

# Transport and Road Research Laboratory

A COMPARISON OF BUS OPERATIONS  
IN CITIES OF DEVELOPED AND  
DEVELOPING COUNTRIES

by

Dr G D Jacobs, D A C Maunder and P R Fouracre

Overseas Unit  
Transport and Road Research Laboratory  
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# A comparison of bus operations in cities of developed and developing countries

by G. D. Jacobs, PhD, MCIT, MIHE, D. A. C. Maunder, BA, MCIT, and P. R. Fouracre, BSc, MIHE  
Overseas Unit, Transport and Road Research Laboratory

**Introduction.** Over the last 20 years something like 600m. people have been born in or have moved to urban areas with populations of more than 100 000 (now generally signified internationally by the word 'city'). Over the next 25 years it has been estimated<sup>1</sup> that they will be joined by a further 1 500 m.—more than half the world's entire population as it stood in the early 1960's. Unfortunately this expected increase is unlikely to spread evenly through the world. Some three-quarters of these newcomers will join the teeming masses of those Third World cities that are at present experiencing great difficulty in feeding, housing and transporting the millions who already live there.

In many cities in developing countries, the rapid rise in population, coupled with limited financial resources available for investment in urban infrastructure, has produced severe transport problems. In the near future, an improved public transport system is likely to be the only solution for reducing traffic congestion and chaos in most Third World cities 'since it is unlikely that the communities concerned can (or even should) afford to build

the road network needed to accommodate unrestrained travel by private car'<sup>2</sup>. Indeed, a number of cities in South-East Asia have taken a lead in the possible introduction of area restraint systems aimed at reducing private car usage within the city centres.

Although one or two cities in developing countries are building rail mass transit systems, the vast majority will still be relying for many years to come on road-based systems. Public transport in cities of the developing world comprises more than just the traditional bus and train of developed cities. Thus shared taxis, motorcycle, scooter, cycle and hand rickshaws, and even horse-drawn vehicles, all play an important role in personal mobility. Previous articles<sup>2,3</sup> explained the role and function of 'paratransit' systems in cities in developing countries; this article makes a broad review of the demand for public transport in cities in the Third World and some of the factors that might be affecting demand, comparing and contrasting them with conditions in the developed world. It also outlines some of the special problems faced by public transport operators in developing countries

and the economic climate under which they operate.

## Urban public transport usage in developed and developing countries

In the U.K. the use of stage bus services has been declining since about 1950. A major cause of this reversal in patronage trends has been identified<sup>4</sup> as the rapid increase in car ownership which has taken place over the last three decades. Although car ownership has also increased in developing countries over the last 30 years, it is still at a relatively low level and there is a great reliance on public transport. Percentage changes in the number of buses and passengers over this period 1964-75 for some 12 cities, most of which would be regarded as being in the 'developing world', are given in Table I.

In almost all the Third World cities there were considerable increases in the number of buses in use and passengers carried. (In Nicosia, the only city to show a decrease in the number of buses, the public transport sector was subject to a comprehensive modernisation programme leading to the scrapping of a number of old vehicles.) The number of passenger trips made on public transport increased at a faster rate than the population growth rates in all cities except Calcutta where unusual changes took place during the period 1964-75—in particular, the large influx of refugees from Bangladesh and also rural migrants with very low incomes who are unlikely to be able to afford any form of public transport. In comparison, in the U.K. there was an approximate 3 per cent reduction in the number of passenger trips per annum.

Apart from Blantyre, Malawi, buses were being used more intensively in 1975 than in 1964. In Surabaya, Indonesia, for example, there was an increase of almost 8 per cent per annum in the average number of passengers per bus. In other cities, increases of 4 per cent were common. In the U.K. there were again consistent decreases for all three transport organisations for which data were available.

The number of trips made per head of population (i.e. the trip rate) increased in all Third World cities except Calcutta, where there was an average reduction of 4.4 per cent per annum. In this city, in 1968, shared taxi services were sanctioned by the Regional Transport Authority and there might well have been a movement from conventional public transport towards unconventional forms such as shared taxis, scooter rickshaws, etc. It might well be that in a number of developing countries a modest increase in real incomes

**Table I.** Average annual percentage changes over the period 1964-75 in the number of buses and passengers in some cities in developing countries and the U. K.

City	Popula- tion	Average number of buses on road	Passenger trips per annum	Average daily passengers per bus	Trips per person per annum by bus
Ahmedabad (India)	+ 5.5	+ 2.1	+ 7.3	+ 0.4	+ 1.1
Barbados (Island)	+ 2.0	+ 1.6	+ 5.0	+ 2.7	+ 2.4
Blantyre	+ 9.7	+12.3	+10.6	- 0.7	+ 0.5
Bombay	+ 5.5	+ 4.1	+ 7.0	+ 2.0	+ 0.9
Calcutta	+18.4	+ 1.5	+ 5.0	+ 3.0	- 4.4
Delhi	+ 4.8	+13.1	+22.7	+ 4.0	+11.6
Istanbul	+ 6.1	NA	+ 8.0	NA	+ 1.3
Mauritius* (Island)	- 3.4	+ 9.8	+14.8	+ 3.4	+21.0
Mombasa	+ 7.3	+ 9.6	+15.4	+ 2.8	+ 4.5
Nairobi	+ 8.1	+ 9.0	+16.6	+ 3.8	+ 4.5
Nicosia	+ 6.4	- 0.4	+ 9.3	+10.4	+ 1.7
Surabaya**	+ 3.0	+ 6.7	+16.7	+ 7.7	+11.2
U.K.					
London Transport					
Executive		- 1.8	- 2.9	- 1.3	
Passenger Transport					
Executive		- 0.7	- 2.7	- 2.2	
Municipal Operators		+ 0.4	- 2.5	- 2.7	

\* 1970-75

\*\* 1970-76

NA: not available

coupled (in some cities) with improved services has led to increased public transport usage, whereas it has been shown that in the U.K. a more substantial increase in real incomes has led to increased car ownership which, together with a decrease in service levels, produced a decrease in public transport usage.

In order to compare and contrast some of the factors affecting public transport operations in cities in both developed and developing countries, basic data for 139 bus companies operating in cities throughout the world were obtained from the UITP Handbook for Urban Transport<sup>5</sup>. For the year 1974, data were obtained on such socio-economic characteristics of each city as population, area and car registration, together with details of each bus company operating in the city, e.g. fleet size, staff employed, routes operated, system length, passengers carried and kilometres operated. The sample of 139 cities were grouped into 97 'developed' and 42 'developing', based on a gross national product per capita for the countries in which the cities were located. A value of U.S. \$750 was taken as the criterion; above this value, countries and hence cities were classified as 'developed', below this value, as 'developing'.

Following the method developed by Legris<sup>6</sup> and Lesley<sup>7</sup> a number of relationships between public transport usage and supply and the physical and socio-economic parameters of the cities described above were derived using regression analysis. An attempt was made to use multiple regression analysis to determine how the various socio-economic parameters, acting together, were related to the number of passenger trips per annum. Unfortunately, 'because the data sets were inadequate, the analysis was statistically invalid. Simple regression analysis was, therefore, used to describe relationships between public transport usage and socio-economic characteristics of the cities and bus companies. Two dependent variables were used: (i) the total number of passenger trips per annum; and (ii) the average number of trips per person per annum. It should perhaps be emphasised that the object of the analysis was not to derive a 'model' for public transport trip-making in Third World cities; it was simply to obtain a clearer understanding of some of the factors that might affect bus usage in these cities.

In both developed and developing cities there was a close correlation between the population of the cities and the number of bus passenger trips per annum. From Fig 1 it can be seen that, for a city of given population, the number of passengers carried in both developed and developing cities is, on average, very similar indeed. This is a surprising result, since with low car ownership in Third World cities usage of public transport might be thought to be correspondingly greater than in cities of Europe and North America with similar population. Five points can perhaps be made in explaining this result:

(1) Many people in developing countries travel by public transport modes other than the conventional bus, e.g. shared taxis, motorised, cycle and hand rickshaws.

(2) Because, in many Third World countries, wages are low and large numbers are unemployed, people cannot afford to travel by bus even though the fares are low (see later).

(3) There is probably still a lack of supply in developing countries which would be reflected in the number of passengers carried.

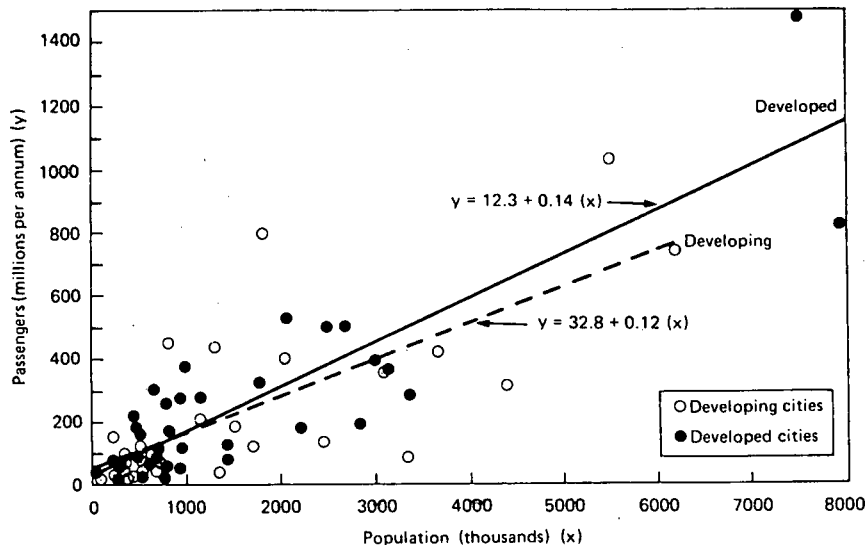


Fig 1. Bus passenger trips per annum for cities of differing population in developed and developing countries.

(4) Population may not be a very satisfactory way of comparing the sizes of cities in developed and developing countries because patterns of social behaviour are different. Thus in the Third World, only one member of a large family may be found to use public transport, usually to travel to and from work, other members of the family staying at home.

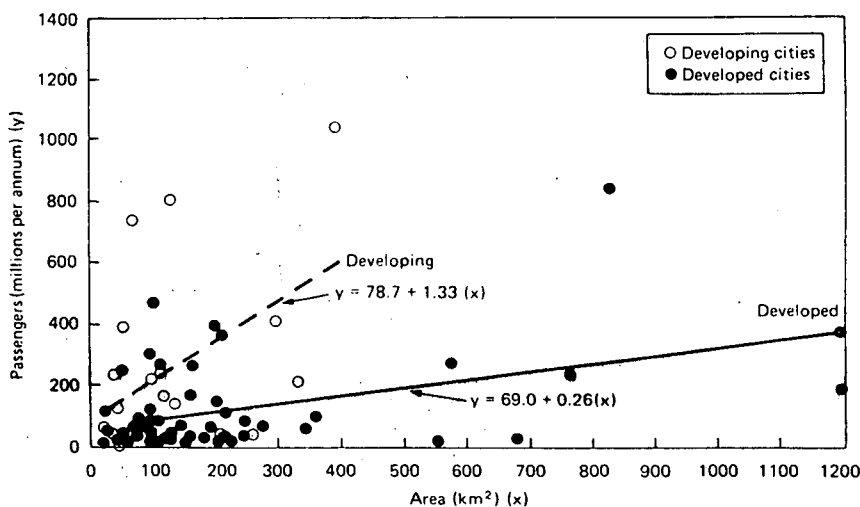
(5) The data are cross-sectional and do not reflect the trends described earlier, i.e. that public transport supply and use is increasing in developing countries.

In comparison with the above result, the regression equations relating the number of passenger trips per annum with area of city were markedly different for cities in developed and developing countries (although correlations are, in this case, weaker). From Fig 2 it can be seen that the number of passengers per annum in cities in developing countries was much greater than in cities of similar area in developed countries. This could reflect differences in land utilisation and greater population densities that exist in most African and Asian cities. The lower densities of cities in the developed world adversely affect the economics of bus services and at the same time

provide a powerful inducement to use private transport. This could explain in part the reason for the different results shown in Figs 1 and 2. Meanwhile, detailed research is being conducted in Delhi by the TRRL's Overseas Unit on the socio-economic factors affecting bus usage in that city.

As might be expected, in both groups of cities there was a close correlation between passenger trips per annum and the independent variables that describe bus operations. The number of passengers carried per bus fleet size and per bus kilometre was fairly similar for both groups, although there was a tendency for the larger fleets in developed cities to carry correspondingly more passengers, indicating perhaps the greater efficiency of bus operations in Europe and North America. There were marked differences in the relationships derived for passengers carried and staff employed, number of routes operated and system length operated for the two groups of cities. The greater number of passengers per route and per system length operated in developing cities might be a consequence of greater population density, an inadequate number of routes (or total network), or perhaps an inadequate supply of vehicles to routes operated. There were considerably

Fig 2. Bus passenger trips per annum for cities of differing area in developed and developing countries.



more passengers per bus company employee in developed cities than in those of the Third World. This illustrates the very high staff:vehicle ratios that exist in developing countries (see later).

The trip rate, i.e. the average number of passenger trips per person per annum was found, in both groups of cities, to be related to gross national product (GNP) per capita of the various countries. Since the GNP values relate to the countries as a whole and not to the specific cities this must be regarded as an approximation of the real relationships that may exist. Nevertheless the relationships derived between trip rates in the cities and the GNP/capita for the countries as a whole were statistically significant at the 5 per cent level. The slope of the regression line in Third World cities was found to be positive, the trip rate increasing rapidly with the increasing GNP, whereas in the European and North American cities the slope was negative, the trip rate decreasing slightly with increasing GNP. This implies (although this may perhaps be an oversimplification) that as people become more affluent in the Third World they may make more bus journeys each year, whereas in the developed world they buy more cars and consequently make fewer bus trips.

In comparing the trip rates with the independent variables that describe bus company characteristics, the trip rates in both groups of cities were found to be significantly related to the number of staff employed, the annual bus kilometrage travelled and number of routes operated. In these relationships, the trip rate was greater in developed countries for the same number of staff employed or bus kilometres travelled. In both groups, the trip rate increased with increasing staff, number of routes or bus kilometres, i.e. the larger the 'service', the greater the number of trips made per person per annum—due possibly to a better service. Current research in Delhi is studying in much greater detail factors affecting both supply of and demand for public transport.

#### Level of service

As seen earlier, the numbers of passengers carried per annum in a number of cities in developing countries increased considerably over the period 1964-75. As shown above the number of bus journeys made per person per annum was found to increase with increasing level of service. It may well be that an inadequate fleet size and route network is constraining the total number of passenger trips and there may be a considerable suppressed demand for public transport in these Third World cities. In order to obtain an estimate of the level of service provided in the two groups of cities, the average values of parameters that describe, in part, the level of public transport service were calculated. These are given in Table II.

As can be seen from Table II there were, on average, about 40 per cent fewer buses per

Table III. Service output levels

Company/city, year	Services operated to services scheduled (percentage)	Kms operated to kms scheduled (percentage)	Fleet utilisation level (percentage)
Delhi Transport Corporation (DTC), 1976	86.2	87.7	67.4
Bombay Electric Supply & Transport Undertaking (BEST), 1976	98.3	—	92.1
Pallavan (Madras) Transport Corporation Ltd (PTCL), 1976	97.5	94.9	88.6
Suva, 1973	66.1	88.4	—
Mombasa, 1977	100	96.1	94
Nairobi, 1977	100	97.9	90
Kingston, Jamaica, 1977	88.4	80.0	88

Table IV. Costs and revenues in various cities

City	Cost per bus km (pence)	Revenue per bus km (pence)	'Profit' per bus km (pence)
Bombay, 1976	21.8	20.0	-1.8
Blantyre, 1977	24.3	23.4	-0.9
Chieng Mai, 1976	9.1	6.0	-3.1
Delhi, 1976	18.8	10.5	-8.3
Kingston, Jamaica, 1977	48.9	47.7	-1.2
Kuala Lumpur, 1977	9.4	10.2	+0.8
Madras, 1976	14.8	14.9	+0.1
Mombasa, 1977	20.1	21.0	+0.9
Nairobi, 1977	21.0	25.2	+4.2
Nicosia, 1977	5.1	6.3	+1.2
Poona, 1976	16.1	15.4	-0.7
Surabaya, 1976	8.5	11.7	+3.2
Average values of 5 municipal operators in U.K. 1974-75	31.9	28.1	-3.8

head of population in cities of the Third World even though the level of car ownership is very much lower than in the industrialised countries. Similarly, the number of route kilometres per head of population is about half that in Europe and North America. It should, of course, be remembered that, in many Third World cities, paratransit systems provide additional transport services. This is discussed later.

The number of buses per route kilometre is the same in both groups of cities. Closer examination of these values shows that bus routes in cities in developed countries are, on average, only half as long as those in developing countries. In order to try to provide a reasonable level of service on these long routes, operators in developing countries have to run more buses per route than is the case in developed countries. One of the most characteristic features of bus operations in Third World cities is the very long routes that meander across large cities with terminal-to-terminal times of up to several hours. Delhi was one city where a major route rationalis-

ation scheme was adopted and passengers now travel directly between nodal interchange points. The effectiveness of this system is presently being examined by a joint team from TRRL and the Indian Association of State Road Transport Undertakings (ASRTU) in Delhi.

The level of service of a bus company is dependent not only on the number of buses owned, but also on the reliability and effectiveness with which they are operated. The internal operating efficiency of a bus company can be assessed by an examination of factors such as ratios of services operated to services scheduled; kilometres operated to kilometres scheduled; and the proportion of vehicles fit for use (fleet utilisation levels). Table III shows values obtained for a small number of bus companies operating in India, Kenya, Fiji and Jamaica. It can be seen that all bus companies reported surprisingly high service levels (comparable with London Transport). Unfortunately such figures can be misleading, since they provide no indication of the condition (and hence the comfort and safety) of the buses, the frequency of service and passenger waiting times. Such factors are also being examined by the TRRL/ASRTU team based in Delhi.

#### Costs and revenue

As seen earlier, the demand for public transport has declined steadily in the U.K. over the past decade. This in turn has led to general agreement that public transport services should be regarded, in part, as providing an

Table II. Level of service in developed and developing cities

Service level	Average value of 97 developed cities	Average value of 42 developing cities
Buses per 100 000 population	93	63
Route kilometres per 100 000 population	100	54
Buses per route kilometre	1.2	1.2

Table V. Operating costs for public transport operators (percentages)

Cost factor	London Transport 1976	National Bus Company 1976	Bombay (BEST) 1974/5	Delhi (DTC) 1974/5	Madras (PTCL) 1974/5	Poona (PMT) 1974/5	Calcutta (CSTC) 1974/5	Average of the five Indian cities	Manila 1974/5	Suva 1973	Chieng Mai 1976	Mombasa 1977	Nairobi 1977	Nicosia 1977	Kingston, Jamaica (JOS) 1977	Mauritius 1975	Kuala Lumpur 1977/78	Blantyre 1977
Staff	59	72	44	39	34	40	39	39	34	31	23	37	39	44	60	37	35	38
Fuel	3	6	15	15	21	20	12	17	19	15	20	18	16	6	4	22	13	12
Tyres/Spares	1	19	10	12	14	14	11	12	5	11	11	6	5	3	24	6	18	6
Maintenance	20		10	12	14	14	11	12	11	18	16	13	19	27	16	21	20	
Depreciation/Interest	4	3	14	24	9	12	27	17	11	15	36	7	6	12	5	10	9	9
Taxes/Licences	1	—	7	4	13	8	2	7	6	2	3	—	—	4	—	3	—	—
Other	12	—	10	6	9	6	9	8	7	10	7	19**	15**	4	7	6	4	15**
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

\* Bus companies allocate maintenance costs mainly as cost of tyres and spare parts

\*\* Depot and traffic operating costs and administration

essential service and, as such, should receive a measure of financial support. In contrast, it might be expected that with the large and increasing demand for public transport in Third World cities, bus companies should have no difficulty in being economically viable enterprises. The small sample shown in Table IV suggests that this is not the case.

In over half the cities for which data were available, operating costs per bus kilometre exceeded revenues. In many of these countries, India being a particularly good example, there has been a policy of maintaining low fare levels irrespective of the cost of providing the service. Requests for fare increases are subject to lengthy enquiries and small increases (if granted at all) are often out of date by the time they are implemented.

An examination of the structure of operating costs in cities in developed and developing countries reveals some interesting differences. It can be seen from Table V that in the U.K. the major cost component, about two-thirds the total, is that of staff, maintenance and spares making up most of the remainder. Operating costs in the Third World cities are clearly different, with staff costs being about one-third the total, but with fuel and depreciation/interest costs being much greater than in the U.K. The number of staff employed per bus in the 42 cities of developing countries was, on average, over twice as high as in cities in developed countries (7.4 compared with 3.6). Thus, even with one-man operation on many buses in the U.K., staff costs are high; in comparison, in many Third World cities there are often three persons operating each bus, but nevertheless staff costs would seem to be relatively low.

The distribution of costs in Nicosia, Cyprus and Kingston, Jamaica, appear to lie some way between the costs in the U.K. and other Third World cities. In these countries of relatively high levels of GNP, staff costs are obviously more than in Africa and Asia. Fuel costs are also similar in Nicosia and Kingston to the U.K. In the U.K. fuel is exempt from duty for bus companies; in many developing countries this is not the case and fuel costs are proportionately much greater.

Perhaps the most interesting difference in operating costs between cities in the U.K. and in the selected cities in the developing countries is the proportion of total costs allocated to depreciation and interest. For example, in

Chieng Mai, Thailand, over one-third of the total operating costs of public transport is spent on these two components. In many Third World countries the operational life of a bus is often extremely short, sometimes as low as six years; consequently vehicles have (in theory) to be replaced at very short intervals of time and depreciation costs are correspondingly high. In addition, many public transport operators in developing countries receive virtually no government support at all. In order to continue supplying public transport services, loans have to be acquired (sometimes from Central Government itself, as in Delhi, or from State Governments, as in Calcutta). The interest paid on these loans is often a considerable proportion of total operating costs for these bus companies.

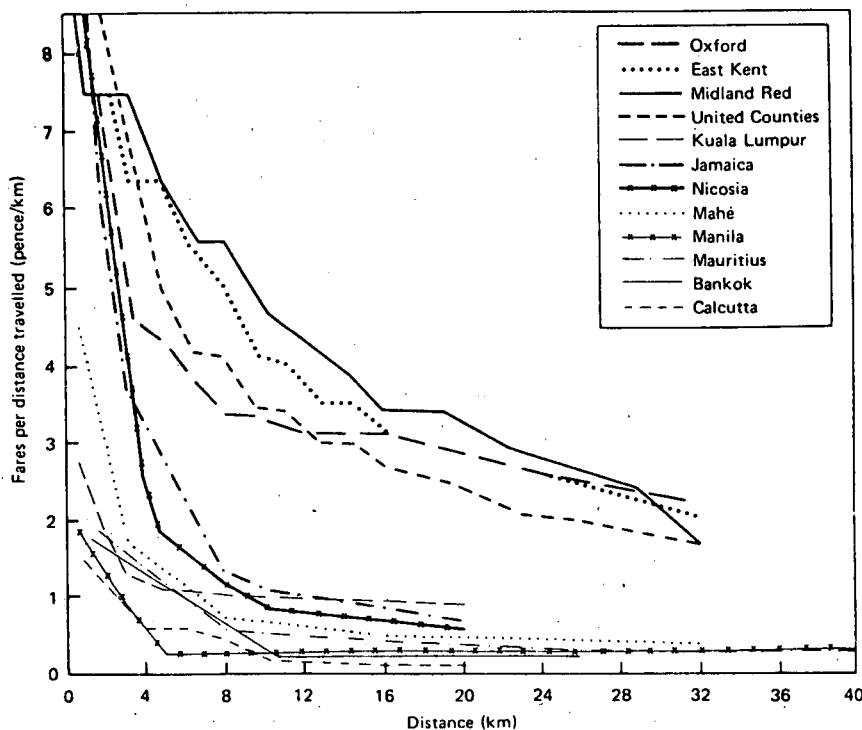
Financial costs of operation are further complicated in India by the imposition of

direct and indirect taxes. Such taxes consist of passenger taxes (levied on the number of passengers carried), vehicle taxes and income taxes. This means that the more successful and efficient the transport organisation, the greater the penalties imposed by government.

To a visitor from Western Europe or North America, bus fares might appear to be low in many cities in developing countries. Where a flat-fare system operates, passengers are able to travel up to 16 km for the equivalent of a 2p fare. In the U.K., a similar journey would cost over 50p.

Figure 3 shows how fares per kilometre travelled vary in parts of England and in a number of developing countries (where a flat-fare system is not in operation). In both England and the developing countries for which data were available, the cost per kilometre of a bus journey decreases with increas-

Fig 3. Bus fares per distance travelled and distance for different countries.



ing distance. A number of bus operators in developing countries show particularly sharp decreases in cost for journeys of over six kilometres in length.

Studies of public transport operations in Chiang Mai<sup>3</sup> and Surabaya<sup>4</sup> indicated that low-income travellers use buses, as opposed to minibuses or other forms of paratransit. In order to relate the cost of bus travel to some measure of the wealth of passengers, the cost of a five-kilometre journey in different cities was regressed against the GNP value of the various countries. As was pointed out in the earlier comparisons of trip rates and GNP levels, relationships derived are approximations since GNP values for city dwellers are likely to differ considerably from those of the country as a whole. However, the relationship derived (see Fig 4) was statistically significant at the 1 per cent level. Thus, even in those cities where particularly low fares may appear to exist, the fares would seem to be commensurate with the general wage levels of the countries concerned.

#### Discussion

With the very low levels of car ownership that exist in most cities in developing countries, it is essential for the social and economic well-being of the community that an adequate public transport system be provided. In a number of cities paratransit systems play an important role, but in most urban areas in the Third World there is, and will continue to be, a heavy reliance on the conventional bus system. The analysis of trends in bus usage in cities for which data were available has indicated the growing demand for public transport that has taken place in recent years.

Whilst this growing demand for public transport has been taking place, government support in many countries has been minimal and operators (be they private, municipally-owned or controlled by central government) are often treated as commercial enterprises and consequently the problem of remaining economically viable lies with the bus company. Indeed, in India successful bus operators are often penalised by means of taxes for providing an efficient service to the general public. On the one hand bus organisations are treated as commercial enterprises, whilst on

Fig 5. Boarding a bus in Delhi.

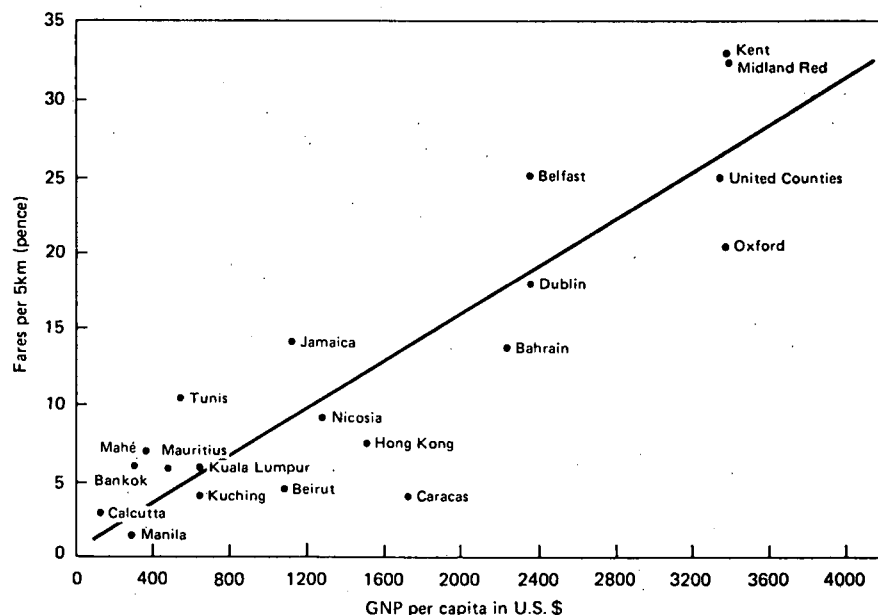


Fig 4. The cost of a 5-km bus journey and GNP per capita (1974) in cities in developed and developing countries.

the other hand they are asked to provide a social service, operating uneconomic routes, providing particularly cheap fares to students and being subject to rigid fare controls.

With the large demand that exists for public transport in developing countries it might be thought that bus companies are thriving, with relatively few financial problems; from data available this appears not to be the case. Although the operating costs per kilometre are lower than in Great Britain, revenues are also much lower. In addition, the large demand appears to be associated with a lower level of service: the total numbers of buses and bus kilometres available per head of population are much lower in Third World cities than in those of Europe and North America. In many cities in developing countries, paratransit systems have developed to satisfy this demand for public transport.

Although this paper has outlined differences in levels of service in the broadest sense, it is important to identify deficiencies in greater detail. The Overseas Unit, TRRL, and the Indian Association of State Road Transport Undertakings (ASRTU) are studying the transportation system of a Third World city (Delhi) to see how it functions, how it is used, who uses it and what satisfaction users receive. All modes of transport (including walking, cycle, auto-rickshaw, etc.) are being examined. The aims of the two-year research programme are:

- (1) To provide information on the effectiveness of urban public transport in meeting the needs of the traveller, particularly from the poorer sections of the community; and
- (2) To provide information on the effectiveness of measures to improve the efficiency of public transport operations.

The research will identify important traveller characteristics and transport supply characteristics and how these vary in response to changes in each other and in the operating environment. This information can be used to provide a sound basis for policy decisions on matters such as fare structure, route rationalisation, control of paratransit and needs of the urban poor.

Meanwhile, throughout the developing

world many passengers travel on unsafe buses in extremely overcrowded conditions (see Fig 5) having waited (as preliminary results from Delhi indicate) up to two hours for a bus to arrive. If levels of service are to improve in the future, but with fares related to the low income levels in developing countries, public transport services may well need some kind of government support in meeting the needs of the community.

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The authors' address: Overseas Unit, Transport and Road Research Laboratory, Crowthorne, Berkshire RG11 6AU.