RAIL MASS TRANSIT IN DEVELOPING CITIES: THE TRRL STUDY

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SYNOPSIS. Many Third World cities have recently built metros, usually encouraged by European manufacturers and their governments, but frowned on - because of their enormous cost - by the World Bank and some disinterested transport planners. How have these metros fared? Were they justified in either financial or economic terms? Or are metros really a luxury that poor cities should forgo? How can an aid agency, or a city government, come to a reasonable appraisal of a metro project without the cost and delay of a large feasibility study? The Overseas Development Association recently sponsored a research study into these questions, and this paper summarises the findings. The Study Team went to 21 developing cities and collected data which was analysed on a strategic transport evaluation model. They enquired into the reasons why people wanted metros and noted a widespread misconception that the metro would cure traffic congestion. The Study found much to praise in the engineering and operation of the Third World metros, but much to criticise in their planning and financial management. It concluded that metros - in developing cities at least - cannot be financially viable but can give good economic returns in the right conditions, which it endeavoured to spell out in broad terms. The Study noted the strong connection between the metro and the growth of the city centre; it concluded that very large cities must either build metros or see the growth of their centres frustrated by inaccessibility, with corresponding growth diverted to suburban centres.

BACKGROUND

1. Mexico City opened its metro just over 20 years ago, following the mould of European and Japanese cities. Since then over 20 cities in the developing world have pursued a similar course and

many others are planning to do so. This trend has been eagerly supported by some industrialised countries (France, Germany, Sweden, Japan, Belgium and others) but fiercely discouraged by some aid agencies and some transport planners. The World Bank, in its Urban Transport Policy Study (1986), pointed to the high construction and operating costs, cost over-runs, over-estimates of demand, inadequate revenues and attempts to suppress bus competition, commonly associated with metro projects. The Bank generally preferred to see money spent on more cost-effective solutions, in particular improvements to the capacity and operation of existing infrastructure.

2. This 'soft path' approach was widely criticised (by Dunbar and Rapp, 1986, and Henry, 1987, for example) and debated (by Ridley, 1986, and Rimmer, 1988, for example). The approach was alleged to overlook the wider and longer-term benefits of metros and to overrate the ability of less costly means of transport to meet the needs of developing cities, many of whom continue to clamour for metros, whether light or heavy, above or below ground. The UK Overseas Development Administration (ODA) has been approached about six metro projects in the past two years. But there has been little research on the performance and impact of such projects. In mid-1987, therefore, the ODA, with the encouragement of the World Bank, commissioned a study by their transport advisers, the Overseas Unit of the Transport and Road Research Laboratory, who appointed Halcrow Fox and Associates to provide most of the staff input.

3. The aims of the study were to:

- review the experience of planning, building and operating rail mass transit systems in developing cities;

- establishing a quick and simple method of appraising metro projects in developing cities;

- identify the conditions under which investment in such systems might be justified;

- recommend a role for aid agencies.

4. The work divided mainly into three parts: case studies of 21 developing cities with metros in operation or in prospect; establishment of a strategic traffic and evaluation model; and application of the model to some of the case study cities. The case studies provided data with which to furnish the model, and the model provided the tool for evaluating metros, either operational or projected. The application of the model to the cities completed the comparative analysis on which some general conclusions about metros in developing cities could be drawn. This paper summarises the findings and conclusions of the study.

CASE STUDY CITIES

5. Case studies were made in 21 developing cities covering a wide geographic, demographic and economic range. All contained more than a million people and most more than 3 million, and they included many of the world's largest cities. They included Singapore and Hong Kong, which are no longer developing cities but were classed as such when they started planning their metros. Metros are in operation in 13 of the cities, are under construction in two and are planned in the other 6. One city, Tunis, has a light rapid transit system.

6. Figure 1 compares the cities in terms of population and income/head. The total income curves (i.e. population x income/head) show that all the cities with incomes above US$ 15 bn have a metro while most below US$5 bn do not.

Transport Policies

7. A review of the cities' transport policies was made in order to see what had been done, apart from building metros, to resolve their transport problems, and this is summarized in Table 1. Traffic management was universal; most of the cities had area traffic control, gyratories, lane markings, channelization, etc. Parking restrictions were common but generally not well enforced. Parking charges were sometimes imposed in central areas, but at very low levels. Apart from Singapore, there was no serious attempt to restrain the user of cars, but Hong Kong, and to a lesser extent some other cities, imposed high motor taxes in order to restrain car ownership.

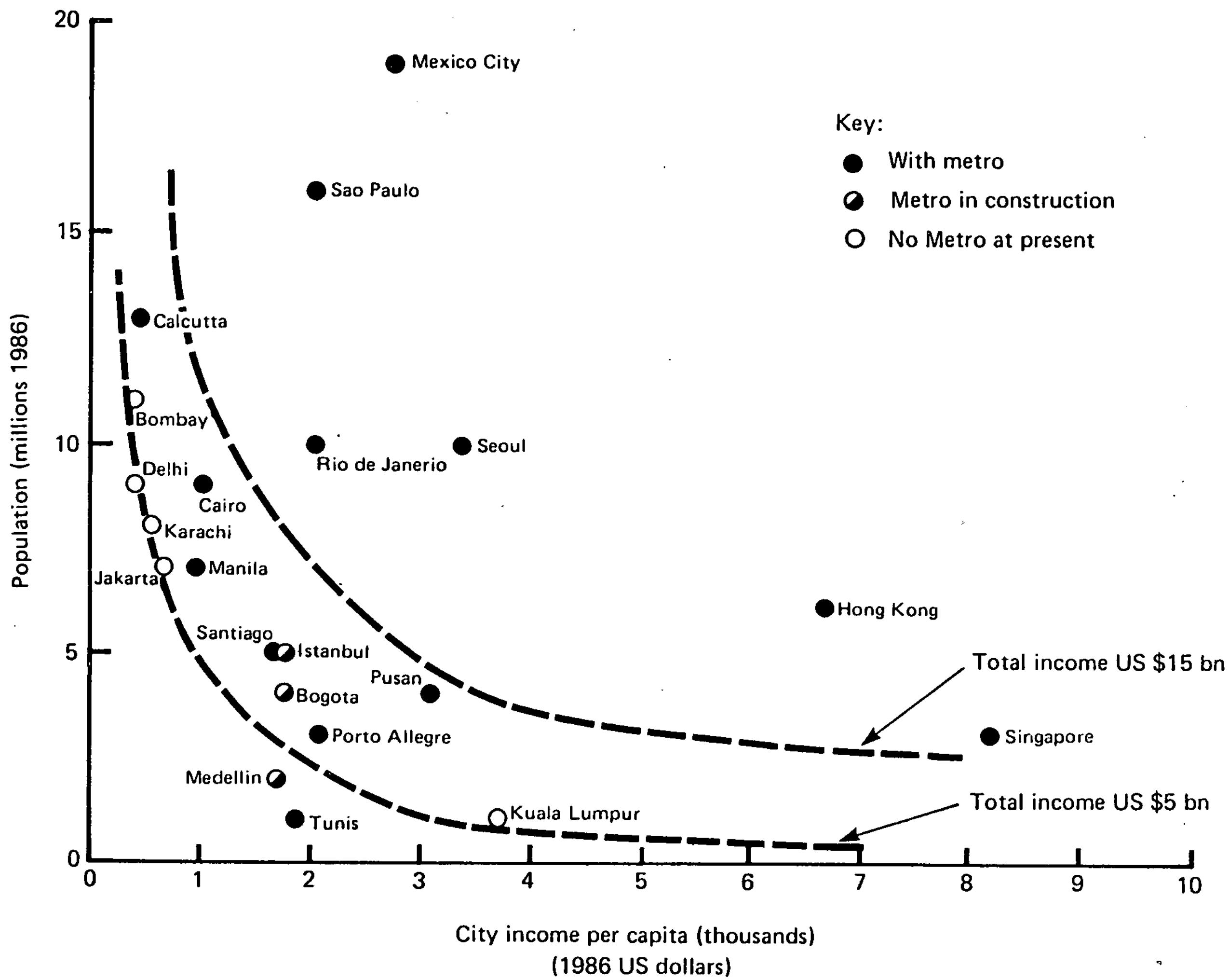

Fig.1 Case study cities

Table 1 Transport policies in case study cities

	No of cities adopting measures	
	All cities (21)	Cities with metros (15)**
Policy Measures		
Traffic engineering	21	14
Bus priorities	5*	5*
Traffic restraint:		
parking	3	3
other	2	2
Bus ownership:		
public	5	3
private	8	7
both	8	5
Paratransit	13	9
Bus fares control	20	13
Bus quality control	7	4
Investment Measures		
Busways	4	3
Light rail, at-grade	6	5
Metro, grade-separated	14	14
Suburban rail, upgrading	13	9
Major highway construction	17	12

* a further 6 cities introduced bus priorities which were ineffective

** includes one city, Tunis, with LRT

8. In 5 cities private bus operators were not permitted; 8 cities let the public and private sector operate side by side, while another 8 cities relied entirely on the private sector. Paratransit was found in 13 cities and often made a major

contribution. Only 5 cities operated effective bus priorities, mostly in the form of bus lanes, which several other cities had also introduced but not enforced.

9. All the cities were investing a high proportion of their resources on transport infrastructure. New roads are essential in a fast-expanding city, and 17 cities were engaged in major road construction. Busways were a feature in 4 cities. Most of the cities were also investing in rail, of course, since the sample was selected because of that; but six of them had opted for light rail and many, in addition to metro building, were also upgrading suburban railways, with mixed success.

Reasons for Building Metros

10. The reasons for building a metro generally become obscure during the long, confused debate that invariably precedes it. Yet it is important to know why people want it. The findings of the study, which are summarised in Table 2, represent the arguments given in official reports and by officials questioned. The most persistent reason was to improve the quality of public transport; in every city the bus services were slow, crowded and uncomfortable. These conditions were invariably blamed in part on the overloading of the bus service - "the buses can't cope" - which was closely connected with another reason, namely, to increase the capacity of public transport in order to carry the forecast volume of passengers. Thus the dominant reason for the metro may be summed up as the need for a bigger and better public transport system. This was especially strong in Latin America.

11. The next most prominent reason was to relieve traffic congestion, by displacing buses and attracting motorists to the metro. For many people, especially in the Far East, the metro was the answer to traffic congestion, and this was its prime justification.

12. The corollary of improving public transport and easing traffic congestion was that people and jobs could be attracted to the areas served by the metro; thus the metro and its stations could be located to support plans for large-scale residential and commercial development. This aspect was

Table 2 Reasons given for building metros: case study cities

Reason	No of cities citing reason	Point score*
It will raise the quality of public transport	17	15
It will relieve traffic congestion	14	11.5
It is needed to carry forecast volume of passengers	9	8.5
It will promote land use policy	10	8.5
It will be good for the environment	8	5
It will support local industry	7	4.5
It will support energy policy	5	4
It will save road accidents	1	0.5
It will be financially viable	13	9
It will be economically viable	9	5

* The study team gave a score of 1 for a 'very important' reason, 0.5 for an 'important' reason

especially important in Istanbul, Porto Alegre, Hong Kong and Singapore.

13. There were many other contributory arguments. By reducing the volume of traffic, the metro would also reduce accidents, pollution and energy consumption. In Korea, Brazil and India, it was seen as a stimulus to the domestic engineering industry.

14. An alternative, and more rational, approach was to consider the financial and economic returns on the investment. However costly, an investment which made a profit thereby proved its justification; and most of the metros were predicted to do just that. Why should government oppose a railway that was going to repay its costs, give a much better service to millions of passengers and at the same time relieve traffic congestion, curb accidents, ease pollution and save fuel?

15. A more sophisticated approach was to consider the economic return but this would normally have

been considered superfluous if the project was expected to be financially viable. In 9 cities the expected economic return had been calculated and found satisfactory, but it appears to have made little impression on the authorities, who were more interested in the financial return.

PLANNING, CONSTRUCTION AND OPERATION OF METROS

Characteristics

16. The earlier systems - in Mexico City, Seoul, Hong Kong and Sao Paulo - were "full" metros in the European tradition, i.e. heavy systems largely underground and often called MRT (mass rapid transit). More recent lines include LRT (light rapid transit) in Manila, Tunis and Istanbul, and also as additions to the heavier systems in Mexico City and Hong Kong. There are now networks in Mexico City, Seoul and Hong Kong, but the other cities are limited to one or two, usually short, radial lines. Table 3 summarises the types of metro built or planned.

17. It makes little difference to the passengers whether they can travel by MRT or LRT; the cars are similar and so are the speeds. The table shows a range of journey speeds between 19 and 42 k/h, the main determinant in variation being station spacing; the high speed in Porto Alegre is assocated with an average station spacing of 1.9 km, while the low speed in Tunis results from a station spacing of 0.8 km and an extremely winding alignment.

18. The systems vary in capacity from 14,000 to 75,000 passengers per hour per direction (p/h/d). The LRT systems are designed for 14,000-28,000 p/h/d as compared with 27,000-75,000 p/h/d for the MRT systems. At the higher capacities, train headways are 2 minutes or slightly less.

Planning

19. Most of the faults with the metros studied arose during their planning. Feasibility studies were sometimes not made, or were made badly, or were irrelevant to the system eventually built. Poor alignments were chosen in eight cities, for bad planning reasons with sometimes distrastrous and irreversible results. The importance of fares structure and integration of bus and metro fares was generally not recognised. In 13 cities it was assumed that bus competition could and would be eliminated, but only two cities achieved it. Patronage forecasts were too high and cost estimates too low in almost every case. The vital programmes

TABLE 3 METRO SYSTEMS IN CASE STUDY CITIES

CITY	TECHNOLOGY	% ug'd	Length kms	Section Spacing kms	Minimum Headway min	Cars/ train	Hourly Design Capacity p/dirn	Average Journey Speed kph
Bogota (planned)	LRT mainly elevated	0	50	1.0	5'	?	?	?
Cairo	MRT part u/g mostly at-grade	11	42.5	1.3	2'30"	6/9	60000	?
Calcutta	Full metro	95	16.5	1.0	2'10"	8	59000	33
Hong Kong:								
Kowloon	Full metro c/c & elevated	77	26	1.1	2'	8	75000	33
Island	Full metro	84	12.5	1.0	3'30"	7	38000	33
Tuen Mun	LRT at-grade	0	23	0.6	1'	1/2	14000	26
Istanbul	LRT part u/g most at-grade	14	24	1.3	1'30"-2'	3/4	28000	?
Manila	LRT elevated	0	14	1.2	2'-2'30"	2	25000	28
Medellin	LRT elevated	0	32	1.3	2'30"	6	?	?
Mexico City:								
Metro	Full Metro	75	131	1.2	1'55"	9	46000	35
Tren leger	LRT part grade part elevated	0	11	?	?	?	?	?
Porto Alegre	Metro mainly at-grade	0	26.7	1.9	6'	4/8/12	16000	41
Pusan	Full metro	79	32	1.0	2'	6	27000	32
Rio; Line 1	Full metro	100	11.6	0.8	3'	6	45000	29
Line 2	Pre-metro	5	22	1.6	?	2	?	?
Santiago	Full metro	81	26	0.7	2'40"	5	20000?	32
Sao Paulo:								
Line 1	Full metro	82	17	0.9	1'45"	6	58000?	29
Line 2	Full metro	35	11.5	1.2	1'50"	6	48000?	38
Seoul	Full metro	80	116.5	1.2	3'-4'	6	29000?	36.5
Singapore	Full metro, u/g and elevated	30	67	1.6	2'	6	?	?
Tunis	LRT at grade	0	10	0.8	1'	2	24000	19

for funding and property acquisition were sometimes not adequately prepared before construction started.

Construction

20. Almost without exception the final engineering of the metros was good. But in about half the cases, important changes were made to the original plan, usually involving higher expenditure. Three-quarters of the projects were late in completion; the average construction time per line was over 7 years, implying an overrun of more than 2 years. Only the Far Eastern cities of Hong Kong, Singapore and Seoul kept to schedule. Other cities suffered from unforeseen service diversions, failure to acquire land soon enough, shortages of materials or funds, or arguments over the alignment.

21. For these reasons, as well as unrealistic costing, the capital costs exceeded budget, usually by a large proportion, in all but three cities.

Operations

22. Nearly all the systems were well operated and gave good service. But operating costs were consistently higher than predicted (in real terms) reflecting consistently poor estimation. Only one system (Hong Kong) had any chance of recovering its capital cost, and that only because of its unique population density and of the large profits made on property development above and near the metro. All other systems were subsidized; at least seven did not cover annual operating costs including depreciation.

23. Every system was planned on the presumption that bus services would be "integrated" - which usually meant "not allowed to compete with the metro" - and that fares would be ajusted to enable the metro to attract the passengers who could benefit from it. But, rightly or wrongly, only Mexico City and Tunis have actually removed bus competition and only Sao Paulo and Porte Alegre have effectively integrated fares, (in both cases resulting in large deficits).

24. Despite subsidized fares, patronage fell short of prediction in two-thirds of the cases, owing partly to failure to compete with buses and partly to unrealistic forecasts.

PREFEASIBILITY MODEL

25. A key part of the Study was to produce a strategic model that could give a quick assessment of the impact of a proposed metro line. This was described as a prefeasibility model and was intended

to show whether a proposal merited the lengthy and costly investigation involved in a full feasibility study. Modified versions of Halcrow, Fox and Associate's standard traffic model programs were used to form a model with minimal data requirements; it was designed:

- to require little data of a detailed nature;
- to use data normally available; and
- where necessary data are unavailable, to use default values obtained from analysis of other cities.

The model can thus be applied in any city within a short period of time. The more data available, the better will be the model, but holes in the data - other than absolutely basic facts - will not scuttle the model. The Study team applied it to 10 cities and applied a simplified version to three other cities.

26. The model was designed specifically for evaluation purposes and comprises two separate parts: a land use and traffic model, and an evaluation model. The former contains typically 20 zones, with their respective populations, average incomes and levels of vehicle ownership, and a rudimentary highway and public transport network, all focused on the main radial corridors where metro projects might be justifiable. The model was designed for strong manual control because it deals with the most complex and sensitive traffic situation, namely the centre of large cities where the capabilities of the roads and bus systems are often stretched to the limit. The traffic model produces estimates of daily passenger flows by mode, and average journey speeds and times, with and without the metro, for two selected years, and calculates the time savings resulting from the metro.

27. The evaluation model extracts the required traffic results, amalgamates them into simple corridor form, introduces costs and annual streams, calculates costs and benefits over a period of up to 50 years, and estimates the net present value and internal rate of return. It also analyses the costs and benefits by type (time savings to different groups, operating costs by mode, capital costs, consumers' and producers surplus) and by class of beneficiary (bus users, car/motorcycle users,

generated passengers, bus and metro operators, and government). There is also a probability analysis which tests the sensitivity of the result to the principal variables in the model, assesses the probability of alternative values for each of them, and calculates a probability distribution of the expected economic rate of return. This helps to compensate for the uncertainties of the data and the predictions.

IMPACT OF METROS

<u>Physical</u>

28. The typical impact of the metro was found to be curiously at odds with the intentions of its planners. The metro was expected to relieve congestion, but nowhere has this been a notable result. Consequently there has been little positive impact on either the environment or energy consumption. But the prime intention was to provide better public transport and more of it, and this aim has been dramatically realised, with two main results. First, the middle- and low-income masses have been spared a great deal of wasted time and discomfort; in some cities, however, metro fares - and lack of integrated fares - have effectively excluded the low-income groups and reserved the metro for the middle classes.

29. Secondly, in the biggest cities, the metro has enabled the growth of activity in the city centre to continue, unchecked by declining accessibility. With a few exceptions, little development has been positively promoted by government, or by the private sector, to exploit the metro facilities; the real impact is permissive, in that the metro permits the city centre to develop freely in response to market forces. Without the metro, the influx of workers, customers and clients would be checked, and the frustrated growth would occur elsewhere, most often in sub-centres. This sort of enforced decentralisation is sometimes considered to have attractions. It also entails costs in terms of continuing, chronic overcrowding of buses on the main radials, inconvenience to the organisations shut out of the centre, and additional transport costs caused by cross-city traffic generated by the location pattern, which would encourage the growth of private transport.

<u>Financial</u>

30. Financial performance has rarely matched expectations: both capital and operating costs have

generally exceeded previous estimates, often by a large margin, while patronage and revenues have usually fallen short. As already mentioned, only Hong Kong shows any possibility of making a respectable return on the capital invested; Seoul is the only other metro to earn any contribution at all towards its capital cost. This is not to say that metros ought to repay their capital cost. Profit maximization (or loss minimization) is not the policy of most governments. The point is that most governments were led to believe that their metros would be financially viable, which they certainly are not.

Economic

31. The economic evaluations made by the Study, using its prefeasibility model, assessed the impact - past and future - of the metros relative to a do-minimum scenario. It was assumed that the road capacity of the affected corridors would increase by 20%, reflecting progress in traffic management, driving standards, vehicle performance and road standards. Thirteen metros were evaluated, ten of them by the full model, and the other three without the traffic model. The benefits consist of time savings to metro passengers, bus passengers and other traffic, vehicle operating cost savings, attributed "consumers' surplus" from generated traffic, and a proxy "bonus" representing the superior comfort of the metro relative to the bus. Time savings were valued at 40% of the average rate of earnings.

32. Table 4 summarises the results. Three metros showed economic rates of return less than 10%, three between 10% and 12%, four between 12% and 15%, and three above 15%. Not included, however, were Lines 4-9 in Mexico City, which are poorly utilized and would produce a low rate; and some lines which were included, e.g. Line 2 in Rio, Line 2 in Santiago, and probably Line 3 in Seoul and Line N in Tunis, would also show low rates if evaluated separately from the other lines in the same cities. Of the three results above 15%, two are for Singapore and Hong Kong, which are no longer developing countries, and the third, for Cairo, is an exceptional case where the metro results from the linking and upgrading of two busy suburban lines. Thus with the single exception of Cairo, no metro in a developing city is expected to produce an economic return greater than 15%.

Table 4. Economic Evaluation of Metros in Case Study Cities

City	Capital cost $mn	Trips/day in metro corridors (000s)			EIRR
		base year (without metro)	evaluation year: total trips	evaluation year: by metro	%
Cairo	526	830	4963	2110	16.8
Calcutta	684	736	992	400	2.8
Hong Kong	5051	2059	9121	3489	18.5
Manila	563	2250	3309	853	11.4
Mexico City	1974	4056	10184	6003	11.4
Porto Alegre	278	567	850	375	8.9
Pusan	680	2273	3616	664	14.2
Rio de Janeiro	2219	2100	4299	1700	7.1
Santiago	940	2302	2700	900	13.5
Sao Paulo	2280	2368	11245	3651	10.7
Seoul	5240	1127	12705	2897	14.7
Singapore	2502	1391	3961	1260	20.5
Tunis	231	162	1728	700	12.4

Notes: 1) capital costs are in 1986 dollars and refer only to the lines tested;

2) base year is first full year of operation; evaluation year is 20 years after completion of investment; i.e Cairo 1988/2008 Calcutta 1984/2010; Hong Kong 1981/2007; Manila 1986/2005; Mexico City 1970/2000; Porto Alegre 1985/2004; Pusan 1988/2007; Rio 1979/2010; Santiago 1976/2000; Sao Paulo 1976/2008; Seoul 1975/2005; Singapore 1988/2009; Tunis 1986/2009;

3) base year estimates are only for the corridor(s) with metro in the base year; evaluation year usually includes additional lines;

4) base trips are the estimated trips in the corridors with a metro before opening of metro; trips in evaluation year are prediction;

5) evaluation includes a period of 30 years after completion of investment, or at most 50 years after start of investment; ie the evaluation period extends beyond the so-called evaluation year.

33. Nevertheless the results do suggest that, despite the high costs, the economic return on metros can be quite high when the conditions are right. It has to be realised, however, that in the averge case the benefits consist mainly of non-working time (62%), relief of discomfort (7%) and the unidentifiable benefits from generated traffic (7%). "Hard" savings of resource costs amount to only 24% of the benefits, of which about half is offset by the operating cost of the metro itself. Furthermore, in most cases, the benefits are not yet "in the hand"; they depend on the assumptions of future growth of population and income.

34. The benefits are enjoyed largely by former bus passengers who now use the metro, but the remaining bus passengers also gain greatly from the relief to the bus services. There is little benefit for users of cars and motorcycles. Bus operators - or their subsidizers - also gain when fleet sizes have been adjusted to the lower demand. Government loses, not only from the subsidy to the metro, but also from lower tax revenues from buses and cars. There is almost no foreign exchange benefits to offset the high foreign exchange borrowings commonly incurred in metro construction.

CONCLUSIONS

35. A metro is an enormous investment for a developing city. Clearly it should not be built until other ways of solving the same problems have been properly studied. Bus lanes and other bus priorities, purpose-built busways, improvements to the road network (short of wholesale expansion), light rail systems, parking controls and various types of traffic restraint: all can help to solve - at much lower cost - the problems of ineffective bus services and traffic congestion. (We have not included major highways as an alternative solution, because of their capacity limitations as carriers of public transport, because of their great cost and environmental disadvantages, and because no one in our case study cities suggested such a solution).

36. In very large cities, however, buses will sooner or later be unable to meet the growing demands of the city centre, and the alternative to a metro will be a change of direction in the development of the city: the growth of the centre will be stifled by chronic inaccessibility; offices, shops, places of culture and entertainment, all of the type that would normally gravitate to the city centre on account of its situation as the focal

point of the transport system, will be forced to seek suburban locations because the city centre will have lost its raison d'etre, its position of maximum accessibility.

37. The economics of the city centre, and the implications of restricting or restraining its growth, are subjects of importance and complexity, and they lie beyond the scope of this Study.

38. The largest of the developing cities, and a few smaller ones, have already chosen to follow the European pattern, and from their experience the Study can confirm the general belief that metros in developing cities cannot be financially viable. But it can also conclude that some of their metros appear economically respectable; and some of the less impressive lines could have performed much better if they had been more efficiently planned and implemented. As developing cities continue to grow in size and wealth, there will be many new proposals for metro lines, and some of them will almost certainly be economically justifiable.

39. Because metro costs do not vary substantially with city income, while benefits do, it is not surprising to find economic viability strongly correlated with city income. Only in the higher income developing cities are metros likely to generate economic returns significantly above Government Test discount rates, typically 10-12%. The exceptions may be short sections of route linking existing underutilised lines, or possibly extensions to existing systems.

40. The Study has produced some rough guidelines as to the prospects of justifying a metro in a developing city. They cannot, of course, be taken as universal rules; but subject to exceptional circumstances, a metro is not likely to produce a good economic return unless most of the following conditions hold:

a) Corridor size: all successful lines serve radial corridors to the city centre, with total corridor flows of over 700,000 trips per day before the metro opens. This recognises the presence of at least one major road, with minor parallel roads, in the corridor and some turnover of passengers along the corridor. It implies very high peak flows of close to 15,000 bus passengers/hour/direction.

b) City size: corridors of this magnitude are found only in cities of at least 5 million inhabitants unless the city is highly linear and contains only two main corridors, e.g. Pusan, Medellin. Singapore has only three main corridors.

c) Income: cities with successful heavy metros have average city incomes above US $1800/head, except for Cairo where the situation was unusually favourable for a metro. Cities with incomes of this level are unlikely to be found unless the national level is at least US $1000/head.

d) Growth prospects: the economic viability of most of the metros tested depends on future growth of population and income. Massive influx of immigrant population tends to depress average incomes, however; so the ideal prospect comes with steady population growth combined with strong economic growth.

e) City centre growth: growth of metro traffic is directly associated with growth of the city centre. The ideal condition is when the city is a national capital and centre of a large, populous economic region.

f) City management: building a metro through the middle of a large congested city is a profoundly demanding task. Considerable expertise is required to achieve success and much can go wrong. The expertise of city authorities in achieving small improvements (eg in traffic management or controlling bus operations) provides an indicator of this institutional capability, which is essential in implementing a metro.

g) Metro management: once operational, economic success depends vitally on good management. Most of the new metros are run by new companies or corporations, independent of government departments, national railways or bus operators, and free to choose their own staff and set up modern management systems.

h) Financial support: fares must be reasonably competitive with the buses, which means that they must be either graduated, on both buses and metro, or integrated (i.e. with through-tickets), and the metro fares must be set low enough to compete. In practice this will seldom be possible without financial support to cover capital costs and at least part of depreciation (asset replacement).

Implications for aid agencies

41. Metros are often risky projects. Much needs to go right to achieve success, and one or two bad mistakes can produce failure. Extensions of existing metros are, however, likely to be less risky than the initial investment. This may weigh heavily with aid agencies.

42. Aid agencies are unlikely to support metro projects that, on an objective evaluation, promise less than 10% economic rate of return. Even if the return is 20%, they may consider that other projects should take precedence. There is no way of proving beyond dispute the case for a metro or any other public investment; but a good rate of return may be regarded both as a necessary condition and as an assurance that the resources will not be wasted.

43. Inevitably there wil be more developing cities seeking support from aid agencies for the construction of metros, and there will almost certainly be some candidates that can pass the normal tests of justification. There may also be new financing arrangements designed to bring in more local contributions and more participation by the private sector.

44. The model and method of analysis developed in this Study are designed to help aid agencies, and also the cities themselves, to come to a first appraisal of the impact that a metro project would have on the city transport system and of its financial and economic viability.

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