

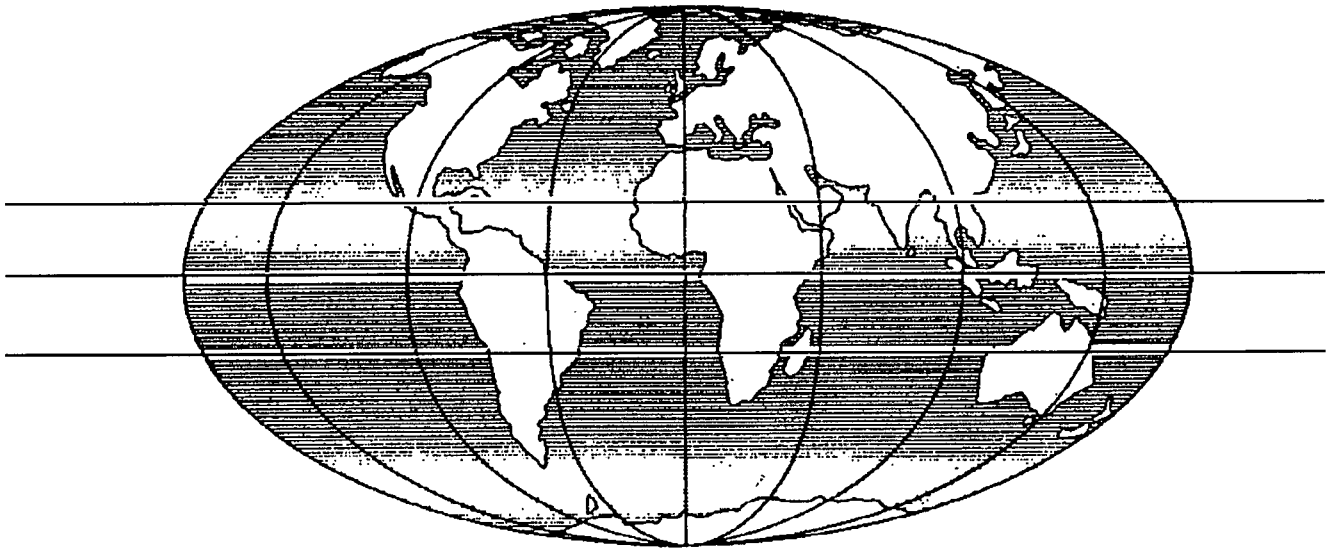


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**TITLE Characteristics of conventional public transport services in Third World cities**

**by G D Jacobs, D A C Maunder and P R Fouracre**



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# **Characteristics of conventional public transport services in Third World cities**

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# Characteristics of conventional public transport services in Third World cities

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**Introduction.** The urban public transport sector in developing countries is broadly characterised by its high growth rate, its diversity and in many cases its poor financial performance. Conventional bus operators play a significant part in the movement of large numbers of travellers in most cities, though the estimated<sup>1</sup> half-million buses operating in cities of over 100 000 are unable to meet the total demands of the travelling public. This has given rise to paratransit or intermediate public transport (IPT) modes such as rickshaws, minibuses, shared taxis and even horsedrawn vehicles.

Demand for urban public transport services is growing at a rapid rate throughout the Third World, due largely to the rise in population in most cities. In 1960 the U.N. reported 53 cities in developing countries with a population of more than 1m.: by the year 2000, the U.N. forecasts that there will be a total of about 300 cities in excess of 1m. and by 2025 a total of about 500. By the end of the century it is forecast that there will be 144 cities in the world with populations in excess of 4m., with 123 (85 per cent) of these in the developing world. Thus growth will continue to take place in the cities that already have great difficulty in feeding, housing and transporting the millions who already live there.

Though personal motorised vehicle ownership will continue to rise (with marginal increases in incomes) and continue to be concentrated in urban areas, walking, cycling and public transport will remain the major travel modes in Third World cities. Fouracre<sup>2</sup> suggests 'with increasing city size (and area) trip lengths will increase and the burden of commuter travel will increasingly fall upon the public transport sector as longer trips will tend to discourage walking and cycling as convenient alternatives'.

Although a few cities in developing countries have or are building rail mass transit systems, the vast majority will still be relying for many years to come on road-based systems. Thus in the future, as at present, the conventional bus and the many forms of paratransit will be playing the key rôle in meeting the increasing demand for transport in these cities.

This paper reviews conventional bus operations in cities of the Third World

using data obtained from a postal survey implemented in 1984 by the Transport and Road Research Laboratory, and supplemented by additional published material. Basic operational data as well as costs and revenues were obtained from 22 conventional bus operators throughout the Third World, updating similar information collected from bus operators eight years ago. A total of 70 operators were initially contacted and therefore the 22 replies received represent a 30 per cent response. The respondents operate throughout the Third World — in cities in Africa, India, Pakistan, South America, the Middle East and the Far East — and range from being the sole supplier (monopolist) of public transport services to being in the minority, (i.e. IPT services are in the majority). Some are publicly-owned corporations, others are privately-run companies, each provide a service to the travelling public and is assumed to be representative of conventional public transport operators throughout the developing world.

## Trends in use of public transport

In the U.K. the use of stage bus services has been declining since about 1950. A major cause of this decline has been

identified as the rapid increase in car ownership that has taken place over the last 30 years<sup>3</sup>. A more recent study of public transport operations in 117 cities in 16 European, North American and Australasian countries<sup>4</sup> showed that public transport usage is not in decline in all (developed) countries. In about 60 per cent of the cities studied the number of passengers carried actually increased between 1960 and 1970. The U.K., however, showed the greatest decline at about 4 per cent per annum. A number of factors affecting public transport usage were examined and increasing levels of subsidy, urban density, levels of migration to the cities, urban form (degree of centralisation) and household size were all found to be important.

Although personal motorised vehicle ownership has increased rapidly over the last three decades in the Third World it is still at a relatively low level and therefore there is still a great reliance on public transport services. Table I shows the percentage changes in the number of buses and passengers carried over the nine-year period 1974-1983 and five-year period 1978-1983 for 13 cities of the developing world. For comparative purposes trends

Table I. Average annual percentage change in number of buses, routes operated and passengers carried in selected Third World cities and the U.K.

City	Total fleet		Routes operated		Passenger trips	
	1974-83	1978-83	1974-83	1978-83	1974-83	1978-83
Addis Ababa	0.6	11.0	2.0	4.7	7.4	5.0
Bangkok	1.5	-0.3	5.9	4.0	16.2	23.0
Bombay	7.8	7.9	7.1	8.6	9.0	2.1
Cairo	9.8	8.7	4.2	3.5	1.1	0.2
Delhi	24.9	39.1	18.3	17.8	24.3	20.7
Harare*		11.0		0		8.9
Istanbul*		8.7		4.0		-0.2
Madras	25.1	8.7	21.8	19.5	62.0	7.3
Nairobi	9.5	0		5.1		8.0
Peshawar		97.0		32.6		30.0
Pune	1.3	-1.2	2.0	18.1	0.6	10.8
Singapore	4.3	6.1	7.9	7.6		
Tunis	11.4	4.0		7.8		2.9
London Transport Executive	-1.3	-2.2			-2.9	-3.3
Passenger Transport Executives, U.K.	-1.9	-2.4			-2.7	-2.6
Municipal operators, U.K.	-1.6	-2.1			-3.2	-3.7

\* 1980-1983

Sources: TRRL, 1984 sample questionnaire, and *Transport Statistics Great Britain 1973-1983*, HMSO, London, 1984

are also shown for three groups of operators in the U.K.

In almost all the Third World cities there were considerable increases in the number of buses in use and passengers carried. In the major Indian cities, for example, the number of buses doubled in Bombay and trebled in Madras and Delhi between 1974 and 1983. Other cities such as Cairo and Tunis also showed large increases in the number of buses in use. Peshawar in northern Pakistan also showed an extremely large increase in the bus fleet over the five-year period 1978-83.

Apart from Istanbul, the number of passengers carried increased in all the Third World cities, with Peshawar, Delhi and Bangkok showing the greatest increases between 1978 and 1983. In about two-thirds of the cities the number of passengers increased at about the same rate or a faster rate than the population growth rate, with Cairo and Istanbul being notable exceptions. In both these cities there has been a rapid growth in the number of shared taxis (either legal or illegal) which now carry substantial numbers of passengers. Surveys carried out in Istanbul in 1981 suggest that the number of passengers travelling by minibus/shared taxi now exceeds those travelling by conventional bus. In these two cities the total combined numbers of passenger trips by conventional bus and minibus might well have increased at a faster rate than the population growth rate.

In contrast, the number of buses run and passengers carried in the U.K. by London Transport, the Passenger Transport Executives or the Municipalities decreased by 2 to 3 per cent per annum.

In all Third World cities replying to the current questionnaire there were considerable increases in the number of routes operated. These have probably been introduced to serve areas of the city experiencing rapid population growth rates. The Indian cities showed some of the largest increases in the number of routes operated. In these cities new routes have also been introduced in recent years which provide passengers with a higher level of service, with limited stops and guaranteed seats. Little background information is available on public transport operations in Peshawar, Pakistan. From the figures available, however, it would appear that the public transport system has been completely restructured in recent years with considerable investment in the bus fleet taking place.

#### Factors affecting public transport demand

Studies were made by Jacobs *et al*<sup>5</sup> in 1979 and by Vijayakumar and Jacobs<sup>6</sup> in 1982 in order to compare and contrast some of the factors affecting urban public transport usage in both developed and developing countries. In both studies data on over 150 cities were obtained from the UITP Handbook for Urban Transport<sup>7,8</sup>. Regression analysis was used to establish relationships between public transport usage, supply and the physical and socio-economic parameters of the cities.

The analysis showed, as might be expected, that the number of passengers using bus services increased with the size (both population and area) of the city, though this trend was more marked in Third World cities. Relationships were found to exist between income and bus patronage: increased income in developed countries was shown to result in a decreased patronage of public transport, reflecting higher income and vehicle ownership levels found in the developed world. However, in developing countries an increase in income led to a marked increase in public transport usage. Relationships between demand for public transport and factors that described the bus systems indicated a greater demand for public transport in Third World cities and an associated lack of supply. For example, a given number of buses in Asian and African cities generated twice as many passengers as those in developed countries. Conversely, in Western cities there were much higher levels of supply with correspondingly lower demand.

Although the number of cities responding to the current questionnaire was fairly small, an attempt was made, using simple regression analysis, to see if similar relationships to those obtained in the earlier studies could be established from the data provided. Two dependent variables were used, the total number of trips per annum and the average number of trips per person per annum. The object of the analysis was not to derive a 'model' for public transport trip-making, but simply to obtain some understanding of the factors that might affect bus usage in these cities. Results are given in Tables IIa and IIb.

It can be seen that parameters that describe either the city or the public transport system in some way were significantly related to the total number of public transport trips per annum (Table IIa). Thus as the city population, number of routes, bus-kilometres, fleet size and fleet in use increase, so does the number of passenger trips per annum. The equation

relating passenger trips to population is very similar indeed to that obtained from the earlier study<sup>6</sup> using data from the UITP Handbook for over 50 Third World cities. The sample obtained from the questionnaire would seem, therefore, to be a reasonably representative sample of Third World cities.

The relationships can be used to calculate various marginal values; for example, the results indicate that each additional thousand population is associated with an increase of 370 bus passenger trips per day. Similarly, for each additional bus operated a total of 880 additional passengers would be transported.

In general, use of total trips as dependent variable gave a better fit to the data than the use of passenger trips per person per annum, i.e. the trip rate (Table IIb). Trip rate is apparently independent of city size. (It should be remembered that this rate excludes other modes of public transport which are likely to be more evident in larger cities.) However, significant relationships were established between trip rate and parameters that described bus operating characteristics. In the earlier study<sup>6</sup> using a larger database similar relationships were derived for Third World cities but not for those in developed countries. In this analysis, however, the relationship between trip rate and GNP per capita was not found to be substantially significant. It would appear, therefore, that demand elasticities with respect to service level are much more important in cities in developing countries. Thus as the number of routes, bus-kilometres and buses increase, so does the average annual trip rate per person. (It is, of course, also possible that demand leads service levels, improvements in the latter being a response to growth in demand.)

#### Level of service

As seen in Table I, the numbers of passengers carried per annum in a number of cities in developing countries increased considerably over the periods 1974-83 and

Table IIa. Dependent variable — passenger trips/annum (million)

Independent variable	Regression constant	Regression coefficient	Correlation coefficient R <sup>2</sup>	F-ratio	Significant at 5%
Population (10 <sup>3</sup> )	-11.7	0.13	0.86	108.30	Yes
GNP/capita	445.7	-0.09	0.05	0.91	No
No. of routes	49.3	2.19	0.60	27.31	Yes
Bus-km (10 <sup>5</sup> )	33.9	0.41	0.81	76.73	Yes
Fleet size	26.5	0.27	0.81	72.43	Yes
Fleet in use	54.5	0.31	0.77	59.43	Yes

Table IIb. Dependent variable — passenger trips/person/annum (trip rate)

Independent variable	Regression constant	Regression coefficient	Correlation coefficient R <sup>2</sup>	F-ratio	Significant at 5%
Population (10 <sup>3</sup> )	93.0	0.003	0.03	0.63	No
GNP/capita	109.2	-0.01	0.03	0.48	No
No. of routes	74.4	0.19	0.30	7.89	Yes
Bus-km (10 <sup>5</sup> )	80.2	0.03	0.23	5.39	Yes
Fleet size	78.9	0.02	0.25	5.89	Yes
Fleet in use	78.8	0.02	0.28	7.11	Yes

1978-83. As shown above, the number of bus journeys made per person per annum was found to increase with increasing level of service. This rapid growth suggests there may well be considerable further demand for public transport in these Third World cities, currently suppressed by inadequate fleet size and route networks. In order to obtain an estimate of the level of conventional public transport service provided in cities in developed and developing countries, Vijayakumar and Jacobs<sup>6</sup> determined average values for the number of buses operated per head of population and per route kilometre in different regions of the world in 1978. The results from this analysis together with the average value for cities responding to the questionnaire are given in Table III.

From Table III it can be seen that in 1978 the Third World cities had, on average, lower levels of public transport provision than cities in the U.K. and the rest of Europe. Even North American cities (where private vehicle ownership is amongst the highest in the world and dependence on public transport correspondingly low) had on average more buses per head of population than African cities. In many Third World cities, however, it should be remembered that paratransit or IPT systems provide additional transport services. This is discussed later. These relatively low levels of public transport provision, coupled with increasing demand for public transport (due to increasing urban populations, city size and relative affluence), indicate the reasons for the large increases in public transport provision over the last 10 years or so shown in Table I.

In the questionnaire sample the number of buses per route kilometre operated is of the same order as that derived from the 1978 data-set for developing countries. Both values, however, are considerably lower than the average number of buses per route kilometre operated by bus companies in the developed world. In Third World cities the fewer buses are also likely to be run on proportionately more routes of longer length.

The level of service provided by 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). Data collected as part of the earlier study<sup>7</sup> showed that bus companies in a number of Third World cities reported surprisingly high ratios of services and kilometres operated to that scheduled. Information obtained from the current questionnaire showed that the average fleet utilisation level of 74 per cent was creditable, when compared with an average value for major U.K. transport undertakings of about 80 per cent. The average daily kilometres operated per bus held for Third World

Table III. Conventional public transport provision by region

Region	Buses/100 0 population	Buses/route-km operated
<i>1978</i>		
Asia	0.25	} 0.56
Africa	0.30	
Other Third World	0.46	
U.K.	0.77	} 0.82
Rest of Europe	0.50	
North America	0.37	
<i>1983</i>		
Third World cities responding to questionnaire	0.39	0.52

companies replying to the questionnaire was also high at 176 km, some 30 per cent higher than the average for major U.K. companies.

Such figures, however, can be somewhat misleading since they provide little indication of condition (and hence comfort and safety) of the buses, the frequency of service and passenger waiting time. Thus the average number of passengers per bus in use per day for companies responding to the questionnaire was almost 1 200, a value twice that for U.K. cities. The estimated load factor at about 0.7 was up to three times greater than that for U.K. operators. This high passenger handling and associated high level of vehicle utilisation reflects the high demand for public transport services and associated lack of supply in most Third World cities. Figure 1 shows an overcrowded bus in Delhi, a scene typical throughout the developing world.

Fig 1. An overcrowded bus in Delhi, India.



#### Costs and revenue

The report of the international collaborative study of the factors affecting public transport patronage in 15 developed countries<sup>9</sup> showed that subsidies for public transport had increased substantially over the period 1966-1976. Many cities rely on subsidies to provide better and cheaper transit services and it is clear that this is having the desired effect of keeping fares lower and total vehicle-km higher than they would otherwise be, so attracting higher levels of patronage. In contrast, it might be expected that, with the large and increasing demand for public transport in Third World cities, bus operations should be economically viable without the need for financial support. Data on profit and

loss for the year 1983 collected from those organisations responding to the questionnaire show that this is not always the case.

Figures 2 to 4 show the operating costs and revenues per bus, per bus-km and per passenger carried for the different bus companies. It can be seen that between one-half and two-thirds of the bus companies operate at a loss. The ogive curves (Figs 5 to 7) show that in each case the median values of revenues are less than those for operating costs. For example, the median revenue per bus-kilometre travelled is 33p whilst the median cost is 39p; equivalent values per passenger carried are 5p and 8.5p, and per bus operated per day are £55 and £66 respectively.

In many of these countries there has been a policy of maintaining low fare levels irrespective of the cost of providing the service, India being a particularly good example. Detailed research by the Transport and Road Research Laboratory's Overseas Unit on low-income communities in Third World cities<sup>10,11</sup> has shown that the poorest sections of the community are often obliged to spend substantial proportions of their household income on transport. Thus in Delhi, people living in low-income settlements located up to 30 km from the city centre spend up to 30 per cent of their household incomes on public transport. In comparison, the poorest sections of the community in the U.K. spend about 4 per cent of their incomes on transport<sup>12</sup>. In many Third World cities public transport fares have become important political issues and it is not surprising that efforts are made by government to keep public transport fares low.

It is interesting to note that of the operators showing a profit per passenger carried, five are in east or southern Africa. Of these, four are operated by private companies under franchise. Thus it could be implied that private operators are more 'efficient' than those under State or Municipal control. An examination of costs and revenues per bus operated and per bus-kilometre travelled shows that whilst costs of those bus companies showing a profit are about average, the revenues tend to be greater than average. Profitability therefore would appear to be more dependent on fares charged than on operating efficiency.

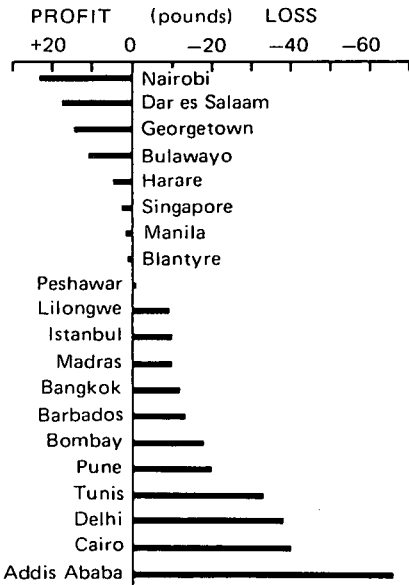


Fig 2. Profit/bus/day.

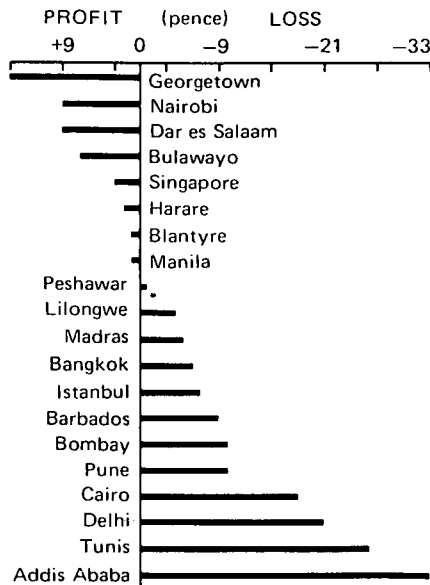


Fig 3. Profit/km operated.

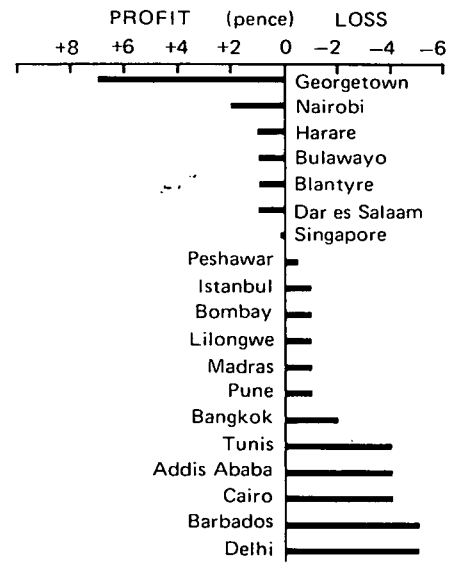


Fig 4. Profit/passenger carried.

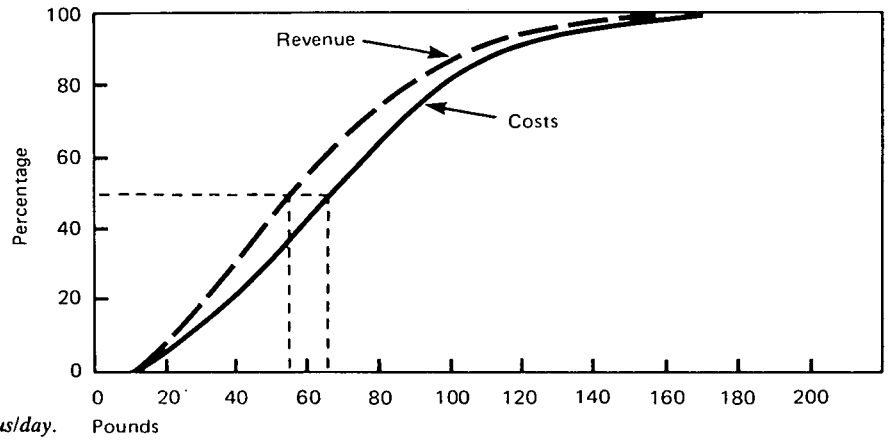


Fig 5. Revenue and operating costs/bus/day.

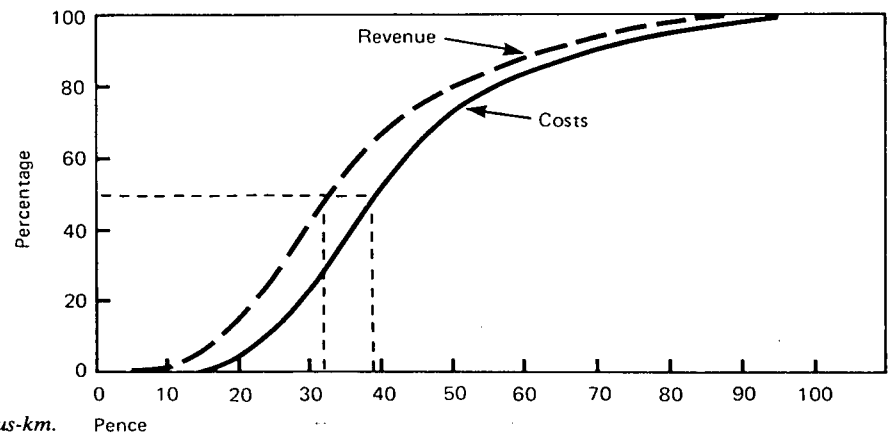


Fig 6. Daily revenue and operating costs/bus-km.

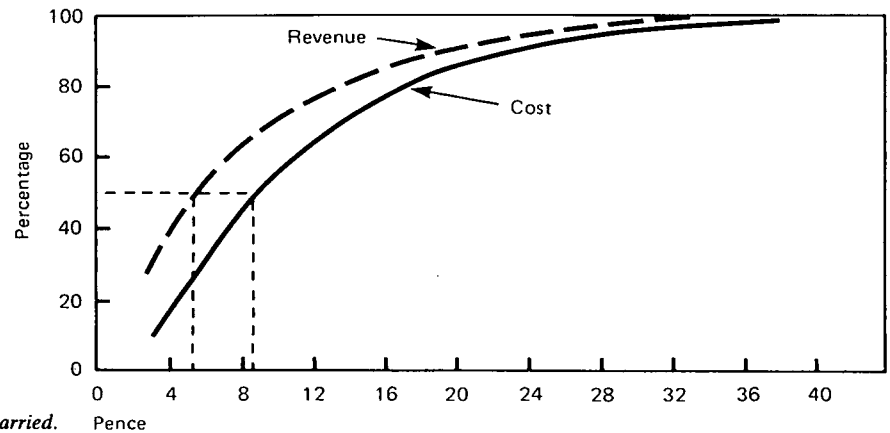


Fig 7. Revenue and operating costs/passenger carried.

**Table IV.** Operating costs for public transport operators in various Third World cities: 1983 (percentages)

Cost factor	City																				Average, U.K. major operators	Average, 36 European cities	Average, 7 Canadian cities
	Addis Ababa	Barbados	Bulawayo	Blantyre	Bangkok	Bombay	Dar-es-Salaam	Delhi	Harare	Istanbul	Lilongwe	Madras	Manila	Nairobi	Peshawar	Pune	San Juan	São Paulo	Singapore				
Staff	30	39	39	14	30	39	23	31	35	51	13	37	15	35	18	36	53	52	52	64	} 34	} 33	} 67
Fuel	16	15	26	38	24	17	13	16	30	22	40	21	35	21	30	22	9	24	12	5			
Tyres, spares and maintenance	21	20	20	22	24	10	23	8	16	13	20	16	17	20	16	15	8	10	13	14			
Depreciation, interest, taxes, licences	27	6	8	8	14	22	24	34	7	13	11	24	31	15	31	12	4	7	15	7			
Other	6	20	7	18	8	12	17	11	12	1	16	2	2	9	5	15	26	7	8	10			

An examination of the operating costs of public transport undertakings in Third World cities responding to the questionnaire and of some of the major operators in the U.K. reveals some interesting differences: see Table IV, which also presents a limited amount of data obtained for 36 European and seven Canadian cities. In cities of the U.K. Europe and Canada staff costs, at about two-thirds of the total, are the major cost component, with maintenance and spares making up most of the remainder. Conversely, in Third World cities, staff costs form about one-third the total, with fuel costs in particular being much greater than in the U.K. The average number of staff employed per bus in most cities in developing countries is over twice that in developed countries. Few operators in cities of developing countries have one-man buses, suggesting that the relatively low staff costs are a result of extremely low wage rates. In Blantyre, Lilongwe and Manila staff costs would appear to be particularly low, whilst in those cities with relatively high income levels, e.g. São Paulo, San Juan and Singapore, the distribution of costs lies some way between costs in the U.K. and other Third World cities.

Fuel costs are a major cost component in Third World cities. In the U.K. fuel for bus companies is exempt from duty (fuel duty grant for all U.K. operators exceeding £100m. in 1983/84), but in the Third World this is rarely the case. Since the early 1970s the price of oil has increased six-fold in real terms and this has had a dramatic effect on developing countries. In Kenya, for example, the cost of imported oil in 1973 was equal to 1 per cent of the country's export earnings, but by 1981 it had risen to over 40 per cent.

A comparison of costs obtained from Third World urban companies in an earlier study<sup>3</sup> suggests that since 1974/5 total costs have increased by about 90 per cent; staff costs have declined as proportion of total costs, whilst fuel costs have increased. Changes in the cost structure are likely to take place for one (or more) of three reasons: changing relative prices; changes in productivity associated with the use of a particular input; and economies or diseconomies of scale. Expenditure on fuel is unlikely to have been greatly affected by either of the latter two changes, but price

changes have had a significant effect. Changes in productivity, however, may have had some effect on staff costs.

Another important difference in operating costs between cities in the U.K. and in the Third World cities responding to the questionnaire is the proportion of costs allocated to depreciation, interest and taxation. In many Third World cities the operational life of a bus is relatively short (sometimes as low as six years) and depreciation costs are correspondingly high. In addition, many public transport operators in Third World cities are not subsidised as is the case in the U.K. and the rest of Europe, and in order to continue operations loans have to be acquired either from Central or State government. This is the case in many Indian cities and the interest paid on these loans is often a considerable proportion of total operating costs for bus companies in these cities. In Delhi, for example, 34 per cent of operating costs comprise depreciation, interest, taxes and licences, whereas for a number of U.K. major operators the figure is 7 per cent.

#### Discussion

The main objectives in sending the questionnaire to a large number of transport undertakings in Third World cities was to update information on trends in public transport usage, on levels of services and costs and revenues, and to use this information to improve the understanding of public transport supply and demand in these cities.

The analysis of bus usage indicated the growing demand for public transport that has taken place in recent years. With the relatively low levels of car ownership that exist in most cities in developing countries, it is essential for the social and economic wellbeing of the community that an adequate public transport system be provided. In a number of cities paratransit systems play an important role. In Manila, Nairobi and Istanbul the number of passengers travelling by minibus, etc., probably exceeds those travelling by conventional bus. In other cities such as Cairo and Bangkok the number of minibuses, shared taxis, etc., has increased very rapidly over the last few years.

The development of paratransit systems has generated controversy over the use of small or large vehicles, the encouragement of small or large enterprises, and whether the public transport sector should be privately-operated or nationalised. Resolving the arguments is not an easy task because technical merits of a particular system may be masked by institutionalised constraints. In general, small vehicles are likely to be more expensive to operate (per seat-km) than large vehicles (assuming the same operator were to be running the two types). But returns on the smaller vehicle may be higher because of higher load factors and fares (per passenger-km). A small enterprise is likely to be able to operate a given vehicle type more cheaply than a large enterprise. This is less likely to be because there are any economies of scale, but because labour productivity is higher in the small enterprise, for institutional rather than technical reasons. The small enterprise is less subject to labour laws and union pressures, which affect manning levels, working hours and wage rates. Lastly, the nationalised industry is likely to incur higher costs than a private concern in operating a given number of vehicles, but the nationalised concern is likely to be under much greater pressure to provide high service levels at artificially low fares. Results from the present study suggest that the economic viability of private operators (using conventional vehicles) is more likely to be due to higher fares than to lower costs per vehicle or per vehicle-km operated. Labour productivity could undoubtedly be improved within the nationalised sector following trends adopted in the Western world such as, for example, one-man operation of buses. However, the associated need for expensive, special technologies (e.g. automatic doors) may make such an exercise prohibitive. Furthermore, data collected showed that buses in the Third World are more highly loaded with average load factors between 70 and 80 per cent, compared with 20 to 30 per cent in the U.K., making the driver's task much more difficult. Neither is there the same pressure on labour costs where, as seen above, approximately 30-40 per cent of costs are attributable to this source compared with 65-70 per cent in the U.K. and other Western countries.



Despite the large and increasing demand that exists for public transport services in Third World cities, relatively few bus companies are profitable and without problems. Most suffer from a shortage of vehicles, thus the total number of buses per head of population is considerably lower than in developed countries. Existing fleets are inadequately maintained, yet used intensively in terms of hours of operation (in service) and kilometres operated per day. Public transport fares are politically sensitive, as in Third World cities large segments of the population are particularly poor and unable to pay the true market cost of providing the service. However, a cheap fares policy can be regressive in that large numbers of passengers who benefit could well pay more for travel. Losses incurred by bus companies in Third World cities are covered from a variety of sources: profits on inter-city operations, loans from central or local government or by having losses written off. There are no criteria on which to judge whether losses incurred are commensurate with benefits to the travellers. The continued losses do not encourage expansion of the industry to meet the ever-increasing demand, which must in part be generated by the low tariff levels.

A bus company which is impoverished by virtue of a low fare structure and at the same time is not in receipt of positive government support will always be short of investment capital, as a consequence of which the service will inevitably deteriorate. (Operating cost figures obtained from this particular study suggest that active government support is needed at least to

reduce fuel costs.) The decaying or stagnant service is further eroded as paratransit forms develop, their owners taking the opportunity to fill the gaps in transport supply.

Transport policies obviously have to be planned in the light of urban development objectives, operating circumstances and resources available. Different cities in the Third World have approached the problem of providing for transport demand in different ways. There is evidence of a broad correlation between certain characteristics of the city and its transport system and also between the demand for public transport and the level of supply. However, the mechanism of interaction between these factors needs much greater understanding in Third World cities if only to avoid the (frequently) inevitable result of creating long-term problems through solving immediate problems concerning transport demand.

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