AN ECONOMIC COMPARISON OF URBAN RAILWAYS AND EXPRESS BUS SERVICES

A Comment

By J. G. Todd and J. A. Baggs

Mr. Smith’s paper [1] develops its comparison between the operating costs of the Victoria Line and those of a hypothetical bus route serving the same purpose by making use of system-wide average cost figures derived from London Transport (LT). However, the staff and vehicles, and hence the costs, of LT operations are determined by the requirements of the twice-daily peak. Because marginal costs are low, some buses and trains are kept in off-peak service carrying a small number of passengers, so that system-wide costs per car-kilometre are lower than they would otherwise be. So long as some spare peak capacity remains (as it did on LT in 1970), costs per car-kilometre conceal the advantage of the railway in low marginal cost per additional passenger carried, and costs so expressed ("running costs" in Mr. Smith’s Table 2) reflect the geographical layout and degree of service peaking which happened to exist on those particular rail and bus networks in that particular year. To eliminate this effect as far as possible, Mr. Smith has calculated "standing costs" in terms of the number of cars in peak service. To sum these costs implies two assumptions:

(1) That each of the costs listed will change in direct proportion to any change in the number of cars in peak service. In fact, the various costs are likely to respond very differently. For example, "drivers" might be expected to vary quickly with a change in number of cars (although still not necessarily in direct proportion), whereas "maintenance of buildings" would change only if some change were effected in the network, such as closure of a station, which would not necessarily be reflected in the number of cars at work.

(2) That any change in the number of cars is representative of an associated change in the peak-hour factor. This could be true only when averaged over a time long enough to allow for replacement of rolling stock (this does not take place uniformly, and vehicles once bought are likely to be used even in face of declining traffic), and to a degree of approximation sufficient to allow for the indivisibility of a 6- or 8-car train when compared to a bus. Since there is no reason to suppose that the curves of average cost per car or per car-kilometre are identical or even similar for bus and rail, or indeed for different types of bus operation, it seems unlikely that the costs which happened to occur on the LT system in 1970 may legitimately be calculated to three significant figures and used for comparison.

The paper compares the capital costs of the Victoria Line (a deep-level railway
across central London) with those of Westway (an elevated motorway through the inner suburbs). It emphasises the variation in construction costs with location, but Mr. Smith's conclusion ("the average cost for the whole route [of the motorway] is not likely to be more than £1.3M/lane-km.") is no more than his opinion, although it forms the basis of the subsequent argument. However, it shortly becomes apparent that the busway works out much cheaper than the railway because it is no longer a busway but a common-user motorway, shared by the bus service. It is therefore the adequacy of provision made for access to and from the elevated road which calls for closest examination.

Frequent intersections will be required to permit buses to join and leave the motorway, since the avoidance of interchange is cited as being one of the attractions of the busway system. The cost of on/off ramps about one mile apart could approach or even exceed the cost of an additional motorway lane for the entire distance, but the paper does not allow for this. Nor does it allow for the cost of accommodating the queues of non-bus traffic which will form at entry points, or the cost of escalators to reach the elevated bus stops (much is made of the cost of escalators to reach the underground railway). Even on the paper's own assumptions, the addition of these costs could more than double the cost of the motorway alternative; but the most important point which the paper demonstrates is that all these costs can be so variable, depending on location, that generalisation on the scale attempted becomes very difficult to justify.

Nothing is said about the number or size of lay-bys required at bus stops; but, for a service which is to "achieve the same penetration of town centres as is expected of urban railways", their provision and layout is clearly critical. The 15 per cent addition to capital costs allowed by the paper would purchase only 150m of additional lane in each km. This would be adequate for deceleration from a running speed of 70 km/hr, although acceleration would require either a greater distance or a higher level of performance than is currently available. Accepting that the latter is attainable, each stop requires an additional 300m, plus the length of the lay-by, platform area, etc. Further, at all but very lightly used stops, buses would have to be able to reach any of the several stopping places in each lay-by, after decelerating, and to do this without obstructing the through route would require the busway to be 3 lanes wide for the length of the lay-by. To attain the average station spacing quoted by the paper variously as 1.3 km and 1.4 km would therefore require an addition to capital costs in the region of 30–50 per cent, rather than the assumed 15 per cent.

These costs are largely dependent upon the cost of land, which can be expected to increase as the central area is approached. The paper overcomes this difficulty by abandoning the use of reserved track in the central area. Instead, it is "assumed that buses have reserved lanes wherever other restraint measures are not adequate to protect buses from congestion". This is a large assumption indeed; the extent and effect of the restraint measures necessary to ensure such protection, and the associated direct and indirect costs, are so far indeterminate, and are ignored in the paper.

A railway maintains a high standard of service only as long as all those concerned in its operation maintain a high standard of discipline. The disastrous effects of a breakdown in discipline have been sharply demonstrated during periods of industrial dispute. The same would be applicable to a busway, which could, in appropriate circumstances, provide a very high level of service. This would no longer be possible
once other road users had been admitted to the track, and any future automatic operation would also be precluded.

On a busway system where headways near the practical minimum are being operated, and a significant proportion of the buses are not observing every stop, vehicles leaving a stop will have to merge at full speed into a slot in the main stream. If capacity is not to be impaired, this slot can only be produced by another vehicle leaving the stream to call at that particular stop. It remains to be shown that such levels of precision can be attained on a completely reserved busway, to say nothing of one shared with ordinary traffic.

The effects of a breakdown on the busway are passed over by the paper with one sentence (page 26, "If one bus is delayed, other buses are not affected"). Since the proportion of track costs attributable to buses is developed on the basis that the roadway is fully utilised by other traffic, any broken down or delayed vehicle (unless in a lay-by) must halt or delay all following traffic, either at the site of the breakdown or at the entry ramps. The only alternative is that normally adopted on rural motorways, a continuous hard shoulder, but this is specifically excluded.

The hypothetical busway relies to a large extent on the imaginative application of up-to-date technology. However, where a hypothetical solution has to be compared with an existing one, great care must be exercised to ensure that similar assumptions are made about both. Such care is markedly lacking in the paper, and no attempt is made to assess the costs or effects of a similar application of new methods to the railway alternative. The best example so far of the application of up-to-date technology is the Lindenwold line, Philadelphia, mentioned by Mr. White [2]. Trains on this line, which opened in its present form in January 1969, complete the 23·2 km journey in 22·4 minutes, an overall speed, including 11 stops, of 62 km/h. (Mr. Smith assumed in his paper that "the average vehicle journey speed is the same for urban trains and express buses, say 40 km/h.") A total of 225 employees, including 41 drivers, operate the 69 cars in peak service, or 3·6 employees/car.

Applying the appropriate factor for speed places this line right at the top of Mr. Smith's Table 1. Further, this is an upgrading, not a completely new line, and speeds are severely restricted in places.

The failure of the paper to compare like with like is taken to the extent of omitting altogether from its Table 1 the staff required for maintenance of the roadway, lighting, signalling, etc. There is reason to suppose that maintenance costs could be significantly higher on a road or lane reserved exclusively for buses, although there has been insufficient experience so far to be certain of this [3]. The justification for omitting signalling costs is the low proportion of the cost of traffic signals which can be ascribed to buses on ordinary streets. The complex signalling required to permit buses to operate on the motorway is quite different in both function and costs. As when ordinary streets are proposed to be reserved exclusively for the use of buses, it may be argued that, since the signalling, maintenance, etc., are required only to facilitate the use of buses, the entire capital and maintenance costs should be ascribed to the bus system.

It is clearly useful to draw attention to the opportunity cost of the land occupied by transport facilities. However, to saddle the existing rail system with an opportunity cost on the assumption that the community would be prepared to convert it entirely to motorways needs a prior decision on the costs and benefits of conversion and
whether motorways would represent the best use. Given the increased realisation
of the social costs of motorways and of car traffic in urban areas, this assumption
may not be correct.

One may summarise by saying that the paper makes a persuasive case for con-
sidering the use of buses in a much more imaginative manner than has hitherto been
the case in Britain. Its conclusion that a case has been made for the conversion of
railways into roads on a large scale is not justified by its argument, in which costs
have been extended from inappropriate averages and most of the practical difficulties
have been hypothesised away.

REFERENCES


A Rejoinder

By Edward Smith

To the railway's advantage, this study assumed that the passenger demand during the
peak would be sufficient to utilize the railway capacity fully. If, as predicted in the
comment by J. G. Todd and J. A. Baggs, there should be unused track capacity on
either a proposed railway or an existing railway suitable for conversion to a road,
this would further enhance the economic advantage to the community of the alterna-
tive express bus service allowing spare track capacity to be used by other traffic.

Indeed station closures would reduce the cost of maintaining buildings, but
closures are precluded by the assumed average station spacing.

The risk of a decline in traffic rendering modern rolling stock obsolete is confined
to railways. The bus is depreciated over a shorter period, about ten years if it runs
1800 km/week while in service. Moreover, a good bus can readily be transferred to a
different route, even in a different city, while urban railway rolling stock is not
interchangeable between lines unless the track gage, loading gage, automatic
braking, power supply, platform height, and many other factors happen to be
compatible.

Much more serious than obsolescent railway rolling stock is the obsolescent
railway route. If suitable for conversion to a road it may have a high opportunity
cost. If it is a deep tunnel, with no opportunity cost, it represents an unfortunate
investment.

The demand for public transport declines usually because of passengers going over
to private cars. Since the express bus can offer a service more like that of the private car, it is more likely to continue attracting passengers.

A glance at my Table 2 shows that for London Transport the operating cost parameters for railway and bus are not "identical or even similar". It is also clear from that table that the most important elements of the operating cost are staff and rolling stock. The staffings and rolling stock costs are given for undertakings in many different countries. Differences in operating cost between stopping buses and express buses will be largely functions of different peak-hour factors and distances run per week, which have been taken into account.

In the suburbs the express bus, serving as its own feeder, will collect most passengers at stops near their homes. Outside the central area the principal function of the motorway will be line-haul. Some stops will be necessary to allow interchange between routes, and these will be further useful to any passengers with trip ends near them, but they need be no more frequent than the usual spacing of access points on suburban motorways. These bus stops can be sited to utilize the deceleration and acceleration lanes provided for normal motorway access. Only where the motorway crosses the central area need substantial extra provision be made for bus stops.

The track cost to the community of buses using existing road space can be assessed only in specific cases. If this cost proves greater than the cost of new track, there is a case for building new track. Therefore it is assumed that the cost to the community of buses using existing track is never greater than the cost of new track.

The vulnerability of railways to labour disputes is well known. Buses offer great flexibility in organization as well as operation, and it is simple for different bus operators—including owner-drivers—to share the same track. If train services fail the valuable track lies idle; if all bus services fail the track can still be used, albeit less efficiently, by cars and taxis.

About 25 per cent below the possible capacity, the figure of 1,000 buses/lane-h for a motorway is a practical capacity. It allows for merging and other normal manoeuvres at a good level of service on a road with the capacity constraints that are typically found.

Westway has continuous hard shoulders to allow disabled vehicles to leave the running lanes. On a two-lane road continuous hard shoulders will probably not be justified, but frequent lay-bys can serve the same function. A train breakdown is much more serious, as it completely blocks the track. Moreover, railways are vulnerable to points failure, signal failure, track defects, and derailments.

The station spacing on the Lindenwold Line averages 2.1 km—compared with 1.3 km on London Transport railways—and is considerably more in the suburbs. In 1972 91 per cent of the Lindenwold passengers used private cars at the suburban end of the journey. It is misleading to compare the staffing and service on this line with either the Victoria Line or an equivalent express bus service. Figures for the Hamburger Hochbahn (Table 1) prove that the staffing on an urban railway can be moderate; but it is wrong to attach great importance to operating cost variations, because variations in track capital costs overshadow all else.

The omission of track maintenance staff from the bus figures in Table 1 was acknowledged in the text. The error thus introduced was about one per cent, and was not considered important.

Motorway buses would require no signaling whatever, unless there were a need
to meter non-bus traffic at access points. It is most unlikely that bus signaling costs will ever be a significant part of the total cost.

Just as the cost to the community of unrestrained private car access to the central area may be unacceptable, so too the cost to the community of railway services may become unacceptable when it is widely understood that express buses can generally provide a service as good or better at significantly less cost.

A generalized study such as this is no substitute for a detailed investigation of a particular case. However, there is clearly a *prima facie* case for such investigations, which will be of great interest if the express bus potential is properly appreciated and evaluated.