (or reduces operating cost by 10%) on each of these types of service, whilst expanding bus miles run by 25%. Using a semilog demand function and reasonable parameter values (Appendix 1), we find that on the local service, breaking even would actually require a 17% increase in fare. Provided that the buses were optimally scheduled, one would see a marginal increase in traffic of 3%; if the competitor simply duplicated existing timings, traffic would fall by 11% and price increase by a further 20% to break even. For the express example, by contrast, if there is no schedule matching, price could drop by 20% and volume rise by 40%. With schedule matching, given that demand is price elastic, an even greater fall in price could be expected before capacity constraints started to bite.

It is thus quite clear that the incentives to enter are far less in the stage carriage business than in the express, and the potential benefits far lower - indeed, as we shall argue, frequently negative.

This leads us to conclude that, while rivalry and schedule matching may occur in some of the most attractive markets, elsewhere another solution is likely. This is recognised in the White Paper.

"Otherwise, one [operator] might be forced to withdraw. But if there is enough demand to support two operators of the same kind of service, they will usually, in practice, agree to co-ordinate their services (subject to the provisions of the Restrictive Trade Practices Court)."

We agree that monopoly or cartelisation of bus routes is a further possibility. But there is no specific discussion in the paper of whether a monopolistic outcome can be considered "competitive" or not. Clearly, if the market is perfectly contestable, then the monopolist will be unable to stray far from the competitive path without attracting entry. But we fear that too much faith is being placed on the threat of entry to regulate prices and output or, if that fails, on the ability of control institutions such as the Restrictive Trade Practice Court to regulate anti-competitive behaviour. In practice, distinguishing operating agreements which are in the public interest, such as timetable co-ordination, from those which may not be, such as agreements to reduce capacity, will be a regulatory minefield. In any case, we shall argue later that we see no reason to expect the agreed price/frequency combination to be that which yields the maximum benefit to the public consistent with breaking even.

2. COMPETITION AND COSTS

In the White Paper, it is suggested that one of the prime benefits of competition will be reductions in unit costs. The scope for improved efficiency is examined in Appendix A to the Annex, where it is stated that NBC costs per vehicle mile are on average more than 25% below the PTE level, with private operators perhaps 30-40% below the NBC level. The conclusion drawn is that "the potential exists for cost reductions of up to 30% of total costs of public operators. Competition is the only way to secure and sustain these efficiency gains". (4.10)

We do not quarrel with the proposition that there is scope for efficiency improvements in the bus industry. But we do suggest that the White Paper, while paying lip-service to the arguments, grossly underplays the effects of the patterns of work of the different types of operator on their unit costs.

As an example, consider the four operators investigated by the Monopolies and Mergers Commission in 1982 [5]. From Table 1, it can be seen that the NBC subsidiaries Bristol and Trent had costs per vehicle mile some 60-70% of the West Midlands PTE and Cardiff City Transport.

Table 1

	WMPTE 80/81	CCT 80/81	BOC 80	THT 80
Cost (p) / Vehicle mile	144	146	104	87
Employees nos / Vehicle mile ('000s)	0.112	0.123	0.109	0.082
Employee cost (£'000s) / Employee nos	9.259	8.475	6.757	6.944
Other cost (p) / Vehicle miles	40.0	41.5	30.2	30.1

Now, it is quite clear that each of the three ratios which together determine the cost per vehicle mile are themselves strongly influenced by the external environment as well as internal efficiency. Employees per vehicle mile will be partly determined by operating speeds and degree of peakiness. Cost per employee will be determined by local labour market conditions, amount of overtime and spreadover working, and other costs per vehicle mile will be influenced by speeds and operating conditions.

We tried [6] to allow for these variations in the external conditions which the four operators face by standardising for the differences in average operating speed and the differences in peakiness, as measured by the peak vehicle requirement per million vehicle miles operated. The result was to cause the differences in cost/vehicle mile between the four operators more or less to disappear (see Table 2).

Table 2

		PARAMETERS		BOC	TMT	WMPTE	CCT
		Av. speed (mph)	PVR/million veh. miles	pence/ mile	pence/ mile	pence/ mile	pence/ mile
Cost per vehicle mile to operate service pattern of:	BOC	13.7	21.72	103.3	103.9	107.5	102.9
	TMT	16.8	19.05	86.6	87.4	90.3	86.9
	WMPTE	10.3	26.94	133.4	133.8	138.4	131.8
	CCT	10.7	26.72	129.1	129.6	133.0	127.6

Thus, to operate the services of Bristol Omnibus Co., as represented by their average speed and peak characteristics, each of the four operators would have had costs per vehicle mile within 3%. If these 4 operators are at all representative, then most of the cost difference between the municipal sector and NBC operators is a product of the different external circumstances they face, rather than the result of different levels of internal efficiency.

If similar arguments apply as between NBC and private sector operators then the target of a cut of 30% in unit costs for a given pattern of work will be difficult to achieve. Of course reported costs per vehicle mile may fall if the mix of work changes, but that is another issue.

Supposing that a cost reduction does take place, it is important to consider its status. The WP presumes that a reduction in unit costs is synonymous with an improvement in economic efficiency. But this is simplistic. There are two ways in which an improvement in cost efficiency can come about:- wages per paid hour can fall or productivity (work hours per paid hour) can rise. If the first of these occurs, then the fall in costs is a pure transfer payment from workers to consumers or taxpayers. If the second happens, then insofar as workers are off their work effort/wages equilibrium because of the complexities of wage bargaining, the effect is part transfer payment, part efficiency gain. Glaister [7] quotes the Department of Transport's estimates. These are that for big buses, competition will cause drivers' wages to fall by 29% and utilisation to increase by 11%. Hence, any reduction in the money costs of running bus services represents predominantly a redistribution of welfare rather than a real efficiency gain.

The White Paper quotes the case of the taxi and hire car business as evidence that competition brings pressure to keep down costs (para 1.7). That evidence consists of the observation that over the period 1972 to 1982 operating costs of buses rose by 15 to 30% in real terms, and fares by 30% whilst taxi fares rose by only 10%. That was despite the fact that the taxi business is even more labour intensive than the bus business.

We do not dispute the statistics, which are consistent with the TRRL's evidence [8]. But the interpretation that this represents a difference in costs due to the pressures of competition is very disputable for two main reasons.

Firstly, the comparisons made relate to prices rather than costs. Public transport costs per passenger mile have increased partly due to a decline of patronage quite independently of the efficiency with which transport services are provided. Over the period 1972-82 passenger kilometres have declined by about 15% more than vehicle kilometres. This has been largely a result of conscious policy decisions to try to maintain the level of service rather than a result of inefficiency in restricting outputs. For taxis, what has been happening to utilisation is a little less clear. Coe and Jackson report "Given that real expenditure on taxis and hire cars has risen by a factor of two over the last ten years, and that real fares have fallen, the number of passengers carried must have more than doubled. While increases in numbers of vehicles have been marked they have been proportionately less and this strongly indicates significant productivity gains. It is these productivity gains, probably facilitated by increasing use of radio, that have enabled real fare levels to fall". On the basis of those calculations the differences in fare trends would appear to be wholly explicable in terms of utilisation rates. Given that taxis do offer a higher quality of service at a higher price than buses one would expect increases in personal incomes to cause increases in taxi patronage and reductions of public transport patronage even if there were no change in relative prices.

The White Paper gives the increase of real expenditure over the decade as only 30% and the increase of the number of taxis as 37% outside London and 22% in London. A weighted average of these figures gives an increase in fleet size of just under 30%. Even on this basis the bulk of the difference between the real price trends appears as a difference in the relevant effective utilisation rates. The pressures of competition appear to have very little to do with it.

Secondly, the inference of the White Paper is that the taxi business is an unregulated business in which the outcomes are determined by the forces of competition. Of course that is not the case. In London, though entry is not restricted statutorily there is a high barrier to entry in the form of "the knowledge", and fares are regulated. Taxi licensing existed in 305 Of the 369 county districts surveyed by Coe and Jackson. In 201 of these there was a binding constraint on the number of taxis operating. In 278 fares were controlled on a prescribed scale.

The effect of these entry and price controls is thus that what is happening to prices is effectively determined not by competition and the level of costs. The equilibrating mechanism in these markets is either the level of service provided (in those districts where the entry constraint does not bind) or the quasi rent of the licence where the entry control kept profits above normal. Coe and Jackson reported evidence of trading in licences in 161 of the districts with a mean value of about £5000. In these circumstances clearly utilisation rates were being maintained above the levels that would have prevailed with free entry. Whether free entry would have led to lower fares or lower utilisation rates and hence higher unit costs is indeterminate. Evidence from at least one of the cities where there is free entry, Santiago in Chile, suggests that a low utilisation high unit cost outcome may occur. But that is the subject of a lively current discussion.

Taking these two points together it is clear that there is very little at all that one can deduce from the evidence of taxi fare trends about the effects of competition on costs. The arguments of the White Paper are spurious.

3. COMPETITION AND EFFICIENT RESOURCE ALLOCATION

The authors of the White paper avoid directly confronting the resource allocation arguments and by implication suggest that any losses in this dimension are insignificant in comparison with the potential cost-efficiency effects. In this section we challenge that assertion by asking the following questions, none of which are adequately addressed in the White Paper:-

(a) are public transport subsidies indeed incompatible with securing allocative efficiency?

(b) if the Government budget is constrained, is cross-subsidisation consistent with alocative efficiency, and if so, what are the implications for regulatory policy?

(c) is competition sure to throw up a pattern of fares and frequencies on bus routes which accords with consumers' preferences?

(d) is quality competition, in the form of minibuses, likely to be commercially viable, and if so, does that automatically mean that it is socially efficient?

(e) is it true that the integration benefits offered by a planned system can in practice be secured through the market?

(a) User cost economies and the case for subsidy

Even if there are no internal economies of scale in production, the fact that there are external economies of scale associated with the existence of user costs is the economic basis of the case for subsidies. This result, which was first demonstrated by Mohring, [9] relies on the fact that increases in frequency simultaneously raise capacity and improve service quality. A simple proof of the result is given in Appendix 2.

The White Paper asserts that "in some of our major cities the cost of subsidising public transport is now unacceptable" (para 1.3). In the supporting Annex 2 it is conceded "This is not to deny the social case for subsidising some routes because otherwise those who live along or near them would be deprived of a valuable service. But the merits of such expenditure need to be judged against the social value of other forms of public expenditure" (para 38). One might be tempted to draw the inference that such a test had therefore been conducted in the case of urban subsidies and that they had failed to meet a "value for money" criterion. That inference would appear to be particularly legitimate as one of the advisors on the Annex, Dr Glaister, was also the originator of the procedure of cost benefit appraisal of urban revenue support which the Department itself promulgated. [10] It would be reasonable to expect a degree of consistency between the arguments of the White Paper and the conclusions reached from the cost/benefit analyses.

The initial calculations of the D.Tp. study in fact showed that the marginal benefit cost ratio for public transport revenue support in the metropolitan counties exceeded unity by a considerable margin in all except South Yorkshire (see Table 3).

Table 3. Returns to subsidy at the margin

	Marginal net benefit per* £ of subsidy in the existing situation when used to		Changes required to equate marginal returns	
	improve service	reduce fares	services	fares
Manchester	- 0.3	+0.4	-18%	-25%
Merseyside	-0.14	+0.3	- 4%	- 6%
S. Yorkshire	broadly	zero	little change	required
W. Midlands	+ 0.2	+0.35	+ 2%	+ 6%
W. Yorkshire	-0.25	+0.3	-15%	-18%
London Bus	- 0.6	+1.05	-31%	-28%
London Underground	+ 0.8	+0.25	+19%	-11%

Source: Department of Transport (10)

* This shows the position in 1982 for London and in 1980/81 for other areas.

Those initial calculations used common estimates of the various relevant elasticities and could therefore be improved on the basis of local evidence. In the context of preparing the Public Transport Plan appraisals of the value of subsidy, required under the 1983 Transport Act, the counties have reworked these calculations, and some of the results are given in Table 4 (see below). There is therefore a basis for answering the question whether subsidies give good value for money at the margin.

Table 4. Marginal net benefits per £ of subsidy*

	Subsidy used to Improve Services	Subsidy used to Fare Level
Manchester	+0.53	+0.29
Merseyside	+0.79	+0.34
South Yorkshire	not available	
W. Midlands	+0.61	+0.29
W. Yorkshire	+0.25	+0.35
Tyne and Wear	+1.41	+0.25

* for the preferred plan options, 1985/6.

Source: PTE Financial Plans 1985/6-1987/8.

In practice the government has steadfastly argued that the Glaister cost benefit calculations are appropriate for testing the balance between the support of fares and that of service levels and for examining the distribution of revenue support between counties, but not for determining the absolute level of subsidy which is justifiable.

There appear to be four grounds on which that refusal might be defended:

(i) that because there are "substantial leakages" of subsidy into cost increases the measured benefit cost ratios need deflation;

The Department appears to make much of the 'leakage' argument. There are three major pieces of work to which it refers in support of this positon - one relying on a comparison of European countries [11] and two referring to American conditions [12, 13]. The weakness of the evidence has been well documented by Collins [14], and we do no more than reiterate his main points.

Correlation between rising costs and subsidy increases is almost certain to exist whether leakage is occurring or not. This is because many of the forces leading to cost increases (rising real wages, declining patronage) simultaneously lead to a need for increased subsidies. Thus we are thrown on to the rather weaker evidence regarding the lag structure of the relationship to see which effect comes first. But even if subsidy does raise unit costs, this need not represent leakage, but may well represent a deliberate and justified use of subsidies to raise wages and aid recruitment, to preserve relatively high-cost services; to improve vehicles, bus shelters, publicity, reliability or any of a host of factors that determine between them the quality of the service offered. Lastly, even if such a relationship does occur in the United States, or in certain European countries, it may not exist in the very different institutional arrangements in Britain, where there are no earmarked sources of revenue support and financial controls are generally much tighter.

Nothing we have said here proves that leakage does not occur. But it would require very much stronger evidence than anything published to date before we could even be reasonably certain of its existence in Britain, let alone of its magnitude.

(ii) that the high level of aggregation in the model leads to an overestimation of the benefits of support;

We have seen no evidence to date to suggest that the degree of aggregation in the Glaister model overstates the benefits of public transport subsidy. Indeed, given the highly non-linear nature of congestion effects, we should rather suspect that, in a model which is based on average conditions over the day and across an entire county, any bias would probably be in the reverse direction.

(iii) that there is an economic distortion involved in the taxation which is necessary to fund public expenditures so that any expenditure needs to generate a direct benefit/cost ratio sufficiently above unity to compensate for these distortions;

(iv) that in any case macro-economic constraints on public expenditure lead to a required benefit-cost ratio in excess of unity;

We would accept both these points in principle, but argue that the implications of neither of them, when examined in detail supports the assertion that urban public transport subsidy at the present level is economically unacceptable. Let us examine each of them in turn.

Increased taxation may cause an "excess burden" as a result of either reduced incentives to work in labour markets (in the case of direct taxation), or distortions of consumers choices between goods and services (in the case of indirect taxation). Dodgson [29] quotes both American and British research as yielding estimates of the appropriate shadow price of funds obtained through national taxes of about 1.1.

For the local tax source, domestic rates, Dodgson obtains a shadow price estimate of 1.15. This is obtained with an average effective tax rate on the rental value of housing estimated as 0.218, and a price elasticity of demand for housing of 0.6. Whilst Dodgson concedes that commercial and industrial rates will also impose welfare costs he finds no basis for an equivalent calculation.

The context of the attack that is being made on the urban public transport subsidies is an attempt to alter the allocation of funds between that particular expenditure and other possible expenditures in the transport sector, such as local road investments, road maintenance, etc. If it were not so then the imposition of some controls on the amount of funding to be provided for local transport expenditures by central government would be a sufficient control.

Within transport sector expenditures, of course, the disparity of the set of relevant costs and benefits is much smaller than between transport and other sectors. The value of time, environmental effects, the value of life, etc are just as relevant to the appraisal of public transport expenditures as to road expenditures and there does not appear to be any valid reason why the samne conventions of valuation should not apply.

In fact, the initial Glaister model calculations included a narrower set of benefits than those applied to road schemes. They did not, for example, include any safety benefit calculations. Some analysis of the London fares changes by Professor Allsop [15] has suggested that the returns to the public transport subsidies would increase substantially if accident savings were included. The omission of any formal way of treating environmental or distributional effects within the calculations is of course parallelled in the appraisal of road schemes where it has on occasion been used to justify investment in schemes with a measured benefit/cost ratio of less than one (a negative net present value in NPV terms). If anything, therefore, the public transport appraisals have been less comprehensive than road investment appraisals and a lower ratio of measured benefits to costs should be acceptable.

Our conclusion on this dimension of the diagnosis follows. The assertion that current levels of public transport subsidy are unacceptable ignores the importance of external economies associated with user costs and is inconsistent with the results of the application of the Department's own techniques of cost benefit appraisal to alternative forms of expenditure. Whilst there are valid reasons to look for a benefit/cost ratio in excess of 1, we see no reason to doubt that existing subsidy levels represent good value for money in the majority of cases.

(b) Cross-subsidy and the economics of the second best.

The White Paper states that "over time, competition will eliminate cross-subsidy" (Para 4.11). This is stated to be a good thing because;

- cross-subsidy hastens the decline of bus services,
- cross-subsidy "requires some passengers to take on their shoulders the burden of maintaining services for other bus users regardless of their ability to do so.

Para. 4.13 of the White Paper reads:

"That kind of cross-subsidy has perverse effects. It raises fares on the more heavily used routes higher than is necessary for profitable operation in order to preserve services for which there is less demand. So it drives people away from using buses. Fare rises lead to a loss of patronage equal, on average, to about 3 per cent for every 10 per cent real fare increase. Thus, far from protecting bus services, cross-subsidy has increased the rate of their decline".

This paragraph is grossly misleading. Suppose that a particular route is making a loss of £L per passenger on a volume of q_1 passengers. Closure of this route would therefore yield a saving of £Lq_1 to reduce fares on profitable routes. Suppose that the profitable routes carry q_2 passengers at a fare of p_2. We may then calculate the percentage reduction in revenue required on profitably routes:

$$= \frac{100\,L\,q_1}{p_2 q_2}$$

% reduction in fares on profitable routes (assuming an elasticity of 0.3)

$$= \frac{100\,L\,q_1}{p_2 q_2\,0.7}$$

% rise in volume on the profitable routes

$$\frac{0.3\;100\,L\,q_1}{0.7\,p_2 q_2}$$

Absolute rise in volume on the profitable routes

$$\frac{0.3\,L\,q_1}{0.7\,p_2}$$

This will exceed the passenger numbers on the unprofitable route if:

$$\frac{0.3\,L\,q_1}{0.7\,p_2} > q_1$$

Or $\quad L > 2.33\,p_2$

In other words, only if the loss per passenger on the unprofitable routes is well over twice the mean fare per passenger on the profitable routes will the removal of cross subsidy boost patronage. It may also be shown that if both routes have the same price elasticity of demand and both are operating with spare capacity, then a passenger maximiser would charge the same fare on both routes. In this case, cross-subsidy will yield an increase in passenger trips whenever it is used to support routes whose operating ratio (revenue over avoidable cost) is better than 30%. In other words, in very many circumstances, cross-subsidy will raise bus patronage rather than reducing it.

This does <u>not</u> prove that cross-subsidy is always socially desirable and indeed we do not so argue. But it is clear that the solution to the second-best problem of maximising social benefit subject to a budget constraint is likely to contain cross-subsidy. Appendix 2 shows that the first best solution to the optimisation problem involves subsidies due to the "Mohring effect". The second best solution, if first best subsidies are not available, involves prices in the more heavily patronised and the less price elastic routes which are further above first best price levels than on "thin" and price elastic routes.

As an example, we have extended one of the illustrative calculations by Nash (16) to show the result of eliminating cross subsidy. It is seen from Table 2 that, in the absence of any subsidy, the social welfare maximising policy involves a substantial degree of cross-subsidy from route A to route B. If the introduction of competition makes such cross-subsidy impossible, then each route will have to break even individually. The result is a significant reduction in social welfare. Details of the example are given in Appendix 2.

Table 5. Net social benefit maximisation example

	Overall breakeven	Breakeven on each route
Route 1		
Price	4.62	3.43
Miles	2.30	2.40
Revenue	180	144
Cost	138	144
Profit	42	0
Route 2		
Price	1.64	2.28
Miles	2.54	1.79
Revenue	60	72
Cost	102	72
Profit	-42	0
Overall		
Change in net social benefit	Base	-48
Passenger miles	77.0	73.4

The second argument is developed further in Annex 2 to the White Paper (paras 38 - 45). Two main points are made. Firstly, "users of good routes are being penalised by being made to pay excessive fares in relation to the costs of the service they use, so the principle of cross-subsidy, rather than of direct subsidy from public funds, can mean that the public transport services of the less prosperous areas are being taxed to cover the deficits in more prosperous areas". Secondly, cross-subsidy "leaves to operators for decision matters that should not be so left". This argument continues "services which the market does not provide and which therefore need subsidy if they are nevertheless to continue should get that subsidy only by decision of elected representatives after proper testing that they represent good value for money and within the resources available to them."

The thrust of this argument is thus that any subsidy of loss making services should, both for reasons of equity and of democratic accountability, be financed directly from taxpayers on the basis of the appraisal of their value for money, rather than indirectly from other users. Whether this would lead to a reduction in the amount of subsidy for unremunerative services or not is left conceptually indeterminate.

If the real alternatives presented by the White Paper were direct or indirect financing of a given amount of support of unremunerative services we would ourselves choose direct subsidies. But that is not what is implied. It is clearly indicated that the total level of external subsidy is to be decreased, so that the effect on the unremunerative services is a reduction of the level of subsidy by an amount equal to the overall reduction, plus the amount of internally generated support eliminated, minus any savings indirectly accruing through cheaper operation consequent on deregulation, minus the special interim grant of £20 million in the first year.

Let us make some calculations of the anticipated effect on the level of subsidy of unremunerative rural services, using the White Papers own estimates of the magnitudes involved. As we have argued earlier, we believe these to be unduly favourable to the case for deregulation because of the unrealistically high estimate given for achievable cost reductions.

Shire county revenue support is said to be approaching £100 million. The ratio of internal to external generation of subsidies given by the joint NBC/D.Tp study of Taunton was 3 to 1, which if generally applicable would give an internal cross subsidy generation of £300 million. That would be lost. On a turnover for the sector of £600 million a 30% cost reduction would reduce the need for subsidy by £180 million, to which we should add the £20 million interim payment. £200 million less would therefore be needed from revenue support. A net reduction of subsidy to unremunerative services of £100 million is therefore implied without any saving to the exchequor. If, as has been indicated, deregulation would be taken as the opportunity to reduce external subsidy levels then the loss of support for unremunerative services would be even greater.

That calculation makes it quite clear that the White Paper proposal is not to replace internal cross-subsidy by external subsidy, but to replace a system with an exogenously determined external subsidy plus internal subsidy supplementation by a system with the same, or less, external subsidy without any internal supplementation. The logically correct test of the proposals is therefore to compare the welfare effects of these alternatives, as we have illustrated above.

c) The balance between fares and service levels under competition

Putting aside the issues of subsidy and cross-subsidy, a very important question remains as to whether free competition will necessarily lead to the best combination of fares and frequencies subject to a breakeven constraint. It is easy to show that an equilibrium position, with operators breaking even and with no incentive to expand or contract, could occur at any of a set of combinations of fare and bus miles.

If $C = C\ (F)$ and $Q = Q\ (P,F)$
where
- C = total cost
- F = frequency
- Q = no of passengers carried

P = fare per trip

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 $\frac{P.\ Q(P.F)}{F}B$ in revenue

(where $\frac{P.Q(P,F)}{F}$ is the average revenue per trip and B is the number of trips made per bus). Assuming constant costs per trip, he will incur costs of $\frac{C(F)}{F}B$. These must equal $\frac{P.\ Q(P,F)}{F}B$ to just break even or in other words $C(F) = P.\ Q(P,F)$, as stated above.

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

It is possible that when new entry occurs, on profitable routes, the original operator may so cut mileage that - assuming the new entrants' costs are the same as his own - the original combination of fare and bus miles is re-established. But it is more likely that he will resist such a cut, leading to an expansion in service levels. Thus a new equilibrium could be established at higher bus mileages <u>and</u> higher fares. Indeed this has often been what has happened abroad when taxi fares and numbers have been deregulated [17]. If the original position was in some sense a planned optimum then - in the absence of a cut in costs or profits - obviously this new position would be inferior in terms of this objective. Yet it is the result of commercially viable new entry. This is the key point: there is no mechanism whereby the free market will ensure an optimal combination of fares and frequencies. Indeed, this point is acknowledged in a paper by Beesley and Glaister on the taxi industry where they argue that it is likely that a free market will tend towards maximising the number of operators able to survive - in other words, a high fare high frequency combination [18].

Clearly, then, new entry can only be of benefit in the following circumstances:

- if the existing operator is providing non-optimal (and probably sub-optimal frequencies).

- If the new entrant has significantly lower costs, and/or competition forces costs down. In the example in Appendix 1, even the small increase in traffic yielded by a 10% all round cost reduction only occurs if the operators co-ordinate their services optimally. If they practice duplication of timings, then even with a 10% cost cut, traffic will fall.

- If the previous operator was making a surplus on the route in question, which is eliminated by competition. In this case the question is whether the benefit to users is larger than the loss of profit to the operator (or the loss of benefit to other users if this profit was used to cross-subsidise other services).We have already indicated that it is quite possible that a 10% profit margin could be eliminated with little- or even negative - benefit to users of the route in question. In our example in Appendix 1, there is a clear disbenefit to both operators and users if timings are merely duplicated at the higher fare. But even when an optimal schedule is negotiated, the net user benefits - at £112 - do not compensate for the loss of £117 profit.

(d) Quality competiton

It is suggested (Annex 2 Para 16) that there may be a substantial market for minibuses, shared taxis and other intermediate modes, providing a form of new entry with different consequences from those analysed above. It appears from Para 1.6 of the White Paper itself that it is believed to be in city centres that "competing minibuses may offer a fast and frequent service".

Minibuses are used extensively in Third World cities to provide public transport services. However, these cities are generally characterised by excess demand for public transport and a plentiful supply of cheap labour. In Britain, both past studies 19, 20) and experience (e.g. Harlow, Harrogate) have suggested that minibuses are a very expensive way of providing public transport services, appropriate - if at all - only where physical factors prevent access by a larger bus or where traffic is consistently very low, with no peaks justifying a larger vehicle. Viable urban operations have not seemed feasible.

Three recent papers challenge this view. The first is the work of Glaister [7], which was specially commissioned by DTp. Glaister concludes that on high density urban routes, minibuses could sucessfully capture a substantial proportion of the market even when operating at four times the fare charged on conventional buses; on lower density routes they would completely supplement the big bus. We attach a critique of this paper in Appendix 3. Suffice it to say that we believe these conclusions arise from a number of unrealistic assumptions, which lead to both large and small buses having very low fares (so that the absolute price penalty of the minibus is understated) and to big buses having very long waiting times, so that the advantage of the minibus is grossly overstated.

Using Glaister's assumptions about costs, we may compare costs per place mile for large and small buses at current and competitive cost level, assuming an average speed of 6.88 m.p.h. for large buses and 7.74 for small (below)

TABLE 6

	Big bus cost per vehicle mile	Small bus cost per vehicle mile	Capacity Large	Capacity Small	Relative cost per mile
Current	2.1297	1.2957	88	15	3.57
Competitive	1.3296	0.8377	88	15	3.70

If we assume, as Glaister does, the same proportionate subsidy and the same load factors for the twotypes of bus, it is clear that minibus fares must be nearly 4 times big bus fares. Let us take a realistic example of a big bus service charging 20p for a 2 mile journey. The small bus fare will be 71p. In vehicle time savings will be slightly under 2 minutes. We may calculate the necessary time savings for the small bus to offset passengers' money losses as $\frac{51}{2V} - 2$, where V is the value of time of the passenger (assumed doubled for waiting time). We calculate this for each of Glaister's three categories of passenger. It is clearly unlikely that even high value of time passengers will benefit from using the minibus; low value of time passengers would certainly greatly disbenefit.

TABLE 7

<u>Waiting Time Savings Necessary for Passengers to Benefit from Using Minibuses</u>

Value of Time	Necessary Waiting Time Savings: Existing Load Factor	Double Minibus Load Factor	Double Both Load Factors
High (2.4 p/m)	8.6	1.33	3.4
Medium (1.35 p/m)	16.9	3.93	7.6
Low (0.57 p/m)	42.7	12.04	20.8

The only way in which minibus operation could be commercially attractive is if they were able to achieve much higher load factors than conventional buses. For instance, if they achieved double the load factor, then the cost ratio would be reduced to 1.8. Reworking the above calculations, the fare on minibuses would be 36p and the necessary time savings $\frac{16}{2V} - 2$, or for the three categories of passenger as shown in Table 2.

It would now seem more likely that high value of time passengers would prefer the minibus, although 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 which can achieve high off-peak utilisation (unless part-time operators 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, evening and on Sunday.

But big bus operators who adopted the same tactics could achieve much higher load factors too. If they also doubled their load factors, they would become much more attractive (Table 7).

A second paper by Walters [21], produces some very surprising results on optimal bus size. He concludes (under given assumptions) that the greater the volume of traffic, the smaller the optimal bus. He argues that typical urban buses in developed countries are far too large, and also that as a result of taking into account the bus size decision, the economies of scale noted by Mohring (1972) whereby increases in traffic volumes lead to some combination of reduced bus operating costs and reduced waiting times, are probably trivially small.

All of these conclusions appear to follow from a simple error in Walters' model. He introduces variables for the flow of passengers (p), the size of bus (λ) and the waiting time for a standard bus (v) without noticing that - given optimal behaviour - v is uniquely determined by p.

Allowing for this relationship radically changes the results from the modal. Given Walters own assumptions, it appears that bus loads in the range 28 - 35 (implying somewhat larger capacities in view of stochastic variations in demand) are optimal on typical urban routes. Only where the flow is very light would something significantly smaller than a standard bus be optimal, and even this result may well be altered by the presence of peaks in demand. In British conditions, the costs quoted in Glaister [7] suggest a smaller cost saving from using small vehicles; thus the optimal bus size will be larger still.

The complete argument is reproduced in Appendix 4. We conclude that Walters has failed to show a case for using smaller buses on typical urban routes; moreover, even when allowing for variable bus size, the economies of scale in bus operations due to the 'Mohring' effect remain very significant.

The third paper is a recent piece of unpublished work [22] by Bly and Oldfield of TRRL. Unlike Walters, they conclude that there is no case for completely replacing conventional buses by minibuses. However, they do conclude that - by operating at high load factors and creaming traffic - a limited number of minibuses may give their passengers waiting time savings which exceed the disadvantages to other passengers of fewer big buses and of increased congestion. We note that regulation is still required to restrict their numbers, however, for otherwise commercial incentives lead to their expansion to a level at which the net disbenefits of minibuses are very large. We note also that the entry of a high price minibus service, leading to fewer big buses themselves at higher fare (due to reduced load factors), would seriously penalise poorer public transport users.

Thus our conclusions are:

- Minibus services could only be commercially viable by operating at high load factors over the better sections of route, with few peak extra, evening or Sunday services.

- The consequences of this would be to force big bus operators to a combination of reduced services and higher fares.

- In some circumstances it is conceivable that there would be net benefits as a result, although we are worried about the distributive consequences of such a change.

- However, the number of minibuses needs to be restricted, and the case for minibus entry needs judging on its merits in each individual context. (It is noteworthy that the current Secretary of State has recently refused entry to AMOS in London.)

Thus we conclude that retention of regulation to enable the authorities to limit minibus entry is essential: more work needs to be done to establish when, if at all, minibus entry really is to the public good.

(e) Integration

The WP argues (Para. 4:14) that loss of the benefits of integration will be small, because where customers need comprehensive information and connecting services, the free market will automatically provide them.

It is important to understand at the outset that the benefits of integrated public transport planning, whilst they include provision of comprehensive information, connecting services and through ticketing, go far beyond these issues. Fundamentally, the point is that the best value for money is obtained from a limited amount of support if the fares and services of an area are planned jointly with that aim in view. Fares differentials may then be established according to second-best principles rather than the profitability of individual routes. The optimal trade-off between highly discriminatory complex systems and less discriminating simple ones can be established. Routes, services and frequencies may be optimised allowing for the important interactions between them - not just as feeders to each other, but also as competitors where routes physically overlap or their catchment areas do so. Of course, we accept that such network planning will be far from perfect, and indeed the computerised techniques which hold high promise of improvements are still in their infancy. But we believe that the experience of integrated network and fares planning provided by the PTE's, the NBC MAP project and the more active shire counties (e.g. Lancashire) is sufficiently encouraging to suggest that more systematic planning, not less, is required. Some of the ways in which the White Paper proposals will make such integration unlikely or impossible are discussed below:

(i) Such integration almost always involves elements of cross-subsidy (see above, and the examples given in Nash, (15, p56, et seq.)

(ii) Integration involves exploiting the economies of scale enjoyed by rail transport when it is present, by designing bus networks to complement the rail service and by attractive ticketing packages. Much progress has been made on this in the PTE's (particularly, of course, Tyne and Wear). Yet if subsidies are inadequate to permit prices which fully reflect the low marginal cost of rail, it will be subject to threat of bus competition at lower fares, in circumstances in which this will cost the rail service revenue greatly in excess of any cost savings it can make. The result will be higher subsidies and/or higher fares and poorer services for remaining rail users. This will occur not just in PTE areas, but also on most Provincial inter-urban routes, where the possibility for profitable inter-urban bus operation exists. There is a clear need for a mechanism to weigh up the benefits of new competition on routes against the costs.

(iii) Simplified ticketing systems and travelcards hold great attractions both in marketing and in administrative cost, as the London Transport experience and the West Yorkshire simplification and 30p off-peak fares have amply demonstrated. Yet such schemes inevitably result in temptation to the small operator to undercut them on healthier routes and times. It is unlikely that the existing operator could offer a side-payment to the small operator to keep his fare up, or that this would be legal. Thus, emergence of competition may well require existing operators to abandon such schemes. In any event, the offers rest on the ability to provide some support on a network basis rather than for individual routes, and the presence of a body charged with performing a co-ordinating role.

(iv) Sensible route planning often dictates that the best way to serve particular communities is often by combining them with other more lucrative destinations. Of course, it needs checking that the benefits to the additional communities served exceed the losses to other passengers, but this is sure to be the case in many instances. Now consider an operator running from A to B via C. A new competitor enters on the direct route, offering a marginally faster service direct from A to B. The existing operator must retaliate, either by ceasing to serve C or by reducing his fares from A to B to such a level that they compensate for the slightly longer journey time. In the first case, passengers to and from C are seriously inconvenienced for the sake of a very minor benefit to passengers between A and B. In the second, the operator will require a greatly increased subsidy. He cannot recoup the substantial benefit to inhabitants of C in his revenue partly because it is not practical in bus operations to price-discriminate in sufficiently fine detail to extract a substantial proportion of the consumers surplus and partly because in any case it is hardly feasible to charge a shorter distance fare from A to C which is higher than the (now reduced) longer distance one from A to B. Thus there is no way in which a free market will lead to the optimal routeing of the service via C.

(v) Similar problems arise when relying on the free market to provide connecting services, through ticketing etc. Such measures invariably require administrative cost, and frequently loss of revenue or increased operating cost for at least one party. Where connections are implemented which attract additional traffic, they will of course benefit most the operator with the highest fare for his part of the journey. In principle, he could pay the other operator a sufficient side payment to ensure that the connection is made, or - if through ticketing is adopted - agree to a non proportional sharing of the proceeds. But there remain two problems. Firstly, it will not be possible for the operators between them to recoup in revenue all of the benefits to users, because of the problem of extracting consumers' surplus referred to above, and because the through fare cannot exceed the sum of the two individual fares. Secondly, in a complicated network of many routes and many operators it is most unlikely that optimal side-payments and revenue sharing agreements will emerge because of the administrative costs involved. An overall co-ordinating body has been found necessary to achieve this; hence the growth of PTE type institutions throughout Western Europe, North America and Australia.

(vi) In a network of many operators, information to the public on routes, times and stopping places becomes a real problem. It is conceivable that such a service to the public might be provided on a commercial basis, but in the vast majority of cases in Britain and elsewhere in Western Europe of which the authors are aware in which printed material or enquiry offices handling enquiries concerning a number of operators exist, they have been provided by public authorities. In the many cases in Britain where neither shire counties nor tourist boards provide this service, it does not exist even in areas with a reasonable array of different operators.

Overall, then, we conclude that sensible integration requires the presence of a public body with overall responsibility for co-ordinating routes, times and fares. The free market will not achieve this both because changes in revenue will grossly understate the benefits to users and because suitable schemes of revenue sharing and side-payments will be too complex to be achieved in practice.

4. UNDESIRABLE SPIN-OFF EFFECTS

A number of the undesirable consequences which may follow deregulation are discussed in the WP. The most important are as follows:

(a) Safety

The White Paper authors regard the maintenance of safety standards as being a matter of the utmost importance, and we welcome the promise of additional resources to this end. Nevertheless, we note that the White Paper produces no evidence on the likely scale of the problem following the entry of many small operators with, in many cases - we suspect - minimal maintenance facilities. One of our students has examined the maintenance record of existing bus operators by fleet size in the Yorkshire traffic area [3]. He found a steady reduction in prohibition and defect notices as fleet size increased (Table 8), with a tenfold increase n the rate for fleets of up to 3 compared with those of over 50. While the result of this sample survey should be treated with due caution, we judge that the task of ensuring safety standards in an industry with many more small firms will greatly increased. Until the Government's detailed proposals are made public, it is impossible to judge their adequacy for the task.

Table 8

Maintenance Record of Bus Operators

Fleet Size	No of Operators	Prohibitions and defect notices per million vehicle kms.
1	131	6.5
2	63	5.6
3	61	6.4
4	54	3.4
5	29	1.4
6-9	71	2.1
10-14	35	2.5
15-19	16	1.7
20-49	7	3.1
50+	11	0.7

(b) Congestion

Congestion imposes real resource costs in terms of both time and operating costs, via the speed-flow-cost relationship. The White Paper makes the valid point that congestion is only serious at limited times and places. Nevertheless, the indications are that if the pcu values and speed/flow curves are to be believed, minibuses could aggravate city congestion substantially. Thus, Glaister [7] finds that minibus competition might reduce road speeds in London by anything up to 1 mph, after allowing for a transfer of 13.7% of the new bus passengers from car and taxi. To prevent a fall in speeds, the share of the market taken from cars or taxi would need to be some 30-45%. Bly and Oldfield [22] show that if minibuses succeed to the extent of becoming as much as half the big bus flow, then traffic congestion becomes appreciably worse, with a fall of some 0.3 m.p.h. (2½%). Some back of envelope calculations based on the Glaister model inputs [10] suggest that a fall in road speed of that magnitude in London and the Metropolitan Counties would impose time losses valued at some £30 million per annum and vehicle operating costs of £10 million p.a. These figures exclude the effect of a fall in speeds on bus operating costs themselves.

(c) Loss of service

The White Paper argues that competition will to ensure that the community gets better value for money from subsidised services....."In each of the (Trial) areas, the county has been able to obtain better value for subsidy payments, and in none has deregulation brought the loss of services which some predicted," (Para 1.9)

It is not our understanding that the intention of the Trial Area experiments was to replace regulation by Traffic Commissioner with regulation by County Council. Nevertheless, we agree with the White Paper that, particularly in rural ares, where bus networks are simple, competitive tendering for services, either on a franchise or a contract basis is a sound commercial practice. The evidence from Hereford and Worcester is clearly that independent operators are willing and able to produce low density services at lower operating costs than NBC. Provided that they can sustain services at these costs and that the relevant quality conditions are met, there is every reason for giving the contracts to the lowest tenderer.

The question of whether service will be lost in rural areas then depends entirely on whether the cost effciency savings are sufficient to counterbalance any loss of revenue support and cross-subsidy (see section 3(b)) which in turn depends on how the Government slices the diminished subisdy cake. As a matter of fact, services were lost in at least one of the Trial Areas (see Table 9), and the White Paper statement "there has been no massive decline in service to the rural communities in these areas" (Para 4.6) treads a fine line in semantics.

The more difficult issue is the likely impact of removing cross-subsidy and reducing external subsidy on bus service in the more urbanised areas. Here, the intention is that

> 'where operators can finance their services through the fare box, what is provided should be left to be determined in the market. Services which the market does not provide and which, therefore need subsidy if they are nevertheless to continue should get that subsidy only by decision of elected representatives after proper testing that they constitute good value for public money, and within the resources available to them'.
>
> (Annex 2, Para 40).

In passing, we note the difficulty of defining the "commercial sector" - are all bus routes which are capable of breaking even at some fare/frequency combination, however poor, to be deemed "viable services determined under commercial pressures" (para 41) and not eligible for subsidies? In any event, none of the Trial Area experiments gives us any useful evidence about whether service may be lost under actual competition, as opposed to competitive tendering.

North Norfolk Trial Area

Table 9 Bus Journeys per week (both ways)

	TOTAL	of which INDEPENDENT
1981	639	2
1983	389	38
1984 (Jan)	380	131

Source R.G. Harman - Surveyor, March 15th 1984

To gauge the effects of removing internal cross-subsidy, we must therefore look to desk studies rather than real-life experiments. Here, the White Paper strikes an uncharacteristic note of caution, citing the wide variations in the importance of cross-subsidy in the different areas studied. This is clearly true - at a recent conference profitable routes in Bedfordshire were said to generate £1/2 million surplus, internal cross-subsidy in Plymouth was worth £3/4 million, yet there were said to be only 3 profitable routes out of 200 in Hertfordshire. No global sums are possible without the relevant data. Yet the White Paper critique of regulation and subsidy concludes (Para 45)

> 'with some limited exceptions, which could arise in both town and country, there is no reason to suppose that the availability of local bus services will be radically affected by the loss of cross-subsidy implicit in opening up the industry to competition. Its loss should be offset by the gains from the more effectively (sic) use of direct subsidy made possible'.

This last assertion that cost efficiency gains will be sufficient to offset both a reduction in external subsidy of £250 million and an unknown reduction in the amount of cross-subsidy is pure conjecture.

The evidence that the availability in terms of network coverage of local bus services will not be radically affected comes from the NBC/ITS study of cross-subsidy in Cheltenham [22]. In fact, the interpretation placed on our evidence in the WP is quite false. It is stated (Para 12 of Appendix B) that our Viable Network System minimised cross-subsidy, except to the extent that supporting unprofitable services was justified on wider commercial grounds. Compared with the base system, total patronage was higher, revenue support eliminated, and practically every residential area in Cheltenham remains within half a mile of a route. This is both ironic and wrong. It is ironic in that the VNS was an attempt by an experienced NBC network designer to produce a network on MAP principles. It is, therefore, precisely the sort of network change which has already been introduced by NBC over the last decade, though rather more radical than the MAP scheme actually adopted in Cheltenham. Compared with the base, pre-MAP network, it does indeed reduce cross-subsidy substantially. But it does not eliminate it. One of the 9 routes in VNS has an operating ratio of only 0.32 and should be eliminated. In any case, the VNS may not be tenable under competition; several routes make sizeable surpluses, and all the remaining 8 make substantial inter-peak surpluses.

We think, therefore, that the operator might well be forced to a smaller, core system. We tested 13 different networks, and found that, as one would expect, several performed similarly in financial terms. Taking a representative example BUILD 10, which is a 6 route network, we see that competiton may produce considerable changes in network coverage (see Fig. 1).

Table 10

TEST	Total Cost per 4 weekly period (£)	Total Rev. per 4 weeks (£)	Net Revenue (£)	Poss Miles (000)
BASE (pre-MAP)	90500	78700	-11800	577.0
Viable Network System (23 buses; routes 1-9)	67400	80000	12600	588.5
BUILD 10 (14½ buses; routes 1-6)	39500	65900	26400	486.1
VNS with fares down 20%	67400	66400	-1000	614.0
BUILD 10 with faresdown 40%	39500	41500	2000	518.6

Table 10 shows the results of the relevant model tests. The test for the VNS with fares down 20%, in row 4 of the table, is representative of the sort of policy which might be followed by an operator concerned to maximise passenger mileage while breaking even. Competition is likely to force the operator towards a smaller network with lower fares, and a smaller volume of patronage, as represented in row 5 of the table.

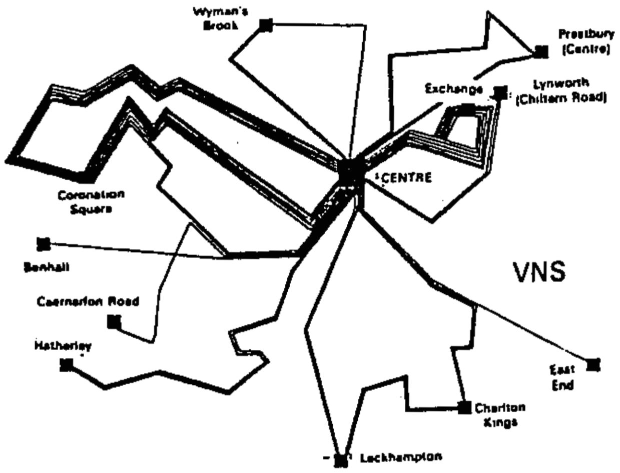
Finally, we would point out that Cheltenham was not one of our most heavily cross-subsidised areas. Hawick, Bridgend and Taunton all relied (relatively) more heavily on internal cross-subsidisation. In some of these areas, the availability of service might indeed be radically affected.

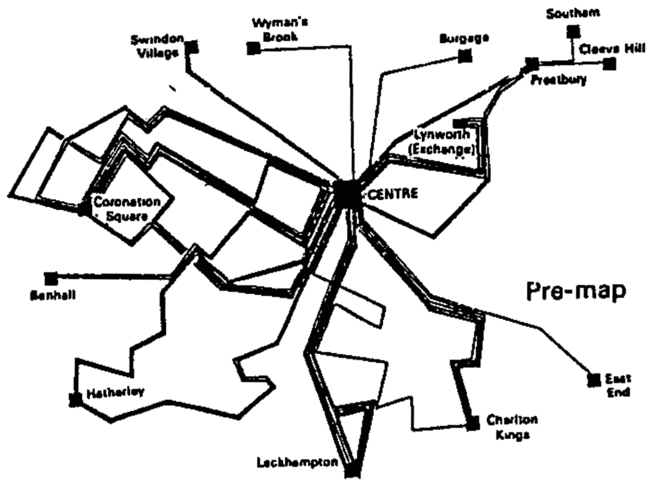
5. CONCLUSIONS

The analysis of the White Paper rests on four straightforward propositions; deregulation will produce a competitive market, competitive pressures will substantially reduce costs, competition will improve resource allocation, and will not cause significant adverse side effects. We reject all of these propositions.

If there is any competition at all on bus routes, it will tend to be small group rather than large group. Active rivalry involving schedule matching and price wars may occur, as may collusion. Neither will produce efficient results except under extreme assumptions concerning contestability of markets, which we reject.

But in any case, competition will not produce an efficient allocation of resources in this market. A first-best optimum





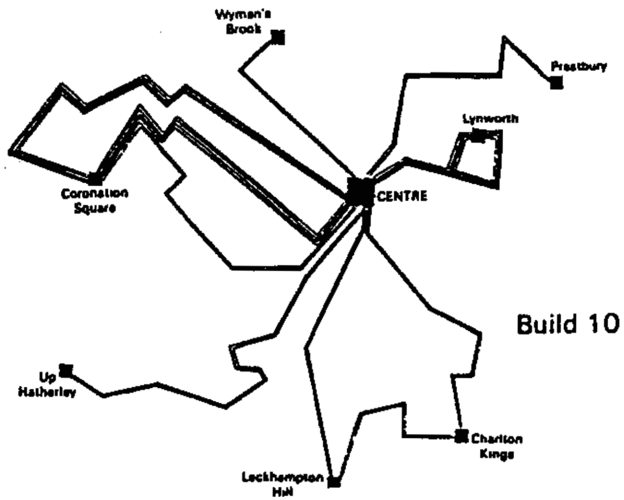


Figure 4.1 Bus Networks for Base, VNS and various Policy Options.

requires subsidies, and if these are constrained below optimal level by Government budget constraints, the second-best solution requires cross-subsidies. Competition is not consistent with either of these. Moreover, we can see no mechanism whereby competition optimises load factors to give a socially efficient balance between fares and service levels. We doubt whether the relative cost structures for buses and minibuses will permit successful entry by minibuses into dense markets except by operating at very high load factors, 'creaming' the best traffic. This may well be undesirable because of the resulting dilution of conventional bus frequencies and the congestion effects.

It appears to us that the White Paper analysis seriously underplays the significance of these resource allocation arguments. In the end, the Government is making an act of faith that the benefits of the cost efficiency savings will dominate all the other undesirable effects. The evidence we have presented suggests the contrary.

Finally, if improvements in cost efficiency are available, most of them could be captured by competitive tendering for bus routes. There is no reason why tendering should be confined to unprofitable routes; it could be extended to profitable ones as well. We accept that there are many difficulties with tendering, and that the problems of handling tenders in complex urban systems are severe. [25] But this solution does preserve the possibility of an efficiently planned public transport system - and competition is possible for the management function as well as for the operations [26]. Competition for the market would avoid many of the costs of on the road competition. As well as making economic sense, these proposals have impeccable ideological credentials. [27,28]

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Appendices by C.A. Nash

Appendix 1	Elasticities and the Effects of Competition
Appendix 2	Optimal Subsidies - Some Results
Appendix 3	Competition on an Urban Bus Route - A Comment
Appendix 4	Walters on Externalities in Urban Buses - A Comment

Appendix 1

Elasticities and the Effects of Competition

This simple example uses a model of a route with the following demand and cost equations.

$$Q = a \exp\left[- b \left(\frac{v}{m} + P\right)\right]$$

$$C = c\,M$$

where

Q = passenger miles demanded
M = bus miles run
P = price per passenger mile (p)
C = total cost (£)

and a, b, v and c are parameters.

Parameter values are as follows:

	a	b	v	c
Local	24,000	-0.0333	10980	.90
Express	100,000	-0.3667	1113	.72

The maximum mean bus load permitted for both local and express services is 40; obviously this is likely to imply higher load factors on the express service.

At the following base positions, each operator is maximising passenger miles subject to earning 10% profits The base elasticities are as quoted in the text. The new position shows the minimum fare at which operators can break even given a 25% increase in bus miles run.

	Bus Miles per day	Fare per Passenger Mile (p)	Passenger Miles Carried	Revenue (£)	Cost (£)
Local Bus (Base)	1170	9.0	13000	1170	1053
Local Bus (New)	1560	10.5	13384	1405	1404
Express Bus (Base)	690	3.0	18428	553	497
Express Bus (New)	860	2.4	25803	619	619

Appendix 2

Optimal Subsidies - Some Results

Let the demand for bus travel be given by:

$$G = G(Q)$$

where G = generalised cost
Q = volume.

$$G = P + T_1(m) + T_2\ (Q/M)$$

where P = price
T_1 = waiting time for first bus
T_2 = expected additiona waiting time due to overloading
M = bus miles run.

$$C = c_1 M + c_2 Q$$

where C = operating costs, which are taken to be proportionate to mileage but with an addition of c_2 per passenger due to loading times.

Thus we wish to maximise

$$Z = \int_0^Q G\ (q)\ dq - Q\ [T_1 + T_2] - c_1 M - c_2 Q$$

$$\frac{\delta Z}{\delta Q} = G - T_1 - T_2 - \frac{Q}{M}\frac{\delta T_2}{\delta(Q/M)} - c_2 = 0 \qquad \text{I}$$

$$\frac{\delta Z}{\delta M} = -Q \left[\frac{\delta T_1}{\delta M} - \frac{\delta T_2}{\delta(Q/M)}\frac{Q}{M^2}\right] - c_1 = 0 \qquad \text{II}$$

From I

$$P = \frac{Q}{M}\frac{\delta T_2}{\delta(Q/M)} + c_2 \qquad \text{Ia}$$

Since $\frac{\delta T_2}{\delta(Q/M)}$ is likely to rise with $\frac{Q}{M}$, or at least certainly not fall, this implies a higher optimal price the higher the mean load factor on the bus.

From II

$$\frac{\delta T_2}{\delta(Q/M)} = \left[c_1 + Q\frac{\delta T_1}{\delta M}\right]\frac{M^2}{Q^2} \qquad \text{IIa}$$

From Ia

$$\frac{\delta T_2}{\delta(Q/M)} = (P - c_2)\frac{M}{Q} \qquad \text{Ib}$$

Thus

$$(P - c_2) \frac{M}{Q} = \left[c_1 + Q \frac{\delta T_1}{\delta M}\right] \frac{M^2}{Q^2} \qquad \text{III}$$

Or

$$P - c_2 Q - c_1 M = M. Q. \frac{\delta T_1}{\delta M} \qquad \text{IV}$$

Since $M > 0$, $Q > 0$, $\frac{\delta T_1}{\delta M} < 0$, this implies the existence of a subsidy (due to the 'Mohring' effect).

If we are now required to meet a binding budget constraint on a whole set of services, the maximisation problem becomes:

$$\begin{aligned} \text{Max } Z^* = & \sum_i \int_o^{Q_i} G_i (q)\, dq - \sum_i Q_i [T_{1i} + T_{2i}] - \sum_i c_{1i} M_i \\ & - \sum_i c_{2i} Q_i - \lambda [\sum_i c_{1i} M_i + \sum_i c_{2i} Q_i + \sum_i Q_i [T_{1i} + T_{2i}] \\ & - S - \sum_i Q_i G_i (Q_i)] \end{aligned}$$

where S = subsidy

$$\frac{\delta Z}{\delta Q_i} = \left\{ G_i - \left[T_{1i} + T_{2i} + \frac{Q_i}{M_i} \frac{\delta T_{2i}}{\delta(Q_i/M_i)} + c_{2i}\right] \right\} (1 + \lambda) + \lambda Q_i \frac{\delta G_i}{\delta Q_i} \qquad \text{V}$$

$$\frac{\delta Z}{\delta M_i} = -(1 + \lambda) \left\{Q_i \left[\frac{\delta T_{1i}}{\delta M_i} + \frac{\delta T_{2i}}{\delta(Q_i/M_i)} \frac{Q_i}{M_i^2}\right] - c_{1i}\right\} \qquad \text{VI}$$

From V

$$P_i = \frac{Q_i}{M_i} \frac{\delta T_{2i}}{\delta(Q_i/M_i)} + c_{2i} - \frac{\lambda}{(1 + \lambda)} Q_i \frac{\delta G_i}{\delta Q_i} \qquad \text{VII}$$

Since $\lambda > 0$ and $\frac{\delta G_i}{\delta Q_i} < 0$, this implies a higher price than in the absence of a budget constraint.

Other things being equal, price will still be higher on routes with higher load factors, but will be raised more where:

- Demand is greater.
- Demand is less responsive to generalised cost, in absolute terms (i.e. the slope of the demand curve is less steep).

Obviously if the budget constraint is at, or near, breakeven, satisfying these constraints is likely to mean some routes operating at a profit and others at a loss.

Tightening the constraint by requiring each route to break even individually will prevent this cross-subsidisation and worsen the overall outcome.

As an example, consider two routes with the following demand curves (Nash, 1982, p. 57).

$$\text{Log } Q_1 = 4 - 0.04\, P_1 - 0.3/M_1$$

$$\text{Log } Q_2 = 4 - 0.12\, P_2 - 0.5/M_2$$

The cost function is

$$C = 60\, B_1 + 40\, B_2$$

(for simplicity, we have ignored the effect of boarding times on costs).

Thus the second route is more elastic, but with lower costs, perhaps indicating a more leisure oriented route than the first.

Net social benefit is as follows:

$$\begin{aligned} NSB = & \frac{1}{0.04} [4 - \frac{0.3}{M_1}]\, Q_1 - \frac{1}{0.04} [Q_1 \log Q_1 - Q_1] \\ & + \frac{1}{0.12} [4 - \frac{0.5}{M_2}]\, Q_2 - \frac{1}{0.12} [Q_2 \log Q_2 - Q_2] \\ & - 60\, B_1 - 40\, B_2 \end{aligned}$$

The results of maximising this function subject firstly to an overall breakeven constraint and secondly subject to breakeven constraints on each route, are shown in Table 2 in the text.

Appendix 3

Competition on an Urban Bus Route : A Comment

1. Introduction

In the Buses White Paper, reference is made to a computer simulation model of competition on urban bus routes which, it is said, predicts that the results will be a mixture of big bus and minibus operation, giving "better results both financially and in terms of overall benefits to passengers than the conventional service" (Cmnd 9300, Annex 2, Para. 23). This model is discussed in an unpublished paper by Glaister (1984) : the aim of this note is to review the model and the results obtained.

By way of introduction, it might be useful to the reader to summarise some of the results presented. The model is used to test three external changes - a reduction in subsidies to one-third of their current level; deregulation followed by an entry by minibuses, and a cost saving of nearly 40% accompanied by elimination of the remaining subsidy. These are tested on three traffic levels - high with a base level of service of 9.7 buses per hour in the suburbs rising to 58 in the city; medium, where the range is 6 to 36, and low where it is 2.8 to 17. Tables 1 and 2 summarise the changes in fares and services in the suburbs and city respectively for the high and low flow cases. Thus at the suburban end of the route, the effect of the subsidy cut is a worsening both of fares and frequencies. Free entry with high flows further worsens the frequency of conventional buses, but offers the choice of a much more frequent service at more than three times the fare (more than four times the base fare) by minibus. It should be noted that since the high cost minibus operation also attracts subsidy of 1/9th of costs the absolute subsidy in this case is much higher than pre-deregulation - more than double, in fact. With low flows (2.8 per hour at the suburban terminal in the base), the effect of deregulation is more dramatic. Conventional buses cease operating, and a high frequency minibus takes over at well over 4 times the base fare. Even if the subsequently predicted competitive cost reduction is achieved, fares remain at very nearly four times their base level. These are startling conclusions, and very much at odds with the assertion in the preceding paragraph of the White Paper that on many services fares will fall. Nevertheless it is claimed that the gains to those who do gain outweigh the losses of those who lose even in this case (P. 15).

2. 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 these are seriously affecting the results. However, in this case, it is our view that the predictions themselves and the estimates of the resulting benefits to passengers are so inherently implausible that it is likely that some of the following list of shortcomings of the model are having a severe effect on its performance.

Firstly, there is a serious problem facing 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 above, P. 17). Glaister overcomes this problem by a simple device. He pegs the load factor for each type of vehicle 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 apparently affects the predictions in two ways:

(a) the base position and the adjustments in fares and services consequent on a reduction in subsidy without deregulation are determined in an arbitrary fashion, rather than in accordance with optimising procedures. This appears to be very important. The assumed mean bus load of 40 is very high, so that in the base - even with high frequencies - so many buses are full that waiting times in the centre are very high. If the base position is unrealistically sub-optimal, this will naturally enhance 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 costings for 'peak only' operations. These would inflate the costs of any type of operation, but presumably big buses can cope with the peak at a lower marginal cost than can small.

    Thus it seems likely that the fares both for big and minibuses are understated, unless he is assuming that peak extra services will cease to be provided. Certainly, the big bus fares are very low indeed.

(b) following deregulation, there is no reason given in the paper why the market should not settle down with lower fares and higher load factors (lower frequencies) or vice versa, rather than those forecast. Indeed, the author himself suggests that minibus load factors 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 to be realised in practice, given the higher load factors to be obtained closer in to the city centre - it seems likely that the free competition combination of fares and frequencies at the suburban terminal would, ceteris paribus, be considerably poorer than suggested by this assumption.

What of the conclusion that passengers, by and large, would prefer a high frequency very high fare service to what they have at present? It seems that this conclusion also rests on these unrealistic assumptions. 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 great potential for waiting time savings for large numbers of minibuses. But it seems most unlikely that these waiting times on high frequency routes are typica in practice : faced with such problems, most operators would supplement the service over the busier part of the route.

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

3. Conclusions

Enough has been said in this note to suggest that the model presented in the paper in question 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 Paper. But if we did believe that its predictions would come true, we should regard the prospects of large numbers of minibuses displacing conventional buses and operating at 3-4 times the current fares as very alarming evidence in favour of the retention of bus regulation.

Table 1 - Suburbs

Policy	Fares and Services
High Flow	
Base	9.7 buses at 3.7p
2/3 cut in subsidy	7.4 " " 4.9p
Entry of Minibuses	5.6 " " 4.9p and 20 minibuses at 16.6p
Cost and subsidy reduction	4.4 " " 3.4p and 28 minibuses at 12.1p
Low Flow	
Base	2.8 buses at 4.5p
2/3 cut in subsidy	2.6 " " 6.0p
Entry of Minibuses	14 minibuses at 23p
Cost and subsidy reduction	21 minibuses at 17.6p

Table 2 - City

Policy	Fares and Services
High Flow	
Base	58 buses at 3.7p
2/3 cut in subsidy	44 " " 4.9p
Entry of Minibuses	34 " " 4.9p and 121 minibuses at 16.6p
Cost and subsidy reduction	26 " " 3.4p and 170 minibuses at 12.1p
Low Flow	
Base	17 buses at 4.5p
2/3 cut in subsidy	15 " " 6.0p
Entry of Minibuses	84 minibuses at 23p
Cost and subsidy reduction	128 minibuses at 17.6p

Note: All fares are expressed in p per passenger mile.

Appendix 4

Walters on Externalities in Urban Buses: A Comment

Walters (1982) produces some very surprising results on optimal bus size. He concludes (under given assumptions) that the greater the volume of traffic, the smaller the optimal bus. He argues that typical urban buses in developed countries are far too large, and also that as a result of taking into account the bus size decision, the economies of scale noted by Mohring (1972) whereby increases in traffic volumes lead to some combination of reduced bus operating costs and reduced waiting times, are probably trivially small.

All of these conclusions appear to follow from a simple error in Walters' model. He introduces variables for the flow of passengers (p), the size of bus (λ) and the waiting time for a standard bus (v) without noticing that - given optimal behaviour - v is uniquely determined by p. Let k be the capacity of a standard bus. The standard bus will only be chosen when, given optimal frequency, it offers just the right capacity.

Thus, frequency (f) will be related to the size of bus by the formula $f = \frac{p}{\lambda k}$ (or this plus a margin of spare capacity to allow for stochastic variations in p). It follows that the waiting time for a standard bus (v) is given by half the headway, or $\frac{k\lambda}{2p}$. Substituting this into the expression for total costs where:

$$c(\lambda) = \frac{wp}{k\lambda} + \frac{\lambda pk\mu w}{2p} \quad + \text{ other costs}$$

and

$$\frac{C(\lambda)}{\delta\lambda} = \frac{-wp}{k\lambda^2} + \frac{k\mu w}{2} \quad = 0 \text{ for minimum costs}$$

where w is the wage rate.

This gives the result:

$$\lambda = \frac{1}{k}\left(\frac{2p}{\mu}\right)^{\frac{1}{2}}$$

If we assume, as Walters does, that $\mu = 0.5$, we may further simplify this to:

$$\lambda = \frac{2p^{\frac{1}{2}}}{k}$$

Thus optimal bus size does rise with p, although less than proportionately.

So far we have assumed that wages costs are constant regardless of the size of bus. Following Walters, we may allow for rising costs with bus size as follows:

$$c(\lambda) = \frac{w(a+b\lambda)p}{k\lambda} + \frac{\lambda pk\mu w}{2p} \qquad + \text{ other costs}$$

$$= \frac{wap}{k\lambda} + \frac{wbp}{k} + \frac{\lambda pk\mu w}{wp} \qquad + \text{ other costs}$$

Minimising this gives:

$$\lambda = \left(\frac{2ap}{k^2\mu}\right)^{\frac{1}{2}}$$

Assuming $\mu = 0.5$, this gives

$$\lambda = \frac{2\, a^{\frac{1}{2}}\, p^{\frac{1}{2}}}{k}$$

Bus size still rises with p, although with a < 1, the optimal bus size is reduced for all values of p.

With Walters assumption of a = 0.33, what values of λk does this imply? For a flow of 900, the optimal bus load is around 35, implying that - with a margin for stochastic variations in demand - the optimal size bus is something like a standard U.S. single decker. With flows of 581 and 129 (the other examples quoted by Walters), optimal bus loads are 28 and 13 respectively. Thus for the latter flow only, a bus significantly smaller than the standard bus would be appropriate. However, given that this is an off-peak flow, it may well still be better to use the larger buses required for the peak to cover it.

In British conditions, it seems unlikely that the difference between large and small bus costs would be as great as Walters postulates for the U.S. The figures quoted in Glaister (1984) suggest that small (15 seater) bus costs are around £1.2957 per mile and 88 seaters are £2.1297 per mile (assuming speeds of 7.74 mph and 6.88 mph respectively). This would imply values of a = 0.53 and b = 0.47. Thus the optimal size buses and frequencies would be as follows:

Volume per hour	Bus load	Frequency	Total operating and waiting costs
900	44	21	31.2 W
581	35	17	23.6 W
129	17	8	9.6 W
100	15	7	8.3 W
50	10	5	5.7 W

(Numbers do not correspond exactly due to rounding.)

Thus the 15 seater minibus only comes into its own at flows of 50 per hour or less. Even this conclusion is uncertain, since at these volumes, conventional bus frequencies would be too low for passengers to arrive at random, so that waiting times are overstated in the model. Again, it should be noted that dealing with peaks in demand by expanding frequencies is very much more expensive than allowed for in this model, so that much higher optimal loads are likely to rule in the peak, leading to the use of larger buses all day.

A further important result should be noted. Substituting back for λ in the equation for total cost gives:

$$TC = w\left(\frac{bp}{k} + \frac{a^{\frac{1}{2}} p^{\frac{1}{2}}}{2}\right)$$

In other words, the portion of total cost that varies with volume has a cost elasticity of 0.5. That economies of scale are highly significant is also seen from the above table.

Thus we conclude that:

- Larger traffic flows generally justify larger buses.
- Only on routes with very low traffic flows is there a case for using smaller buses than standard.
- Even when variable bus size is allowed for, there remains a good case for subsidising urban bus routes due to the "Mohring" economies of scale effect.

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