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ELSHABANI, ABDELGADER OTHMAN

SHORT RANGE, QUICK RESPONSE TRANSPORTATION PLANNING TO  
MEET THE NEEDS OF THE POOR IN DEVELOPING COUNTRIES

The University of Oklahoma

PH.D.

1981

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

SHORT RANGE, QUICK RESPONSE TRANSPORTATION PLANNING TO MEET  
THE NEEDS OF THE POOR IN DEVELOPING COUNTRIES

A DISSERTATION

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1981

SHORT RANGE, QUICK RESPONSE TRANSPORTATION PLANNING TO MEET  
THE NEEDS OF THE POOR IN DEVELOPING COUNTRIES

APPROVED BY

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## ABSTRACT

The main objective of this study is to prepare a framework for analysis that addresses the transportation needs of the poor in developing countries and provides travel estimation procedures for quick response to policy questions in the context of the dynamic urban changes and data inadequacies in the cities of the developing countries.

Cities in the developing countries have increasing numbers of people living below the poverty line, and who have real "transportation needs" that cannot be analyzed adequately by the existing "demand models" which are inflexible in terms of the changing objectives of development, urbanization, mobility, employment, and levels of expenditures on travel in developing countries.

In this study a framework for transportation needs analysis is proposed where the key goal is to provide a desirable level of access to employment, health, education and other opportunities that would satisfy the transportation needs of the urban population. The proposed analysis framework is both nonspatial and spatial. The main objective of nonspatial analysis is to make use of data obtained from household interviews for policy analysis, such as: the effect of road pricing policies on the mobility of different income groups, and the budget needed to meet the poor's standards of accessibility and expenditures on travel. The main objectives of spatial analysis are to identify the zones in an urban area with deficiencies in transportation supply and to estimate the trips needed by purpose at the zonal level. Three examples are provided of the proposed analysis framework. In the example of Amman, Jordan, the proposed approach was tested against the conventional demand approach which was used in a recent (February 1981) transportation study of Amman, Jordan.

It is to be noted that the proposed analysis framework will be useful only to those developing countries that have a relatively large number of people who are considered to be poor and those countries have to be politically committed to providing the "basic needs" for their poor segment of the population.

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## CHAPTER I

### INTRODUCTION

The lessons of the last three decades have taught the developing countries<sup>1</sup> that demand strategies that emphasize economic growth over poverty<sup>2</sup> elimination have led to an increase in the number of people living below the poverty level as well as a higher inequality in the distribution of income.

At present, many world organizations believe that strategies for development in developing countries should be need-oriented. The "basic needs approach," for example, has been endorsed by the 1976 World Employment Conference as well as by the leaders of the non-aligned nations who constitute the majority of the developing countries.

In transportation, policies that emphasize demand and that estimate travel as based on actual behavior have failed to provide efficient transport policies for the poor. The failure might be partially due to the fact that:

1. The estimates of travel based on demand do not consider why the poor do not travel.

2. Transportation improvements are not related to such goals as minimum acceptable levels of access to employment, health, and education opportunities.
3. Alternative transport projects are economically analyzed on the basis of GNP added to the economy without studying the question of who benefits and who does not and the effects on different income groups.
4. The absence of the poor from the decision-making process leads, in many developing countries, to the concentration of transportation and other facilities in the zones where the affluent and politically powerful reside.

A symptom of the failure of demand strategies to provide adequate mobility<sup>3</sup> for the poor could be demonstrated by the figures from the 1969 transportation study on Bogota, which showed that 55 percent of all trips by low income groups were on foot, 40 percent by bus and five percent using taxi. In comparison, 80 percent of all trips by high income groups were by private automobiles, ten percent by bus and ten percent using taxi. The figures from other urban areas of the developing countries reflect the same trend in the mode of travel between the rich and the poor.<sup>4</sup>

In addition, the poor are spending a high percentage of their income on travel (as demonstrated in Chapter III). The high expenditures on gasoline and taxi fares had led, for example, to riots by the workers of Freetown, Capitol of Sierra



Leone in March 1980.<sup>5</sup>

This study mainly deals with the development and application of a proposed approach to transportation planning titled "Short Range, Quick Response Transportation Planning to Meet the Needs of the Poor in Developing Countries."

In Chapter II the changing objectives of development in developing countries are discussed. Chapter III provides a discussion on urbanization in developing countries, and the major differences between cities in developed and developing countries as well as a discussion on mobility and the expenditure on travel. Chapter IV analyzes the existing transportation planning process and the inadequacies of current models that simulate the process for use in developing countries. The proposed overall nonspatial/spatial transportation analysis framework for the need approach to transportation planning in developing countries is discussed in Chapter V, and a number of applications for the proposed analysis framework are illustrated in Chapter VI. Finally, Chapter VII covers the conclusion of this study and some prospects for future research.

It is to be noted that all underlining in this dissertation is the author's and is for the purpose of emphasizing the points underlined.

### Footnotes

<sup>1</sup>"Developing countries" are defined throughout this study as including all of Asia (except Japan), Africa (except South Africa) and Latin America. Recent statistical, country-level data are presented in Appendix A. The data are based on the 1979 World Bank Atlas which contains information about the population, GNP at market prices, GNP per capita, and average annual growth in developed and developing countries.

<sup>2</sup>The poor are those in a state of poverty. Poverty can be defined in terms of an individual's or household's ability or inability to afford a minimum basket of essential goods and services (or basic needs) that will permit a level of living widely regarded as satisfactory within the society concerned. (A detailed discussion on how to estimate poverty and basic needs is provided in Chapter II). This research work deals mainly with the need of travel of that segment of the poor whos main problem is that of earning limited income. (Since no information is available on those who have other problems beside being of limited income such as the very old, the chronically ill, the mentally retarded and others in the developing countries.)

<sup>3</sup>Mobility is the capacity, capability, and opportunity to move as well as the cost involved in such action. A  
travelers mobility per day = total number of trips traveled

$$\begin{aligned} & \times \text{distance involved in each trip} \\ & \quad (\text{km/trip}) \\ & \times \text{speed involved in each trip} \\ & \quad (\text{km/hour}) \\ & = \text{km}^2/\text{day} \end{aligned}$$

Cost of mobility  
to the user per day

$$\begin{aligned} & = \text{total number of trips traveled} \\ & \times \text{distance involved in each trip} \\ & \quad (\text{km/trip}) \\ & \times \text{operating cost of vehicle or the} \\ & \quad \text{fare required (Jordan Dinar/Kilo-} \\ & \quad \text{meter; JD/Km)} \\ & = \text{JD/Day} \end{aligned}$$

Illustrative capacities of varying types of urban travel by different modes and cost estimates are provided in Alpendix B.

<sup>4</sup>For an interesting discussion on urban travel patterns, rich versus poor, see W. Owen, 1973, pp. 9-17.

<sup>5</sup>The Norman (Okla.) Transcript, Sunday, October 5, 1980, p. 2A, "Poverty Continues to Plague Many African Nations," by Andrew Torchia.

## CHAPTER II

### THE CHANGING OBJECTIVES OF DEVELOPMENT IN DEVELOPING COUNTRIES

#### Introduction

Despite the fact that planning has been a part of official economic policy over the last three decades in many of the developing countries, statistics provide a very grim picture of the existing situation there. Desai provides a description of the situation in India, where 650 million people live, and where planning has been exercised since 1951.

Planning in India has become justly famous. It has attracted a brilliant collection of Indian and foreign economists, demographers and planners to this task. At the same time, in achieving its objectives of doubling real per capita income (in 20, 30 or 35 years) or of relieving unemployment, poverty and hunger, of reducing income and wealth inequalities, of improving social conditions, planning was woefully inadequate. The proportion of poor in the population, estimated at around 40 percent on some minimum-income criterion, has certainly not decreased and may have increased. Successive plans have failed to absorb the addition to the labour force, much less reduced the backlog of unemployed.<sup>1</sup>

The problems of the poor in many of the developing countries are severe. The fact that the planning policies have failed to reduce the income and wealth inequalities is

demonstrated by the overall degree of inequality in the distribution of income in developing countries, where, on the average, 40 percent of the households receive 15 percent or less of the personal income.<sup>2</sup> This happened despite the fact that the gross national product (GNP) per capita of the developing countries as a group grew at an average rate of 3.4 percent a year during 1950-75.<sup>3</sup> (GNP is the measure of the total domestic and foreign output claimed by residents of a country.)

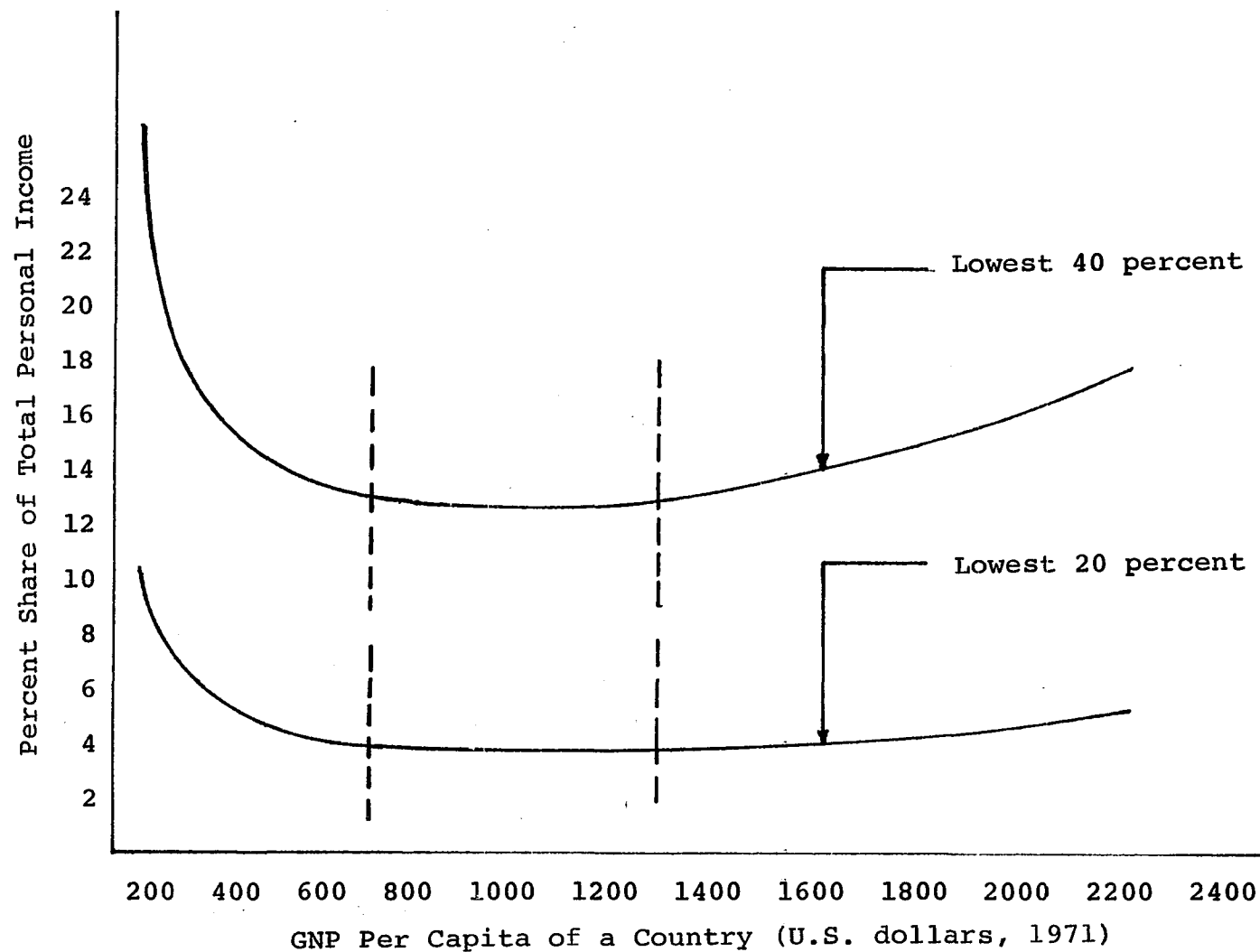
Figure 2.1 demonstrates the percent share of total personal income as related to GNP per capita and indicates that:

- a) Income inequality increases in the early stages of development, stabilizes at \$700 to \$1,300 GNP per capita, and begins to diminish only after a per capita income of \$1,300 is reached.
- b) Income shares of the lowest 20 percent increase more slowly than the shares of the lowest 40 percent as a result of the improvement in GNP per capita.

#### Development Objectives in the Last Three Decades in Developing Countries

In the early 1950s the developing countries were faced with a number of objectives for development. These objectives were typically: (1) maximum production (GNP growth), (2) full employment, and (3) economic equality and social justice. These objectives were emphasized, for example, in the first development plan of India.<sup>4</sup>

In confronting the problems of development, the policymakers in developing countries selected maximum production (GNP growth) as a primary objective over economic and social



SOURCE: Data based on Morawetz (1977) Table 2. (See table in Appendix C-3.)

Figure 2.1 Cross Section Estimates of Percent Shares of Total Personal Income as Related to GNP per Capita in Developing Countries

equality. It was thought that the primary objective would take care of other objectives. In other words, those policymakers accepted and worked with the following concept; "take care of the GNP, as this will take care of poverty."<sup>5</sup>

The exceedingly unequal distributions of income in many of the developing countries might be related partially to this planning approach which emphasized GNP growth over poverty alleviation. Such an approach has led to an increase in the absolute number of people living below the poverty level.<sup>6</sup> Roth<sup>7</sup> points to the fact that the poverty group has been increasing at a rate of 11 million people a year.

Since the early 1970s, there has been an awareness in the developing countries that economic growth does not solve the problem of poverty. This conclusion has been also realized by world organizations. In a speech to his Board of Governors in September 1972, Robert McNamara, President of the World Bank, emphasized the need for new policies designed specifically to reduce poverty and social and economic inequality:

We know, in effect, that there is no rational alternative to moving toward policies of greater social equity. When the highly privileged are few and the desperately poor are many—and when the gap between them is worsening rather than improving—it is only a question of time before a decisive choice must be made between the political costs of reform and the political risks of rebellion. That is why policies specifically designed to reduce the deprivation among the poorest 40 percent in developing countries are prescriptions not only of principle but of prudence. Social justice is not merely imperative. It is a political imperative as well.<sup>8</sup>

This study agrees with the position of President Julius K. Nyerere of Kenya on the question of the poor and their rights:

I am saying it is not right that the vast majority of the world's people should be forced into the position of beggars without dignity . . . when I am rich because you are poor and I am poor because you are rich, the transfer of wealth from the rich to the poor is a matter of rights, it is not an appropriate matter for charity . . . the question, as the poor see it, is not whether there should be changes in the present world economic structure, change will come one way or another. The question is when, and how, they will be brought about.<sup>9</sup>

The developing countries have experienced the fact that it is difficult to redistribute income arising from GNP growth by means of taxes, public employment and the like. Among the researchers reaching this conclusion are Meerman,<sup>10</sup> Bird and DeWulf,<sup>11</sup> Sen,<sup>12</sup> Adelman and Robinson,<sup>13</sup> Adelman and others,<sup>14</sup> Stewart,<sup>15</sup> and Taylor and Lysy.<sup>16</sup> The main conclusions of these studies are that: a) A society that begins growing with an unequal income distribution is quite likely to remain unequal or become more so. b) Any considerable improvements in the income shares of the poor are realized at relatively high GNP per capita (\$1,300 GNP per capita) as demonstrated in Figure 2.1. It should be noted that it would take the majority of developing countries a long period of time to reach a GNP per capita of \$1,300. (The average GNP per capita in developing countries in 1975 was \$375.00, and the annual growth rate was 3.4 percent.)

In the last few years there has been a call for a new development strategy for the developing countries, opposite in

nature to the old one and emphasizing the need for policies designed specifically to reduce poverty and social and economic inequality, which will lead to a more meaningful growth. In the words of Morawetz;

The historical evidence suggests that it simply may not be possible to "grow first and redistribute later," because the structure of growth may largely fix the pattern of distribution, at least until much higher developed country levels of per capita income are approached. That is to say, if greater equality of incomes is to be an objective in the medium term, it may be necessary to tackle it as a first priority by land reform, mass education, and whatever other means are available, rather than leaving it until after growth has taken place.<sup>17</sup>

Haq may have been one of the first to call for such a strategy in speeches he delivered in 1971.<sup>18</sup> In his words,

The objective of development must be viewed as a selective attack on the worst forms of poverty. Development goals must be defined in terms of progressive reduction and eventual elimination of malnutrition, disease, illiteracy, squalor, unemployment, and inequalities. We were taught to take care of our GNP, as this will take care of poverty. Let us reverse this and take care of poverty, as this will take care of the GNP. In other words, let us worry about the content of GNP even more than its rate of increase.<sup>19</sup>

Having worked for thirteen years as one of the chief economic planners for Pakistan (1957-1970) and later in his work for the World Bank, Haq was in a position to give some important concepts for development.<sup>20</sup> These concepts provide a new perspective on development that is important and might be useful for future developments in the 1980s in the developing countries.



The following is a summary of Haq's development concepts for the developing countries:

1. Development planners should first set their targets for meeting basic human needs, irrespective of market demand, and then only in the next phase go on to correct the price system in such a manner as to implement these goals. Haq noted that the institutional reforms are often more decisive for a developing country than marginal changes in the price system.
2. Economic growth does not filter down automatically to the masses except in the modern urban sector and at very high rates of GNP growth.
3. Consumption patterns that the governments of developing countries can supply to their masses are entirely different from the ones presently prevailing in the developed countries, thus development strategies should be need-oriented rather than market-demand oriented.
4. The economic condition of the poorest sections cannot be improved simply by distributing some purchasing power to them through short-lived welfare schemes. Any long-term improvement requires increasing the productivity of the poor by restructuring the pattern of investment through fundamental institutional reforms.
5. Development strategies should be shaped by domestic needs and not by either export or foreign assistance requirements; that is, the pattern of production and

consumption should be based on the resources, manpower, and technology of the developing countries.

### Employment Policies in the Developing Countries

Development policies that emphasize growth in the Gross National Product have neglected employment as a primary goal of economic development in favor of capital accumulation. This has resulted in a high percentage of the population in developing countries being unemployed or underemployed.<sup>21</sup>

Haq summarized his experience on the subject of employment in developing countries:

. . . looking at the national plans of the developing countries, it was obvious that employment was often a secondary, not a primary, objective of planning. It was generally added as an afterthought to the growth target in GNP but very poorly integrated in the framework of planning. I know from my own experience with the formulation of Pakistan's five-year plans that the chapter on employment strategy was always added at the end, to round off the plans and make them look complete and respectable, and was hardly an integral part of the growth strategy or policy framework. In fact, most of the developments which affected the employment situation favorably, such as the rural works program and the green revolution, were planned primarily for higher output, and their employment-generating potential was accidental and not planned.<sup>22</sup>

"There is a strong link between employment, poverty and income distribution"; this conclusion has been the result of an extensive policy research done at the International Labor Office Headquarters, combined with the efforts of "comprehensive employment strategy missions" that have visited seven countries in order to work out employment-oriented development policies.<sup>23</sup> In almost all countries, insufficient and unequal physical access to employment rank high among the major causes of poverty and inequality.

Employment policy must play a central role in the formulation of a basic need strategy for the next two decades of this century.

Employment productive enough and well enough remunerated to allow individuals to meet their basic personal consumption needs is a fundamental requirement. Without it there is no feasible way to achieve adequate expansion of the output of such goods and services. Even if there were, in the absence of full productive employment the poorest people of the developing countries would not be able to meet their needs because of lack of purchasing power, and would continue to lack an opportunity of participating in development....

Between the early 1970s and the year 2000 the labour force and the population of developing countries, excluding China, will approximately double. Productive employment opportunities must be found not only for the approximately 300 million people at present unemployed or inadequately employed, but for a total of 1,000 million if those who will be entering the employment markets of the Third World over the next 25 years are included.<sup>24</sup>

For an effective policy on employment, surveys have to be conducted to give the policymaker information on two important issues of greatest concern:

1. the availability of labor for employment in various activities, and
2. the welfare effects of unemployment.

Many authors have noted that there is a lack of information on the employment situation in developing countries. For example, Haq, in his address to the 12th World Conference of the Society for International Development in 1971, commented:

. . . it appears that we are assembled here to discuss a problem whose nature and dimensions we simply do not know. I looked at various estimates of unemployment and underemployment which had been prepared for the developing countries and was distressed to find that estimates of 5 to 10 percent unemployment and 20 to 25 percent underemployment were tossed around with a casualness which was simply frightening. There was no agreed methodology for measuring unemployment or underemployment, no definite ideas or projections on what had happened in this field in the 1960s or what might happen in the 1970s, and very poor knowledge about this "vital" concern even in some of the largest and most affected countries like India, Pakistan, and Brazil.<sup>25</sup>

In 1977 Morawetz expressed his concern for the deficiency and the lack of accuracy in historical data regarding employment.

The only historical data that are available on unemployment or underemployment are figures on open unemployment in a small number of countries for the period between 1960 and 1974. These data are deficient for two principal reasons. They do not measure the concept that is needed, which is unemployment plus underemployment. And even what they do measure, they do not always measure accurately or consistently. For example, labor force surveys often place urban open unemployment in India at around 3 percent. But after making a series of simple and apparently quite

reasonable adjustments, Turnham [1971] concludes that the true rate may be closer to 6 to 9 percent.

Morawetz examined further the nature of unemployment in developing countries.

. . . consider for a moment the nature of unemployment in developing countries. Most people in such countries work in family or self-employment in agriculture, services, and informal industry, in which the notion of a "job" is much less clear than in the formal sector. Furthermore, in the absence of unemployment compensation, only the relatively well-off can afford to be openly unemployed. Therefore, in most developing countries the employment problem expresses itself more as underemployment—working too few hours or with excessively low productivity—than as open unemployment.<sup>26</sup>

In 1978 Bruton<sup>27</sup> criticized the conventional classification of an entire population as employed, unemployed or outside the labor force. Such classification is still in use by many of the statistical departments in developing countries.

The following is a summary of the points that Bruton raised in his criticism.

1. The main difficulty of the conventional classification arises from the fact that self employed workers constitute, in almost all developing countries, a large percentage of the labor force. In Tanzania less than 40 percent of the labor force are classified as "employees," in India less than 20 percent, Indonesia about 32 percent, Korea 37 percent. This is in contrast to the United States and the United Kingdom where over 90 percent of the labor force are classified as salaried employees or wage earners.

2. Where the concept of a "job" is not clear, the use of the conventional classification of a population as employed, unemployed or outside the labor force often lead to obtaining unrealistic information from the population concerned. This is especially evident with respect to women in rural areas. In the Sudan, for example, women often do most of the farming of family lands as men migrate to find work and are frequently away from home for a year or more at a stretch. Yet most data would show that the men did the work, and the women were "housewives."
3. The general inability of most developing countries to maintain any sort of formal unemployment or welfare payment arrangement often means that employment is a means by which the unemployed are sustained. In Egypt, for example, the government guarantees every university graduate a job. Since university education is virtually free to the individual, and since a job is promised, university enrollments are enormous. The result is a large and increasing number of government employees who, for all practical purposes, do nothing in the way of productive work. Yet unemployment figures for Egypt in no sense capture that fact.

Table 2.1 demonstrates the different types of occupations that exist in urban Sierra Leone. From the occupation groups defined by their income, Lisk and Hoeven<sup>26</sup> discovered that on the average hawkers, unskilled laborers, vendors and artisans

TABLE 2.1

OCCUPATION GROUPS DEFINED BY THEIR ANNUAL EARNINGS IN URBAN SIERRA LEONE  
Sierra Leone 1977

	Occupational Group	Number ( '000)	Total Income (million leones) <sup>1</sup>	Average per Capita Income (leones per annum)	Percentage	
					Number	Income
No Estab- lished Work Location Generally	Hawkers	45	10	222	18.3	3.5
	Unskilled labourers	40	17	425	16.3	6.0
	Vendors	40	21	525	16.3	7.4
	Artisans	35	20	571	14.2	7.1
	Semi-skilled workers	27	17	630	11.0	6.0
Established Work Location	Skilled workers	19	17	895	7.7	6.0
	Clerical workers	15	35	2333	6.1	12.4
	Retailers	14	58	4143	5.7	20.5
	Professional/ managerial group	6	39	6500	2.4	13.8
	Entrepreneurs	5	49	9800	2.0	17.3
All groups		246	283	1150	100.0	100.0

SOURCE: F. Lisk and R. D. Hoeven, "Measurement and Interpretation of Poverty in Sierra Leone." International Labor Review, Vol. 118, No. 6, November-December 1979. Table 3, p. 718.

<sup>1</sup>At the time Leone (le.) was equivalent to U.S. \$1.20.

are living below the poverty line. Occupation groups defined by their income, therefore, are of greater utility than those defined by income classes for the measurement of travel behavior; since unlike a distribution of income classes, it enables the planner to construct a more vivid profile of the travel needs of the poor according to their occupational background.

The conclusion to the above discussion suggests that employment/unemployment figures are not useful for planning purposes and that it would be more useful to classify the population by the type of occupation for transportation planning purposes.

#### The Basic Needs Approach

A peaceful solution to the problems of the poor in developing countries requires the adoption of a different approach to planning which is the basic needs approach.

The "basic needs approach" clearly aims to take into account both what goods and services are available and who are the beneficiaries in terms of consumption. Thus the "definition of a set of basic needs, together constituting a minimum standard of living, would at one and the same time assist in the identification of these groups and provide concrete targets against which to measure progress."<sup>27</sup>

Two very important elements to this planning approach that should be insured by the government (whether it is a capitalistic country, a socialistic one, or one having a mixed economy) are:



1. That the essential goods and services are produced in the right quantities to meet the requirements of the basic needs.
2. That these goods and services are obtainable to those who are identified as requiring those basic needs.<sup>28</sup>

The value of such an approach stems from the fact that it recognizes that the welfare of each individual in the society should be measured in physical terms before any aggregating of people is done in monetary or other terms. (An example of such aggregation is the estimation of trip demand based on the income average of all households living in a zone.)

The approach has gained steadily in favor with development planners and policymakers in the late 1970s. For example, the 1976 World Employment Conference endorsed the strategy.<sup>29</sup> And, the leaders of the nonaligned nations meeting in Colombo, Sri Lanka, in August 1976, called for the "eradication of unemployment and poverty" through the implementation of a policy for "satisfying the basic human needs of the population."<sup>30</sup>

Countries such as China, Sri Lanka, Taiwan and both North and South Korea are good examples of poor countries which have to date addressed the basic needs of the poor majority with relative success; and which generally have had a better development record than other developing countries.

According to James P. Grant, Overseas Development Council President of the International Labour Office (ILO):

If the poorer developing countries today were able to achieve death rates and birth rates comparable to those of Sri Lanka, Taiwan and China—all of which (from very different ideological-political bases) implemented basic-needs strategies in the 1950s and the 1960s—this could mean over 10 million fewer deaths a year and an even larger number of births avoided each year.<sup>31</sup>

#### How Are "Basic Needs" Met?

The developing countries have limited financial resources. Generally, the governments in developing countries evaluated projects in the last three decades on the basis of benefit/cost analysis to the society as a whole without regard to which income group benefits and which do not. The goal was to increase GNP from which benefits were supposed to "trickle down" to the poor—but seldom did. The "basic needs" approach calls planners to "target" their projects directly and as a matter of priority to the poor. Projects would be evaluated on the basis of the least possible cost. Jobs created for the poor would have the objective of increasing their income as well as the GNP. In the area of transport, the cost of providing adequate transport system supply which meets the poor's travel needs at appropriate fare levels, would be given a priority of a total country's transportation budget.

#### How to Estimate Poverty and Basic Needs

In order to estimate the extent and intensity of poverty, it is essential to agree on an acceptable definition of what poverty means. An excellent attempt to develop useful

means for the measurement and interpretation of poverty, in the context of basic needs, has been introduced by Lisk and Hoven in their study of the basic needs of the poor in Sierra Leone. The definition of poverty that they have introduced accounts for both the absolute and relative concepts of poverty:

Poverty can then be defined in terms of an individual's or household's ability or inability to afford a minimum basket of essential (or basic-needs) goods and services that will permit a level of living widely regarded as satisfactory within the society concerned. This definition is consonant with the view that the satisfaction of basic needs implies a level of living that is above the bare subsistence or mere survival level. Such a definition has greater validity in that it is based on actual levels of consumption and reflects current patterns of consumption in society.<sup>32</sup>

In order to measure the number and proportion of the population living in poverty, a poverty line budget was developed by costing, at prevailing market prices, the components of a nutritionally adequate minimum diet and adding to this the sum total of the cost of each essential nonfood item in the basic-needs basket on the basis of standard requirements.

Although the poverty line relates to household expenditure rather than household income, it was not considered necessary to convert the poverty threshold into an income value, since the total consumption expenditure of lower-income households in Sierra Leone is largely equal to total income. Tables 2.2 and 2.3 provide information on the basic needs of the poor in Sierra Leone and the total budget for food and nonfood

Table 2.2

Minimum Food Budget for Average Sized Urban Household  
(Sierra Leone 1977)

Members of household	Recommended daily calorie intake	Average monthly cost of minimum food basket (leones) <sup>1</sup>
1 active male	2,700	12.60
1 moderately active female	2,200	10.17
First child (10-14 years)	2,200	10.17
Second child (5-9 years)	1,600	7.93
Third child (0-4 years)	1,100	5.91
TOTAL FOOD BUDGET	9,800	46.78
<sup>1</sup> At the time the leone (Le.) was roughly equivalent to U.S. \$1.20		

SOURCE: International Labor Office, International Labor  
Review, Vol. 118, No. 6, Table 1.

Table 2.3  
Non-Food Basic-Needs Budget for Average-Sized Urban Household  
(Sierra Leone 1977)

Non-Food Item	Assumption regarding minimum household requirements	Average Monthly Cost per household (leones) <sup>1</sup>
Rent and fuel	"Low-cost" two-room dwelling unit plus fuel for lighting and cooking.	9.00
Clothing	Actual expenditure incurred per household on clothes and footwear as indicated in the 1976 HBS adjusted upwards for price increases between 1976 and early 1978.	5.00
Health	One visit per household per month to a government hospital or health centre plus prescribed medicines	1.40
Education	Maintaining two children at school (one primary and one secondary)—school fees, books and uniforms.	5.50
Transport	One daily return journey within Greater Freetown area by public transport.	4.00
TOTAL NON-FOOD BUDGET		24.90

SOURCE: International Labor Office, International Labor Review, Vol. 118, No. 6, Table 2.

<sup>1</sup>At the time the Leone (le.) was equivalent to U.S. \$1.20.

items. Those whose income is below the total budget are considered poor. The example of Sierra Leone might be a useful one for the estimate of basic needs in other developing countries. It is to be noted that in a country such as Sierra Leone, the budget estimated is considered a satisfactory one since the country as a whole is poor and the population average is not living at a standard much higher than that of the subsistence standards.

### Summary

- Demand strategies for economic development that emphasize economic growth over poverty elimination have led to an increase in the number of people living below the poverty level as well as a higher inequality in the distribution of income.

- The employment/unemployment figures are not useful for planning purposes. It would be more useful to classify the population by the type of occupation for transportation planning purposes.

- At present, many world organizations believe that strategies for development should be "need oriented." The "basic needs approach," for example, has been endorsed by the leaders of the nonaligned nations who constitute the majority of the developing countries.

- Means for the measurement and interpretation of poverty do exist, and such measurements would be useful in providing basic needs. An example of such a measurement for Sierra Leone was discussed earlier in this chapter.

### Footnotes

<sup>1</sup>Meghrad Desai, 1979, p. 111.

<sup>2</sup>The estimates are based on a cross-section of income shares and average absolute income levels of low-income groups in developing countries at various years. For details, see Ahluwalia (1976).

<sup>3</sup>Statistical information on poverty, the overall degree of inequality in the distribution of income, and the GNP growth rate are provided in Appendix C.

<sup>4</sup>Government of India, Planning Commission, 1950.

<sup>5</sup>This concept was emphasized by the works of a number of authors such as W. Arthur Lewis (1955) and Mahbub Ul Haq (1963).

<sup>6</sup>Whereas the proportion of the poor declined slightly in each region of the developing countries, this was offset by demographic expansion so that the poor increased in absolute numbers in the years between 1963-72. For further discussion see International Labor Office, Employment Growth and Basic Needs: A One-World Problem, 1976.

<sup>7</sup>G. Roth, 1977.

<sup>8</sup>Robert S. McNamara, 1972.

<sup>9</sup>Julius K. Nyerere, 1979, p. 27.

<sup>10</sup>Jacob Meerman, 1972.

<sup>11</sup>R. M. Bird and L. H. DeWulf, 1973, pp. 639-82.

<sup>12</sup>Amartya Sen, 1976.

<sup>13</sup>Irma Adelman, Cynthia Taft Morris, and Sherman Robinson, 1976, pp. 561-82.

<sup>14</sup>Irma Adelman and others, 1977.

<sup>15</sup>Frances Stewart, 1977.

<sup>16</sup>Lance Taylor and Frank Lysy, 1977.

<sup>17</sup>David Morawetz, 1977, p. 41.

<sup>18</sup>Mahbub Ul Haq, 1971.

<sup>19</sup> Mahbub Ul Haq, 1976.

<sup>20</sup> Those concepts by Haq are dealt with in a comprehensive way in an excellent book titled The Poverty Curtain.

<sup>21</sup> See Appendix D for tables on the employment, unemployment and underemployment in developing countries.

<sup>22</sup> Mahbub Ul Haq, 1976, p. 30.

<sup>23</sup> International Labor Office, Towards Full Employment: A Programme for Columbia, prepared by an inter-agency team organized by the International Labour Office (Geneva, 1970); idem: Matching Employment Opportunities and Expectations: A Programme of Action for Ceylon, report and technical papers in two volumes (Geneva, 1971); idem: Employment, incomes and equality: a strategy for increasing productive employment in Kenya (Geneva, 1972); idem: Sharing in Development: A Programme of Employment, Equity and Growth for the Philippines (Geneva, 1974); idem: Generacion de Empleo Productivo y Crecimiento Economico: El Caso de la Republica Dominicana (Geneva, 1975); idem: Growth, Employment and Equity: A Comprehensive Strategy for Sudan (Geneva, 1976) (provisional edition).

<sup>24</sup> International Labor Office, Employment, Growth and Basic Needs: A One World Problem, 1976, pp. 8-9.

<sup>25</sup> Mahbub Ul Haq, 1976, p. 29.

<sup>26</sup> F. Lisk and R. Hoeven, 1979.

<sup>27</sup> International Labor Office, Employment Growth.

<sup>28</sup> Ibid.

<sup>29</sup> The Conference, formerly called the Tripartite World Conference on Employment, Income Distribution and Social Progress and the International Division of Labour, was held in Geneva under the International Labor Office auspices, June 4-17, 1976.

<sup>30</sup> Fifth Conference of Heads of State or Government of Non-Aligned Countries, 1976, p. 13.

<sup>31</sup> International Labor Office, Employment Growth, p. ix.

<sup>32</sup> International Labor Office, International Labour Review, Vol. 118, No. 6, 1979.



### CHAPTER III

#### THE BASIC NEEDS OF THE POOR FOR TRANSPORTATION

##### Urbanization in Cities of the Developing Countries

The population projections made by the United Nations<sup>1</sup> in 1970 indicate that the developing countries have been experiencing a rapid growth in urbanization and that this trend will continue for the next two decades. Table 3.1 demonstrates the tremendous expected growth in the urban population of the developing countries, in comparison to developed countries, by the year 2000.

Because of its rapid rate of growth and magnitude, urbanization in developing countries has become one of the most important phenomena of the second half of the twentieth century.

The United Nations forecast points to the expected dramatic increase in the urban population of the developing countries. For example, by the end of this century, it is estimated that India may have more than 20 cities of over a million inhabitants while Latin America can be expected to have a higher proportion of urban population than Europe has today.

Table 3.1

Rural and Urban Population for Developed and Developing  
Countries, 1950, 1970, and 2000 (forecast)  
(in Millions)

Type of Country	1950		1970		2000	
	Population	Percent	Population	Percent	Population	Percent
Developed						
Urban	273	16.49	819	28.23	2,153	42.28
Rural	1,382	83.51	2,075	71.77	2,939	57.72
Developing						
Urban	429	51.62	731	66.88	1,048	79.70
Rural	402	48.38	362	33.12	267	20.30

SOURCE: World Population Forecasts, United Nations, 1970.

Tremendous growth in urban population is expected. For example in Lagos, Nigeria, there were 300,000 inhabitants in 1950. By 1975 Lagos had a population of more than two million.<sup>2</sup> It is expected to have 7,800,000 inhabitants by the year 2000. Similar rates of population growth are expected also for Mexico City. It had only 2,900,000 inhabitants in 1950; in 1975 there were 10,900,000 inhabitants and by the year 2000 there will be an estimated 31,500,000 inhabitants.

There are many factors that contribute to the rapid growth in the urban population of the developing countries, including: (1) the increased natural growth from high birth rates, longer life span that has resulted from improvements in health care systems, (2) the increasing dependence on machines and modern irrigation methods in rural areas which has led to a reduction in the demand for manual labor.

It is estimated that migration from rural areas accounts, by itself, for half of the urban population expansion in developing countries.<sup>3</sup> The migration of workers from the countryside to urban areas has been explained from two points of view:

1. Some authors explain migration purely in terms of relative wages and incomes.<sup>4</sup> The main movement to urban areas has resulted from the fact that average income differs widely

between urban and rural areas. Table 3.2 demonstrates the relatively wide difference in income between urban and rural areas in a number of developing countries.

2. More recently, other authors explained migration in terms of the changes in land tenure, type of employment, degree of commercialization, mechanization, and related factors. For example, Peek and Standing explained the rural-urban migration in terms of government policies:

. . . as countries have begun to industrialize, urban-industrial interests have increasingly influenced official policies. And as governments have come to play a more active role in stimulating industrial expansion, they have introduced measures that have directly or indirectly increased population mobility.<sup>5</sup>

Many policy makers, in developing countries, are convinced that city size should be contained by some measure, and they have attempted to discourage additional urban growth. One important measure that they have depended upon heavily is to discourage rural-urban migration. In Jakarta, Indonesia, a decree issued in 1970 required such migrants to register upon arrival and, if without a job after six months, leave the city. Although many thousands of migrants have been sent back to their village of origin for lack of a necessary identification card, the various administrative restrictions have had only a modest impact and have given rise to petty corruption.<sup>6</sup>

A number of urban analysts have concluded that controlling migration would worsen rural-urban inequality,

between urban and rural areas. Table 3.2 demonstrates the relatively wide difference in income between urban and rural areas in a number of developing countries.

2. More recently, other authors have examined migration in terms of the changes in land use, the extent, degree of commercialization, and the role of various factors. For example, in the case of Indonesia, rural-urban migration is

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corruption.<sup>6</sup>

A number of urban analysts have concluded that  
controlling migration would worsen rural-urban inequality,

Table 3.2

## Urban and Rural Mean Incomes in Selected Countries

Country	Type of Population <sup>a</sup>	Urban	Rural	Year
Brazil	Economically active population	3,300 new cruz.	1,450 new cruz.	1960
		4,650 new cruz.	1,650 new cruz.	1970
Colombia	Income recipients	16,270 pesos	1,730 pesos	1970
India	Household	Rs2,700	Rs1,360	
Malaysia <sup>b</sup>	Household per capita	M\$744	M\$456	1970
Philippines <sup>c</sup>	Household	7,785 pesos	3,736 pesos	1971
Thailand	Household	21,600 baht	8,800 baht	1970
Tunisia	Per capita	U.S.\$160	U.S.\$75	1961
Uganda	Adult male employees	3 120 sh	1,780 sh	1970

<sup>a</sup>Type of population refers to the different units reported in various studies: Income recipient - Individuals who receive income of any kind. Economically active population - Individuals who are able to work, both employed and unemployed.

<sup>b</sup>Malaysia - Sudhir Anand (1973), p. 40.

<sup>c</sup>Philippines - IBRD Manila Urban Sector Survey, July 1974. Section 2, p. 15 (mimeo).

SOURCE: Reproduced from C. R. Frank, Jr., and F. C. Webb, Income Distribution and Growth in the Less-Developed Countries, Chapter XI, Table 2.

primarily because it would reduce the downward pressure on urban wages while allowing rural poverty to increase.<sup>7</sup>

Mohan<sup>8</sup> argued for an urban land policy that would not be geared to containing city size but rather aimed at providing the best structure possible for the growing city. He built his argument on the following:

1. Large cities are here to stay, and their growth could not be slowed because the differential between urban and rural incomes is clearly very large; and the average level of well-being is higher in urban areas.
2. There are certain advantages in having larger cities in the provision of services. In other words, that there may be economies of scale for at least part of social overhead cost expenditures. Mohan cites the research studies by Alonso<sup>9</sup> and Mera<sup>10</sup> which demonstrate that in developing countries, the per capita income rises much faster than per capita local government expenditure.

In spite of the appalling conditions in major cities of the developing countries, particularly in their poorest districts (characterized by the absence of even minimal standards of housing, water supply, sewerage, streets and social facilities), a 1975 World Bank Sector Policy Paper on urban transport indicated the following advantages of rapid urbanization in developing countries:

Rapid urbanization, however, deserves to be considered not only as a problem, but also as a solution, as a way of absorbing productively

the growing totals of rural labor that are surplus to the requirements of agriculture. Few people 25 years ago would have dared predict that the cities could possibly absorb so much additional labor as in fact they have—in jobs where productivity may be very low, but on the available evidence is generally higher than in the case of marginal rural labor. The deficient living conditions of the urban poor, though more visible than those of the rural poor, are nonetheless a distinct improvement for most migrants.<sup>11</sup>

The conclusions of the above discussion on the problem of rapid urbanization indicate the following:

1. There might be certain advantages to urbanization at a certain level of economic development.
2. It is difficult to implement policies to stop migration from rural to urban areas by legal means for two main reasons. Past experiences indicate that these policies had caused extensive human suffering and failed to arrest migration. Such policies are against Article 13(1) of the Universal Declaration of Human Rights which states that everyone has the right to freedom of movement and residence within the borders of his own state.
3. A possible way to discourage migration to urban areas might be through implementing policies that would improve the absolute and relative incomes of the population in the rural areas; in general, to improve the rural areas populations' standard of living.



What Makes Developing Countries Cities Different  
From Those in the United States  
and Western Europe?

A literature search on the structure of cities in developing countries indicated a lack of information about this subject. This conclusion is supported by a recent study by Mohan (1979):

Little descriptive information is currently available on the structure of cities in developing countries. Moreover, the available information crosses disciplines and is not easily accessible to individual researchers.<sup>12</sup>

Mohan made an attempt to clarify the differences between cities in developed and developing countries and the effect of that on modeling:

It is difficult to describe the aspects in which cities in developing countries differ from, or are similar to, those in developed countries. Consequently, making judgments on the transferability of models developed in the West is somewhat hazardous. But on examining the available information, scanty though it is, I have come to believe that cities in developing countries do exhibit phenomena that are different from those observed in Western cities of today, as well as when these cities were at similarly low levels of income. These differences stem essentially from the unprecedentedly high rates of population growth in the non-Western cities, the coexistence of high and low levels of technology with predominantly low incomes.<sup>13</sup>

More information on the two major differences between cities in developed and developing countries are provided in the following:

### 1. Rapid Urbanization:

In the last section I discussed the rapid urbanization in developing countries, which at present, have an annual population growth rate of 2.5 to 3 percent. This growth rate is high compared to that of Europe, which had a typical annual population growth rate of about 0.5 percent during the rapid urbanization of Europe.<sup>14</sup>

European cities had time to adapt and evolve as they grew in size. This is in contrast to the current experience in developing countries where institutions are not able to adapt rapidly to growth and consequently, the structural growth of the city becomes unpredictable and difficult to manage.

### 2. The Coexistence of High and Low Levels of Technology with Predominantly Low Incomes:

The coexistence of different levels of technology is due to high income inequality. Currently, the demand pattern of the rich in developing countries corresponds roughly with that of the rich in Western countries. They demand and receive services and products that use twentieth-century technology while some poor might still live much as they did a century ago.

The analysis of transport systems, for example in Western cities, encompasses a limited number of high technology modes (such as; automobiles, buses, and subways). In an Asian city, however, these modes coexist with hand-pulled

rickshaws, bicycles, scooters, and animal-powered vehicles as well as a far greater number of pedestrians than typically encountered in Western cities.

The Mobility Needs of the Poor in the United States  
and Developing Countries - A Literature Review

The interest in providing better mobility for the poor in the United States started in the mid-1960s in response to the ghetto riots which occurred in many American cities between 1964 and 1968. One of the worst riots that occurred was in the Watts area of Los Angeles in the summer of 1965.

The investigating commission, in its report on the causes of the Los Angeles riots, concluded that:

The Commission recognized that inadequate and costly transportation creates a significant barrier to the employment of the poor:

Our investigation has brought into clear focus the fact that inadequate and costly public transportation currently existing throughout the Los Angeles area seriously restricts the residents of the disadvantaged areas such as South Central Los Angeles. This lack of adequate transportation handicaps them in seeking and holding jobs, attending schools, shopping and in fulfilling other needs. It has had a major influence in creating a sense of isolation, with its resultant frustrations, among the residents of South Central Los Angeles, particularly the Watts area.<sup>15</sup>

Since the end of the 1960s, a number of research studies have been conducted to determine the relationships between employment, income, and the mobility needs of the poor in the United States.

The results of a study by Wachs<sup>16</sup> about the possible relationship between employment, mobility, and public transportation in Chicago demonstrated the fact that

If new links do perform as well as existing routes and if they connect areas of unemployment with concentrations of available jobs, it is likely that they will provide the opportunity for many unemployed persons to seek jobs now not accessible to them.

Table 3.3 demonstrates the findings of the survey in terms of the impact of mobility on job search of the employed and unemployed respondents in the Chicago area.

Wach's study gave a clear indication of the strong relationship between employment and transportation when he reached the conclusion that

Among those who, for reasons of mobility, had not applied for or taken jobs of which they were aware, two-thirds of the unemployed and three-fourths of the employed cited travel time as a reason for not applying. The need for a car to reach job locations was cited by more than one-half of the unemployed respondents, and more than 40 percent of both groups responded that travel costs were among reasons for not taking these jobs. There is no doubt that job-seekers perceive the transportation system to be a major barrier to the finding of suitable employment.

Ornati<sup>17</sup> analyzed the mobility needs of the poor. He suggests that mobility is an important factor that could enhance or constrain employment and income of the poor.

Table 3.3

Impact of Mobility on Job Search,  
Chicago, 1970

Item	Employed (percent)	Unemployed (percent)
Respondents actively seeking jobs	9.4	100.0
Respondents actively seeking jobs but looking in special areas of the city	92.3	48.1
Respondents knowing of other jobs they would take now if they could get to them more easily	15.9	19.6
Jobs known of located in the suburbs	64.3	54.2
Respondents not applying for or accepting jobs during the past year for accessibility reasons	17.4	39.2
Respondents not applying for or accepting jobs for accessibility reasons who said this was true of more than half the jobs they applied for	42.3	37.5
Reasons cited by respondents not applying for or accepting jobs (several reasons may have been cited by each respondent)		
Takes too long	75.0	66.1
Costs too much	41.7	46.9
Too many transfers	37.5	20.9
Waits too long	29.2	33.9
Need a car	20.8	54.8
Do not like to ride CTA	16.7	4.4
Have no way to get there	16.7	40.1
Other	12.5	16.1
Do not know location	4.2	25.8

SOURCE: Employment, Mobility, & Public Transportation in Chicago: A Survey of Attitudes and Behavior. Table 5, Martin Wachs. Highway Research Board Record 348, p. 147.

What it is that makes non-workers of many of the poor overlaps with other problems of the poor. The problem of getting to where the jobs are (whether the problem is due to poor transportation or because the poor live in ghettos) is part of the larger problem of the lack of mobility of the poor. The social benefits of high labor mobility have been recognized since Adam Smith, in the Wealth of Nations, inveighed against "whatever obstructs the free circulation of labour from one employment to another."

<sup>18,19</sup>  
Kaye, an expert on the relationship of transportation and the economically disadvantaged, asserts that mobility is essential to conquer poverty. He argues that one of the factors leading to the decline of rural life in America is the lack of mobility. The failure to achieve a more balanced development strategy, and lack of mobility, particularly the lack of reliable, inexpensive human transportation, is beginning to surface as an important inhibiting factor to job seeking and job keeping.

The fact that the lack of mobility has led to unemployment or underemployment for the poor has been recognized in the literature that deals with transport in developing countries.

Squatter settlements, often accounting for well over a quarter of city populations, frequently lack any effective public transport service. Where, as is usual, squatters are located on the outskirts of the city, inadequacies of the public transport system and long journey times can effectively preclude participation in many employment opportunities and thus aggravate income maldistribution.<sup>20</sup>

In Rio de Janeiro,<sup>21</sup> workers who travel from the northern suburbs spend four hours traveling to and from work and expend 25 percent of their income for public transit fares; in Kuala Lumpur,<sup>22</sup> the poor pay 25 percent of their income on transport; the figures from Bogata indicate that 55 percent of all trips by the poorest families in 1969 were on foot (see Table 3.4). This is in contrast to high income families who seldom walk. The figures from Hong Kong and Taipei demonstrate the same trend in the differences in the mode of travel between the rich and the poor and might be representative of other cities in developing countries. According to Owen:

Cities that estimate the number of pedestrian trips confirm the substantial dependence on walking. The percentage of total trips made on foot was as high as 67 percent in Dar Es Salaam, 63 percent in Kinshasa, 48 percent in Taipei, 27 percent in Seoul, and 22 percent in Madras. The very poor operate outside the mechanized transport system or do not travel at all.<sup>23</sup>

Thus, it is evident that the poor in developing countries are suffering from inadequate means of transport supply indicated by high travel times as well as high expenditures on travel as a percentage of income. The travel conditions of the poor might have resulted in less trips taken than those that could have been taken by better and

Table 3.4

## Urban Travel Patterns by Income Groups

## I. Bogota

<u>Income Group</u>	<u>Percent of Home Based Trips, 1969</u>				
	<u>Walk</u>	<u>Bus</u>	<u>Taxi</u>	<u>Car</u>	<u>Total</u>
Low	55	40	5	0	100.0
Medium	5	70	15	10	100.0
High	0	10	10	80	100.0

## II. Hong Kong

<u>Monthly Income (Hong Kong \$)</u>	<u>Percent of All Trips, 1966</u>		
	<u>Public Transport</u>	<u>Taxi</u>	<u>Private Car</u>
0-300	88.4	5.6	6.0
1,001 - 1,500	67.6	9.7	22.7
2,001 - 3,000	37.3	9.9	52.8
Over 5,000	14.9	12.8	72.3

## III. Taipei

<u>Monthly Income (Taipei \$)</u>	<u>Mode Utilized, 1969</u>
Below 1,000	Bicycle
2,000 - 3,000	Bicycle or Bus
3,000 - 5,000	Bus, Motorcycle, Taxi
5,000 - 20,000	Taxis or cars
Above 20,000	Cars

SOURCE: Owen, W. Automobiles and Cities, Strategies for Developing Countries, Paris 1973, p. 12.



less expensive transport system supply.

### Expenditures on Travel in Developed and Developing Countries

#### Background

The final demand due to private consumption expenditure is determined by need as constrained by personal income and prices.

A better understanding of the structure of consumers' expenditure constraints as a function of economic development is essential to designing policies to meet the mobility needs of the poor and for analyzing general economic development.

In a recent research project for the World Bank on the consumer preferences in seventeen countries, covering a broad range of the GNP per capita, the results reported indicate that:

If total expenditure or "income" per capita is increased by one currency unit in low-income countries, it is allocated approximately as follows: 39 percent to food, 12 percent to housing, 9 percent to transport, and 7 percent to clothing, with a third going to other goods and services. For high-income countries the comparable figures are: 21 percent each to housing and transport, 17 percent to food, and 8 percent to clothing, with a third again going to other goods and services. (High-income countries are defined as those with a GNP per capita of over \$1,500.)<sup>24</sup>

The study on consumers' expenditure constraints indicate that a significant portion of income is spent on transport, and that travel demand is related, to a considerable degree, to the nine percent expenditure constraint on transport.

The seventeen countries that were chosen for the research work included countries at all levels of economic development. Appendix E has a number of tables that provide statistical information about those countries; such as the mean values of the average budget shares, the changes in the average budget shares, and the relationships between the marginal budget shares and the level of GNP per capita for different items. The tables in Appendix E were manipulated to produce Figure 3.1, which indicates that the marginal budget share for transport increases noticeably with income.

#### Analysis of the Expenditure on Travel

Two countries were selected for the analysis, the United States and Singapore, representing the developed and developing countries. The basis of the selection was the availability of statistical data and other information.

#### Expenditures on Travel in the United States

According to the June 1979 final report on national transportation policies through the year 2000:<sup>25</sup>

Passenger transportation expenditures—about 94 percent for user-operated forms (mainly automobiles) and 6 percent for purchased services (mainly air travel and urban transit)—have kept pace with other personal consumption expenditures in recent years at about

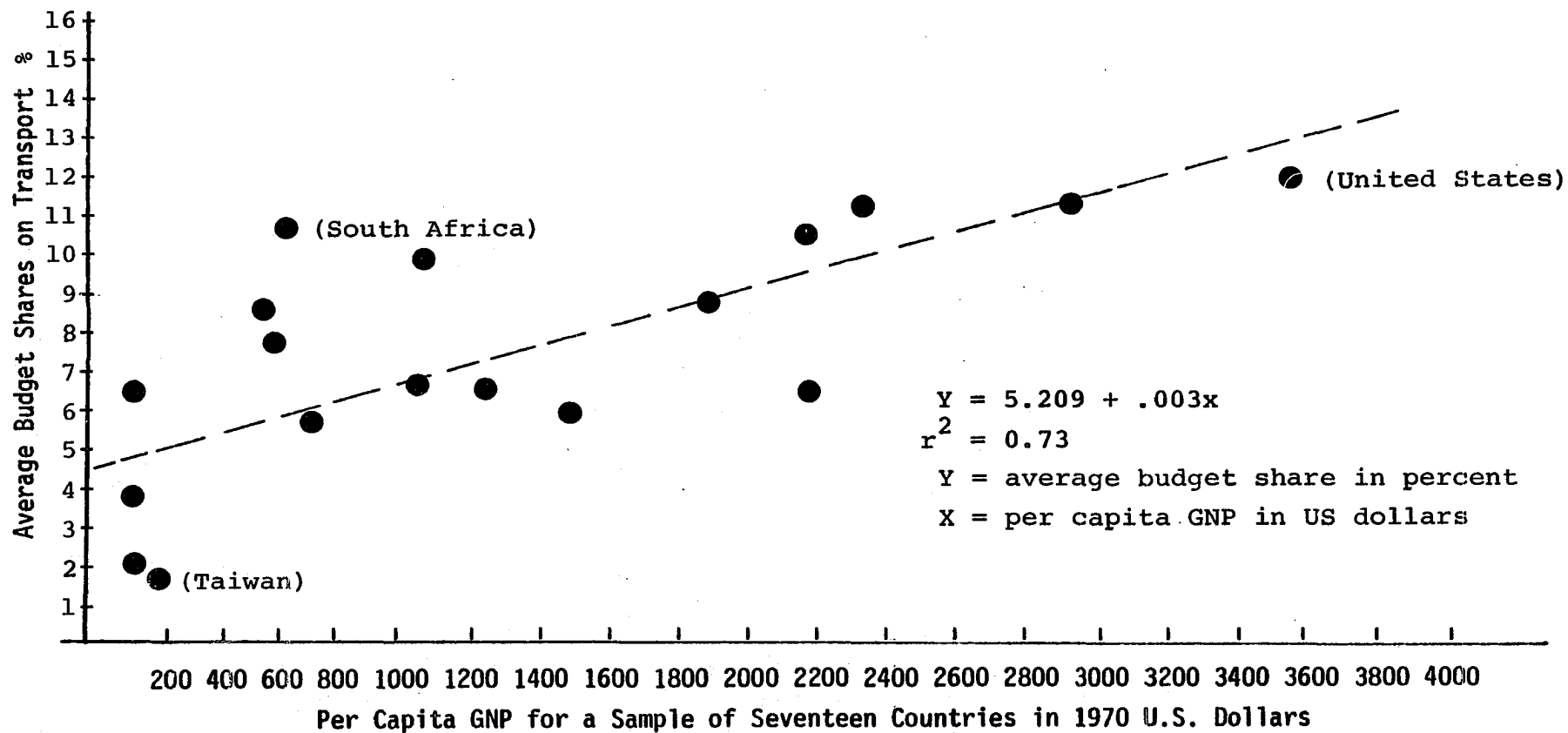


Figure 3.1 Marginal Budget Share on Transport as Related to GNP per Capita.

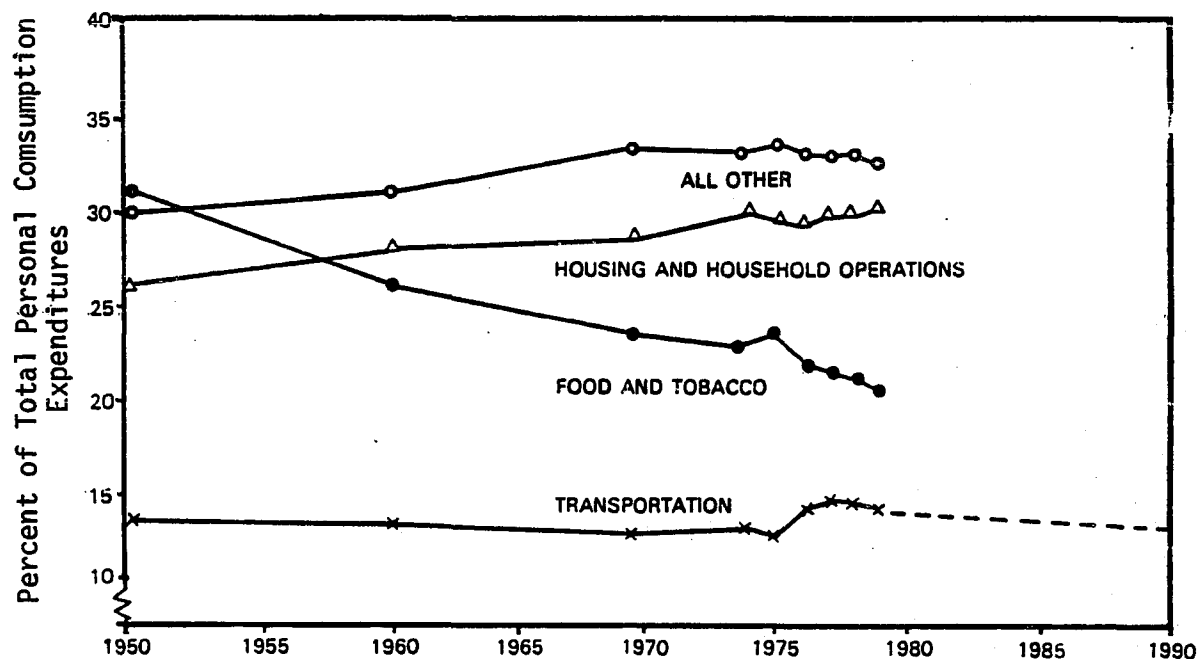
13.5 percent of total dollars spent (see Fig. 3.2). Passenger transportation expenditures have risen in number of dollars expended, however, from \$58 billion in 1965 to over \$172 billion in 1977.<sup>26</sup>

The figures quoted above do not include personal consumption expenditures for foreign travel in 1977 of about \$10 billion or purchases of largely recreational goods such as bicycles, personal aircraft, and private boats, which exceeded \$11 billion.<sup>27</sup>

The "final report" statement about the passenger transportation expenditures support Zahavi's<sup>28</sup> indication of the existence of a travel-money budget at the macro level. Zahavi extended his analysis to the level of cities for households at different income levels. His analysis included two cities in the United States, Washington, D.C., and Minneapolis and St. Paul, Minnesota (See Figure 3.3). Zahavi's figure indicates that expenditure on travel increases with income.

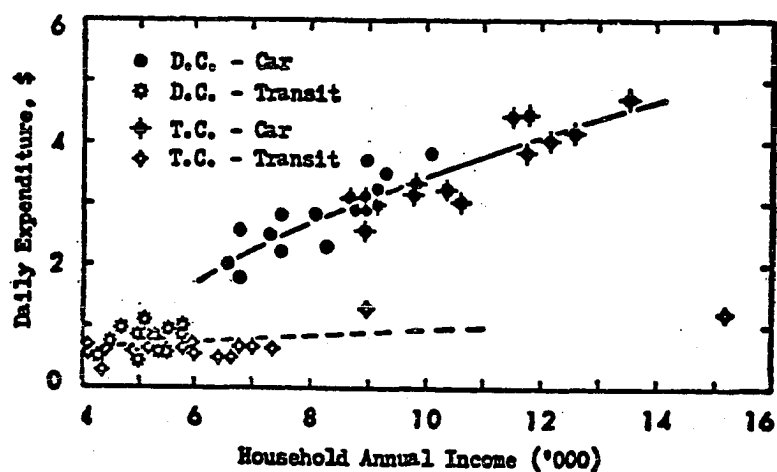
The Motor Vehicle Manufacturers Association figures, of the expenditure on gasoline as a percentage of family income (see Table F-1 in Appendix F), indicate that the higher the income the lower the cost of operation of an automobile as a percentage of income. (The Motor Vehicle Manufacturers Association data covered income groups from all areas of the United States.)

The figures from other tables, showing the characteristics of travel in the United States, are provided in Appendix F. These figures indicate that 82.4 percent of those whose income is under \$5,000.00 a year use automobiles for the work



SOURCE: Demographic, Economic and Travel Characteristics.  
 A paper prepared for the 1981 Transportation Research  
 Board Meeting. By: Frank Spielberg, Edward Weiner  
 and Ulrich Ernst.

Figure 3.2. Transportation Expenditures as a Percent of Total Personal Consumption Expenditures.



\*By households that made all their trips by car only or transit only versus household annual income, Washington, D.C. 1968 and Twin Cities (Minneapolis-St. Paul, Minnesota) 1970.

SOURCE: Y. Zahavi, The UMOT Project, 1979, p. 114.

Figure 3.3. Daily Expenditure on Travel\*

trip and that while the lower income groups are spending a higher percentage of income on travel, they actually are traveling less.

#### Data Indications

If by the United States standards, those whose income is below \$5,000.00 a year were considered poor, then the picture that we can draw of the existing transportation system, based on the need approach, could be presented in this way:

The poor in the United States are spending a higher percentage of their income on travel, to achieve a lower mobility level, than the rich.

#### Expenditures on Travel in Singapore

Singapore is the smallest and one of the most prosperous nations in Southeast Asia. Together with its 40 tiny adjacent islets, the Republic of Singapore occupies 226 square miles (585 sq. km.). According to Table A-1 in Appendix A, in 1978 Singapore had a population of 2,355,000; the GNP per capita in U.S. dollars was 2,620; and the average annual growth rate in GNP per capita (1970-77) was 6.6%.

In 1975 Singapore implemented the CBD License Scheme. The key concept underlying the Singapore Area License Scheme was that a special fee (S \$80 a month and S \$4 a day) was to be imposed on each car carrying fewer than four persons entering a restricted zone during the morning peak period, from 7:30 a.m. to 10:15 a.m. The goal of the Singapore Government was to reduce peak hour traffic by 25 to 30 percent. The second element of the

scheme was to open ten thousand spaces in car parks around the periphery of the restricted zone, with special shuttle buses to carry commuters from the fringe car parks to the central area. The third element of the scheme was an increase in parking charges within the restricted zone in favor of short term as opposed to all day parking.

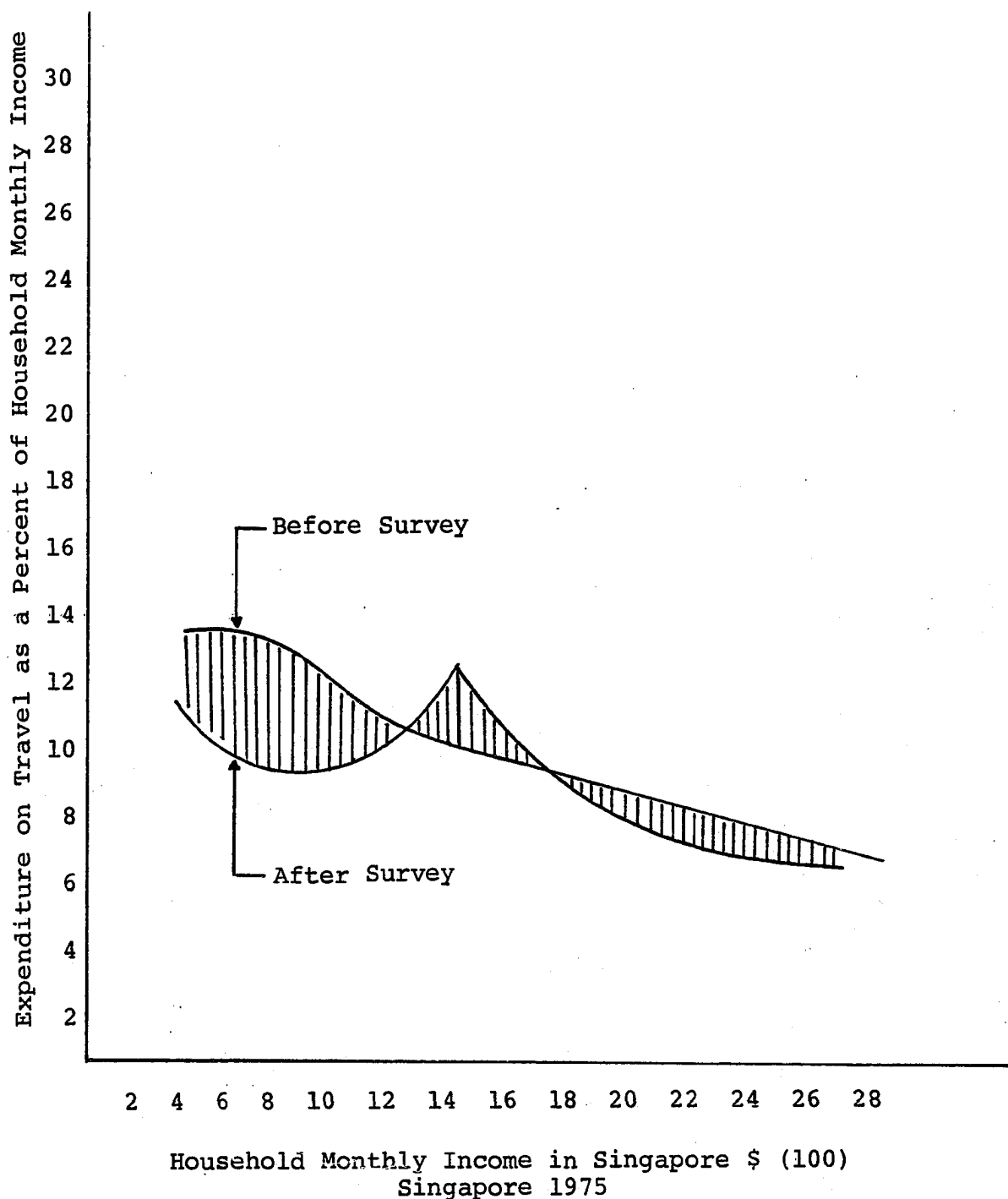
Households were interviewed twice, "before" and "after" the introduction of Singapore's Area License Scheme (ALS), in order to identify and quantify its possible effects on the household's travel behavior.

Four sets of tables were prepared by the World Bank during 1978-79. Those tables were summarized and commented on by Zahavi and Roth.<sup>29</sup> They show the principal results by household income on the travel characteristics in the whole city area of Singapore, as derived from the before-and-after home-interview surveys.

The tables mentioned above were useful to the author in preparing new tables where the cost of travel was estimated by different modes and for different income groups. Information on the cost of travel by different modes was obtained through Wilbur Smith and Associates.<sup>30</sup> The results of the travel cost estimates are presented in four tables in Appendix G. The costs of travel by different income groups are shown graphically in Figure 3.4 and Figure 3.5.

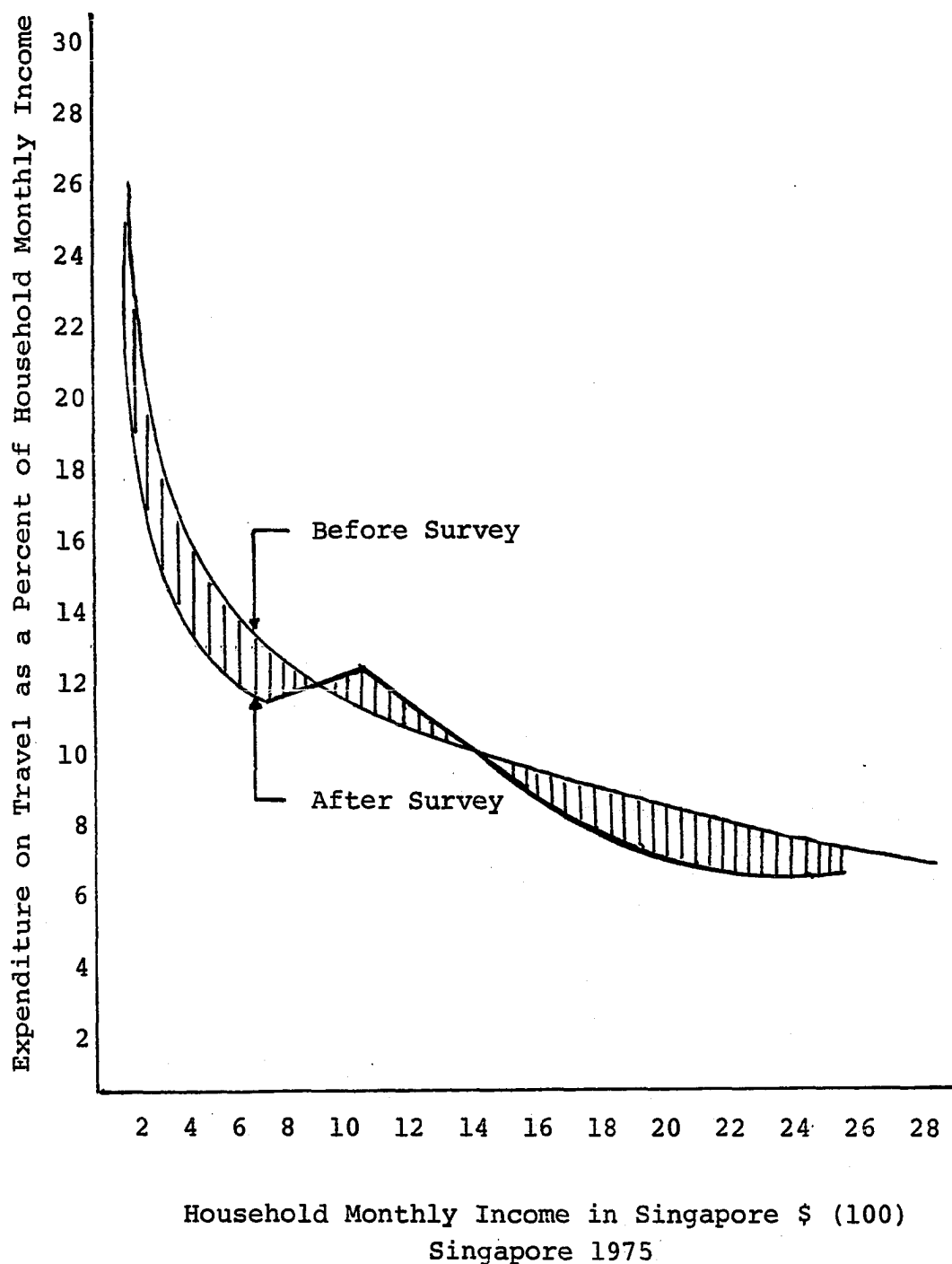
The analysis of the Singapore data concentrates on the cost element as related to different income groups since the





SOURCE: Travel and Income Data on Singapore are based on Y. Zahavi & G. Roth TRB Paper 1980. Cost of travel data is based on information the author obtained from Wilbur Smith & Associates 1980 (see footnotes 29 and 30).

Figure 3.4 Cost of Travel in Singapore (1975) for Vehicle-Owning Households.



SOURCE: Travel and Income Data on Singapore are based on Y. Zahavi & G. Roth TRB Paper 1980. Cost of travel data is based on information the author obtained from Wilbur Smith & Associates 1980 (see footnotes 29 and 30).

Figure 3.5 Cost of Travel in Singapore (1975) for NonVehicle-Owning Households.

other elements have been discussed by Zahavi and Roth as mentioned above.

The analysis of the expenditure on travel in Singapore points to the following:

A. Vehicle-Owning Households: (see Figure 3.4)

1. Before the introduction of the Singapore License Scheme, the lower income groups paid a higher percentage of their income for travel; 13.46 percent for those with an income between S\$200.00 to S\$400.00 (hereinafter S\$ refers to Singapore dollars) vs. 7.11 percent for those with an income above S\$2,500.00.

2. After the introduction of the license scheme, there was a 2.02 percent decrease in the cost of travel for the income group S\$200.00 to S\$400.00. However, this decrease was accompanied by a 22.24 percent loss in mobility (distance traveled per day) per household. For the income group above S\$2,500.00 there was a decrease in travel cost of about 1.18 percent accompanied by a 17.24 percent loss in mobility per household. In contrast, the middle income group with income between S\$1,300 to S\$1,700 suffered an increase in the cost of travel as well as a decrease in mobility.

3. Figure 3.4 demonstrates how each income group was affected in its expenditure on travel as a result of the introduction of the license scheme.

The analysis of travel cost by vehicle-owning households thus indicates that the poor, while they had minor gains in

travel cost as a result of the introduction of the license scheme, have suffered substantially in their loss of mobility relative to the rich.

B. Nonvehicle-Owning Households: (see Figure 3.5)

1. Before the introduction of the license scheme, the lower income groups paid a much higher percentage of their income for travel (27 percent for those having an income between S\$2,000.00 to S\$2,500.00).

2. After the introduction of the license scheme, the trend described above continued with a slight change in the cost of travel for different income groups and with relatively little change in mobility.

3. The income group with the highest percentage in their expenditure on travel is the group with an income below S\$200.00 (about 27 percent). The next income group, with an income between S\$200.00 to S\$400.00, spent 15.28 percent of their income on travel (with a difference of 11.72 percent between the two groups' percentages). This difference might suggest that an effective mobility need policy can be very helpful and could make a difference in the fight against poverty.

4. On the average, nonvehicle-owning households spent a higher percentage of their income on travel than vehicle-owning households. (This was true before the introduction of the license scheme and after its implementation.) This is a surprising conclusion, since

the opposite was to be expected, and might have considerable policy implications for designing policies (such as subsidized transit fares) directed toward those groups that have no access to vehicles with the goal of reducing the percentage of income spent on travel.

Data Indications and Policy Implications for Expenditures on Travel in Developed and Developing Countries

Data Indications

A. Between countries

1. The World Bank research report on consumer preferences indicates that:

a. High income countries put proportionately more into transportation than poor countries (21 percent versus 9 percent).

b. In developing countries, between the years 1955 and 1968, there has been a considerable increase in the average budget shares of transport.

2. According to the figures from the Motor Vehicle Manufacturing Association, the travel cost budget in the United States remained the same over time, at least until 1979 (13.5 percent). The stability of the travel cost budget over time has proved to be true also for other Western countries.<sup>31</sup>

B. Between income groups at the country level

1. In the United States, the data from the Motor

Vehicle Manufacturing Association indicates that the poor are spending a higher percentage of their income on travel and traveling less than the rich. The reason might be that more than 80 percent of the poor use automobiles for their work trips.

2. Expenditures on travel in the United Kingdom in 1972, stratified by income groups, indicate that expenditures on travel as a proportion of the total household income increases as income increases.<sup>32</sup> This might be due to the fact that, unlike the United States, the poor in the United Kingdom have better access to public transit.

C. Between income groups at the city level

1. Developed countries:

Transportation studies in Washington, D.C., in 1968 and in the twin cities (Minneapolis and St. Paul, Minnesota) in 1970 in the United States<sup>33</sup> indicate that expenditure on travel increases with income for car trips and transit trips. The analysis also indicates that the poor who have no access to public transit and have to use a car for the work trip are at a great disadvantage, and are actually paying a higher percentage of their income on travel than the rich.

The trend of the expenditure on travel by car trips and transit trips discussed above was true also for Nuremberg,

West Germany, which might indicate that it could be also true for other cities in developed countries.

## 2. Developing countries:

In Singapore, as income rises, the percent spent on transportation declines. The very poor use more transit and travel less than the rich. Though the Singapore's license scheme had the effect of decreasing the cost of travel slightly on the poor who have access to cars, the mobility loss by that group was considerable. In Singapore the lowest income group pays 27 percent of their income for public transit.

### Policy Implications for Developing Countries

1. The World Bank research report on consumer preferences indicates that developing countries spend nine percent of their income on transport.

2. The figures obtained from urban areas in developing countries, on the expenditures on transport, indicate that a much higher percentage of income than nine percent is spent on travel by the lowest income group living in urban areas (Singapore, 27 percent; Rio de Janeiro, 25 percent; Kuala Lumpur, 25 percent).

3. The conclusion that could be reached from the above is that in developing countries, the poor pay higher percentages of their income on travel than the affluent (or generally, the non poor income groups of the population).

4. The analysis on the expenditures on travel thus indicates that:

- a. The overall percentage of income spent on travel by itself, is not a reliable indicator of mobility needs by income groups.
- b. The poor often pay a higher percentage of their income on transport than the affluent in urban areas of the developing countries.

#### Summary

Different sections of this chapter indicate the following findings:

- Developing countries have been experiencing rapid growth in urbanization. Population forecasts by the United Nations indicate that this trend will continue for the next two decades (1980-2000).
- The increased urban sprawl has had an unfavorable impact on the mobility of low income groups.
- An inadequate public transport system and a long journey time to work can effectively preclude participation in many employment opportunities.
- In developing countries, the poor pay higher percentages of their income on travel than the affluent (or generally, the non poor income groups of the population).
- Cities in developing countries have a significant number of poor people who have "mobility needs."



### Footnotes

<sup>1</sup>United Nations, Concise Report on the World Population Situation in 1970-1975 and Its Long-Range Implications, July 1974, Sales No. E-74, XIII 4.

<sup>2</sup>International Bank for Reconstruction and Development, The Task Ahead for the Cities of the Developing Countries, Washington, D.C., 1975.

<sup>3</sup>World Bank, Urbanization, Sector Working Paper, June 1972, p. 10.

<sup>4</sup>For a sympathetic review of such approaches see M. P. Todaro: Internal Migration in Developing Countries (Geneva, International Labor Office, 1976).

<sup>5</sup>P. Peek and G. Standing, 1979.

<sup>6</sup>A. B. Simmons, 1979, pp. 92-93.

<sup>7</sup>An empirical study of the Philippines suggested that migration control would have that effect, as did a similarly detailed study in the Republic of Korea. See G. Rodgers, M. Hopkins, and R. Wery: Population, Employment and Inequality: BACHUE Philippines (Westmead, Saxon House, for the International Labor Office, 1978), pp. 323-324; and I. Adelman and S. Robinson: "Migration, Demographic Change and Income Distribution in a Model of a Developing County," in J. L. Simon (ed.) Research in Population Economics, Vol. 1 (Greenwich, Connecticut), JAI Press, 1978, pp. 1-26, especially Table 3, p. 20.

<sup>8</sup>R. Mohan, 1979.

<sup>9</sup>W. Alonso, 1968.

<sup>10</sup>K. Mera, 1973.

<sup>11</sup>World Bank, Urban Transport, Sector Policy Paper, May 1975, p. 3.

<sup>12</sup>R. Mohan, 1979, p. ix.

<sup>13</sup>*Ibid.*, pp. ix-x.

<sup>14</sup>G. Beier and others, 1975.

<sup>15</sup>J. C. Falcocci and E. J. Cantilli, 1974.

<sup>16</sup>Martin Wachs, pp. 142-151.

- <sup>17</sup>Oscar Ornati, 1969, pp. vii and viii.
- <sup>18</sup>Ira Kaye, January 1976.
- <sup>19</sup>Ira Kaye, October 1976.
- <sup>20</sup>World Bank, 1975. "Urban Transport," sector policy paper, p. 18.
- <sup>21</sup>M. M. Webber, 1977.
- <sup>22</sup>G. J. Roth, 1977.
- <sup>23</sup>W. Owen, 1973, p. 9.
- <sup>24</sup>C. Lluch, A. A. Powell, and R. A. Williams, 1977, p. xxv.
- <sup>25</sup>National Transportation Policy Study Commission, National Transportation Policies Through the Year 2000. Final Report, June 1979.
- <sup>26</sup>U. S. Department of Commerce, Bureau of Economic Analysis (BEA), Survey of Current Business, Washington, D.C.: July 1978, Table 2.6.
- <sup>27</sup>Ibid.
- <sup>28</sup>Y. Zahavi, 1979, pp. 104-112.
- <sup>29</sup>Y. Zahavi, and G. Roth, 1980.
- <sup>30</sup>According to information received from Wilbur Smith and Associates, the estimated cost of travel by bus was 20 cents up to 3.22 km of travel, 30 cents for 3.22 to 6.44 km, 40 cents for 6.44 to 12.88 km, 50 cents for 12.88 to 19.32 km, and 60 cents for over 19.32 km of travel. Perceived cost of operating a car in 1975 was estimated as equal to 4.5 cents per km and for motorcycle 1.08 cents per km.
- <sup>31</sup>Y. Zahavi, 1979, p. 104.
- <sup>32</sup>Ibid., p. 110.
- <sup>33</sup>Ibid., p. 114.

## CHAPTER IV

### THE INADEQUACIES OF A CONVENTIONAL TRANSPORTATION PLANNING FRAMEWORK

In this chapter, the conventional long range transportation planning process is reviewed briefly and the models that simulate the process are critiqued. Later, a closer look is provided on demand modeling as related to the developing countries present development strategy.

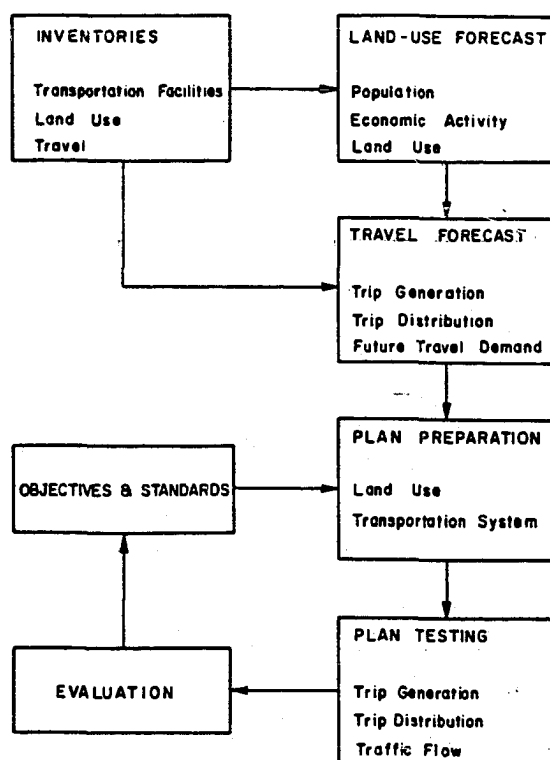
#### Conventional Long-Range Transportation Planning Process\*

##### A Historical Evolution

Transport-planning studies have been conducted in a large number of urban areas throughout the world during the past 25 years. A process for conducting these studies has developed, and is still evolving, which attempts to provide a systematic method for solving urban transport problems. The planning process that is most commonly used at present had its origins in the studies performed at several cities in the United States during the 1950-1960 period, particularly in Detroit and Chicago. While more recent transport studies have made significant contributions to the development of land-use prediction models, travel demand forecasting methods, and

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\*See Figure 4.1.



This diagram illustrates the processes used in moving from inventories and forecasts to the preparation, testing, and evaluating of a transportation plan.

SOURCE: Reproduced from Hutchinson (1974), Figure 1.1.

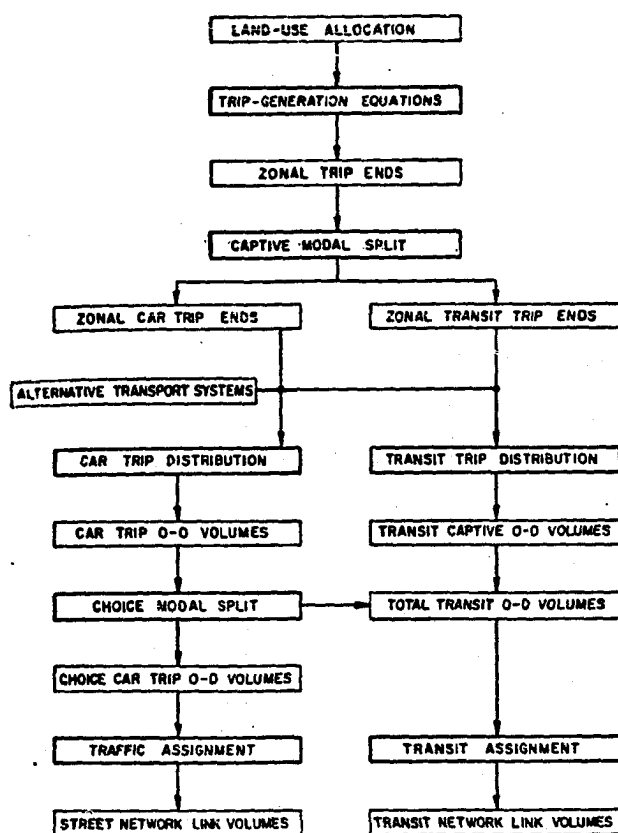
Figure 4.1 The Planning Process Used in the Chicago Area Transportation Study.

evaluation procedures, most of these studies have been organized within the same type of framework developed for the Chicago study.

### Context

The fundamental premise which underlies most transport-planning studies is that some future horizon-year equilibrium condition of an urban area is a meaningful state to attempt to predict and evaluate. In the typical study the most probable pattern of land development is predicted for the horizon-year (usually 20 years ahead) and the transport demands created by that land use are estimated. A set of alternative transport plans is then generated for that horizon-year; these plans incorporate varying amounts of highway and public transport facilities. The operating characteristics of each alternative in the horizon year are then estimated in the form of flows on each link of the horizon-year networks. The usual criterion for choice among the alternatives is that the difference between the collective benefits to users, in the form of reduced travel impedance, and the monetary costs of constructing and maintaining these facilities, should be a maximum. The present planning process implies that there will be an orderly and easily identifiable sequence of public investments that will yield the horizon-year plan selected.

An important part of the transportation planning process is the travel-demand forecasting process (see Figure 4.2). This process consists of five stages which are: trip-



SOURCE: Reproduced from Hutchinson (1974), Figure 1.13.

Figure 4.2 Travel-Demand Forecasting Activities for Horizon Years.

generation analysis, captive modal split analysis, trip-distribution analysis, choice modal split analysis, and traffic-assignment analysis. The principal outputs of the travel-demand forecasting process for each alternative network are: (1) the travel demand between any pair of zones, (2) the properties of the travel between any pair of zones (such as travel distance, travel time, and therefore average speed), (3) the volume of travel on any link, and (4) the properties of travel on any link.

#### A Critique of the Conventional Transportation Planning Framework

The conventional long-range transportation/land use planning process has been carried out in considerable detail for the last three decades in large cities of the developed countries and has been extensively adopted in the cities of the developing world. However, the conventional process and the models that simulate the process have proved unsatisfactory according to a number of studies. Some of these commentaries are reviewed below.

##### 1. The World Bank, Urban Transport Sector Policy Paper (1975)

The following is a summary of concepts introduced in the World Bank Transport paper.<sup>1</sup>

In the context of the developing countries, the transportation planning models have serious limitations both because of weaknesses in the models and because of the more dynamic changes and data inadequacies in

the cities of the developing world.

The difficulties stem in part from the interaction between changes in the transport system and the requirements for trips. Facilities provided to meet demand induce additional demand. Short-term effects on the number of trips may be highly important as is frequently apparent when a new major link is introduced such as a new bridge. Longer term effects on land use, as people and companies adjust their locations to take advantage of changes in transport conditions should also be incorporated. However, no satisfactory way has yet been found to incorporate feedbacks into the models so that the number of trips adjusts automatically to the conditions of transport supply. The models are also weak in simulating traffic behavior under conditions of acute congestion such as are encountered over large areas and long periods in developing countries. The models, in extrapolating one static position to another in a future year, may also be biased towards preservation of highly unbalanced and unsatisfactory conditions. Difficulties also exist in modeling the interactions between different parts of the road network and, in particular, determining necessary speed/flow relationships on minor arterial and local streets. Though the grid system customarily used is complex,



a more detailed complex of linkages is needed for studying local traffic management schemes such as one-way streets.

Furthermore, the models cannot readily handle major changes in policy such as the introduction of congestion changes. Problems arise not only from absence of data establishing the impact of price changes on demand but also from the increasing model complexity. The models are already highly complex and costly to prepare and run as a result of the numerous zones and system links required. Iterative and other processes to introduce additional factors affecting demand, supply and interactions between them, and involving changes in inputs and further reruns, are likely to be prohibitively expensive. Already feedbacks of system supply changes on modal split and trip distribution are proving very costly. Even to evaluate a simple investment plan with existing methodology and computer techniques generally costs well above \$500,000 and takes at least two years to become operative. The developing countries may well hesitate on these grounds alone. Attempts to reduce financial and time costs of preparation by borrowing existing modes are in practice likely to lead to use of models little suited to the particular task or condition.

For the developing countries, the current conventional urban transport models have further serious limitations due to the rapidity and uncertainty of change. To allow for long time periods needed for technical studies, design, and building of major urban transport investments, the "design year" is often as much as 20 years ahead. Over 20 years, the population and area of a city of a developing country may have more than quadrupled; the urban pattern and the economic and social characteristics of the population will have changed drastically. The growth of income is subject to great unpredictable variation. Alternative estimates of numbers of families able to afford private cars in the design year may, validly, vary by 100 percent or more. Past data and trends, even if much more accurate than in fact they are, cannot unfortunately, provide a reliable guide for future demand conditions either in total or, even less, by city zone. In brief, extrapolation techniques that may be valid for relatively gradual and small changes of urban population and land use cannot be relied upon to yield similar accuracy with the abrupt and large changes encountered in developing countries. There are additional difficulties in evaluating the choice of transport modes. Over 20 years the additions to the transport system in developing countries cities will

be so large in comparison with the existing system that greater variation in future urban transport patterns is feasible; the existing capacities, which can be measured, are likely to be only a small fraction of the total.

2. Zahavi and Roth (1979)

Two additional reasons could be added from a paper by Zahavi and Roth<sup>2</sup> to the inadequacies of the existing transport models.

The first reason has to do with the absence of causality in the typical transportation model. This means that trip patterns are correlated to such factors as income, car ownership, etc. By using the base year correlation, transport conditions are extrapolated to the future. The problem with this process of estimating future trips is that it is not based on any logical or behavioral responses of travelers to new conditions.

The second reason has to do with the difficulty of checking the results of urban transport planning projects, conducted by consultants employed by the developing countries, in order to evaluate their work and check the accuracy of their predictions. Zahavi and Roth noted that few (if any) of the urban transport studies carried out in recent years (1970s) have been followed up by measurements to check the accuracy of the predictions.

Zahavi and Roth explained the World Bank need for new methodology to evaluate transport projects in developing countries.

The Bank requires then, a completely new methodology, that allows for the effects of transport changes on trip behavior and land uses; that is sensitive to changing conditions; that incorporates explicit, rational causal relationships; and that can be tested for accuracy against available data. Accuracy is not regarded as the key requirement: the Bank is more interested in obtaining quick, approximate, evaluations of the consequences of urban transport improvements to different income groups, having regard to the rapid pace of change that is typical of the cities of developing countries.<sup>3</sup>

#### Transport and Development in Developing Countries

The lessons of development of the last three decades described in Chapter II have taught the developing countries some valuable lessons about the weakness of the demand strategies and indicated the usefulness of "need strategies" as a means for: a) correcting the inequalities in the distribution of income, b) eliminating poverty through a basic needs strategy, and c) as a new means for growth in the economy.

A country's general strategy for economic development dictates the appropriate transport strategy, thus there is a strong indication for the desirability of a need strategy in transportation planning for the developing countries.

In transportation planning, travel demand is an important concept which has been conveniently defined as the

trips taken after the interaction of the demand for travel with system supply. The estimation of travel demand is currently measured by daily trips per person and mode of travel. Trip frequency and modal choice are most frequently derived from data on family income, car ownership, relative travel times and costs by transit in comparison to the auto. Most travel demand models are based on trips that are calibrated to—that is adjusted to—the observed travel measures which they are asked to reproduce as a final output.

The problem with the demand approach to estimate travel is that it is based on current actual behavior of persons who travel, as decided by market demand, and does not consider why persons do not travel.

Analysis of the travel conditions of the poor in developing countries (provided in Chapter III) indicate that the poor are suffering from a considerable amount of time that they have to put on their travel; an inadequate public transit supply, and are spending a high percentage of their income on travel. The existing travel conditions of the poor indicate that they might have taken more trips if they were provided with adequate and less expensive means of transport system supply. So, the travel needs of the poor as defined in this research work will be those trips taken by the poor to their desired activities (methods for estimating travel needs are provided in Chapter V), at an acceptable level of fare and an acceptable level of service that have been set in the goals and

objectives of mobility provided for the poor.

Thus the above discussion points the way to the desirability of a need approach to transportation planning in the developing countries where "need" is emphasized over "demand."

Chapter V provides a suggested reorientation to modeling in which more emphasis is put on "need" in contrast to "demand" for estimating travel requirements, and for the purposes of evaluation of different transport alternatives presented in a proposed nonspatial/spatial analysis framework.

Summary

The conventional transportation planning models fail to address "need." Also, prominent authors point out that cities in the developing countries change rapidly, and conventional models can't cope with these changes. Therefore, in this thesis, an analysis framework is suggested that would address "need" and provide for quick response to policy questions.

Footnotes

<sup>1</sup>World Bank, Urban Transport, Sector Policy Paper, May 1975, pp. 94-100.

<sup>2</sup>Y. Zahavi and G. J. Roth, May 1979, pp. 1-3.

<sup>3</sup>Ibid., p. 3.

## CHAPTER V

### A FRAMEWORK FOR TRANSPORTATION NEEDS ANALYSIS

#### Introduction

In the previous chapter, it was concluded that the conventional transportation planning framework for analyzing urban transport problems and designing solutions specifically related to conditions of the poor in developing countries is inadequate. In this chapter, a framework for analysis is proposed that would provide quick responses to policy questions as well as address the transportation needs of the poor in the context of the more dynamic changes and data inadequacies in the cities of the developing countries.

Table 5.1 describes briefly the major differences between the conventional transportation planning framework and the proposed need approach framework.

A summary of the proposed nonspatial/spatial analysis framework is provided in the following steps. (Figure 5.1 illustrates the nature of the analysis performed at each step.)

#### Step (1) Needs are Defined

- a) Define the poor as a function of their income, occupations and skill level (a detailed discussion on how to estimate poverty level is provided in Chapter II).



TABLE 5.1

THE DIFFERENCE BETWEEN THE CONVENTIONAL AND THE NEED  
TRANSPORTATION PLANNING FRAMEWORKS

The Conventional Transportation Planning Framework	The Proposed Need Approach Transportation Planning Framework
<p>Estimates of the poor's travel requirements are based on current actual behavior of persons who travel, as decided by market demand.</p> <p>Priority for projects to be implemented are based on the highest benefit cost ratio, for the society as a whole, without regard to which income groups benefit and which do not.</p> <p>The planning process is relatively uniform, directed primarily at analyzing and evaluating transportation requirements and developing major long-term capital investments as the solutions.</p> <p>Models that simulate the planning process cannot readily handle major changes in policies. And are highly complex and costly to prepare and run, and require at least two years to become operative.</p> <p>Data requirements are huge.</p>	<p>Estimates of the poor's travel requirements are based on their assessed need.</p> <p>Priority for projects to be implemented are based on meeting the transportation needs of the poor at the least possible cost.</p> <p>The planning process is "short range." This process focuses on the present and near future urban poor transport conditions in cities of the developing countries. The process is responsive to changing conditions, policies, and local attitudes or unforeseen circumstances (i.e., provides quick response to "What if" policy questions).</p> <p>Models that simulate the planning process would provide assistance to decision makers by identifying problems, developing options, and recommending solutions in a quick manner at a minimum cost. Those models would require relatively short time to prepare.</p> <p>Data requirements are simple. A small stratified sample of 30 households by each income/occupations group would be required.</p>

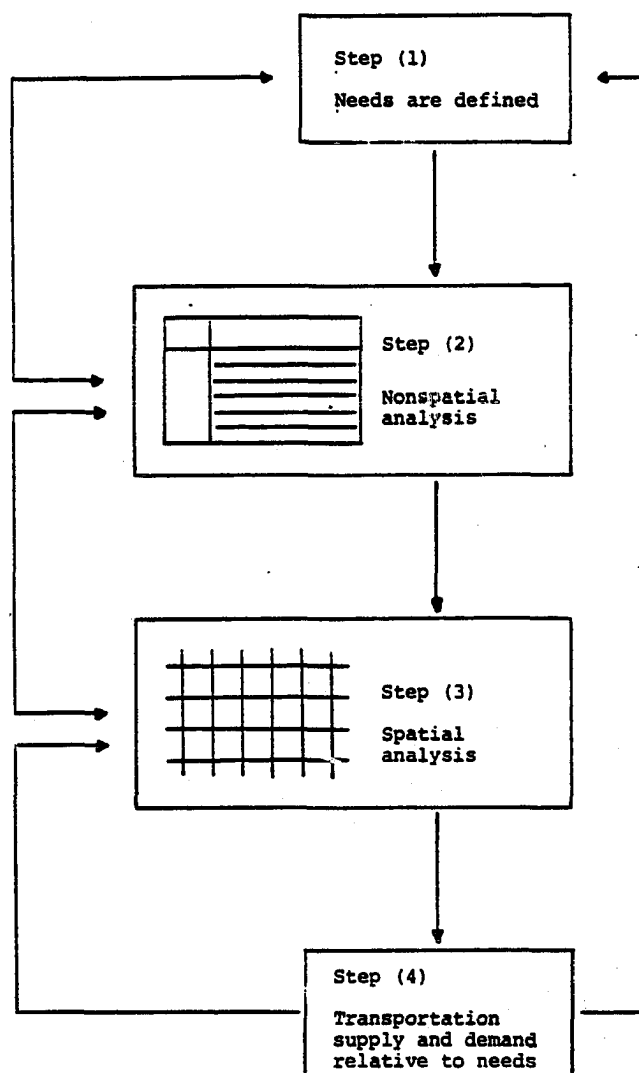


Figure 5.1. A framework for transportation needs analysis

- b) A transportation profile of the poor is drawn by:
  - a. Categories of poor:
    - 1. poor
    - 2. very poor
  - b. Travel habits:
    - 1. automobile ownership
    - 2. modal split
    - 3. by sector
  - c. Expenses of travel in time and money:
    - 1. by mode
    - 2. by sector
- c) Define goals, objectives, criteria and user standards of accessibility.
- d) Provide estimates of the basic needs for travel. Need for urban public transportation is the number and length of trips that would be taken on public transportation by residents of an urban area living below poverty level at a given level of fare and level of service. The level of fare and service should meet the defined goals and objectives of accessibility. Need can be expressed in passenger-kilometers.

### Step (2) Nonspatial Analysis

Nonspatial analysis involves identifying problems and developing public policy and programs to meet the needs of the poor for transport.

The transportation needs of the poor must be identified, quantified, and evaluated before appropriate public policy and programs could be adopted and executed with the objective

of meeting those needs. Data obtained from a household interview survey would be arranged in a format that is useful in policy analysis of the type "What if situation" such as: What if the poor are increasing by 200,000 persons per year, what would be the cost involved in meeting their transportation needs; the effect of road pricing policies on the mobility of different income groups; the budget needed to meet standards of accessibility for the poor and their expenditures on travel.

### Step (3.1) Spatial Analysis

Divide the urban area into zones that would reflect the first criterion below and one or more of the following other criteria.

- a. Clusters (depending on available data, the clusters or neighborhood groups of people could be parcels, census blocks or tracts).
- b. Social class.
- c. Income class.
- d. Land use characteristics.

### Step (3.2)

For each zone, find what is the percentage of the population within each occupation category, and then estimate the travel characteristics for each zone and plot spatially.

### Step (3.3)

The information obtained from Step 3.2 would be transferred to zonal maps, or to uniform grid system maps for

possible computerized analysis, with the objective of identification of those zones or cells with deficiencies in transportation supply.

#### Step (3.4)

For zones that are identified to have deficiencies in transportation system supply, estimate the household population living below poverty level; their daily trip rates needed (total and by purpose); multiply rate by low income family population; and distribute the total daily trips to likely destinations according to function of destination.

#### Step (4) Transportation supply and demand relative to needs

Provide for an acceptable level of accessibility to opportunities. The transportation system supply should be adequate to handle the estimated needed trips that would require some form of public transit.

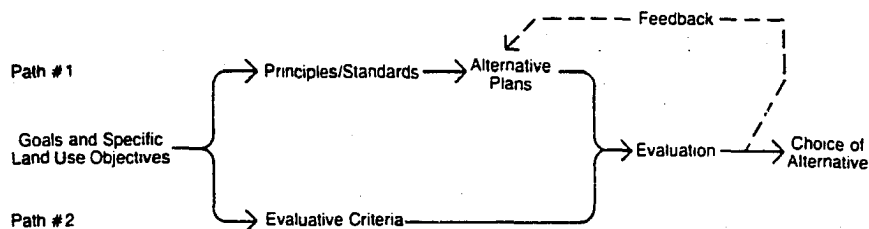
A more detailed discussion on the spatial and the nonspatial transportation analysis is provided later in this chapter. However, it would be appropriate at this stage to discuss briefly the goals, objectives, criteria and user standards of accessibility, the sampling strategy suggested, as well as the household travel survey data requirements.

#### Goals, Objectives, Criteria and User Standards of Accessibility

It is proper at this point to define the goals and objectives of accessibility in the framework of providing the

basic needs for the urban poor in developing countries. However, it might be useful to illustrate theoretically the interpretation of goals and objectives in terms of planning principles and evaluation criteria. Such an interpretation as related to land use and which might be useful to accessibility, was explained by Chapin.

Two branches of goal interpretation exist at this step. One path is in the direction of planning principles and standards, that is, goal-oriented guides to be used in the design of goal form and programmatic solutions. This is the connecting link between land use objectives and land use and guidance system plans. Although they do not insure optimum solutions, planning principles and standards focus the search for solutions in more fertile directions than might otherwise be the case. Along a second path, the objectives are refined in the form of evaluative criteria for later use in assessing trend projections and projections associated with alternative plans. Evaluation criteria are intended to measure and assess consequences associated with alternative solutions or projections in relation to the initial goals and objectives. Both planning principles and standards and evaluative criteria are intended for direct application to community decision-making as well as subsequent planning. The following diagram illustrates this double-path concept.<sup>8</sup>



An important factor in a policy for "satisfying the basic human needs of the population" is the provision of a

desirable level of access to opportunities. "A desirable level of access to opportunities" is the key goal of the proposed "need approach to transportation planning in developing countries."

The objectives of mobility provided would be defined by:

1. Whether or not transportation system users can reach a variety of activities within a reasonable time or cost.
2. Or alternatively, whether or not such activities are provided within reach of the transportation system which exists or can be expected to exist.

This definition of mobility objectives does agree with the need felt in developing countries of integrating transportation and land use policies. In their concluding remarks, Sargon and Maguire called for the enhancement of such policies.

In the field of transportation, the largest need in the developing nations is to enhance the concept of comprehensive and balanced transportation planning and development.<sup>9</sup>

Two possible criteria for the objectives to mobility discussed above are the number of the poor people served and the number of opportunities made accessible. The standards will be discussed in terms of the "user standards." The user standards are defined in terms of opportunity values to satisfy urban needs. The application of such standards within an urban area would indicate where and for whom transportation or other urban services need to be improved and would permit trade-offs to be made between the provision of transportation

service and the location and the type of development. Areas where standards are not met can be identified and corrected either by the introduction of opportunities (jobs, hospitals, schools, etc.) or by improving transportation. Such standards would serve to tie transportation planning processes more closely to other urban planning activities. Illustrative examples of such standards are provided in Talbe 5.2.

The literature review on employment in developing countries, provided in Chapter II, indicated that insufficient and unequal access to employment rank high among the major causes of poverty and inequality.

To determine the relative effectiveness of the existing transportation system for each subarea, in terms of accessibility to job opportunity, it is proposed to compute the percentage of total urban area employment by type of employment, which is within a suggested set time (say 45 minutes).

A desired "user standard" for the working trip might be to reach, for example, 75 percent of employment opportunities, that could possibly employ the user, since many of the employment opportunities might not be useful for the user to reach simply because he/she might not be qualified for the job. A time framework within which to reach employment opportunities is suggested to be 45 minutes.<sup>10</sup>

A desired "user standard" for the expenditure on travel by the poor might be a maximum of nine percent of the total income. The nine percent figure does agree with a study of



TABLE 5.2

RANGES OF TRAVEL  
AND PREFERRED DISTANCES

Ranges of Travel

<u>Modes of Travel</u>	<u>Speed (Km/Hr)</u>	<u>Time (min.)</u>	<u>Distance m</u>	<u>Maximum Distance(m)</u>
Walking	4	6	400	2000
		14	1000	
		28	2000	
Bicycling (flat ground)	16	15	2000	8000
		30	8000	
Motorized	30	30	15000	30000
		60	30000	

Preferred Distances

<u>Activities/Facilities</u>	<u>Frequency of Travel</u>	<u>Distance(m)</u>
Education		
Primary	Daily	400
Secondary	Daily	1000
Recreation (Social)		
Children - Local	Daily/Weekly	400
Adolescents- Local	Daily/Weekly	1000
Adults - Local	Daily/Weekly	400
- Regional	Occasionally	Over 30000
Shopping		
Local-Food, Goods/ Services	Daily/Weekly	400
Regional	Daily/Weekly	1000
Employment		
Low Income Groups	Daily Walking	2000
	Motorized	15000
Other Income Groups	Daily	30000

Source: Horace Caminos, & Reinhard Goethert, Urbanization Primer (MIT Press, Cambridge, 1978), p. 61.

consumer's expenditure constraints as a function of economic development, that was conducted by the World Bank, which showed that for low income countries if the total expenditure or "income" per capita is increased by one currency unit, nine percent of the increase is allocated to transport.<sup>11</sup> (A discussion of the expenditure on travel, provided in Chapter Three, illustrates the desired user standards of nine percent.)

Having set standards of accessibility and expenditure on travel, one can start the process to estimate the needed number of trips that would satisfy the basic needs. Different methods of estimating the needed trips will be explained. The transportation planner in a developing country would be free to use the methodology that is most appropriate to local needs. The first suggested method might be explained as follows:

A "gap analysis" approach is used to compare daily trip rates of individuals in families just above the poverty level with those below poverty level. The basis of the approach is that if a country is attacking the poverty problem in other sectors (food, health, education . . . to reach a level just above poverty level), to attack the problem of mobility is to provide trips equal to those just above the poverty levels.

The second suggested and preferred method includes the following steps:

1. Divide the population into as many classes of users as there are needs to be met. Different types of income/

occupational groups require different types of work-trip patterns, and this is very much related to different incomes earned by different occupations. In addition to work-trips, household trips include those for purchasing foodstuffs, receiving treatment in health centers, children going to school, and potential users of religious, cultural and sporting facilities.

2. Identify those trips that need some form of public transit, that is, those trips for which destinations are not within walking distance (e.g., trips to medical centers).

3. Calculate for each of these classes not only the number of trips actually made but also those which ideally should be made in order to satisfy basic needs.

Needed trips for each class of users could be decided either:

1. By the people surveyed and the planner (This process however could result in overestimating or underestimating the needed trips.).

2. Or, a preferred process would be through estimating those trips in number and length that would be taken on public transportation by an urban area population poor, at a given level of fare and a given level of service; those standards should meet the user standards in travel time and travel cost. Information on the existing elasticity of demand for transit and its sensitivity to changes in level of fare and level of service would be very useful in

estimating the number of needed trips by each class of users; as well as the cost involved in providing different levels of service. For example, a change in the level of fare and service to that required by the user standards might result in an increase in trip making of 25% as estimated from an elasticity of demand model. So, the estimated needed trips would be the existing ones adding to it 25%.

#### The Sample and the Household Travel Data

The sample size collected in a regular household interview O-D survey is based on criteria that are primarily concerned with the reliability of aggregated values such as the zonal trip ends or the interzonal trips. Thus in the case of regular surveys, samples must be taken from every zone and when the number of zones is substantial, even small numbers from each zone add up to a large overall sample. The sampling plan developed would be based on "pooling" of data from various zones to common categories, and thus, the sample size requirements are much less. Three prime objectives for the sampling plan are: first, to represent the main types of occupations by geographic location that reside within an urban area; second, to obtain a significant number of observations of all transport choice behavior (since the trip is treated in this study in the context of an associated activity pattern, or sequences of social and spatial interactions); and third, to minimize the number of samples needed, and consequently, the cost involved in sampling.

A small stratified sample of 30 households by each income/occupations group would be adequate to register the trip to work travel pattern as well as the nonwork trip patterns.<sup>12</sup> The goal in drawing a sample is to obtain enough information that adequate precision can be obtained in the estimates within the context of available resources, i.e. the cost of drawing a sample buys a certain level of precision. The precision obtained depends on several factors including the sampling design and the population size. Sophisticated survey sampling techniques would dictate different sampling rates within different sectors, depending on the sector population and the desired precision within the sector. A less rigorous approach involves drawing a sample of an acceptable size [say  $N = 30$ ] in each sector, and although this produces different rates of precision within different sectors, the degree of precision required and the simplicity of the approach may deem it appropriate. A cluster sample (neighborhood groupings of people are referred to as clusters) would provide estimates of the percentage of different income/occupational groups that reside within each cluster in a geographical area. The cluster sample size depends on the size of the cluster, the type of activities that exist there and the statistical reliability required.

The above discussion has been a simple and brief outline of the type of samples needed, however many statistical references have detailed instructions and guidelines on this method of sampling as well as other methods and should be

consulted by anyone making this type of study.<sup>13</sup>

The household travel data is obtained normally in a comprehensive origin-destination type of survey and contains information on individual trips (start and end times, origins and destinations, mode, purpose and waiting time), the travelers making these trips (age, sex, relation to household head, education and occupation), and the households from which these travelers originate (household size, income class and vehicle ownerships, cost of travel as a percentage of family income).

The collection of travel data would have as its primary purpose the provision of information designed to support the development and usage of:

1. nonspatial/spatial analysis, and
2. to benefit from existing, disaggregate behavioral demand models,<sup>14</sup> that would possibly be used in developing countries.

#### The Singapore Data

The Singapore data are discussed here as an example of the type of data that possibly could be collected in a home interview survey.

Household surveys were carried out before and after the implementation of the Area License Scheme in Singapore in 1975. The objective was to obtain detailed data on travel behavior and facts about the households and individuals

interviewed. There were two principle samples; a sample of members of nonvehicle-owning households, and a sample of members of vehicle-owning households.

A summary of the Singapore Data Scheme was tabulated by the World Bank staff and was analyzed by Zahavi and Roth.<sup>15</sup> This summary of Singapore's data was reproduced and is provided in Appendix H as an example of the type of data that could be collected in a home interview survey, as well as to show a possible method of data tabulation.

What is noticeably missing in Singapore's data is the cost of travel for different income groups, since this could be an important factor in the evaluation of the mobility policy directed toward the population group living below the poverty line. Sampling by income class in Singapore and Santiago required a large sample (Singapore's sample was 2,063 households and Santiago's sample was 22,000 households), and relatively little information was obtained on travel requirements by different occupational groups.

This research study, therefore, recommends that for future home interview surveys, adequate information should be obtained on the cost of travel by different income/occupational groups. A smaller sample of the population by different income/occupational groups would be useful in providing a more vivid profile of the travel needs of the different income/occupational groups, and the cost involved in sampling should be reduced considerably.

### The Need Approach to Nonspatial Analysis

The nonspatial dimensions of the need approach involve:

Step 1. Estimating the relationships of existing as well as needed trips per day (mode of travel, cost), the travelers (occupation, education), and the households from which these travelers originate (household size, income class and vehicle ownership).

Step 2. The relationship of existing and needed number of trips and the cost involved in those trips, as related to income, occupation and other factors, would be obtained from the household travel survey.

Step 3. Information obtained in Step 2 would be put in a useful format with the objective of using those formats in policy analysis. Examples of the types of format suggested are shown in Figure 5.2 and Figure 5.3.

Figure 5.2 illustrates the type of travel information that would be collected from a household by different activities. The occupation and education of other household members involved in any type of work activity would be registered, however, sampling would be conducted by head of the household type of occupation. In order to obtain a complete picture of the travel needs, each activity is divided into four types of trips. Information by each type of activity is summarized for the complete sample collected (as shown in Figure 5.3 of the work trip activity).



Occupation of household head ( )  
 Occupations of other household  
 members if any is involved in  
 a work activity \_\_\_\_\_

Education \_\_\_\_\_

Household size \_\_\_\_\_

Education \_\_\_\_\_

Household income \_\_\_\_\_

		Trips/ Day	Dist./ Trip	Mode of Travel	Travel Time	Travel Cost	Speed
HOUSEHOLD ACTIVITIES	Work	a					
		b					
		c					
		d					
	School	a					
		b					
		c					
		d					
	Shopping	a					
		b					
		c					
		d					
	Health	a					
		b					
		c					
		d					
	Social/Rec.	a					
		b					
		c					
		d					
	Others	a					
		b					
		c					
		d					

FIGURE 5.2  
 (Travel information by household activities)

Occupation of household head (                      )  
 Occupations of other household  
 members if any is involved in  
 a work activity \_\_\_\_\_

Education \_\_\_\_\_

Household size \_\_\_\_\_

Education \_\_\_\_\_

Household income \_\_\_\_\_

	Jitney	Bus	Motor- cycle	Bicycle	Walk	Total
Number of trips of the average household						
% of total trips of the average household						
Time of travel of the average household						
% of total time of the average household						
% of total distance of average household						
Distance of travel of the average household						
Cost of travel of the average household						
Cost as a percentage of family income						

FIGURE 5.3  
 (The Work Trip)

Step 4. Before serious, long-term, large scale efforts are undertaken, careful analysis of the need for public transportation service and the cost of providing service to meet the identified need must be made. The analysis should cover the different public transit modes available in a country.

Having estimated the number and length of needed trips by different activities, estimates of the total poor population travel needs in passenger-kilometers could be calculated; multiplying the calculated passenger-kilometers by cost per passenger-kilometers will produce the total estimated cost.

Government subsidies required to keep the overall fare structure could be estimated by subtracting the collected fare from the total cost of operating as well as the annual cost of capital assets of the transit system. Models that would estimate transit use expected from the supply of a given level of service would be illustrated in Chapter VI in the example of Amman, Jordan.

Step 5. Government planners involved in policy analysis would benefit from information organized in previous steps to determine the magnitude and the nature of the transport problems faced by the poor and in developing public policy and programs to meet the needs of the poor for transport. Examples of policy questions that might be addressed could include the following: (A number of policies are discussed in Chapter VI.)

1. What are the mobility needs that are not met?

And, what are the estimated number of trips that need some form of public transit?

2. What are the income/occupations group or groups that suffer the most in terms of travel time and travel cost?

3. What are the likely effects of a government training or educational program to create a more skilled population within a certain income/occupational group, on trip making and thus the need for additional transportation system supply to meet the additional trips generated by the execution of that program?

4. Transport is one sector of the economy that is competing with other sectors for scarce funds. In estimating the GNP's per sector of the economy, input-output analysis is often used. Input-output analysis<sup>23</sup> involves estimating coefficients that reflect the relationships between the volume of output for each sector of the economy and the volume of input required from all other sectors. Analysis performed by the need approach would be helpful in estimating reliable coefficients between the transportation sector and other sectors of the economy, and thus, answer the question of the needed GNP's per sector of the economy; more specifically, the budget allocated for the transportation sector. Once the budget allocated for the transportation sector is estimated, the next step would be to distribute the budget between the different elements of the transportation sector, such as the street system,

public transit, personal transit, trucking and other transportation elements. A nonspatial analysis relating mobility and cost of travel to income (as shown in example one and two in Chapter VI) could help the transportation planner to design policies that are appropriate for the general economic development of the country, and consequently, to estimate the budget needed for different transportation elements.

The above policy questions are examples of the type of policy questions that the nonspatial dimension of the need approach would attempt to answer. Examples for the use of this approach to analysis of policy issues are provided in Chapter VI.

#### The Need Approach to Spatial Analysis

The goals of spatial analysis are:

1. To identify zones of existing low mobility in an urban area.
2. Define the markets to be served in those zones through an inventory of income distribution of residents (and their occupations), especially families below poverty level.
3. Design transit service to serve families above poverty level by market demand and evaluate market response to alternative changes in service.
4. Design transit service to serve families below poverty level by their assessed needs for travel as discussed in the section of goals and objectives. In order to do that, the following steps should be accomplished:

- a) estimate the household population living below poverty level,
- b) estimate the daily trip rates needed (total and by purpose),
- c) multiply rate by the number of poor families living in that zone,
- d) distribute the total daily trips to likely destinations according to function of destination
- e) select the service to be provided and communicate the service changes to the poor.

Inventories of population characteristics would determine the nature of existing conditions so that the objectives of transit service can be formulated on a rational basis. The inventories should result in a profile of an urban area "existing travel characteristics" as related to income, employment and car ownership. Data obtained from a household interview survey would be used to build a number of simplified models for forecasting household characteristics. The reason for building those models is to locate potential transit tripmakers by the characteristics that are known to influence transit use. The proposed models are disaggregate behavioral cross classification type models. The example of spatial analysis from Amman, Jordan, in Chapter VI, illustrates all the steps to be taken by the planner after the identification of zones of existing low mobility.

The following are the steps that should be taken to

identify areas of low mobility (as it has been illustrated on an example from Santiago, Chile, in Chapter VI):

The first step to identify areas of low mobility in a spatial analysis is the choice of a locational identification system. Two systems that could be used for that purpose are:

1. Predetermined Irregular Polygon Systems: These polygons are normally clusters of statistical and/or administrative entities.

2. Uniform Grid Systems: These systems originally were developed to facilitate computerized spatial analysis and mapping and because they are generally easier to handle. A matrix of cells is produced by laying a uniform grid structure over the planning area. Each cell has a uniform shape (usually square), and the cells are normally uniform in a geographic unit. The size of the cell depends on the area being planned. For regional-scale planning cell sizes of one kilometer to one-fourth kilometer square are the most common. For a planning jurisdiction of  $258.99 \text{ km}^2$  or smaller, cell size of one-fourth to one-third of a kilometer is preferred.<sup>17</sup> For example, the urban models developed at the Harvard School of Design<sup>18</sup> used a one kilometer square grid as a basic spatial unit for data collection and analysis. The cell size depends generally on the size of the geographical area, the type of activities that exist there, and the statistical reliability required.

At present both systems discussed above could be computerized, however the analysis could also be conducted on

a zonal basis without the use of computers.

The output of analysis performed using any of the two systems are presented in the form of maps. The mapping output capability could allow the production of maps in either quantitative or gray-tone format showing the spatial distribution of originally measured data or derived data.

In order to identify areas of existing low mobility, factors that are indicative of low mobility could be synthesized by one of several map overlays methods, using one of the two systems of locational identification discussed above.

Map overlays methods were developed originally to determine land use suitability for specific uses. (For a comparative evaluation of these methods see Hopkins 1977.)<sup>19</sup>

Successive Overlays<sup>20</sup> is an adaptation of one of the methods that are used in land use suitability analysis to identify areas with transit potential. The following is a brief description of the Successive Overlays method.

The Successive Overlays process is a practical, accurate and economic method of defining areas with transit potential. The process is not intended to define the size of the market or its desires, but rather where the market exists. The objective is to define areas that have varying propensities for transit rather than to quantify transit ridership. A decision could then be made on which areas should be surveyed.

The process begins by first determining socio-economic factors indicative of potential transit ridership, e.g., passenger cars per dwelling unit, average income, females age 16 to 24 years, persons age 62 or over, and dwelling units per acre. These indices are then stratified to reflect high, medium and low propensities to use transit, and shadings



of gray are developed for each level. Each index is graphically recorded on an individual transparency that can overlay a map of the study area. The five transparencies are then successively superimposed, resulting in various shadings of gray on the composite overlay. The darkest areas indicate a high transit potential

Examination and a visual analysis of the composite overlay is undertaken by both planning professionals and city officials to define areas/zones to be surveyed in the field. With this market defined, a postal card home interview is then conducted.<sup>21</sup>

The problem with the "successive overlays" method described above is in using shades and ordinal numbers to represent relative ratings. (Ordinal numbers mean that a 2 indicates a suitability better than 1 but not necessarily twice as good.) The addition of ordinal numbers is an invalid mathematical operation; one cannot add, subtract, multiply or divide numbers which indicate only that a higher value is better than a lower value, but do not indicate how much better. The hand operation of overlaying shaded maps is the graphic equivalent to arithmetic addition of ordinal numbers. Because of this limitation the "successive overlays" method is not a preferred technique, however, it is useful when sufficient resources are not available, a situation that exists in many urban areas of the developing countries.

#### The Proposed Need Approach to Identify Areas of Low Mobility in a Spatial Analysis

The above discussion is an introduction to another technique of spatial analysis that would be suggested in this research study with the objective of identification of areas of low mobility.

The suggested spatial analysis will adapt, from land use suitability analysis, a more efficient overlays technique (a combination of linear and nonlinear techniques). In this approach, an attempt is made to attribute the assumptions of interval data to the original factor rating so that the operations of addition and multiplication can be applied vividly. Data and maps of Santiago, Chile, are manipulated in Chapter VI to illustrate, step by step, the proposed process.

The "need approach to spatial analysis" could be summarized in the following steps:

Step 1. A map is made for each factor that is thought to be indicative of low mobility in an urban area. The map would show the way categories of that factor are distributed. The following factors are thought to be indicative of low mobility.

- a) Vehicles per household
- b) Travel time per traveler per day
- c) Travel distance per traveler per day
- d) Trip rates per traveler per day
- e) Distance on public transit per traveler per day
- f) Mean daily travel speed
- g) Expenditure on travel as a percentage of income per traveler per day
- h) Walking trip percnetage per traveler per day

Step 2. Each factor mentioned in Step 1 is rated on its own separate and different interval scale by category ratings.

Category ratings are estimates of relative influence among categories of a single factor, as shown in Appendix I of the factors rated on maps of Santiago.

A weight or multiplier is assigned to each factor. Weighting multipliers are estimates of relative influence among separate factors.

Since each factor mentioned in Step 1 would be rated on its own separate and interval scale, a range that is common to all factors has to be developed. This range might be 0 to 1, 0 to 10, or 0 to 100. A transformation technique suggested could be presented in the following equation.

$$r'_{ij} = \frac{r_{ij}}{r_i^{\max}}$$

Where:  $r'_{ij}$  is the transformed rating score for category  $j$ ,  
 $r_{ij}$  is the originally assigned rating for category  $j$   
 of factor  $i$ , and  
 $r_i^{\max}$  is the maximum rating given any category of  
 factor  $i$ .

Step 3. The mapping of implications of the categories and factors discussed above is accomplished for each factor separately. That is to say, for each category of a factor on the map there is substituted a score obtained by multiplying the transformed rating by the factor weight.

This step might include a nonlinear relationship, for example:

Distance per traveler per day = Time spent on travel x  
Mean speed

So the distance might be substituted for the other two factors.

Step 4. All factors discussed above would be added together to form one score representative of the degree of mobility that exists in different areas. The scores reached would be associated with a cluster or a cell on a grid of an urban area. Thus the analysis output could be presented in a computerized form as well. A number of computer programs do exist for graphic display of scores associated with each cell. Among these computer programs is GRID, a computer program created at the Laboratory for Computer Graphics at Harvard University. As discussed earlier, data and maps of Santiago, Chile, are manipulated in Chapter VI to illustrate, step-by-step, the proposed process.

### Footnotes

<sup>1</sup>NCHRP Report No. 186, ("Travel Estimation Procedures for Quick Response to Urban Policy Issues") provides a survey of a number of travel estimation procedures for quick response to urban policy issues. Among the models surveyed in the report that could be useful for analysis of the transportation needs of the poor in developing countries are the following: Successive Overlays--A Small City Transit Survey Process;<sup>2</sup> Transit Travel Analysis for Smaller Urbanized Areas;<sup>3</sup> Latent Travel Demand for the Elderly, Youth and Low Income Population;<sup>4</sup> Forecasting Demand for Improved-Quality Transit Service with Small Sample Surveys;<sup>5</sup> Disaggregate Travel Demand Models;<sup>6</sup> and Estimating the Effects of Urban Travel Policies.<sup>7</sup>

<sup>2</sup>Ibid., p. 49.

<sup>3</sup>Ibid., p. 52.

<sup>4</sup>Ibid., p. 54.

<sup>5</sup>Ibid., p. 55.

<sup>6</sup>Ibid., p. 58.

<sup>7</sup>Ibid., p. 58.

<sup>8</sup>F. Chapin, Jr. and E. J. Kaiser, 1979, p. 93.

<sup>9</sup>S. D. Sargon and C. E. Maguire, p. 75.

<sup>10</sup>Zahavi's research indicates the existence of travel budgets over time. Studies on travel budgets from cities in developing countries indicate that the 45 minutes is a reasonable time to reach employment centers within the existing travel budgets. See Zahavi and Talvitie, 1980.

<sup>11</sup>C. Lluch, A. A. Powell and R. A. Williams, 1977, p. xxv.

<sup>12</sup>Note: Often a sample size of 30 is used as an acceptable cutoff for the difference between "small" and "large" samples. For instance, for  $N > 30$  the t distribution can be approximated by the more tractable normal distribution, and many other asymptotic statistical results are considered appropriate.

<sup>13</sup>Two useful references are: L. Lapin, Statistics, Meaning and Method, 1975, Harcourt Brace Jovanovich, Inc.; and G. H. Weinberg and J. A. Schumaker, Statistics: An Intuitive Approach, Brooks/Cole Publishing Company, 1974.

<sup>14</sup>For a review of the "Disaggregate Travel Demand Models" see the work by Charles River Associates, Inc., NCHRP Project, pp. 8-13, Phase 1 Report (Unpublished).

<sup>15</sup>Y. Zahavi and G. Roth, 1980.

<sup>16</sup>F. Chapin, Jr. and E. J. Kaiser, 1979, pp. 131-132.

<sup>17</sup>F. Chapin, Jr. and E. J. Kaiser, 1979, p. 303.

<sup>18</sup>C. Steinitz and P. Rogers, A Systems Analysis Model of Urbanization and Change, MIT Report No. 20.

<sup>19</sup>Lewis D. Hopkins, 1977, pp. 386-400.

<sup>20</sup>J. C. Corradino, B. D. Coomer, and W. S. Upshaw, 1974.

<sup>21</sup>NCHRP Report No. 186, "Travel Estimation Procedures for Quick Response to Urban Policy Issues," p. 49.

<sup>22</sup>F. Chapin, Jr. and E. J. Kaiser, 1979, pp. 74-78.

## CHAPTER VI

### APPLICATIONS OF THE ANALYSIS FRAMEWORK

#### Example One

The following is an example from Amman, Jordan, the purpose of which is to demonstrate the application of the need approach to transportation planning in a developing country as described in Chapter V. Figure 6.1 reproduced from Chapter V illustrates the nature of analysis performed at each step. Three phases are defined for the Amman example: (The stages at each phase are related to Figure 6.1.)

Phase I: The Existing Conditions of the Poor in Jordan.

- 1) The government of Jordan's political and practical commitment to provide the basic needs for the poor.
- 2) The income distribution and poverty level in Jordan (Step 1).
- 3) Transportation conditions of the poor in Amman, Jordan (Step 1).

Phase II: Analysis of Need

- 1) The urban poor's travel needs in Amman Region (Step 1).

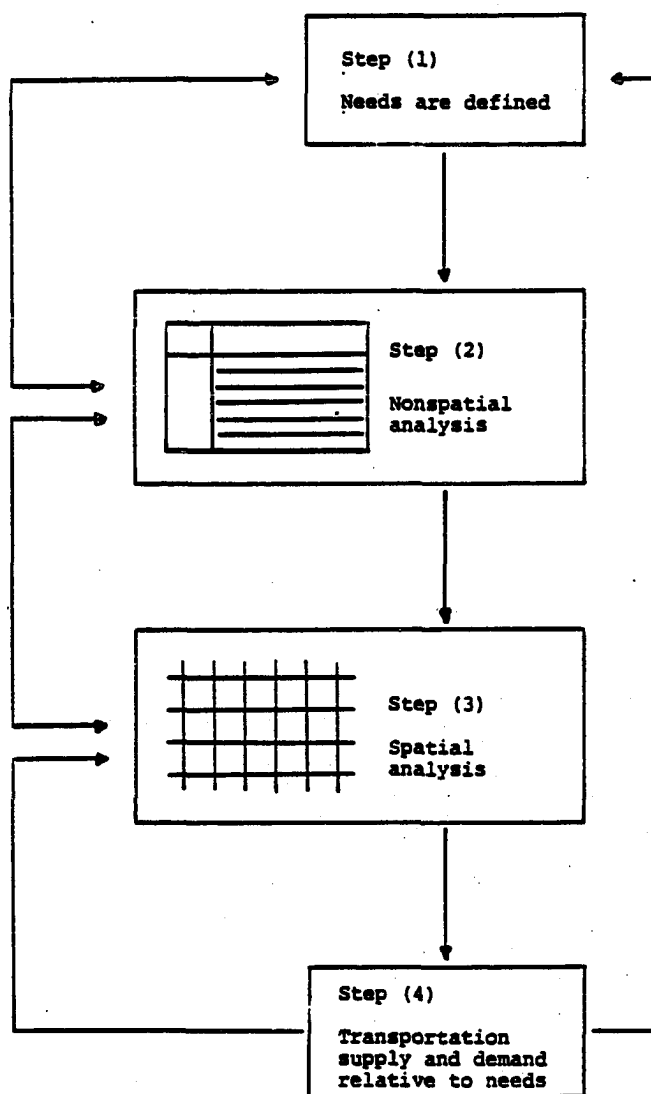


Figure 6.1. A framework for transportation needs analysis



- 2) Strategies for meeting needs (Step 2).
- 3) Availability of finance for transport investment (Step 2).
- 4) Spatial analysis (Step 3 and Step 4).

Phase III: Uncovered deficiencies in conventional travel demand forecasting

### Introduction

Since the 1967 war, the West Bank of Jordan has been under the Israeli occupation. The population of the East Bank area of Jordan (see Figure 6.2) was estimated at 2.2 million in 1979, and the overall growth rate was estimated at about 4.3 percent per annum.<sup>1</sup> Forecasts for the future population in the East Bank and in the Amman Region are as follows:

<u>Year</u>	<u>East Bank</u>	<u>Amman Urban Region</u>
1985	3.0m	1.9m
1990	3.6m	2.3m
2000	5.3m	3.4m

The Amman Region has experienced a very rapid urbanization and population growth in the last three decades as illustrated in Table 6.1. This has resulted in a significant increase in the number and distance of trips taken on the public transit system.

The public transit system of the Amman Region presently (1981) consists of four main elements:

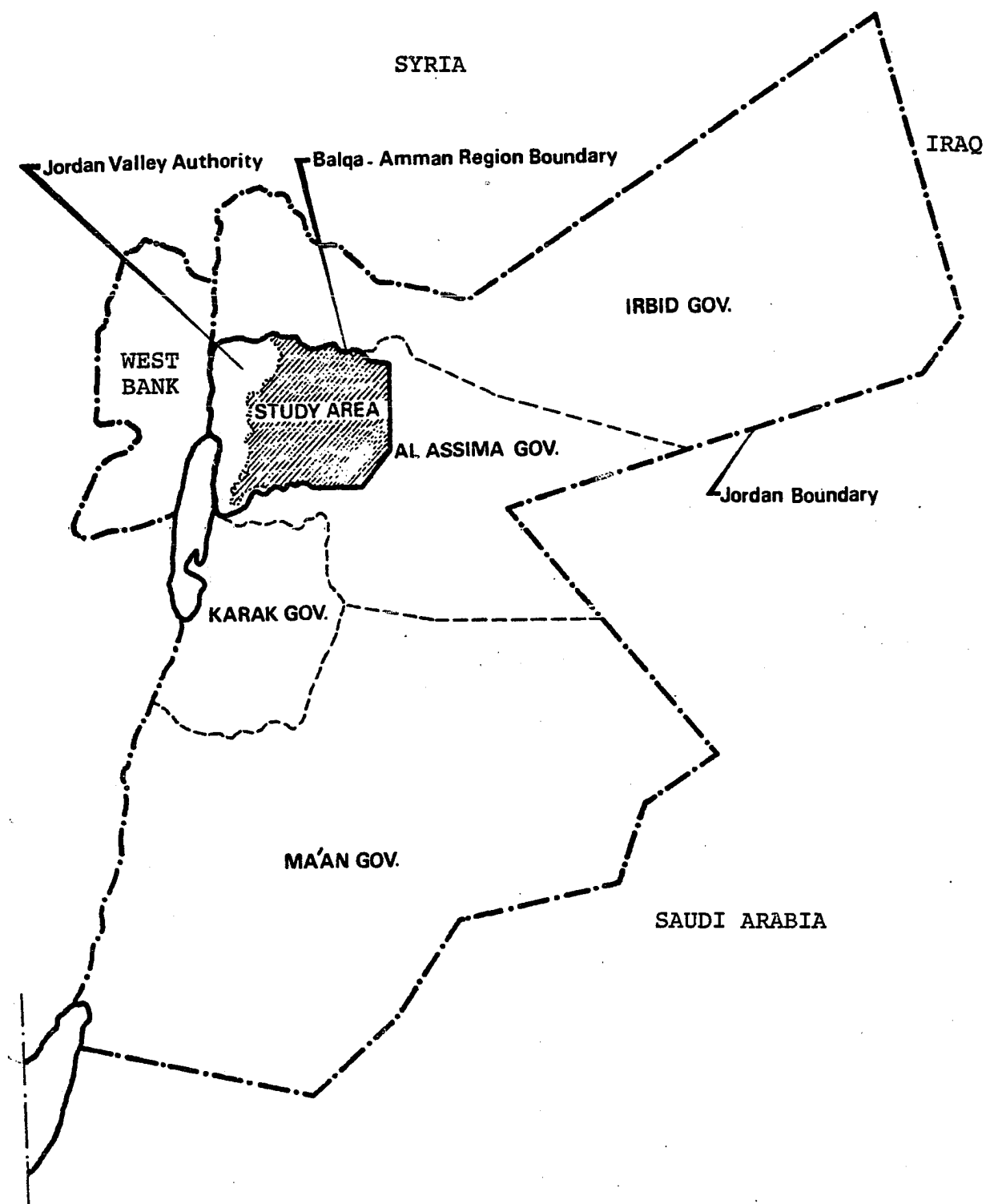


Fig. 6.2 The Study Area of Amman Region Transportation Study, Jordan.

Source: Based on Fig. 3.1, Amman Region Transportation Study Phase 1, Interim Report, Feb. 1980.

TABLE 6.1

## HISTORICAL DEVELOPMENT OF AMMAN

PERIOD	POPULATION	BUILT AREA		DENSITY	TOTAL LENGTH
YEAR	PERSONS	Km <sup>2</sup>	Dunums	Persons/ Dunum	OF MAIN ROAD NETWORK Km
1946	56,000	2.5	2,500	22.4	26.5
1953	115,000	4.6	4,600	25.0	26.5
1962	255,000	10.0	10,000	25.5	45.0
1972	550,000	21.0	21,000	26.2	57.0
1979	823,000	43.0	43,000	19.1	64.0

Source: Planned Development in the Balqa-Amman Region,  
Interim Report, Amman Urban Region Planning Group,  
Amman, 1979.

- Public sector buses (owned and operated by the Public Transportation Corporation (PTC)).
- Private sector buses (owned and operated by companies and individuals)
- "Call" taxis, which are hired to take passengers to their stated destination from the point of hire, at a distance-related fare
- "Servis" taxis (jitney), which ply fixed routes and are shared by casual passengers, at a fixed fare.<sup>3</sup>

Phase I: The Existing Conditions of  
the Poor in Jordan

- 1) The political and practical commitment of the government of Jordan is to provide the basic needs of the poor.

Jordan's political commitment to improve access to basic needs and to a more equitable distribution of income is clear and has been widely expressed:

It is the Government's responsibility to ensure for every citizen, justice and individual integrity, and to grant him freedom of speech and constructive criticism, to guarantee him a just pay and future security, and to provide him the health, education, leadership and all other public services required for modern life.<sup>4</sup>

It is the individual's right to feel "that it is his right to have the country's wealth distributed in a most comprehensive and equitable manner."<sup>5</sup>

The "long-term objectives of economic and social development in the Kingdom" include the "achievement of a better and more equitable distribution of

national income," the "achievement of the highest possible...development of manpower capabilities," and the "distribution of economic activities, public services and ensuing gains on a more equitable basis among the various regions of the Kingdom."<sup>6</sup>

Though the government of Jordan is politically committed to the objectives above, there are at present no institutions directing their efforts specifically and as a matter of priority to the poor. This fact has been expressed in a recent study on housing for low income groups in Jordan.<sup>7</sup>

In order to bring the Jordanian government commitment to basic needs for the poor into reality, specific policies have to be adopted by different government agencies with the objective of improving access to basic needs; such policies would require the adoption of planning frameworks that are useful for that purpose; furthermore, suggested plans must be economically feasible as well, in the context of national financial circumstances mentioned above. In the area of transport, the proposed need approach would provide such a planning framework.

## 2) The income distribution and poverty level in Jordan.

A family's income is a critical factor in the health and well being of its members. Level of income--distance above or below poverty line--is a significant influence on the family standard of living. Information on the distribution of income helps identify the beneficiaries of government programs. It also helps in determining pricing and subsidy

levels for selected services.

The Department of Statistics in Amman, Jordan, has no information about the distribution of income in Jordan<sup>8</sup> (1981).

Halcrow-Fox,<sup>9</sup> as part of their World Bank Urban Project in Amman, estimated the 1979 income distributions for three populations: national urban households, households in the Amman slums, and households in the Zarqa slums. Table 6.2 illustrates graphically and summarizes the result. Among other findings, it was revealed that:

- the richest 20% of households earn 45% of the total income,
- the average income of the richest 10% is 13 times that of the poorest 10%.

The Halcrow-Fox Study estimated the poverty line at the 40th percentile of the national urban distribution, which would be the family earning below JD 100 per month (JD 1200 per annum) as shown in Figure 6.3. Table 6.3 shows the distribution of income within the poor.

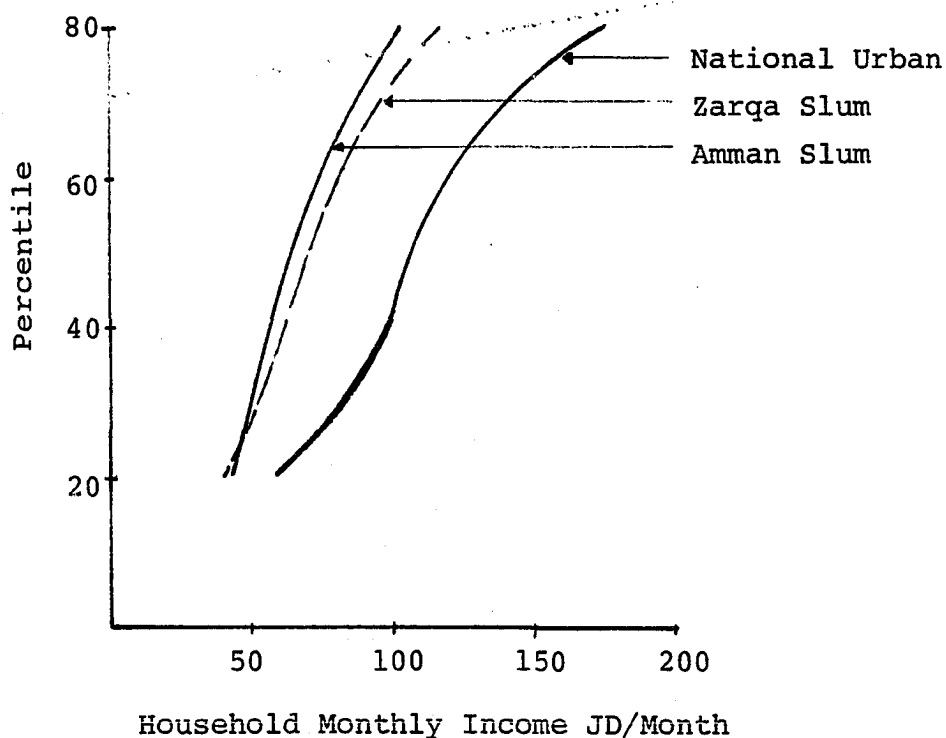
The Halcrow-Fox social survey of squatter areas indicated that population characteristics of the poor (those with incomes less than JD 100 per month) show certain basic consistencies. Average household sizes, at 8.9 persons, were generally high, and in all areas more than a fifth of the households were of ten persons or over. In terms of education, a substantial proportion of household heads were illiterate and less than a fifth had qualifications higher than preparatory

TABLE 6.2  
HOUSEHOLD MONTHLY INCOME DISTRIBUTION

Percentile	National Urban	Amman Slums	Zarqa Slums
20	JD60	JD44*	JD42
40	JD96	JD56	JD62
60	JD116	JD74	JD78
80	JD175	JD112	JD116

Source: Halcrow-Fox, Jordan Urban Project: Interim Report May 1979, p. 3.

\*In 1979 JD was equivalent to \$3.30.



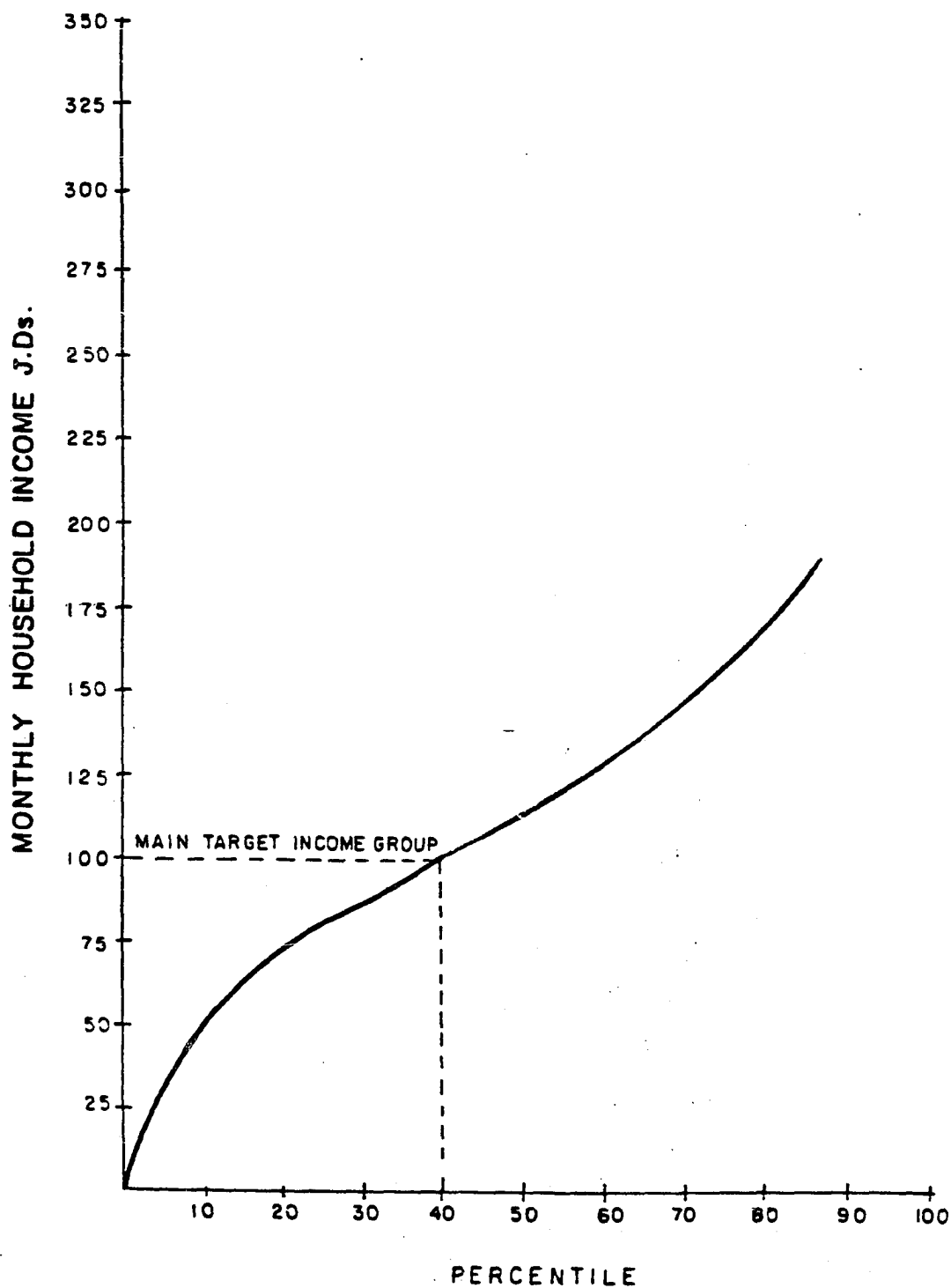


Fig. 6.3 AMMAN URBAN HOUSEHOLD INCOME DISTRIBUTION

Source: Halcrow-Fox, Jordan Urban Project: Interim Report, May 1979.



TABLE 6.3  
HOUSEHOLD MONTHLY INCOME DISTRIBUTION  
IN AMMAN AND ZARQA SLUMS

Monthly Household Income Group (JD Per Month)	Monthly Household Income Mid-Point (JD Per Month)	Percentage of Households	
		Amman	Zarqa
35-45	40	19%	10%
45-55	50	27	12.5
55-65	60	19	15
65-75	70	16	17.5
75-85	80	11	20
85-95	90	9	22.5

Source: Halcrow-Fox, Jordan Urban Project: Interim Report,  
May 1979, p. 3.

level. In terms of occupations, the household heads were mostly unskilled or had no work, generally little information is available on the poor's occupations. The majority of household incomes lay in the range of JD 40 to JD 99 per month.

In the absence of other reliable information about income and poverty level, the Halcrow-Fox figures will be used in this study to identify households living below poverty level; which would be households with incomes below JD 100 per month.

3) Transportation conditions of the poor in Amman, Jordan, and their basic needs for travel.

The Sample and Household Travel Data

A household interview survey was carried out in Amman region in the period between the 25th of January 1980 and the 26th of February 1980. The household survey was designed to provide information about the movements of people by all modes of transport. In addition, socio-economic data were collected. A sample of 1770 interviews were collected covering 118 zones in the urban region of Amman,<sup>10</sup> (see figures 6.4 and 6.5). The households were selected on a random basis within each sector of the interview area, but a higher sampling rate was used in the higher income/car ownership areas; the bias towards the higher income/car ownership areas was given the explanation that it would facilitate car ownership, trip end and modal split analysis.<sup>12</sup> The household survey forms used in the Amman Transportation Study are available in Appendix I.

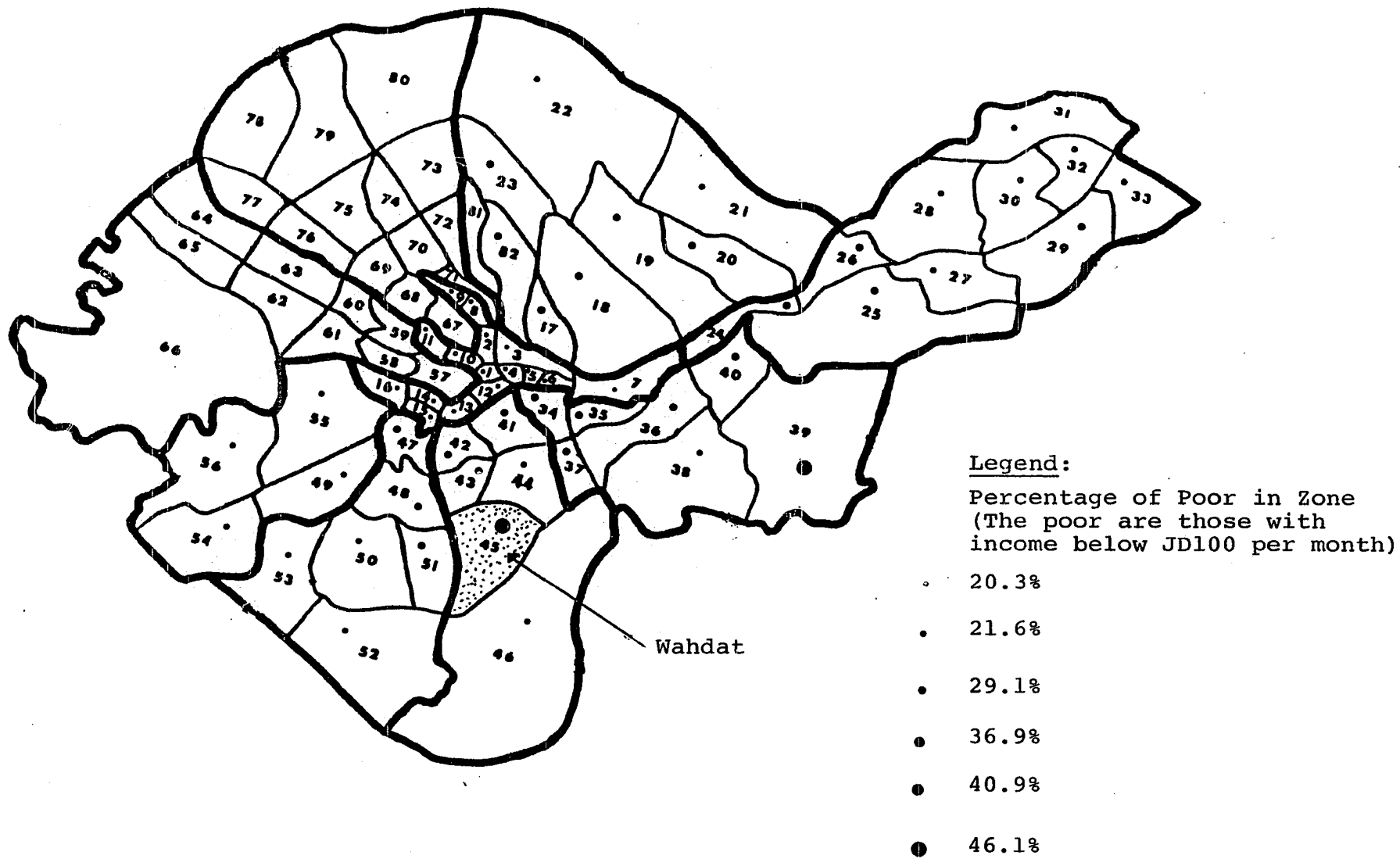


Fig. 6.4 Percentage of Poor in Zones of Amman City, 1980.

Source: Based on Figure 3.2 of Phase 1 Interim Report in Amman Region Transportation Study, February 1980.

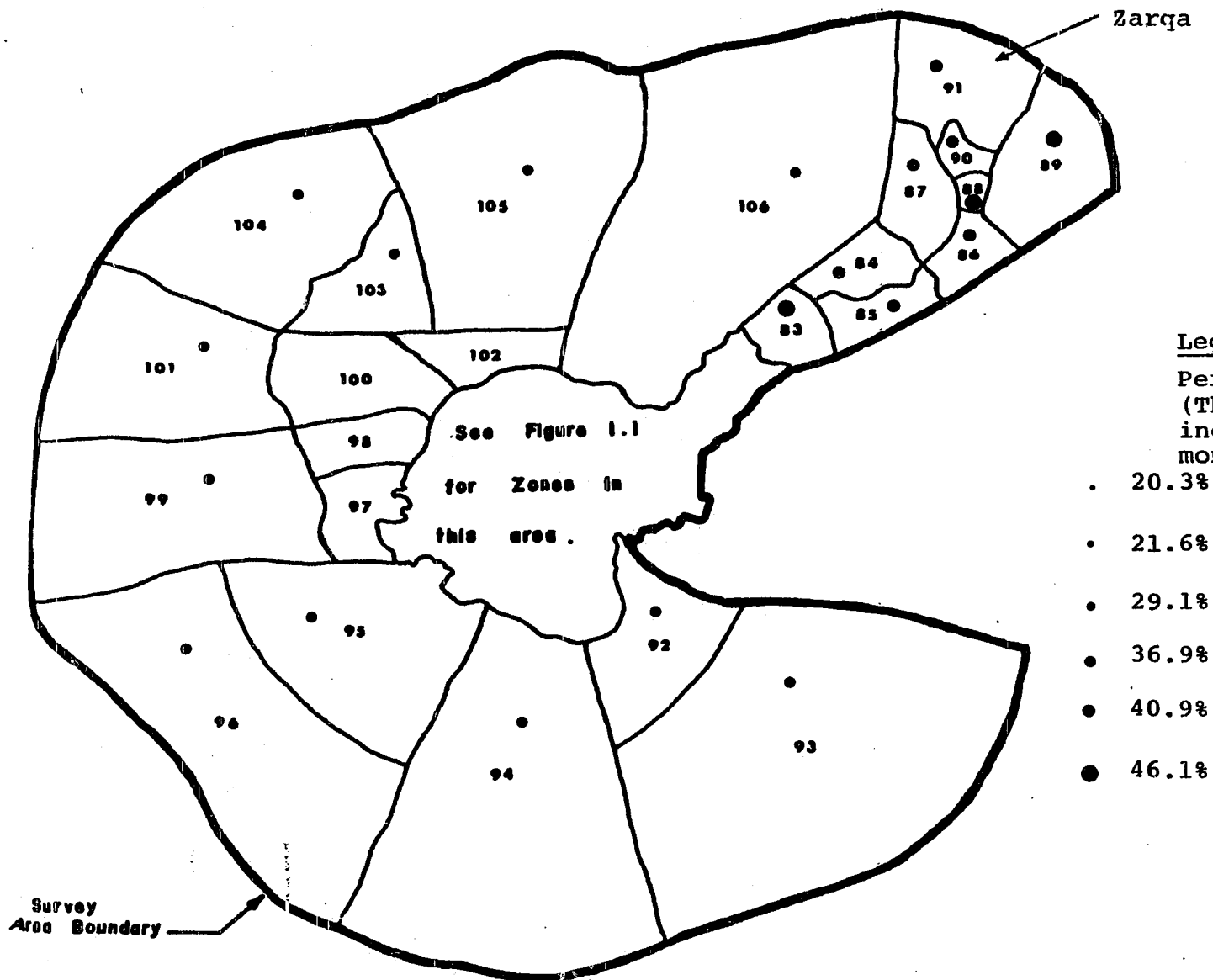


Fig. 6.5 Percentage of Poor in Zones of Amman Environs.

Source: Based on Figure 3.3 of Phase 1 Interim Report in Amman Region Transportation Study, February 1980.

### Travel Habits of the Poor in Amman Region

The tables and figures produced in this research study for the poor in Amman, based on the household interview survey, are useful mainly for two purposes. a) Identification of the problems of the poor and their categorization by extent, and b) to identify the goals and objectives as well as policies and programs necessary to deal with the transportation problems of the poor in Amman. Two categories for the poor were identified as JD 0-50 per month and JD 50-100 per month. The analysis of travel habits of the poor was done with 269 samples. Comparisons were made of travel habits in each income category to gain some understanding of their travel needs and the effects of income level. Travel habits were also compared to the regional average to further explore basic needs.

The travel habits of the poor are as follows:

#### 1. Auto Ownership:

The two lowest income categories own approximately 26% of the private cars in Amman Region (Figure 6.6), while the same group according to Figure 6.3 comprise 40% of the total population.

Auto ownership in Amman is related much to other household characteristics such as income and household size.

To predict the distribution of household characteristics within a zone in Amman, two graphs have been developed from the household data. a) The household size graph (Figure J1 in Appendix J. b) The car ownership graph (Figures J2, J3, and J4).

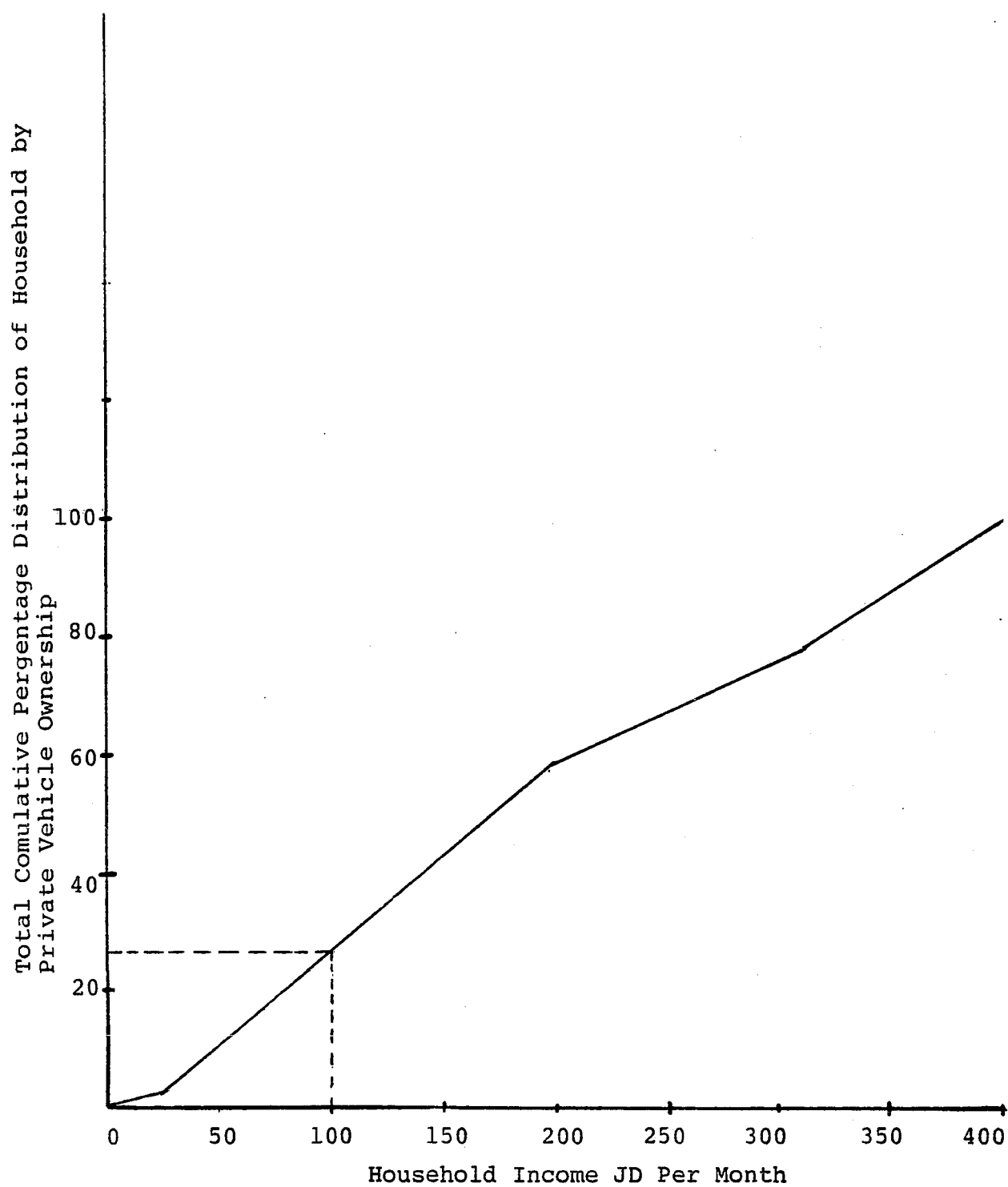


Fig. 6.6 Cumulative Percentage Distribution of Household by Private Vehicle Ownership

The two graphs indicate the following characteristics for the poor population:

Household Size

<u>Household Size</u>	<u>Household Income</u>	
	<u>JD 0-50/month</u>	<u>JD 50-100/month</u>
1-4 persons/household	28.5%	18%
5-8 persons/household	49.0%	42%
9+ persons/household	22.5%	40%
	<u>100%</u>	<u>100%</u>

Car Ownership for 1-4 Persons/Household

<u>Car Ownership</u>	<u>Household Income</u>	
	<u>JD -50/Month</u>	<u>JD 50-100/Month</u>
0 car	92.5%	80%
1 car	3.75%	14%
2 car	3.75%	6%
	<u>100%</u>	<u>100%</u>

Car Ownership for 5-8 Persons/Household

0 car	79.5%	74.0%
1 car	5.5%	23.0%
2 car	15.0%	3.0%
	<u>100%</u>	<u>100%</u>

Car Ownership for 9+ Persons/Household

0 car	79%	68.5%
1 car	12.5%	19.5%
2 car	8.5%	12.0%
	<u>100%</u>	<u>100%</u>

The following general observations are based on the data in figures J1, J2, J3, and J4:

1. Households in the higher income category for the poor

(JD50-100) have higher percentages of very large families (9+ persons/household) than the lower income group (JD0-50), or in other words, as income increases so may the tendency to have larger size families or vice versa.

2. Generally, car ownership increases with the increase in household size or income.

3. An increase in income from JD 0-50 per month to JD 50-100 per month will result in an increase in car ownership for all household sizes of 5.5% to 12.5%; the highest increase is for the families 1-4 persons per household and the lowest are for families 5-8 persons per household.

## 2. Trip Frequency Per Day by Purpose:

According to figures 6.7 and 6.8:

<u>Income Per Month</u>	<u>Total Trips/Day</u>	<u>Work Trips/Day</u>
JD 0-50	2.73	0.66
JD 50-100	3.38	1.45
Average <sup>12</sup> (of all households in Amman Region)	5.66	2.17

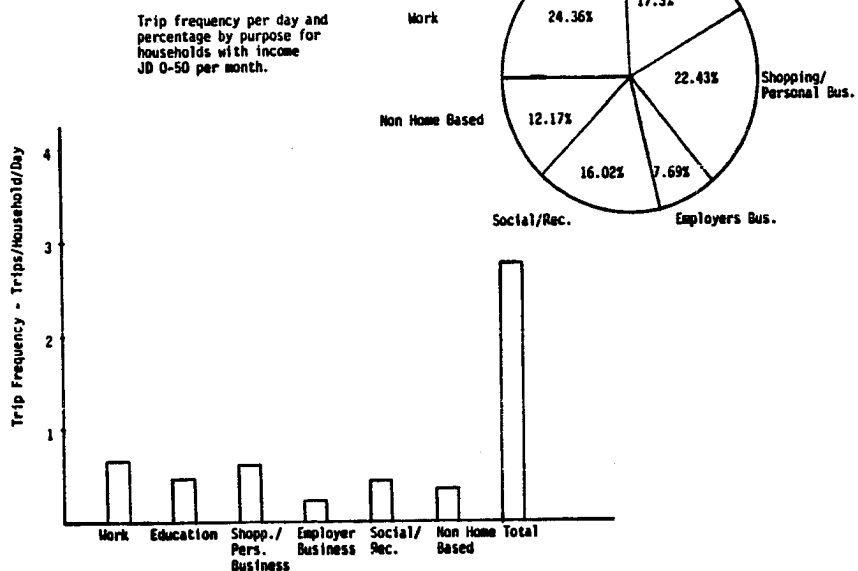
Figures 6.7 and 6.8 indicate that:

1. The poor with income of JD 0-50 per month are traveling 50% less than that of the average of all households in Amman Region; while the poor with income JD 50-100 per month are traveling approximately 39% less than that of the average of all households in Amman Region.

2. It should be noted that work trips account for much of the difference in total trip making discussed in the previous step. This is to be expected, for the poor are less likely to have jobs or jobs away from their residential



### Income Group JD 0-50 Per Month



### Income Group JD 50-100 Per Month

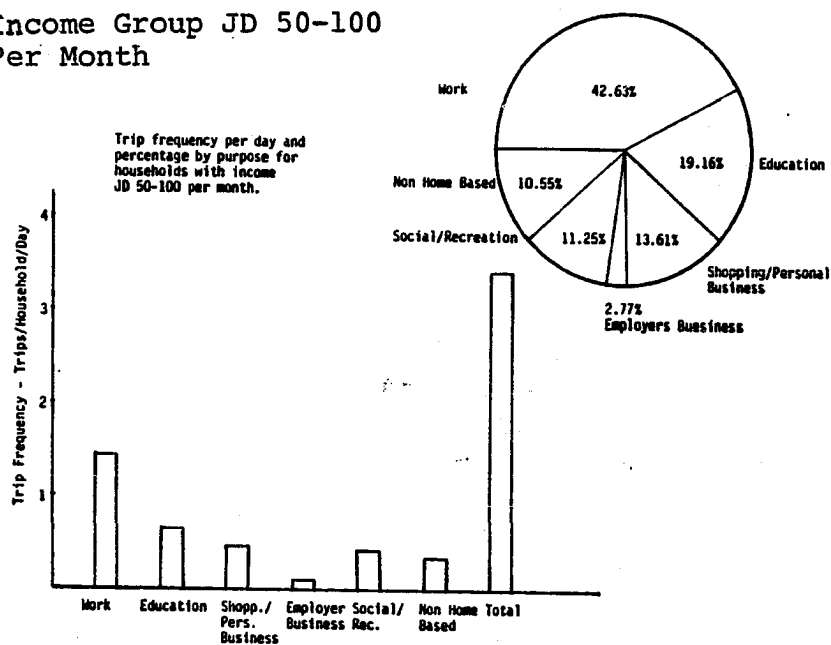
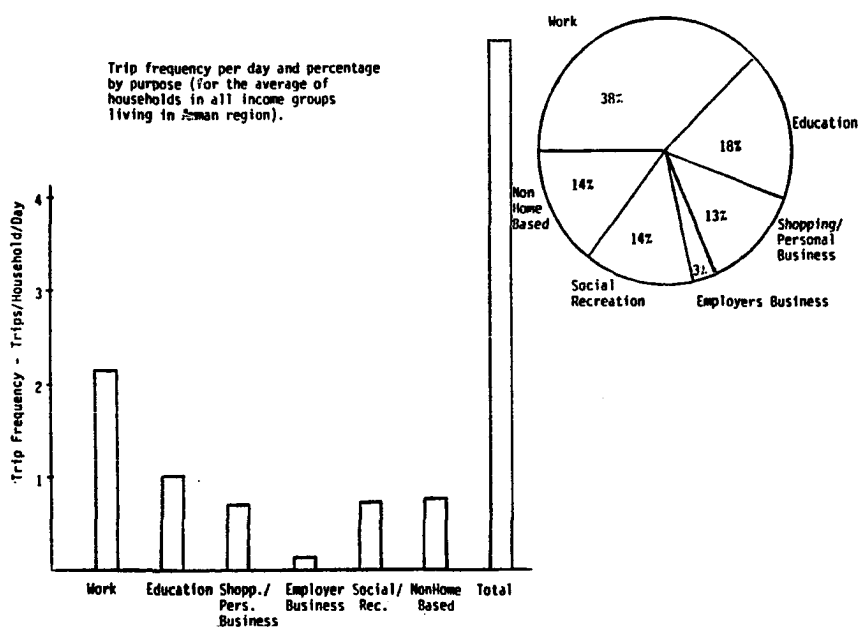


Fig. 6.7 Trip Frequency Per Day by Purpose

Source: Analysis is based on the Household Travel Survey Data, Amman Region Transportation Study, February 1980.

## Average Household



## Average Household

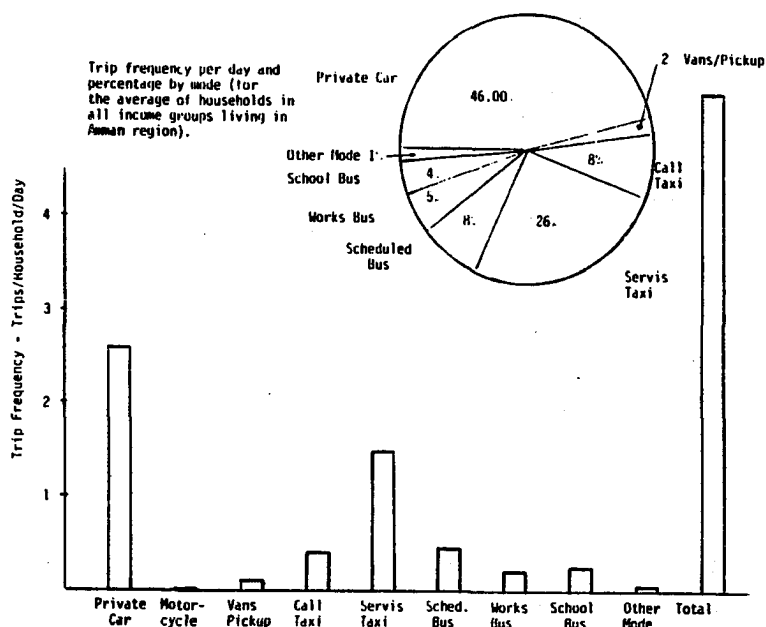


Fig. 6.8 Trip Frequency Per Day by Purpose and Mode

Source: Analysis is based on the Household Travel Survey Data, Amman Region Transportation Study, February 1980.

neighborhood, and consequently the necessity to make the trip to work.

### 3. Trip Frequency Per Day by Mode:

According to figures 6.8 and 6.9:

	<u>Servis Taxi</u>		<u>Call Taxi</u>	<u>Sched. Bus</u>	<u>Private Car</u>
	<u>Trips/ Day</u>	<u>Percent- age</u>			
JD 0-50	1.04	37.82%	14.74%	22.43%	22.43%
JD 50-100	1.43	42.08%	9.58%	15.69%	20.00%
Average	1.47	26.00%	8.00%	8.00%	46.00%

Figures 6.8 and 6.9 indicate that:

1. Servis Taxi is the most widely used mode among the poor in both magnitude and percentage.

2. A considerable percentage of trips by the poor are taken by call taxi, the most expensive means of "moving around" in Amman; which suggests that other means of public transit are not available, or are not available at certain hours of the day.

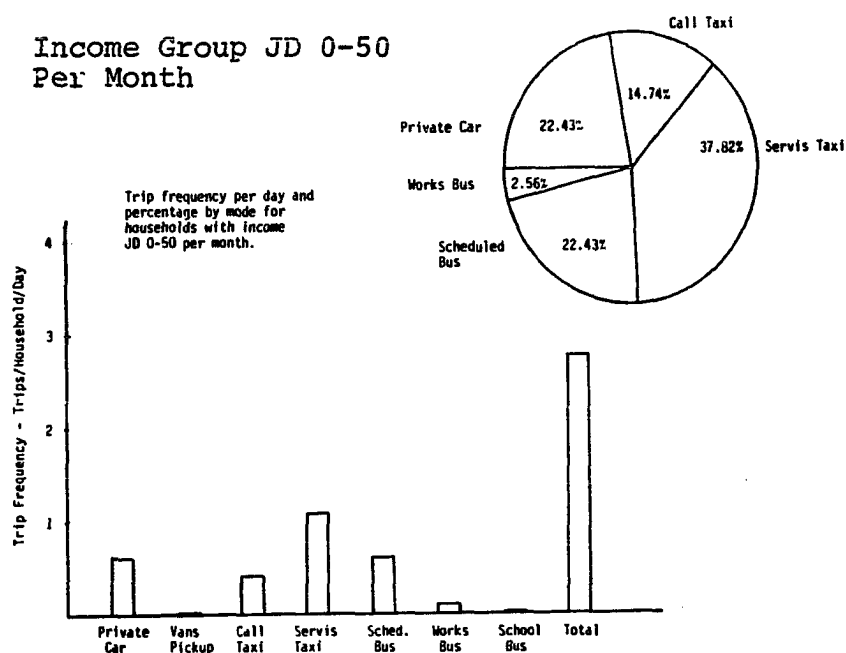
3. The percentage of trips taken by servis taxi are much more than those taken by scheduled bus which might suggest that:

1. Either bus service is unreliable or non-existent.

2. Or, the poor prefer servis taxis over buses.

4. The regional average use of private cars is much higher than that of the poor.

### Income Group JD 0-50 Per Month



### Income Group JD 50-100 Per Month

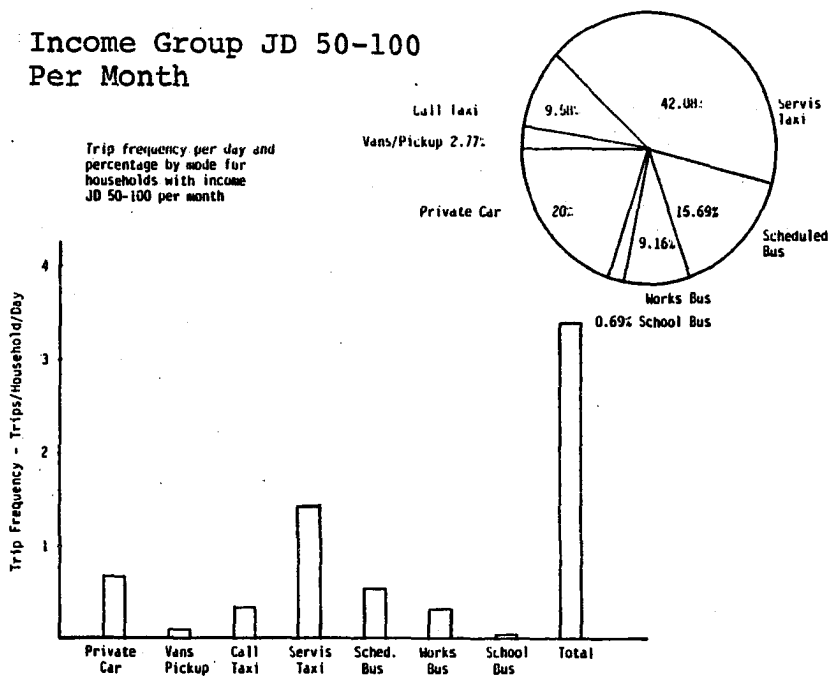


Fig. 6.9 Trip Frequency Per Day by Mode

Source: Analysis is based on the Household Travel Survey Data, Amman Region Transportation Study, February 1980.

What trips are made by Servis Taxi?

	<u>Work</u>	<u>Educa- tion</u>	<u>Shopping Pers. Business</u>	<u>Employers Business</u>	<u>Social/ Rec.</u>	<u>Non- Home Based</u>
JD0-50	37.28%	11.86%	18.64%	8.47%	16.95%	6.77%
JD50-100	49.17%	17.16%	14.52%	2.31%	11.88%	4.95%
Average	43.00%	19.00%	16.00%	2.00%	12.00%	8.00%

The indications from the figures above are that work trips are the largest category of servis taxi trips, which gives the servis taxi a special importance as a means of transport to employment. The figures above also indicate that there is no considerable difference in the purposes for which servis taxi are used between the poor and average populations, including use for work trips.

4. Travel Time Per Day by Mode:

Trip time has been estimated by subtracting the starting time from the ending time of the trip from information collected in the household interview survey. The trip time as described in the survey includes the a) in vehicle travel time, b) out of vehicle travel time. The out-of-vehicle travel time includes access time of origin and destination to the mode of transit used; added to this is the waiting time for the vehicle to arrive. In the case of private cars, vans and pick-ups out-of-vehicle travel time has been neglected in the estimation of trip time.

Since the trip time obtained includes out-of-vehicle travel time (except for private cars, vans and pick-ups), no reliable information about the travel distance per mode could

be estimated except the travel distance by private cars, vans and pick-ups; however information about travel speeds and travel cost by different modes were made available to the author by officials of the Department of Transportation in Amman and are available in footnote 13.

According to Figure 6.10

	<u>Sched. Bus</u>	<u>Servis Taxi</u>	<u>Call Taxi</u>	<u>Private Car</u>	<u>Total Travel Time Hours Per Day</u>
JD0-50	27.05%	43.96%	14.97%	13.52%	2.07
JD50-100	15.14%	47.53%	10.21%	16.90%	2.84

Figure 6.10 indicates that:

1. Significant travel time is spent in servis taxi.
2. The travel time goes up as income rises.

#### 5. Travel Cost Per Day by Mode:

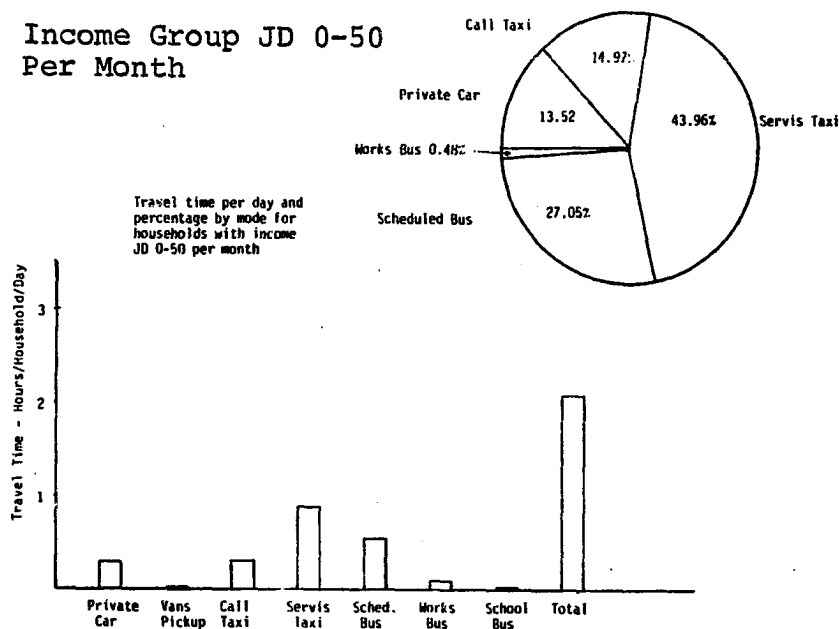
According to Figure 6.11

	<u>Sched. Bus</u>	<u>Servis Taxi</u>	<u>Call Taxi</u>	<u>Private Car</u>	<u>Cost as a Percentage of Family Monthly Income</u>
JD0-50	9.12%	20.83%	42.96%	26.04%	19.96%
JD50-100	6.52%	23.91%	26.08%	36.95%	15.94%

Figure 6.11 indicates that:

1. Call taxi absorbs the largest percentage of the money the poor spend on travel, with private car expenditures second, both amount to approximately 66% of the money spent on travel by

### Income Group JD 0-50 Per Month



### Income Group JD 50-100 Per Month

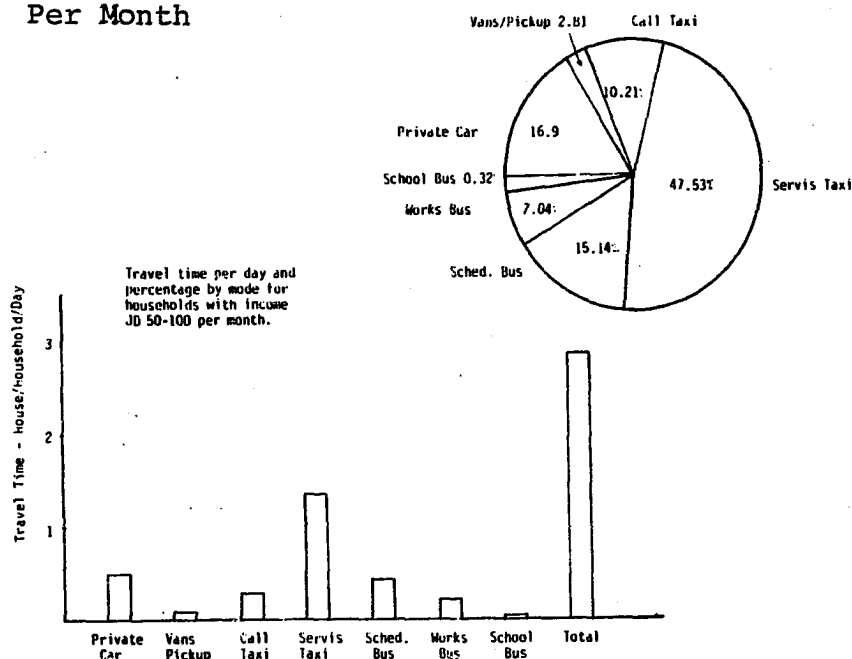
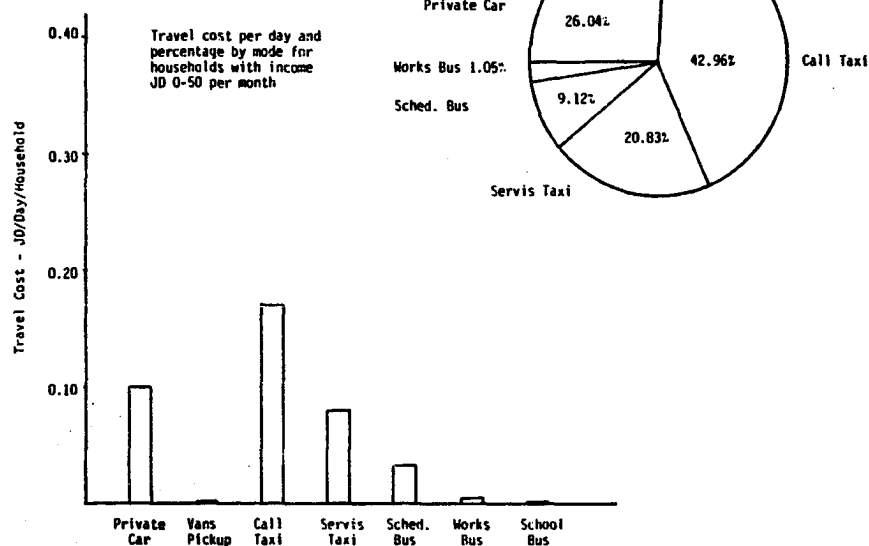


Fig. 6.10 Travel Time Per Day by Mode

Source: Analysis is based on the Household Travel Survey Data, Amman Region Transportation Study, February 1980.

### Income Group JD 0-50 Per Month



### Income Group JD 50-100 Per Month

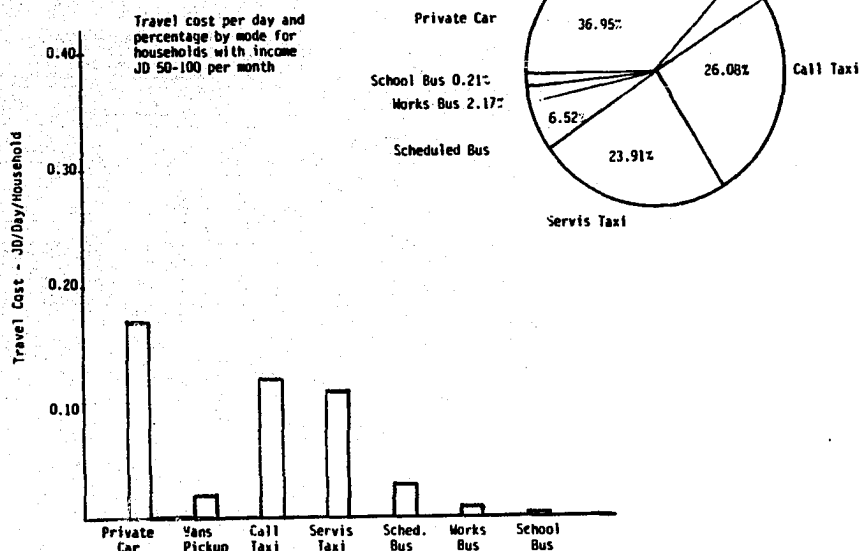


Fig. 6.11 Travel Cost Per Day by Mode

Source: Analysis is based on the Household Travel Survey Data, Amman Region Transportation Study, February 1980.



the poor (while buses and servis taxis amount to 34% only).

2. The poor in Amman spend a high percentage of their income on travel, which supports the hypothesis about the high expenditures on travel by the poor in urban areas of the developing countries (as discussed in Chapter III). While the figures for the cost of travel as a percentage of family income were 25% for Rio de Janeiro, 25% in Kuala Lumpur, 27% in Singapore; it was slightly less for Amman (15.94%-19.96%).

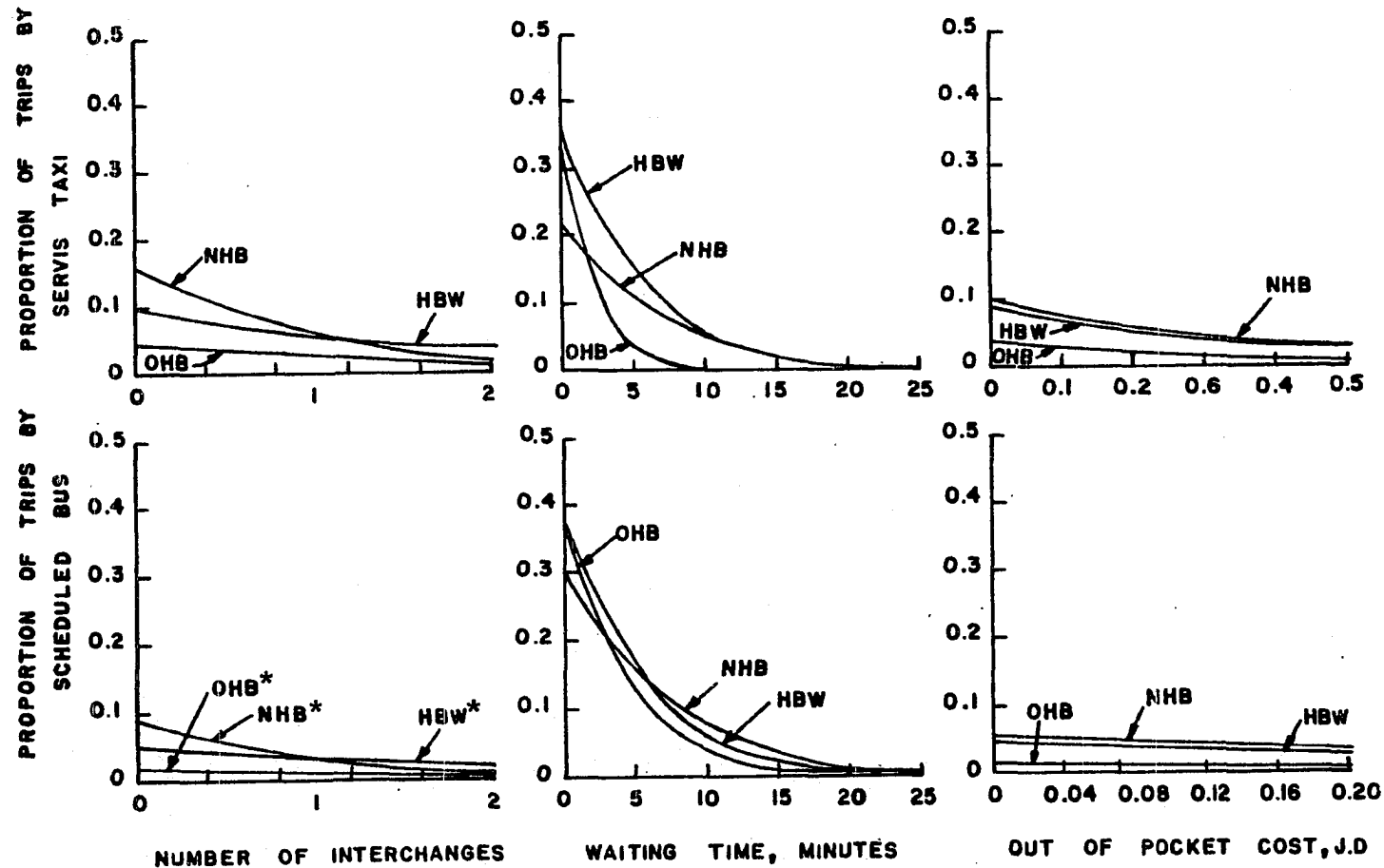
## Phase II: Analysis of Need

### 1) The Urban Poor Travel Needs in Amman Region

Different methods can be used in estimating the travel needs of the poor (as discussed in Chapter V). One such method that has been indicated earlier in Chapter V is estimating the number of trips by the poor through gap analysis; the goal would be to reach the same number of trips taken by the average of all households in Amman Region. The disadvantage of using gap analysis is that it might result in an overestimation of trips needed.

A preferred process to estimate the needed trips is to estimate those trips that would be taken on public transportation, at a level of fare and level of service that meets the user standards of travel time and travel cost defined as set earlier in the section on objectives and evaluation criteria. The advantages of this method of projecting need is that it is based on actual behavioral conditions. Information on the elasticity of demand for transit and its sensitivity to changes in level of fare and level of service has been obtained for non-private vehicle owning households in Amman Region.<sup>1</sup> The split between scheduled bus and servis taxi would be affected using the coefficients for two levels of service variables: 1) waiting time in minutes, 2) number of transfers<sup>15</sup> (interchanges) (as shown in Figure 6.12). The out of pocket cost service variable was not considered to have much influence on trip making by either scheduled bus or servis taxi since the fares on both were generally low.<sup>16</sup> This result, however, might not be accurate for the poor.

\*HBW: Home Based Work Trips  
 OHB: Other Home Based Trips  
 NHB: Non Home Based Trips



Source: Amman Region Transportation Study, Technical Memorandum 10, based on Figure 4.8, Halcrow, Fox & Associates, Jouzy & Partners. September 1980.

Figure 6.12. Factors affecting the modal split of trips between scheduled buses and servis taxis for non-vehicle owning households.

The Amman bus routes all terminate in various parts of the central area. To make a journey from one side of Amman to another by bus; a passenger has to travel in one vehicle to its central area terminal, walk across town to the second terminal and then take a second bus. Decreasing the number of interchanges will have considerable impact on trip making since it will decrease both the trip time and trip cost; and that's why a decrease of the number of trip interchanges by 25 percent was considered an appropriate goal for the poor's mobility improvement in Amman Region.

The estimated average waiting time for servis taxi in Amman is 2.56 minutes at peak hours, 3.29 minutes at off peak.<sup>17</sup> The level of service for servis taxi was considered to be adequate in areas covered by this mode of transit. The scheduled bus has a higher average waiting time of 12.27 minutes at peak hours and 15.08 minutes at off peak.<sup>18</sup> The congestion in CBD and the "bunching" of buses and the difference in service levels between different routes makes the waiting time longer than that indicated by the average. A change of the level of service for the scheduled bus is suggested with the goal of bringing the average waiting time in peak hours to 5 minutes and 6 minutes for off peak.

The expected increase in the percentage of trips made by the scheduled bus as a result of the suggested improvements in trip waiting time and number of interchanges are affected by the coefficient of level service variables discussed in footnote 14.

The change in the percentage of trips made due to  
the decrease in waiting time = Elasticity of demand for waiting  
time

X Percentage change in the  
waiting time.

The change in the percentage of trips made due to the  
decrease in the number of transfers = Elasticity of demand for  
number of transfers  
X Percentage change in the  
number of transfers.

Total change in the percentage of trips made =  
The percentage change due to the decrease in waiting time  
+ The percentage change due to the decrease in the  
number of transfers.

Total change in the percentage of trips made =

<u>Trip Purpose</u>	<u>Waiting Time</u>	<u># of Interchanges</u>
HBW	$(-0.219 \times \frac{5-12.27}{12.27}) + (-0.489 \times - .25) = 0.2520$	
OHB	$(-2.272 \times \frac{6-15.08}{15.08}) + (-0.526 \times - .25) = 0.2953$	
NHB	$(-0.163 \times \frac{6-15.08}{15.08}) + (-1.075 \times - .25) = 0.3669$	

The expected additional number of trips made by  
scheduled bus (for income group X) =

trips per household per day by scheduled bus for purpose Y	x	<u>Total change in the percentage of trips made</u> Percentage of trips per household (per day by scheduled bus for purpose Y to total trips per day by scheduled bus)
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Based on tables K-1 and K-3 in Appendix K.

The expected additional number of trips made by  
scheduled bus:

Income Group JD 0-50 Per Month

HBW	$.0526 \times \frac{.2512}{.0857} = .154$	trips
OHB	$.526 \times \frac{.2925}{.8572} = .175$	trips
NHB	$.035 \times \frac{.3667}{.057} = .225$	trips
	Total	.558

The estimated total needed trips include those taken after the suggested improvement in the transit system added to them are those trips taken on other modes (such as the trips made by call taxi and private car).

The total needed trips for the income group JD 0-50.

	<u>Existing Demand</u> (based on tables K1 and K3 in Appendix K)		<u>Additional</u> <u>Needed</u> <u>Trips</u>		<u>Total Needed Trips</u>
HBW	.66	+	.154	=	.814
OHB	1.79	+	.179	=	1.969
NHB	.33	+	.225	=	.555
					<u>3.338</u>

Thus, based on the need approach to estimate trips generated, there would be an increase of 16.71% in trip making.

The same approach was used to estimate the total needed trips for income group JD 50-100.

	<u>Existing Demand</u> (based on tables K2 and K4 in Appendix K)		<u>Additional</u> <u>Needed</u> <u>Trips</u>		<u>Total Needed Trips</u>
HBW	1.45	+	.133	=	1.580
OHB	1.58	+	.155	=	1.735
NHB	.35	+	.195	=	.545
					<u>3.860</u>

Thus, based on the need approach to estimated trips generated, there would be an increase of 12.51% in trip making.

To compare needed trips as described above with those based on gap analysis:

Income Group JD 0-50 Per Month

	Elasticity-Based Estimated Needed Trips	Gap Analysis Approach <sup>19</sup>	Percentage <sup>20</sup> Difference
HBW	0.814	2.17	166.58%
OHB	1.969	2.72	38.14%
NHB	0.555	0.77	40.00%
Total	<u>3.38</u>	<u>5.66</u>	<u>67.45</u>

Income Group JD 50-100 Per Month

HBW	1.580	2.17	37.34%
OHB	1.735	2.72	56.77%
NHB	.545	0.77	41.28%
Total	<u>3.86</u>	<u>5.66</u>	<u>46.63%</u>

The figures above thus indicate that estimates of trips based on gap analysis are 47-67% more than those estimated earlier.

One of the goals of providing adequate mobility for the poor is that their needed trips should not consume more than 9 percent of their income. So for the income group with less than JD 50 per month, the travel expenses should not exceed JD 4.5/month (since the majority of that group have an income of JD 44-50 per month);<sup>21</sup> and should not exceed JD 6.75/month for the income group JD 50-100/month.

Trips Per Month for Income Group JD 0-50 (assuming trips are made in 26 days of each month)

$$3.38 \times 26 = 87.88$$

$$\text{maximum fare/trip} = \frac{4.5}{87.88} = \text{JD } .051$$

Trips Per Month for Income Group JD 50-100

$$3.86 \times 26 = 100.36$$

$$\text{maximum fare/trip} = \frac{6.75}{100.36} = \text{JD } .067$$

In comparison with the existing fares for scheduled bus (JD .058/trip) and servis taxi (JD .078/trip); the existing fares are not far higher than those affordable by the poor.



## 2) Strategies for Meeting Need

The main objective of the examination of strategies for meeting travel needs is to come up with the best form of public transit supply capable of satisfying the needs of the poor for travel at the least possible cost to the government of Jordan.

The census results for Amman Region population in 1979 was 1,288,682 making 191,877 households<sup>22</sup> (Average Household size 6.71 persons/household).

The poor make 40% of the population or 76,750 households. Forty-six percent of the poor or 35,305 households were in the income category JD 0-50 per month, while 54 percent of the poor or 41,445 households were in the income category JD 50-100 per month.

The total number of needed trips for Amman Region per day =

<u>JD 0-50/Month</u>	<u>JD 50-100/Month</u>
$(35,305 \times 3.338)$	$(41,445 \times 3.86)$
$= 278,000$	

Two main alternative policy options would be discussed here as an example for providing transit system supply to the poor.

Policy A: To provide servis taxis coverage at an adequate level of service capable of handling the needed trips of the poor. The discussion on Policy A will deal with the existing situation, advantages and disadvantages of servis taxi and the cost involved in providing such service.

### Servis Taxi

Servis taxi is the most widely used mode among the poor. Approximately 40 percent of the trips of the poor are made by servis taxi, and approximately 49 percent of those trips are related to work, which gives the servis taxi a special importance as a means of transport to employment. While 40 percent of the trips were made by servis taxi, only 22 percent of the travel money was spent on servis taxi, which indicates that servis taxi is relatively a cheaper mode of travel in relation to the other existing ones.

### The Advantages of a Servis Taxi System

1. A servis taxi usually offers a high standard of comfort.
2. The absence of fixed stops enable passengers to be set down at points convenient for them.
3. The speed of the servis taxi is generally higher than by bus which gives better journey times and adds to the attractiveness of the servis taxi.
4. The operational efficiencies during peak periods are higher than the bus because of: a) short loading times, related to low seating capacity and informal fare collection arrangements, b) maneuverability in traffic, which reduces the effect of peak congestion, and c) the high proportion of passengers traveling from one end of the route to the other, which reduces intermediate stop time.

### The Disadvantages of a Servis Taxi System

1. The most difficult problem of reliance on the servis taxi is that it is difficult to guarantee a level of service to be supplied, or, indeed, to control the level of service at all. A license as presently issued only confers the right to operate; it imposes no corresponding duty.<sup>23</sup>
2. It's negative effects on traffic congestion and the space requirement for parking in downtown Amman.
3. It's high energy consumption relative to the bus.

### The Cost of Trips Supplied to the Poor by Servis Taxi System

Assuming that the servis taxi system will continue working in the form existing at present,

The total cost = (Total # of needed trips per day) x  
(Existing fare - fare affordable by  
the poor)

Total cost = 278,000 (.078 - .051)

JD 7,500/day

JD 2,400,000/year

The subsidies could be handled in different forms such as coupons, direct funding to servis taxis working in poor areas and other forms as well.

Policy B: To provide bus service coverage at an adequate level of service, capable of handling the needed trips of the poor.

#### Scheduled Bus

In spite of the fact that the scheduled bus fares were generally 35-40 percent less than servis taxi fares, only 17 percent of trips by the poor were made on scheduled buses in comparison with 40 percent on the servis taxi. The difference is generally due to the better level of service provided by the servis taxi, and lack of capacity of the existing bus system.

#### The Advantages of a Bus Service System

1. Provide a low cost alternative to taxis under high density conditions.
2. Offer a high passenger capacity to road space ratio.
3. An efficient user of fuel and labor resources per passenger journey, assuming high load factors.

#### The Disadvantages of a Bus Service System

1. Provide lower speeds and higher travel time per trip due to:
  - a) the nature of Amman topography (mountains), b) the existing high traffic congestion especially in the narrow streets of the central business district, and c) bus size which adds to the difficulty of maneuvering in such traffic conditions.
2. The Passenger Transport Corporation (PTC) is the sole operator of bus service in Amman, and the only publicly owned element of the public transit system. There are some problems connected with the management and operation of

PTC.<sup>24</sup> Among those are:

- a. No cost information and no meaningful analysis of route profitability are available on a regular basis to the management of the operation department of PTC. There is also a lack of management information in the sphere of performance review such as return of kilometer run by each bus, fuel and oil consumption and spare parts usage by vehicle, and costs on a "per kilometer" basis.
- b. Other main deficiencies of the system at present involve lack of sufficient capacity and an indifferent standard of service reliability (such as the lack of scheduling, and operational supervision outside city center).
- c. Other problems outside the control of PTC is the condition of many roads which are in use as bus routes that result in slower operating speed, higher operating cost, passenger discomfort and generally a reduction in service levels.

The Cost of Trips Supplied to the Poor by Scheduled Bus System

No reliable information is available to estimate the operational cost of scheduled bus service. However a rough estimate of the number of buses required to meet the needed trips and the cost involved is estimated as follows:

The average daily loading<sup>25</sup> of a bus in the Amman Region in 1979 was 844 passengers.

The total number of buses required to meet the travel needs of the poor on a daily basis is:

$$\frac{294,391}{844} = 349 \text{ buses}$$

and the cost at JD 40,000 per vehicle = JD 14 million. Assume the bus lifetime is 12 years and interest rate is 8%, the capital recovery factor CRF would be equal to .1327 and the yearly cost of capital stock is roughly: JD 14 million x .1327 = JD 1,900,000.

A break even position in the cost of operation by an efficient management of PTC, would leave the cost of providing the system capital cost by the government of Jordan at approximately JD 1,900,000/year.

3) Availability of Finance for Transport Investment:  
To Meet the Basic Needs of the Poor in Amman Region.

It is important to evaluate the transport investment required to meet the basic needs of the poor in the Amman Region relative to the total national financial picture.

The National Economic Plan (1976-80) for Jordan terminated on December 1980. No final figures on investment expenditures were available for the next plan (1981-86) at the time data was collected for this report (February 1981).

One method of obtaining probable figures of future investment in transport is to investigate the 1976-80 National Economic Plan (Table 6.4). Table 6.4 gives transport investment figures for Jordan with those parts in the Amman Region shown in paranthesis. The figures indicate that the sum of JD 35 millions was spent on transport in the Amman Region between 1976-80 and that of this amount only JD 0.7 million was spent on buses; or approximately JD 140,000 per year out of a total of JD 7 million per year.

What are the factors that have to be considered in  
planning future transport investment in the Amman Region?

1. Over this planning period (1981-86) there will be an expected population growth of 25%. It is clear that in order for living standards to be maintained, total revenue will have to increase in line with those population increases.

2. It is important to bear in mind the general state of Jordan's economy which largely depends on unpredictable aid

TABLE 6.4  
TRANSPORT INVESTMENTS FOR THE EAST BANK - 1976 TO 1980

Transport Sector	Expenditure in JD million					
	1976	1977	1978	1979	1980	Total
Roads	7.8(0.4)	8.9(1.2)	7.7(0.6)	6.8(1.8)	6.2(1.0)	37.4(5.0)
Rail	1.5( - )	3.0( - )	4.5( - )	5.0( - )	-	14.0( - )
Port	8.2( - )	6.4( - )	8.7( - )	5.5( - )	-	28.8( - )
Airports	7.4(7.2)	9.8(9.6)	8.1(8.0)	4.5(4.5)	-	29.8(29.3)
Buses	0.2(0.2)	0.3(0.3)	0.2(0.2)	-	-	0.7(0.7)
Total	25.1(7.8)	28.4(11.1)	29.2(8.8)	21.8(6.3)	6.2(1.0)	110.7(35.0)

Source: National Economic Plan 1976 - 1980.



from other countries and upon remittances from Jordanians working abroad; for example, foreign aid and remittances totaled in 1976 JD 250 million compared to a gross domestic for that year of about JD 400 million.

3. It is questionable whether domestic production would pull ahead of demographic growth and inflation over the planning period 1981-86. It would be useful to keep in mind what has been discussed earlier about the fact that at present 40% of the population in the Amman Region are living below poverty level.

4. In the conditions of the Amman Region therefore; an important factor to keep political stability is to take care of the poor over the next five years as a matter of priority for investment. The transportation sector cost of doing so is approximately JD 2 million/year.

5. How much to spend on transportation in Jordan at present (1981) is largely a political question. How it is to be spent is the technical one; it is here that the planners have a role. Assuming that the budget for transport in Amman Region is approximately JD 8 million per year for the planning period 1981-86, it is a matter of priority to put 25% of the transport budget aside to take care of the travel needs of the poor in the Amman Region. The transport projects for the poor would be given priority in a package of projects that could be selected to fit the available budget, and tailored to the inevitable changes in budget allocation.

6. Some ideas to finance the transport system supply needs of the poor in Amman Region include adopting policies that would result in less money spent on constructing new residential streets and/or through tax put on auto road users from which an efficient public transit supply could be financed.

Many of Amman's transport problems are ultimately related to one thing: the lack of a pricing mechanism for urban roads. The problems that stem from this are basically of two kinds: a) those related to urban sprawl, and b) those that are related to traffic congestion.

There has been a considerable urban sprawl in Amman Region in the past three decades as described earlier in this chapter. Residential streets make up a large part of the cost of servicing new residential areas. The relationship between residential density and the cost of servicing is a complex one, but if density is reduced, the per capita cost of servicing increases substantially.<sup>26</sup> The system for building residential streets at present (1981) in Amman is that the developer gives 25% of developed land to the municipality for roads, but it is the municipality that constructs and pays for them.<sup>27</sup> This results in considerable burden on the budget for transport; therefore, it is suggested in this research study that a new policy should be adopted whereby developers of new areas pay for most of the cost of new residential streets and other services. The reduction in the cost of building new streets would clearly make more money available in the budget for financing the

transportation system supply needs of the poor in Amman.

The problem of congestion in Amman is due to Amman's topography (mountains) and the tremendous increase in car ownership in the years 1970-78. In 1978 there were more than five cars on the road for every one in 1970.<sup>28</sup> In Amman, more and more middle class and rich families are buying cars for which they expect road space to be provided by the government. At present (1981) the automobile owners are not charged for the costs they incur when they use roads. It is suggested therefore that a specific tax should be put on auto road users of the Central Business District of Amman to reduce congestion at peak hours (similar to what has been done in Singapore and described in Chapter III). The money collected from auto users would be used to finance an efficient public transit system in Amman for the poor and middle class families.

7. Transport policy in Amman Region is made by four ministries, six municipalities, and two governorates, and in addition there is the influence of the National Planning Council and the Amman Urban Region Planning Group.<sup>29</sup>

The solution to problems of coordination which avoid the dangers of overcentralization and overregulation in Amman Region is in the establishment of a small analytical and policy unit close to the center of municipal decision-making, to be called The Public Transport Unit.

The Public Transport Unit would serve two basic functions:

1. Ensure that local public transport services will offer standards of service and cost convenience which will meet the needs of the public, and encourage the greatest possible use of public transport, both immediately and in the future; and
2. Act as the link between the realities of present conditions and the long-range plans for the future, and to see to it that what is done now is consistent with and leads logically into the accomplishment of future plans. It should serve to bring together the public transport undertakings and regulatory agencies with the other groups which deal with the wider aspects of economic development, social, environmental and land-use planning, traffic control, and road construction, so that each may have a better understanding of the objectives, problems and potentials of the other, and of the role which public transport can play in the solution of urban mobility problems.

Staff Members should include:

1. A Director General or Senior Operation Officer, who would act as a head of the special unit. This officer should if possible have had management experience in public

transport operation, and a good working knowledge and understanding of scheduling, routing, fares, equipment and manpower assignment, labor relations, finance and accounting, and maintenance.

2. A qualified Accountant, who would be responsible for instituting uniform accounting and reporting procedures, auditing source records, and preparing composite summaries and analysis.

3. An Economist, with qualifications in the analysis and use of statistics;

4. A city Planner, with knowledge of environmental transportation as well as land-use planning, and who would work closely with the Municipal Research and Planning Division.

Some additional support staff will be required, particularly in the areas of (a) mapping, (b) graphic presentation, and (c) statistics and records. In addition, a small staff of traffic inspectors to verify schedule, loading standards, bus stop locations and amenities, and traffic-related causes of delays.

### Spatial Analysis in Wahdat Zone, Amman Region, Jordan

The main objective of the following example on spatial analysis is to demonstrate the application of the need approach to transportation planning spatially (as described in Chapter V) on data from the study area (see Fig. 6.2) of the Amman Urban Region in Jordan.

One of the important factors in identifying areas with low mobility is the distribution of the poor spatially. Based on the household survey<sup>30</sup> and the definition of the poor as those with income below JD 100 per month, two figures were developed that show where the poor people live and their percentage for each zone<sup>31</sup> (see figures 6.4 and 6.5).

The Amman bus and servis taxi routes terminate in various parts of the central area (see figures 6.13 and 6.14). For example, to make a journey from one side of Amman to another by bus; a passenger has to travel in one vehicle to its central area terminal, walk across town to the second terminal and then take a bus (as has been discussed in an earlier section of this chapter).

Figures 6.4, 6.5, 6.13 and 6.14 indicate that:

1. The poor are spread over most of Amman Urban Region,
2. Higher percentages of the poor live in Amman Environments; or at the outskirts of Amman City, and
3. There are too many trip interchanges at the CBD which add to the travel time and cost of the poor.

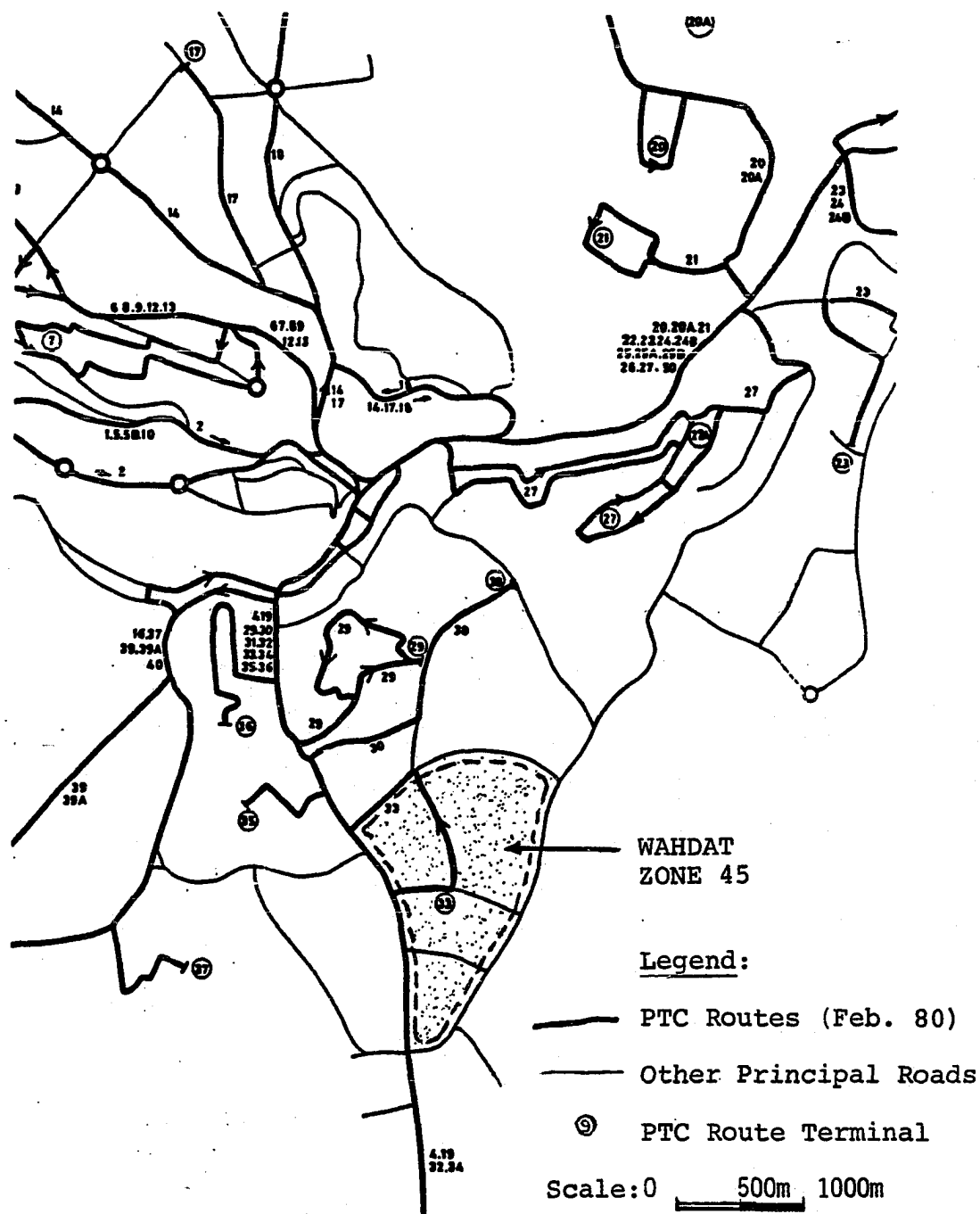


Fig. 6.13 Public Transport Corporation (PTC) Bus Routes in Amman, 1980.

Source: Based on Fig. 8.4, Amman Region Transportation Study, Phase 1, Final Report, 1980.

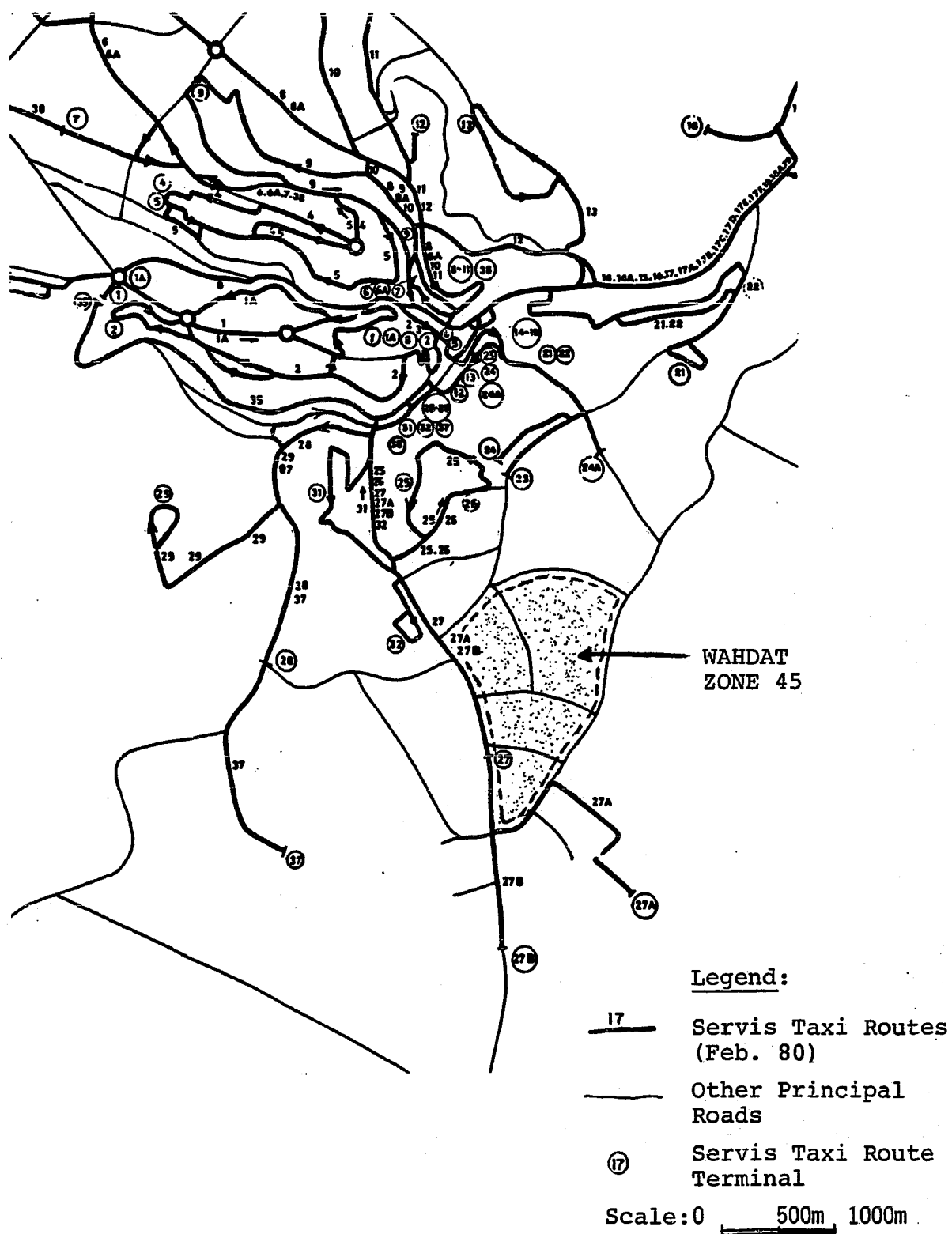


Fig. 6.14 Servis Taxi Routes in Amman, 1980.

Source: Based on Fig. 8.1, Amman Region Transportation Study, Phase 1, Final Report, 1980.



The conclusion from the above are that many of the poor have to travel considerable distances to reach the Central Business District of Amman City where a high percentage of employment opportunities exist. The lack of adequate public transport systems in the Amman Region and the high cost of travel as related to the income of the poor (as discussed in an earlier section) can effectively preclude the poor's participation in many employment opportunities that exist in the Central Business District and other areas of Amman City.

It has been suggested in Chapter II and V of this study that information by income and occupations should be collected for transportation need analysis. In the example of Amman, no accurate information was available to the author regarding occupations within each income group. However, the occupations of the following income groups could be characterized as follows:

Poor	JD 0-50/month	Hawkers, unskilled laborers, venders
	JD 50-100/month	Semi-skilled workers
<hr/>		
	JD 100-150/month	Clerical Workers
<hr/>		
	JD 150-250/month	Skilled Workers
<hr/>		
Non Poor	JD 250-350/month	Retailors, Professional & Managerial Group
	JD 400+/month	Entrepreneurs
<hr/>		

Transportation Supply and Demand Relative to  
Needs in Wahdat

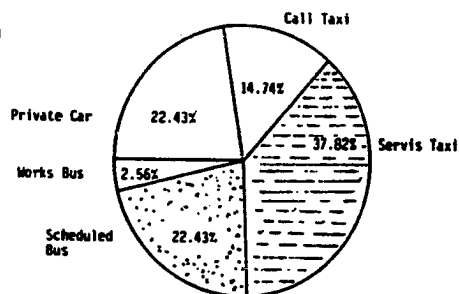
The Wahdat zone was chosen as an example to demonstrate the analysis involved in meeting "need" spatially at the zonal level.

Wahdat zone (see figures 6.4, 6.13 and 6.14) has a population total of 44,500 or 5,933 households.<sup>32</sup> Table 6.5 has statistical information about the Wahdat. Figure 6.15 indicates the existing modal split for the poor and the average population in Amman Region.

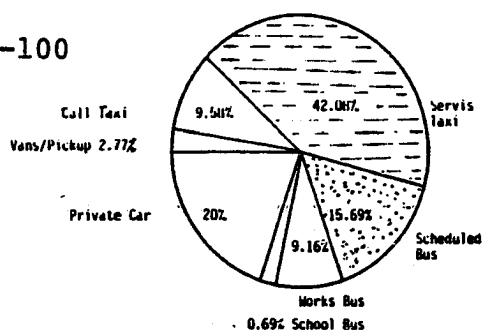
TABLE 6.5  
STATISTICAL INFORMATION ABOUT THE WAHDAT ZONE<sup>33</sup>

	Income Per Month					
	JD0-50	JD50-100	JD100-150	JD150-250	JD250-350	JD400+
Zone Household Percentages	9.8%	36.3%	20.7%	21.4%	8.4%	3.4%
No. of Households	581	2154	1228	1270	498	202
Work Trip Demand HBW/Household/ Day	.66	1.45	2.11	2.48	2.72	3.08
Total Trip Demand Per Household Per Day	2.78	3.38	5.79	7.63	9.27	11.7
Work Trip Need HBW/Household/ Day	.814	1.58				
Total Trip Need Per Household Per Day	3.338	3.86				

Income Group JD 0-50  
Per Month



Income Group JD 50-100  
Per Month



Average Household

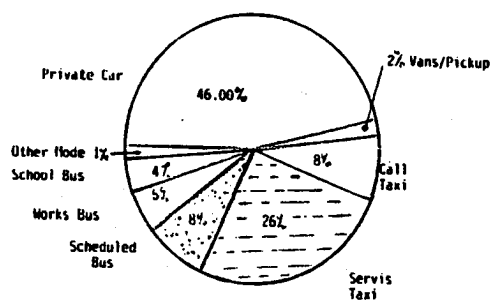


Fig. 6.15 Trip Percentage by Mode

Source: Based on figures 6.8 and 6.9.

### A) Wahdat Zonal Trip Estimates

Assuming the Government of Jordan has decided to provide adequate public transit system supply for all trips needed by the poor in addition to those trips demanded by the non poor currently taken on public transit:

- 1) a) Total Needed Work trips by the poor per day =  
# of Households X Needed Work trips per household per day.

Based on Table 6.5

$$(581 \times .814) + (2154 \times 1.58) = \underline{3,900}$$

- b) Total Demanded Work trips by other income groups per day = # of Households X Demanded Work trips per household per day X Percentage of trips taken by scheduled bus and servis taxi.

Based on Table 6.5 and Fig. 6.13

$$(1228 \times 2.11 \times 34\%) + (1270 \times 2.48 \times 34\%) + (498 \times 2.72 \times 34\%) + (202 \times 3.08 \times 34\%) = \underline{2618}$$

- c) Total Work trips for Wahdat Zone per day =  
 $3900 + 2618 = \underline{6,520}$

Assume that the work trip is divided equally into two peak periods per day; the total work trips at each peak period is equal to:

$$\frac{6,520}{2} = \underline{3,260}$$

- 2) a) Total needed trips by the poor per day =  
# of households X total needed trips per day.

Based on Table 6.5

$$(581 \times 3.338) + (2154 \times 3.86) = \underline{11,000}$$

- b) Total demanded trips by other income groups per day =  
# of households X total demanded trips per day X  
percentage of trips taken by scheduled bus and service  
taxi.

Based on Table 6.5 and Fig. 6.13

$$(1228 \times 5.79 \times 34\%) + (1270 \times 7.63 \times 34\%) + (498 \times 9.27 \times 34\%) + (202 \times 11.7 \times 34\%) = \underline{8,160}$$

- c) Total trips for Wahdat Zone per day =  $11,000 + 8,160 =$   
19,160

#### B) The Existing Transit System Supply in Wahdat Zone

The Wahdat Zone is one of the low income zones in Amman Region that are served poorly by public transit. A recent study (1979) of housing for low income groups in Amman Region supports this fact.<sup>34</sup>

Public transit system supply that serve Wahdat Zone consist of the following:

- 1) Bus Route number 33 as shown in Figure 6.13 which circulates partially inside that zone. The "round trip" length of the bus route to the CBD is 8.6 kilometers and it consumes 42 minutes. The bus fare is JD .04/trip. In 1980 there were 14 buses allocated to the Wahdat Zone and they carried 12,575 passengers per day.<sup>35</sup> (Average of 898 passengers/

bus/day. A bus with 44 seats can handle 189 passengers assuming a one-way peak for 3 hours duration.)

- 2) Wahdat zone is served on its borders with zone 51 (see Figure 6.4) by servis taxi number 27 as shown in Figure 6.14. The "round trip" length of the servis taxi route to the CBD is 5 kilometers and it consumes 30 minutes. The fare in 1980 was JD .055/trip. No accurate information is available on how many passengers from the Wahdat zone were served by servis taxi number 27 or other servis taxis.<sup>36</sup> It is also to be noted that no servis taxi circulate within the Wahdat zone. In estimating additional system supply required to circulate and serve the Wahdat; the only existing system considered would be bus route number 33.

#### C) System Supply Required

In the discussion provided earlier on "Strategies for Meeting Need" two main alternative policy options for providing transit system supply to the poor were discussed. In this section both alternatives would be discussed in terms of estimation of the transit system supply required at the zonal level in Wahdat if any of the two policy options were adopted.

Policy A: To provide servis taxis coverage in Wahdat at an adequate level of service capable of handling trips estimated for Wahdat.

- a) How many servis taxis required to meet the work trip only, assuming that the government is interested in meeting those trips that affect employment.

The total work trips at each peak period equal to 3,260 passengers.

A servis taxi can handle 30 passengers at peak period (assuming a 3 hour peak).

# of servis taxis required at each peak period =

$$\frac{3260}{30} = \underline{109} \text{ servis taxis}$$

Therefore to meet the work trips 109 servis taxis are needed for six hours per day.

- b) How many servis taxis are required to meet the total trips per day assuming that the government is interested in meeting all trips estimated for Wahdat.

Total trips for Wahdat zone per day as estimated earlier is 35,000 passenger trips/day. Non-peak period passenger trips per day = 19,160 - 6,520 = 12,640. On the average a servis taxi can serve 236 passengers/day.

# of servis taxis required per day for non-peak travel

$$\frac{12,640}{236} = \underline{54}$$

Therefore, to meet the total trips per day 109 servis taxis are needed at peak period, and 54 servis taxis at non-peak period.

Policy B: To provide bus service coverage in Wahdat at an adequate level of service capable of handling trips estimated for Wahdat.

- a) How many buses are required to meet the work trip

only assuming that the government is interested in meeting those trips that affected employment. The total work trips at each peak period equal to ~~3260~~ 6000 passengers.

A bus with 44 seats can handle 189 passengers at peak period (assuming a 3 hour peak).

# of buses required at each peak period =

$$\frac{3260}{189} = \underline{18} \text{ buses.}$$

Therefore, to meet the work trips 18 buses are needed for six hours per day.

- b) How many buses are required to meet the total trips per day assuming that the government is interested in meeting all trips estimated for Wahdat.

Non-peak period passenger trips per day as estimated earlier = 12,640

On the average a scheduled bus in Wahdat can serve 898 passengers/day.

# of buses required per day for non-peak travel

$$\frac{12,640}{898} = \underline{14} \text{ buses}$$

Therefore, to meet the total trips per day 18 buses are needed at the peak period, and 14 buses at non-peak period. Since in 1980 14 buses were working



on the Wahdat bus route. The additional required buses =  
 $18 - 14 = \underline{4}$ .

The Cost of Trips Supplied to the Poor by  
 Servis Taxi System

The total cost = (total # of needed trips per day) X  
 per day (Existing fare - fare affordable by the  
 poor)

Assuming that trips are taken 313 days of the year:

The amount of work trips cost =  $313 \times 3900 \times (.078 -$   
 $.051) = \text{JD } \underline{33,000}$

The annual total trips cost (work and non work trips)  
 $313 \times 11,000 \times (.078 - .051) = \text{JD } \underline{96,400}$

The annual cost of an additional 4 buses to the existing  
 bus system (assuming the collected fares are adequate to take  
 care of the cost of operating the system).

At the cost of JD 40,000 per vehicle; assuming the  
 bus life time is 12 years, and the interest rate 8%, the  
 capital recovery factor would be equal to .1327.

The annual cost of additional buses in the Wahdat

$4 \times 40,000 \times .1327 = \text{JD } \underline{21,300}$

A statistical summary of spatial analysis in Wahdat  
 Zone is provided in Table 6.6.

TABLE 6.6

A statistical summary of transit system supply as related to estimated travel in Wahdat are provided below.

	The Work Trip at Peak Periods	All Trips - Work and Non-Work Trips
# of trips in Wahdat zone per day	6,520	19,160
# of servis taxi required per day	109	109 at peak period 54 at non-peak period
# of buses required per day	18	18 at peak period 14 at non-peak period
Annual cost of policy A. (only servis taxi)	JD 34,180	33,000 + 96,400 = JD 129,400
Annual cost of policy B. (only buses)	JD 21,300	JD 21,300

### Phase III: Uncovered Deficiencies in Conventional Travel Demand Forecasting

The conventional long-range transportation/land use planning process that traditionally has been carried out in North American and West European cities has been adopted for use in the Amman Region Transportation study. The transportation study has been extensive and was a good example for the application of the traditional approach to transportation planning. The important question however is, whether such an application has been a useful one for Amman. The following points will discuss the question above:

1. Demand oriented models have been used in estimating the trips needed by the poor, which make 40 percent of the population in the Amman Region. The transportation study recognized the abundance of poor in the Amman Region.

There are a large number of very poor people in Amman and this problem will not disappear rapidly. Accessibility to economic and social opportunities is a basic goal but it is one that tends to slip away from the poor as a city expands and becomes increasingly dependent on motorized transport. The transport needs of the poor, and equally of the old and disabled, should not be forgotten.<sup>37</sup>

The problem with demand models used in the Amman study was that they estimated the trips demanded by the poor as those observed at the time of the study, and they did not ask the question of what additional trips the poor need to make. Analysis of the transportation conditions of the poor in Amman discussed earlier in this chapter indicated that many areas where the poor reside lack adequate public transit systems

and that the poor are paying a high percentage of their income on travel; so, these two reasons might be some of the reasons why the poor are not having higher trip demand; and that is why it is important to estimate trips by the poor based on their assessed need (as estimated earlier in this chapter). This would tend to support comments made in Chapter IV about the inadequacies of demand models to estimate the travel needs of the poor in developing countries.

2. In the Amman transportation study, trip patterns were correlated to such factors as income and car ownership. By using the base year correlation (1980), transport conditions were extrapolated to the future (1985, 1990, 2000). The problem with this approach to estimating future trips is that it may be biased towards preservation of the poors' highly unbalanced and unsatisfactory conditions (which also confirms comments made in Chapter IV about the inadequacies of conventional travel demand models).

3. Much of the rapid growth in population (discussed earlier in this chapter) that Amman has seen in the past has to do with unpredictable incidents in the Middle East (such as the wars of 1948 and 1967 which forced more than one million Palestinians to move to the East Bank of Jordan). The conditions that have led to such incidents in the past still exist (mainly the unresolved highly explosive issue of

the Arab people of Palestine and more recently the Lebanese situation). So, in the conditions of Amman, it is very risky to try to predict the population growth in a certain zone by land use models twenty years from now or even ten years from now.

4. The structure of Jordan's economy should be considered carefully when planning future projects. Table 6.7 demonstrates Jordan's dependence upon aid from other countries and upon remittances from Jordanians working abroad, principally in the gulf states. Remittances from Jordanians working in the gulf states might decline in the future as their expertise would be replaced by the newly educated gulf states own population. Also, the aid from foreign governments is not a stable matter, and depends largely on the political atmosphere in the Region from one year to another. In circumstances such as those of the Jordanian economy it would be difficult to make long range transportation planning investments, simply because there is no way to financially guarantee a long range plan. Also, it is not possible to estimate accurately employment opportunities by zone twenty or even ten years from now; and attempt to build transportation models based on such information.

The conclusion drawn from this section is that the need approach presents an improved method over demand modeling for the purpose of assessing the travel requirements of the poor in the Amman Urban Region.

TABLE 6.7

## TRENDS IN THE EAST BANK ECONOMY - 1967 TO 1978

Year	GDP (J.D millions)	Per capita GDP (J.D)	Per capita GDP at 1975 prices (JD)	Foreign Aid (JD million)	Alternative estimates of Remittances from Jordanians working abroad (J D millions)		
					Central Bank of Jordan	Department of Statistics	Royal Scientific Society
1967	131.2	120	216 (crude estimate)	-	-	-	-
1968	156.1	139	-	-	-	-	-
1969	183.4	115	-	-	-	-	-
1970	174.4	105	-	-	-	-	-
1971	186.2	108	-	-	-	-	-
1972	207.2	117	-	66.0	-	7.4	-
1973	218.2	119	-	61.1	-	14.7	-
1974	247.3	131	-	84.8	-	24.1	-
1975	278.6	143	143	138.0	53.4	53.3	-
1976	401.7	197	177	122.8	136.6	131.6	131.6
1977	477.6	225	176	-	143.7	137.8	139.8
1978	561.6	253	185	-	-	-	140.0

Sources: Statistical Yearbook, Department of Statistics, Amman 1975-1978  
 Planned Development in the Balqa - Amman Region, Interim Report, Amman Urban Region  
 Planning Group, Amman, 1979.

- indicates data not available from the above sources

### Example Two: Nonspatial Analysis

Governments in developing countries play a large direct role in fields such as transportation and urban services. Direct government participation includes investment, operation, and pricing of the infrastructure of government transport services. In addition, governments regulate (to a greater or lesser extent) the private sector firms that perform transport services.

Policymakers are often involved in debating whether the government should participate in economic activities related to transport, and if so, what the pricing structure should be. The criteria for government involvement based on the need approach to transportation planning involves:

a) the identification of income groups (by types of occupation) who are living below the poverty level (a detailed discussion on how to estimate income groups below the poverty line is provided in Chapter II), and b) providing the needed accessibility at an acceptable level of expenditure through the implementation of specific mobility and pricing policies designed for that purpose (methods to estimate needed trips are provided in Chapter V).

The developing countries are faced with limited resources to devote to transport projects. Consequently,

measures aimed at reducing the demand for building new roads are often implemented. An example for such a measure is the "Road Pricing Scheme" for Singapore in 1975. This scheme was introduced by the government in the form of its "Area License Scheme." Data from Singapore's Area License Scheme on mobility, trips per day, and cost of travel by different income groups were manipulated to produce Figure 6.16 for vehicle-owning households and Figure 6.17 for the nonvehicle-owning households (as well as figures 6.18 and 6.19).

Figures 6.18 and 6.19 demonstrate the mobility and expenditures on travel by different income groups before and after Singapore's Area License Scheme. A transportation planning based on the need approach would have predicted the mobility loss by the poor (by estimating the change in the elasticity of travel demand for the poor as a result of the change in the cost of travel) and would have compensated them by alternative means of public transit supply.

The relationships indicated in the figures could be useful for the purpose of policy analysis. For example, an increase in the cost of travel as a result of road pricing policy would have an identifiable effect on the mobility of different income groups. This mobility could be detected before the implementation of a road pricing project (by



estimating the change in elasticity of travel demand as a result of change in travel cost for different income groups). Also, the additional mobility required as a result of an increase in income of a population group could be estimated from these figures.

One method to attack the problem of mobility for the poor is to provide trips equal to those just above the poverty level (see Chapter V). Assuming that S\$600 is the poverty line in Singapore, it would be possible to estimate from Figure 6.16 and Figure 6.17 the additional trips needed at each cluster. (Multiply additional trips needed times number of households.) Once the total needed trips is estimated, alternatives for the transportation system supply could be studied and, consequently, the budget that should be allocated to attack the problem of mobility for the poor. Depending on the income by different groups of the poor, a pricing policy could be set for public transit so that the user cost would not exceed the nine percent user standard for expenditure on travel.

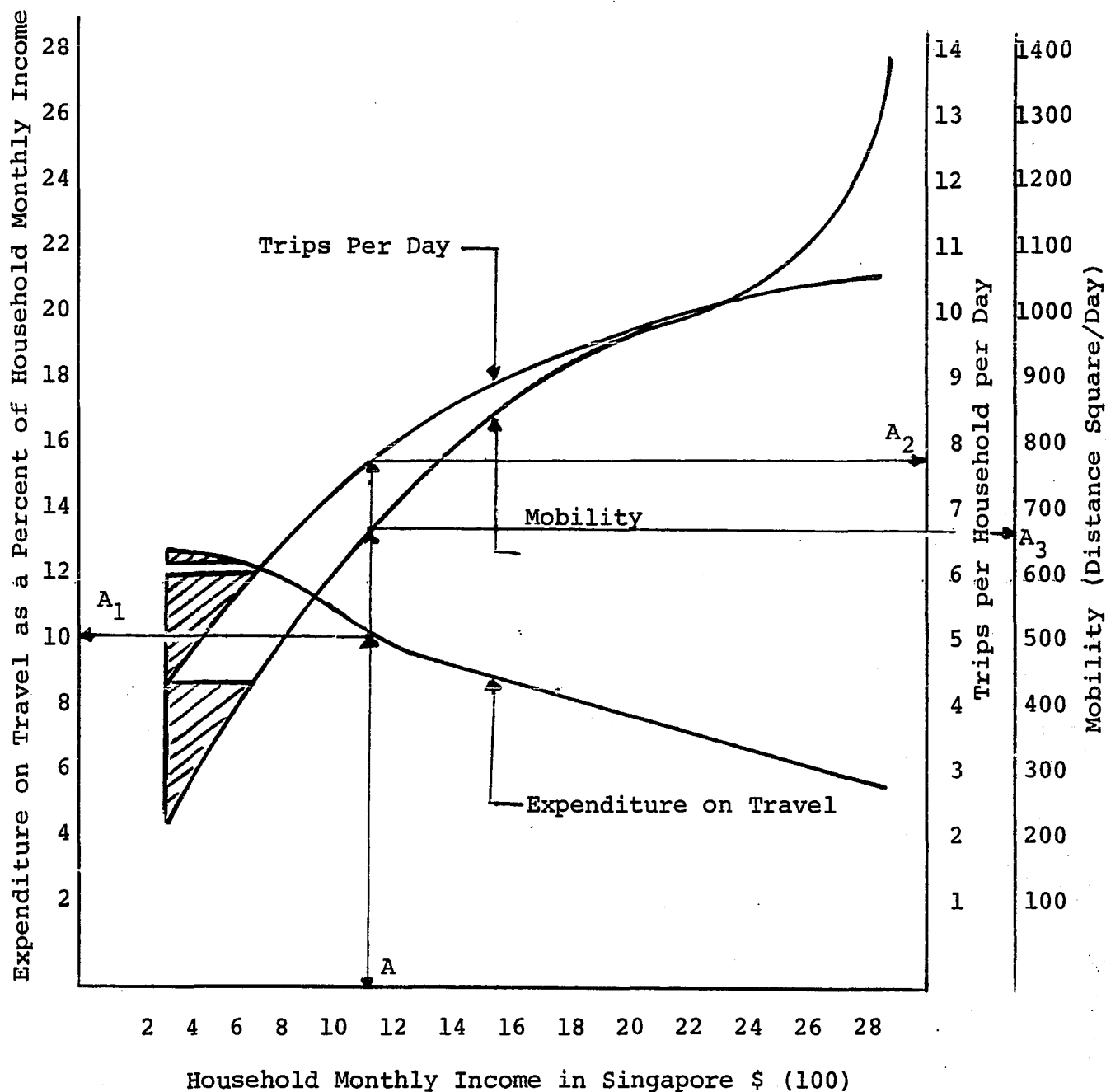


Figure 6.16 Mobility, Trips per Day, and Expenditure on Travel by Different Income Groups, Vehicle-Owning Households - Singapore (1975).

Source: Travel and Income Data on Singapore are based on Y. Zahavi & G. Roth TRB Paper, 1980. Cost of travel data is based on information the author obtained from Wilbur Smith & Associates 1980.

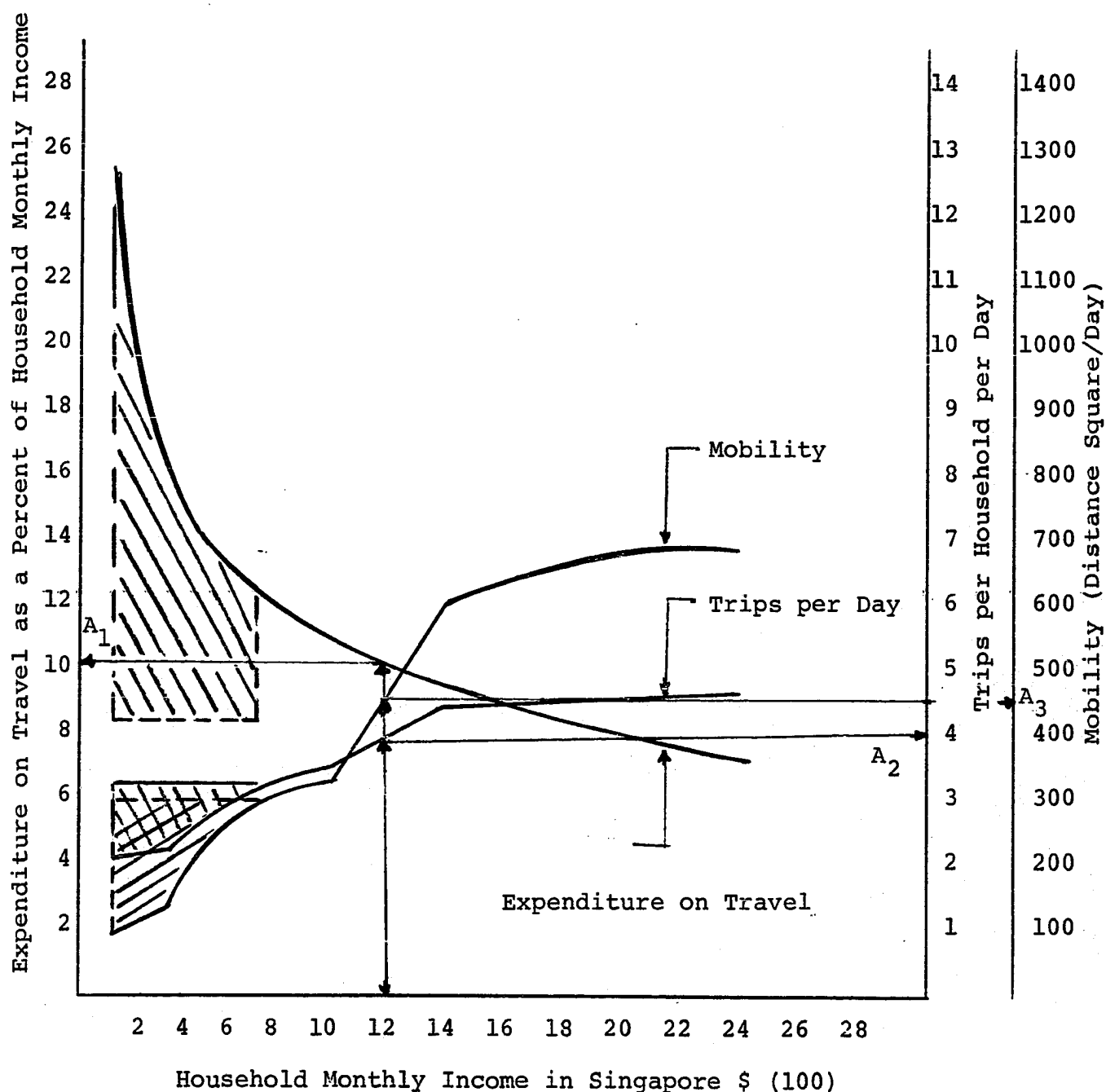


Figure 6.17 Mobility, Trips per Day, and Expenditure on Travel by Different Income Groups, Nonvehicle-Owning Households - Singapore (1975).

Source: Travel and Income Data on Singapore are based on Y. Zahavi & G. Roth TRB Paper, 1980. Cost of travel data is based on information the author obtained from Wilbur Smith & Associates 1980.

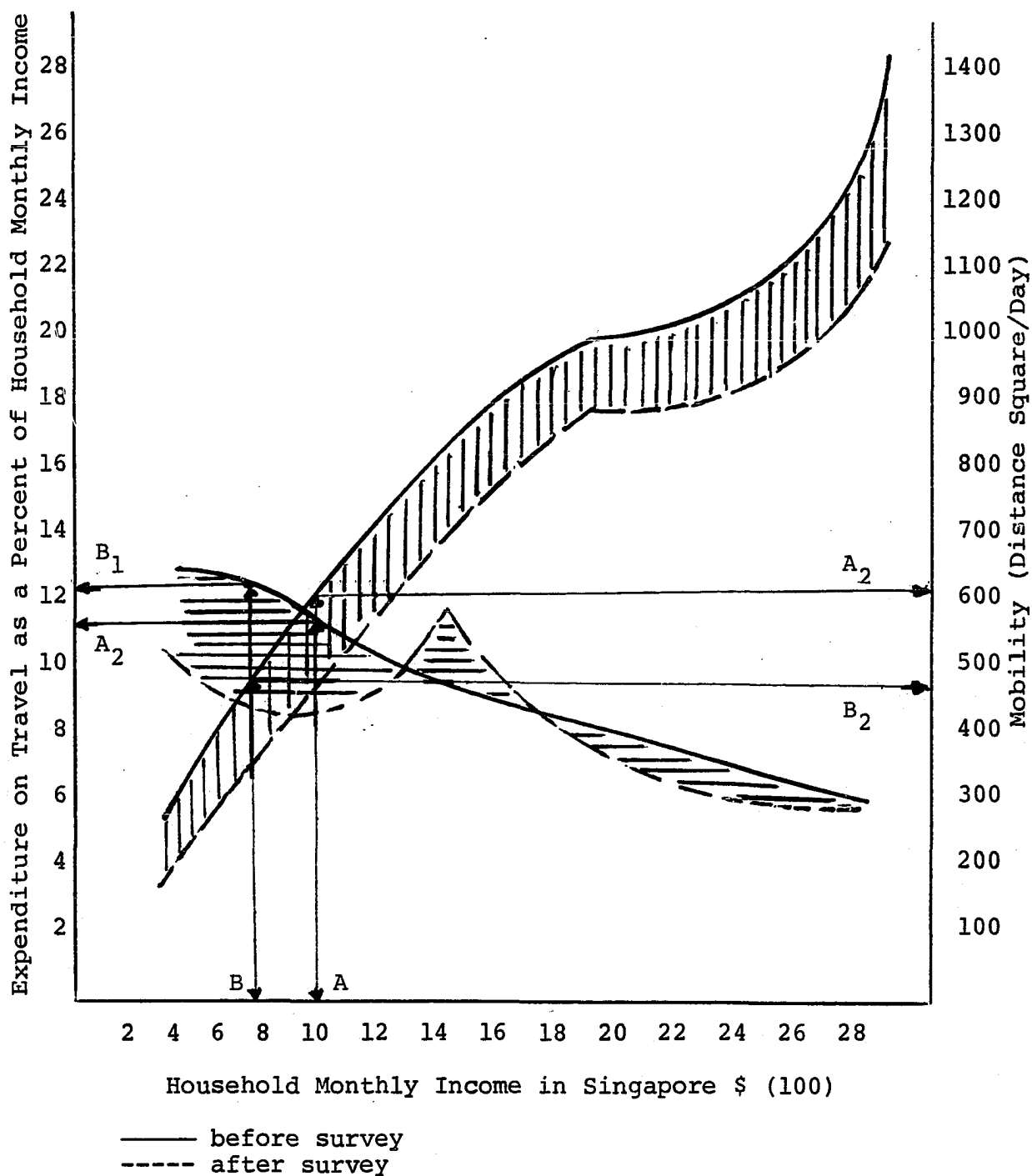


Figure 6.18 Mobility and Expenditure on Travel by Different Income Groups, Vehicle-Ownning Households - Singapore (1975).

Source: Travel and Income Data on Singapore are based on Y. Zahavi & G. Roth TRB Paper, 1980. Cost of travel data is based on information the author obtained from Wilbur Smith & Associates 1980.

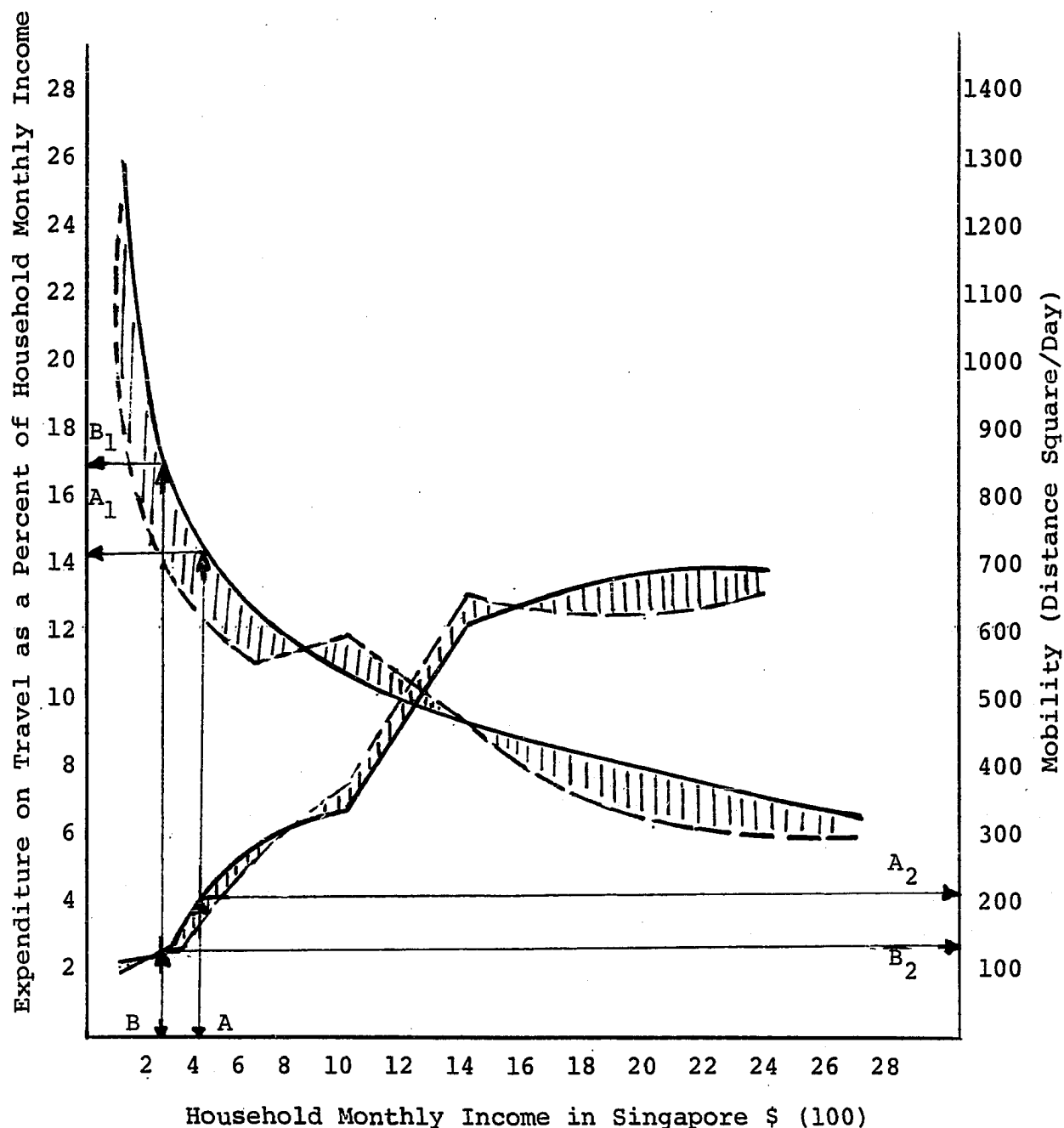


Figure 6.19 Mobility and Expenditure on Travel by Different Income Groups, Nonvehicle-Owning Households - Singapore (1975).

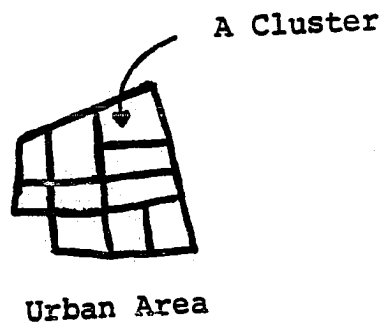
Source: Travel and Income Data on Singapore are based on Y. Zahavi & G. Roth TRB Paper, 1980. Cost of travel data is based on information the author obtained from Wilbur Smith & Associates 1980.

### Example Three: Spatial Analysis

A step-by-step application of the proposed need approach to spatial analysis on data from Santiago, Chile. Data and maps of Santiago areas travel characteristics were obtained by the author from the World Bank (1980). The maps of Santiago were manipulated to illustrate the need approach to spatial analysis and are available in Appendix L. The data of Santiago was used to demonstrate the steps required in the application of spatial analysis as described in Chapter V.

#### Step 1

- a) The urban area is to be divided into clusters (clusters or the neighborhood groupings of people could be parcels, census blocks or tracts; depending on available data).



- b) A decision is to be made of the factors that are believed to be indicative of low mobility.

Based upon available data from Santiago, Chile, the following factors are considered as indicators of low mobility.

1. Vehicle per household
2. Household income
3. Distance on public transit
4. Trips per day
5. Travel time per day
6. Distance traveled per day

Maps of Santiago divided into clusters by the above factors were made available to the author by the World Bank. These maps are available in Appendix J.

## Step 2

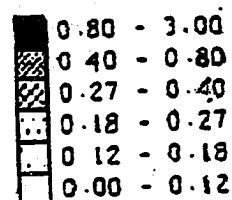
Each factor mentioned in Step 1 is rated on its own separate and different interval scale by category ratings (category ratings are estimates of relative influence among categories of a single factor).

The category ratings of factors in Santiago:

- a) Households were divided into six categories for each factor. The categories of vehicle ownership factor as represented graphically is shown below.

Vehicles Per Household

(A higher rating of vehicle ownership per household indicates more mobility.)



- b) Ratings of vehicle ownership per household were plotted on the map of Santiago to indicate graphically the rate of vehicles per household for each cluster (as shown

below and in Appendix J).



- c) A weight or multiplier equal to one was assigned to the factor of vehicle ownership, as well as to other factors in Santiago. (Weighting multipliers are estimates of relative influence among separate factors.)
- d) Since each factor mentioned in Step 1 would be rated on its own separate and interval scale, a range that is common to all factors has to be developed. The chosen range for Santiago data was 0 to 10, and the transformation technique could be presented in the following equation.

$$r'_{ij} = \frac{r_{ij}}{r_{i\max}}$$

where:  $r'_{ij}$  is the transformed rating for category  $i$ ,  
 $r_{ij}$  is the originally assigned rating for category  $j$  of factor  $i$ , and  
 $r_{i\max}$  is the maximum rating given any category of factor  $i$ .

The transformed values for vehicle ownership: For category ratings of 0.8 to 3.00 vehicles per household

$$r_{ij} = \frac{0.27 + 0.40}{2} = .335$$

$$r'_{ij} = \frac{.335}{3.00} \times 10 = 1.12$$



The same procedure is worked out for other category ratings as shown below.

<u>Vehicles Per Household</u>	<u>Category Ratings</u>	<u>Transformed Values</u>
	0.80-3.00	6.33
	0.40-0.80	2.00
	0.27-0.40	1.12
	0.18-0.27	0.75
	0.12-0.18	0.50
	0.00-0.12	0.20

### Step 3

Transformed values for all factors are estimated and mapped as it has been done for the factor of vehicles per household. Two examples are given below on a) household income and b) distance traveled on public transit.

	<u>Category Ratings</u>	<u>Transformation Values</u>
a) Household Income in	11,000.00-20,000.00	8.25
Pesos/Month for	7,000.00-11,000.00	4.50
Santiago, Chile in	5,000.00- 7,000.00	3.00
1977.	4,000.00- 5,000.00	2.25
(Higher income indicates	3,000.00- 4,000.00	1.75
more mobility.)	1,000.00- 3,000.00	1.00

	<u>Category Ratings</u>	<u>Transformed Values</u>
b) Distance on Public	17.00-30.00	7.83
Transit in Kilometers/	13.00-17.00	5.00
Traveler/Day. (Longer	11.00-13.00	4.17
distances per traveler	9.00-11.00	3.33
per day indicates higher	7.00- 9.00	2.67
mobility.)	4.00- 7.00	1.83

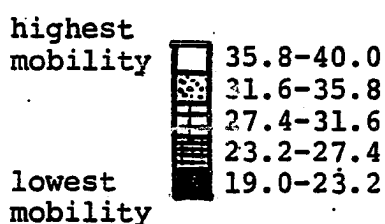
Transformed values for other factors are obtained similarly to the examples given above. The values obtained are shown below as well as on the maps of Santiago in Appendix L.

Transformed Values for the Factors That are  
Considered as Indicators of Low Mobility  
in Santiago, Chile

Household Income in Pesos/Month	Vehicles Per Household	Household Income	Distance on Public Transit	Trips Per Day	Travel Time Per Day	Distance Traveled Per Day
11,000-20,000	6.33	8.25	7.83	8.50	8.59	7.75
7,000-11,000	2.00	4.50	5.00	6.81	6.86	5.00
5,000- 7,000	1.12	3.00	4.17	6.44	6.25	4.13
4,000- 5,000	0.75	2.25	3.33	6.13	5.63	3.50
3,000- 4,000	0.50	1.75	2.67	5.88	5.00	3.00
1,000- 3,000	0.20	1.00	1.83	5.83	4.22	1.88

Step 4

- a) The transformed values from all factors would be added together to form one total score representative of the degree of mobility that exists in different clusters.
- b) The difference between the lowest and the highest "total scores" is divided into five equal values as shown below for the Santiago data.

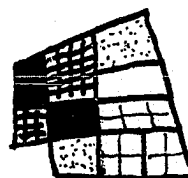


- c) The "total scores" which are representative of the degree of mobility could be plotted on the clusters in three forms:

1. Total scores placed  
on each cluster,



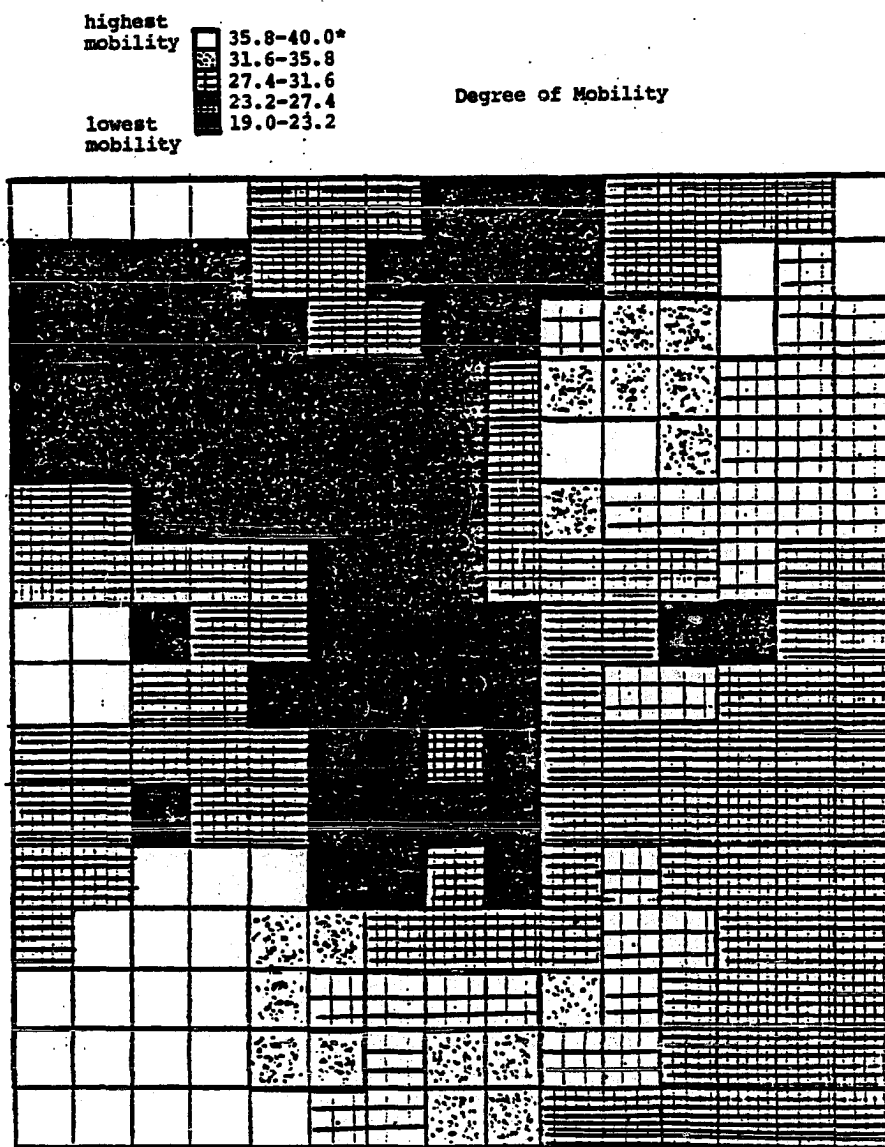
2. or graphically presented,



- d) A grid system could be used  
for possible computerization  
as shown in Figure 6.20 of  
Santiago data. (By trans-  
forming the values for all factors individually on the  
grid system and adding the values for each square by

itself to form one total score representative of the degree of mobility within that square.)

The data obtained in the Amman Region Household Survey (1980) could be useful to do a similar analysis performed on Santiago, Chile. Amman data, however, lacked certain information such as the distance traveled on public transit per day and the total distance traveled per day.



\*The scores are representative of the degree of mobility that exists in different areas of Santiago, Chile.

Figure 6.20 Degree of Mobility

Other Applications Which Could be Addressed  
by the Need Approach

(1) Objectives and evaluation criteria

The author proposes the following objectives for transportation development in the Amman Region based on the "basic needs" of the poor.

Transportation Need Performance Objectives:

a) Objective

To provide a transportation system that promotes rapid and easy movements thus minimizing travel time and/or distance traveled by the poor.

Criteria for Evaluation

1. Home to employment trip must be within tolerable limits and does not exceed 45 minutes.
2. In any home to employment trip distance traveled must not exceed 15 Kms.

b) Objective

The urban transportation system in Amman should operate with a minimum operational cost to users.

Criteria for Evaluation

1. For income groups living below the poverty level, expenditure on transportation must not consume more than 9% of total household income.

Transportation Need Service Aspects

c) Objective

To improve the transportation infrastructure and services in low income urban areas which are often

in poor condition, particularly in areas where households are living below poverty level.

#### Criteria for Evaluation

1. The improvement of local roads to urban communities with household incomes below JD 100 per month presently served by below standard roads.
2. The provision of public service bus transport to communities identified through spatial analysis to have low mobility.

#### d) Objective

To re-establish the movement rights of the pedestrian (a considerable percentage of which are poor), particularly in urban areas of Amman, where pedestrian movement is most extensive and concentrated.

#### Criteria for Evaluation

1. The restoration of the pedestrian's right to cross major urban roads at specific points where they are now grossly restricted and dominated by the 'rights' of vehicular flow.
2. The provision of an integrated pedestrian system, linked to major local activities and alternative transportation modes, both in urban centres and residential neighborhood areas.

e) Objective

To ensure that high income areas do not have public transportation services provided to them which are subsidized by the low income areas.

Criteria for Evaluation

1. The provision of public transportation services to areas with an average household income above JD 1200 per annum should be financed through local fares and not through profits made from high density poor areas.

f) Objective

To increase the capacity and number of public transportation bus routes within Amman urban areas to accommodate the travel needs of the non-car owning community in general and the poor in particular.

Criteria for Evaluation

1. The provision of public transportation services to areas of lowest mobility (identified through spatial analysis) as priority areas.
2. The provision of such services commensurate to the travel patterns and distribution of the community's traveling habits and needs.
3. The provision of such services in a manner whereby the volume of need may be accommodated in the most efficient manner, given the available funds and transport facilities.



g) Objective

To provide a transportation system within Amman urban area which offers adequate physical, economic and temperal access to the basic necessities of life; including the basic commodities required for everyday living.

Criteria for Evaluation

1. The number of links provided to basic public services such as medical, educational and other public transportation services, as well as the number of links to main retailing centers and markets (both locally and within the urban centers).
2. The affordability of the public transportation service to the non-car owning community and low income groups especially those defined as poor.
3. The regularity and suitability of the public transportation service against the travel habits and volume of travel need.
4. The location of the major access points to the public transport service, which should be within walking distance of the majority of households.

## 2) Transportation Problems and Policies Based on Need

### Problems related to transportation need performance

1. The lack of efficient transportation system management that allows the full utilization of present facilities and capacities.
2. The inadequacy of some transportation links that contributes to congestion and longer travel times.
3. The lack of an integrated public transport system which causes long queues and delays.

### Policies

1. The provision of transportation links that improve the system and permit rapid movements and minimize distance traveled as permitted by available resources.
2. The application of an integrated, properly managed transportation system that takes into account the coordination of different means and patterns of travel of the system.

### Problems Related to Transportation Need Service Aspects

1. The inadequate and poor condition of transportation infrastructure and services in low income urban areas, particularly where households are living below poverty level.
2. The erosion of pedestrian movement rights, particularly in urban areas, and the subsequent absence of adequate

pedestrian facilities.

3. The suspected unintended indirect subsidization of bus public transportation to high income areas of Amman by lower income groups.
4. The inadequate public transportation services, particularly in urban poor areas for access to even the most basic of needs, as evidenced by the extensive use of the highly expensive call taxi.

#### Policies

1. Priority for investment to be made into public transportation provision, especially for low income areas at the urban and regional level, to accommodate both the needed trips that would require public transportation services and to utilize existing transportation infrastructure more effectively, giving priority to low income groups and areas of low car ownership.
2. Greater priority to be given to the rights of the pedestrian in urban areas, with both additional funds and rights being made available to accommodate, safer and more pleasurable pedestrian movement, both as a means of access to modes of transport, other activities and as an activity in itself.
3. Subsidies to be provided for public transportation services to low income areas, particularly at the edge

of urban areas, which would otherwise be isolated from the main urban services of the Amman Region and would not qualify for public transportation facilities on commercial grounds of public transportation operation.

#### Problems Related to Transportation Operating Cost Aspects

1. The absence of efficient public transport means on certain routes leads to the use of other means thus consuming more than what is tolerable by the household income.
2. The length of certain transport routes or the deficiency in the geometry and pavement conditions of some links lead to high operational cost of buses operated by the Public Transport Corporation (tire costs, depreciation of vehicles, value, etc.).

#### Policies

1. Subsidizing the public transport routes and means in low income areas to reduce the household expenditure on transportation so it does not exceed 9 percent of the income.

#### Example of a Program

Rerouting of public transport routes to reduce costs, improvement of road conditions and provision of bypass routes. Special low fare programs in poor areas.

## Footnotes

<sup>1</sup>Jordan Urban Project, Final Report, p. 7.

<sup>2</sup>Ibid., p. 7.

<sup>3</sup>Amman Region Transportation Study, Technical Memorandum 1, pp. 1-2.

<sup>4</sup>His Majesty King Hussein in his instructions to the Prime Minister on the occasion of the establishment of the Ministry of Municipal and Rural Affairs, February 13, 1965.

<sup>5</sup>National Planning Council, The Three Year Development Plan (1973-1975), Amman, 1973, p. 16.

<sup>6</sup>National Planning Corporation, Five Year Plan 1976-1980, Amman, 1976, pp. 26, 53.

<sup>7</sup>Jordan Urban Project, Final Report, October 1979.

<sup>8</sup>This information has been revealed to the author through direct contact with officials from the Department of Statistics in Amman, Jordan, in January 1981.

<sup>9</sup>Jordan Urban Project.

<sup>10</sup>The household survey data was made available to the author by officials of Amman Municipality on February 1981. One out of the three household survey data tapes wasn't readable, however the other two tapes were in good condition and had 1156 samples representing all income groups in the Amman Region. The analysis of the travel habits of the poor was done with 269 samples (or 65.31% of all samples) representing the two income groups JD 0-50 per month and JD 50-100 per month.

<sup>11</sup>Amman Region Transportation Study, Phase 1 Interim Report, p. 26.

<sup>12</sup>In estimating the number of needed trips by the poor through gap analysis, the goal would be to reach the same number of trips taken by the average of all households in Amman Region.



<sup>16</sup> Amman Region Transportation Study, Technical Memorandum 10, p. 73.

<sup>17</sup> As estimated from Table 4.3, Technical Memorandum 1, Amman Region Transportation Study, 1980.

<sup>18</sup> As estimated from Table 4.1, Technical Memorandum 1, Amman Region Transportation Study, 1980.

<sup>19</sup> Gap analysis approach to estimate needed trips by the poor would be to reach the same number of trips taken by the average of all households in Amman Region as shown in Talbe K-5 in Appendix K.

<sup>20</sup> An example for estimating the percentage difference for the home based work trips HBW:

$$\text{Percentage difference} = \left( \frac{2.17}{0.814} \times 100\% \right) - (100\%) = 166.58\%$$

<sup>21</sup> Jordan Urban Project, Interim Sector Report 4, Social Surveys (1), Table 8, p. 11.

<sup>22</sup> Amman Region Transportation Study, Technical Memorandum 9, Table 2.1.

<sup>23</sup> Amman Region Transportation Study, Technical Memorandum 1, p. 5.

<sup>24</sup> Amman Region Transportation Study, Technical Memorandum 1.

<sup>25</sup> Ibid., p. 15.

<sup>26</sup> Servicing costs are closely related to the length of service lines, be they roads, cables or pipes. A doubling in area will therefore cause service line lengths to be multiplied by roughly the square root of two, an increase of 40 to 50 percent.

<sup>27</sup> Planned Development in Balqa-Amman Region, Interim Report: September 1979, p. 111-8-30. Amman Urban Region Planning Group.

<sup>28</sup> Ibid., pp. 11-8-7.

<sup>29</sup> As it has been revealed to the author through discussions with officials of the Amman Municipality in February 1981.

<sup>30</sup>Amman Region Transportation Study, Technical Memorandum 9, Tables 2.15 and 2.16.

<sup>31</sup>The zonal division is based on Figures 3.2 and 3.3 of Phase 1 Interim Report in Amman Region Transportation Study, February 1980.

<sup>32</sup>Amman Region Transportation Study, Technical Memorandum 9, Table 2.3.

<sup>33</sup>Zone household percentages of different income groups is based on Table 2.15, Technical Memorandum 9 of the Amman Region Transportation Study. The trip demand for different income groups are based on information available in Appendix K. The trip needs are based on earlier section estimates of travel need for the poor.

<sup>34</sup>Jordan Urban Project, Final Report, p. 48.

<sup>35</sup>Amman Region Transportation Study, Technical Memorandum 1, Table 4.1.

<sup>36</sup>Ibid., Table 4.3.

<sup>37</sup>Amman Region Transportation Study, Phase 1, Final Report, 1980.



## CHAPTER VII

### CONCLUSIONS AND SUGGESTED RESEARCH

#### Conclusions

This research study attempts to answer the following three questions:

Question One: Do the poor in cities of the developing countries have genuine "transportation needs" that are essential to be met?

This study provides an analysis on a number of subjects that are related to the question above. These subjects are; urbanization, employment, mobility, expenditures on travel, and the changing objectives of development in the developing countries. The conclusions from the analysis provided on these subjects are:

• A discussion provided on the problem of rapid urbanization concluded that:

1. There might be certain advantages to urbanization at a certain level of economic development.
2. It is difficult to implement policies to stop migration from rural to urban areas.
3. The trend for rapid urbanization will continue in the next two decades (1980-2000) as indicated by a population forecast by the United Nations.

4. The increased urban sprawl has an unfavorable impact on the mobility of the poor. Data indicates that a high percentage of the trips by the poor are on foot.

- The study on the expenditures on travel in developing countries concluded that the poor often pay a higher percentage of their income on transport than the affluent (or generally, the non poor income groups of the population).
- A literature review concluded that adequate mobility is essential to conquer poverty and that the inadequacies of public transport systems and long journey times to work as well as the high cost of travel can effectively preclude participation in many employment opportunities. Squatter settlements in developing countries, often accounting for over a quarter of the city's population, frequently lack any effective public transport service. In many urban areas, poor workers spend four hours a day traveling to and from work and expend 25 percent of their income on transport.
- Several world organizations believe that strategies for economic development in developing countries should be "need oriented" rather than "market-demand oriented." At present (1980), many developing countries have adopted and are working with a policy for "satisfying the basic human needs of the population." An important factor in a policy aimed at satisfying the basic human needs is the provision of a desirable level of access to opportunities (jobs, schools,

hospitals, etc.) at an acceptable user time and cost. Consequently, those countries that are politically committed to "a basic needs policy" for the poor have genuine transportation needs to be met.

- The summary of the conclusions to question two are: Cities in the developing countries have a considerable number of poor people who travel extensively on foot and pay a high percentage of their income for travel; i.e., the poor in developing countries have real "transportation needs." Adequate public transit is an important factor in making use of available employment opportunities. Governments that are committed to providing the basic needs for the poor have to supply the "transportation system supply needed" to make use of the available urban opportunities such as employment, health and education as well at acceptable user standards of time and cost.

Question Two: Is the conventional transportation planning framework adequate for the purpose of analyzing the transportation needs of the poor in developing countries?

This study evaluated the conventional transportation planning framework for analyzing the transportation needs of the poor in developing countries. The conclusions that could be drawn are:

- The conventional transportation planning models fail to address "need," as it was demonstrated in the example of Amman, Jordan. In addition, this study is in agreement with some prominent authors who indicate that the conventional models are

complex and expensive to apply, not capable of providing quick answers to policy questions, and cannot cope with the dynamic changes and data inadequacies in cities of the developing countries.

Question Three: What type of transportation planning framework is required for the purpose of analyzing the transportation needs of the poor in developing countries? Does the proposed nonspatial/spatial analysis framework meet the desired qualities?

• The conclusion of this study about the type of transportation planning framework required indicates that it should:

1. address the transportation needs of the poor,
2. be easy to understand and inexpensive to apply,
3. provide quick responses to policy questions, and
4. require minimum data to apply.

• This study proposes a nonspatial/spatial analysis framework for analyzing the transportation needs of the poor in developing countries. The proposed framework requires a relatively small sample. Nonspatial analysis' main objective is to make use of data obtained from household interviews for policy analysis. Spatial analysis' main objective is to identify the zones in an urban area with deficiencies in transportation supply as well as estimate the trips needed by purpose at the zonal level. The application of the proposed analysis framework on available data from Santiago, Chile, and Singapore indicated that the proposed framework is not a complex one to apply, and that it

might be useful for application in developing countries that are committed to providing the basic needs for the poor. In the example of Amman, Jordan, the proposed approach was tested against the conventional demand approach used in a recent (February 1981) transportation study of Amman, Jordan. The conclusion drawn from the example of Amman is that the need approach presents an improved method over demand modeling for the purpose of assessing the travel requirements of the poor in Amman Region.

#### Prospects for Future Research

This study suggests the following areas for future research work:

1. A practical demonstration of the nonspatial and spatial analysis framework, proposed in this study, by a city in a developing country.
2. This research work dealt mainly with the travel needs of that segment of the poor who's main problem is that of earning "limited income." Further research is needed to study the structure of poverty in developing countries. Such research work would shed light on trips needed by the poor who have other problems beside being of "limited income." This segment includes the very old, the young, the chronically ill, the mentally retarded and others. Various segments of the poor might be in need of making certain types of trips for specific purposes that would require a certain level of service and different types of transportation supply than those used by

the rest of the poor population. Future research should be directed towards developing precise techniques for estimating the poor's "basic needs" for travel for every segment of the poor population, and the specific surveys required for that purpose.

3. The goal of mobility provided to the poor is to have an adequate level of access to urban facilities. Assuming that the basic needs have been evaluated by the government of a developing country and that targets for improvements have been set (for example, eliminating over five years the lag in a region's health or educational services), the planner is faced with the fundamental question of deciding what criteria should govern the spatial distribution of facilities so as to make as many as possible available to the maximum number of users, while at the same time minimizing costs and problems of providing an adequate level of transportation system supply. The decisions to be made on the "trade off" between transportation and facility location are complex ones and could make an interesting area for future research.

4. In terms of employment, the transportation system supply needs should be tied closely to future manpower requirements of cities in the developing countries. A detailed demonstration research project in a developing country could result in the development of transportation/manpower analysis techniques useful for the economic development of cities in the developing countries.

## BIBLIOGRAPHY

### Books

- Chapin, Stuart F. Jr., and Kaiser, J. Edward. Urban Land Use Planning, Third Edition. University of Illinois Press, 1979.
- Desai, Meghrad. "Planning in India." Models, Planning and Basic Needs. Edited by Sam Cole and Henry Lucas. New York: Pergamon Press, 1979.
- Haq, Malibub Ul. The Strategy of Economic Planning. New York: Oxford University Press, 1963.
- \_\_\_\_\_. The Poverty Curtain. New York: Columbia University Press, 1976.
- Helly, Walter. Urban Systems Models. New York: Academic Press, 1975.
- International Labour Office. Employment, Growth and Basic Needs: A One World Problem. New York: Praeger Publishers, 1977.
- Lapin, Lawrence. Statistics, Meaning and Method. New York: Harcourt Brace Jovanovich, Inc., 1975.
- Lewis, Arther. The Theory of Economic Growth. Homewood, Ill.: Richard D. Irwin, 1955.
- Lluch, C.; Powell, A. A. and Williams, R. A., Patterns in Household Demand and Saving. Published for the World Bank, Oxford University Press, 1977.
- Manheim, M. Fundamentals of Transportation Systems Analysis, Volume 1: Basic Concepts. The MIT Press, 1979.
- Mohan, Rakesh. Urban Economic and Planning Models. Published for the World Bank, The Johns Hopkins University Press, 1979.
- Morawetz, David. Twenty-five Years of Economic Development, 1950 to 1975. Published for the World Bank, The Johns Hopkins University Press, 1977.

- Nyerere, Julius. "Basic Needs: Indicators and Ideology." Models, Planning and Basic Needs. Edited by Sam Cole and Henry Lucas. New York: Pergamon Press, 1979.
- Owen, Wilfred. Automobiles and Cities, Strategies for Developing Countries. The Brookings Institution, 1973.
- Todaro, M. P. Internal Migration in Developing Countries. The International Labour Office, Geneva, 1976.
- Webb, R. C. Government Policy and the Distribution of Income in Peru, 1963-73. Cambridge, Mass.: Harvard University Press, 1977.
- Weinberg, G. H., and Schumaker, J. A. Statistics: An Intuitive Approach, Third Edition. Brooks/Cole Publishing Company, 1974.

#### Studies, Proceedings and Reports

- Adelman, I., and Robinson, S. "Migration, Demographic Change and Income Distribution in a Model of a Developing Country." In Research in Population Economics, Vol. 1. Edited by J. L. Simon. JAI Press, 1978.
- \_\_\_\_\_, and others. "A Comparison of Two Models for Income Distribution Planning." Paper read at the World Bank Workshop on Analysis of Distributional Issues in Development Planning, Bellagio, Italy, April 1977.
- Bird, R. M., and Dewulf, L. H. "Taxation and Income Distribution in Latin America: A Critical Review of Empirical Studies." International Monetary Fund Staff Papers, Vol. 19, No. 3, November 1973.
- Burnett, Pat, and Thrift, Nigel. "New Approaches to Understanding Traveler Behavior." A paper.
- Charles River Associates, Inc. NCHRP Project 8-13, Phase 1 Report (Unpublished).
- Fifth Conference of Health of State or Government of Non-Aligned Countries. Economic Declaration, Colombo, Sri Lanka, August 1976.



Goodwin, P. B. "A Hypothesis of Constant Outlay on Travel." P.T.R. Summer Conference 1973.

Government of India, Planning Commission. The First Five Year Plan: A Summary. New Delhi, 1950.

Hagerstrand, T. "What About People in Regional?" Papers of the Regional Science Association, 1970.

Hanson, S., and Marble, D. F. "A Preliminary Typology of Urban Travel Linkages, East Lakes, Georgia." 1971.

Hauser, Edwin W.; Rooks, E.; Johnston, S. A.; and Billivray, L. M. Guide for Transportation Providers. "The Use of Existing Facilities for Transporting Disadvantaged Residents of Rural Areas." Prepared for Socioeconomic Studies, Office of Program and Policy Planning, Federal Highway Administration, Research Triangle Institute, Research Triangle Park, North Carolina, January 1975.

International Bank for Reconstruction and Development. The Task Ahead for the Cities of the Developing Countries. Washington, D. C., 1975.

Jones, Peter M. "New Approaches to Understanding Travel Behavior: The Human Activity Approach."

Kaye, Ira. "Mobility in Rural America - Need for Public Transportation for People." Rural Housing Alliance and Rural America, Inc., Conference Working Paper No. 1, Transportation. Washington, D. C., January 1976.

Kostyniuk, L. P. A Behavioral Choice Model for the Urban Shopping Activity. Ph.d. Dissertation, Department of Civil Engineering, State University of New York at Buffalo, 1975.

Martin, B.; Memmott, F.; and Bone, A. Principles and Techniques of Predicting Future Demand for Urban Area Transportation. MIT Report No. 3. The MIT Press, 1974.

McNamara, Robert S. "Annual Speech to the Board of Governors." September 1972.

Meerman, Jacob. "Fiscal Incidence in Empirical Studies of Income Distribution in Poor Countries." Washington, D. C.: U.S. Agency for International Development, Discussion Paper no. 25, processed. 1972.

- National Cooperative Highway Research Program. Travel Estimation Procedures for Quick Response to Urban Policy Issues. Report No. 186.
- Rodgers, G.; Hopkins, M.; and Wery R. Population, Employment and Inequality: Bachue, Philippines. Westmead, Saxon House, for the International Labour Office. 1978.
- Rodgers, H. B. Pilot National Recreation Survey: First Report. B.T.A. and University of Keele, 1967.
- Roth, G. "Improving the Mobility of the Urban Poor." Paper prepared for the PTRC Summer Meeting, Warwick, June 1977.
- Sargon, S. D., and Maguire, C. E. Transportation in Developing Countries: Some Sensitivity Considerations. Transportation Research Board Special Report 168.
- Sen, Amartya. "Economic Development: Objectives and Obstacles." Paper presented at the SSRC-ACLS Conference on the Lessons of China's Development Experience for the Developing Countries, San Juan, Puerto Rico. 1976.
- Steinitz, C., and Rogers, P. A Systems Analysis Model of Urbanization and Change. MIT Report No. 20.
- Stewart, Frances. "Inequality, Technology, and Payments Systems." Paper presented at the World Bank Workshop on Analysis of Distributional Issues in Development Planning, Bellagio, Italy, April 1977.
- Taylor, Lance, and Lysy, F. "Vanishing Short-Run Income Redistributions: Keynerian Clues About Model Surprises." Paper read at the World Bank Workshop on Analysis of Distributional Issues in Development Planning, Bellagio, Italy, April 1977.
- United Nations. Concise Report on the World Population Situation in 1970-1975 and its Long-Range Implications. July 1974.
- U.S. Department of Commerce, Bureau of Economic Analysis (BEA). Survey of Current Business, Washington, D.C., July 1978.
- University of Oxford. "Identifying the Determinants of Destination Choice." Studies Unit 1, March 1977.
- Webber, M. M. Potential Urban Transport Projects in Brazil. Prepared for the World Bank, February 1977. (Unpublished.)

World Bank. Urbanization. Sector Working Paper. June 1972.

\_\_\_\_\_. Urban Transport. Sector Policy Paper. May 1975.

\_\_\_\_\_. Relieving Traffic Congestion: The Singapore Area License Scheme. Staff Working Paper No. 281. June 1978.

Zahavi, Y. "Travel Time Budgets and Mobility in Urban Areas." U.S. Department of Transportation, Final Report, 1974.

\_\_\_\_\_. "Travel Behavior in Transportation Systems." Paper presented at the Conference of Research Directives in Computer Control of Urban Traffic Systems, California, 1979.

\_\_\_\_\_. The UMOT Project. 1979.

Zahavi, Y. and Roth, G. J. "Travel 'Budgets' in Developing Countries." Paper presented to the Conference on Personal Travel Budgets, University of Leeds, May 1979.

\_\_\_\_\_. "Measuring the Effectiveness of High Occupancy Vehicles Priority Schemes." Paper presented at the TRB meeting, January 1980.

### Articles and Periodicals

Adelman, I.; Morris C.; and Robinson, S. "Policies for Equitable Growth." World Development, Vol. 4, No. 7, July 1976.

Alonso, W. "Urban and Regional Imbalances in Economic Development." E.D.C.C., October 1968.

Bruton, Henry J. "Unemployment Problems and Policies in Less Developed Countries." American Economic Association, Vol. 68, No. 2, May 1978.

Corradino, J. C.; Coomer, B. D.; and Upshaw, W. S. "Successive Overlays - A Small City Transit Survey Process." Traffic Engineering, December 1974.

- Lisk, F., and Hoeven, R. "Measurement and Interpretation of Poverty in Sierra Leone." International Labour Review, Vol. 118, No. 6, November-December 1979.
- Markovitz, J. K. "Transportation Needs of the Elderly." Traffic Quarterly, Vol. XXV, No. 2, April 1971.
- Mera, K. "On the Urban Agglomeration and Economic Efficiency." E.D.C.C., January 1973.
- Peek, P., and Standing G. "Rural-Urban Migration and Government Policies in Low Income Countries." International Labor Review, Vol. 118, No. 6, November-December 1979.
- Simmons, A. B. "Slowing Metropolitan City Growth in Asia: Policies, Programs, and Results." Population and Development Review, March 1979.
- Wickstrom, G. V. "Defining Balanced Transportation - A Question of Opportunity." Traffic Quarterly, Vol. XXV, No. 3, July 1971.

#### Reports

- Amman Region Transportation Study, Technical Memorandum 1, Halcrow-Fox & Associates, Jouzy & Partners, 1980.
- Amman Region Transportation Study, Technical Memorandum 2, Halcrow-Fox & Associates, Jouzy & Partners, March, 1980.
- Amman Region Transportation Study, Technical Memorandum 9, Halcrow-Fox & Associates, Jouzy & Partners, July, 1980.
- Amman Region Transportation Study, Technical Memorandum 10, Halcrow-Fox & Associates, Jouzy & Partners.
- Amman Region Transportation Study, Phase 1 Interim Report, Halcrow-Fox & Associates, Jouzy & Partners, February 1980.
- Amman Region Transportation Study, Phase 1, Final Report, Halcrow-Fox & Associates, Jouzy & Partners, 1980.
- Jordan Urban Project, Final Report. Halcrow-Fox & Associates Jouzy & Partners, October 1979.
- Jordan Urban Project, Interim Sector Report 4, Social Surveys (1).

Planned Development in Balqa-Amman Region, Interim Report:  
September 1979. Amman Urban Region Planning Group.

## APPENDIXES

## APPENDIX A

Recent statistical, country-level data on population, GNP at market prices, GNP per capita, and average annual growth in developed and developing countries.

The data are based on the 1979 World Bank Atlas.

Table A-1

Population (mid-1977 and mid-1978), GNP at Market Prices (1977 and 1978), GNP per Capita (1977 and 1978), and Average Annual Growth Rate (1970-77)

## ASIA

GNP at market prices rounded to US\$ tens of millions. GNP per capita rounded to nearest US\$10.

No.	Country	Population (000)		GNP at market prices (US\$ millions)		GNP per capita (US\$)		Growth rate (%)	
		mid-1977	mid-1978 (P)	1977	1978 (P)	1977	1978 (P)	Population 1970-77	GNP per capita (real) 1970-77
1	China, People's Republic of <sup>1,2</sup>	902,337	914,139	372,800	424,620	410	460	1.6	4.5
2	India	631,726	643,896	100,180	112,660	160	180	2.1	1.1
3	Japan	113,216	114,053	737,180	836,160	6,510	7,330	1.2	3.6
4	Bangladesh	81,219	83,641	6,520	7,630	80	90	2.5	-0.2
5	Pakistan	74,905	77,337	15,070	17,530	200	230	3.1	0.8
6	Viet Nam	50,647	52,179	n.a.	8,870	n.a.	170	3.1	n.a.
7	Philippines	44,473	45,639	20,410	23,250	460	510	2.7	3.7
8	Thailand	43,326	44,345	18,660	21,790	430	490	2.8	4.1
9	Korea, Republic of	35,953	36,616	35,150	42,460	980	1,160	2.0	7.6
10	Iran	34,782	35,849	n.a.	n.a.	n.a.	n.a.	3.0	n.a.
11	Burma	31,512	32,205	4,330	4,900	140	150	2.2	1.3
12	China, Republic of	16,793	17,139	19,800	23,930	1,180	1,400	2.0	5.5
13	Korea, Democratic People's Republic of <sup>1,2</sup>	16,651	17,066	11,380	12,530	680	730	2.6	5.3
14	Afghanistan	14,304	14,616	3,150	3,530	220	240	2.2	2.7
15	Sri Lanka	14,097	14,350	2,290	2,720	160	190	1.7	1.3
16	Nepal	13,322	13,627	1,450	1,580	110	120	2.2	2.4
17	Malaysia	12,961	13,300	12,600	14,540	970	1,090	2.7	4.9
18	Iraq	11,803	12,216	18,490	22,720	1,570	1,860	3.4	7.1
19	Syrian Arab Republic	7,835	8,088	6,700	7,490	860	930	3.3	6.1
20	Saudi Arabia	7,633	7,870	55,210	63,310	7,230	8,040	3.0	13.0
21	Yemen Arab Republic <sup>1</sup>	4,982	5,098	2,540	2,960	510	580	1.9	n.a.
22	Hong Kong	4,536	4,622	11,890	14,050	2,620	3,040	2.0	5.8
23	Israel	3,604	3,716	13,570	15,300	3,760	4,120	2.8	2.0
24	Lao People's Democratic Republic <sup>1</sup>	3,200	3,300	290	300	90	90	n.a.	n.a.
25	Lebanon	2,939	3,011	n.a.	n.a.	n.a.	n.a.	2.5	n.a.
26	Jordan <sup>3</sup>	2,888	2,985	1,960	2,270	940	1,050	3.3	6.5
27	Singapore <sup>4</sup>	2,319	2,355	6,540	7,690	2,820	3,260	1.6	6.6
28	Yemen, People's Democratic Republic of <sup>1,5</sup>	1,717	1,749	600	740	350	420	1.9	11.2
29	Mongolia <sup>1,2</sup>	1,530	1,575	1,330	1,470	870	940	3.0	1.6
30	Bhutan <sup>1</sup>	1,231	1,259	110	120	90	100	2.3	-0.3
31	Kuwait	1,137	1,212	14,420	18,040	12,690	14,890	6.2	-0.9
32	Oman	814	839	2,050	2,160	2,510	2,570	3.2	4.0
33	United Arab Emirates	750	804	11,100	11,440	14,800	14,230	16.7	-3.6
34	Bahrain <sup>1,5</sup>	343	368	1,390	1,510	4,050	4,100	7.1	0.2
35	Macao <sup>1</sup>	291	299	370	440	1,270	1,460	2.3	17.1
36	Qatar	215	223	2,440	2,840	11,370	12,740	10.3	-2.4
37	Brunei <sup>1</sup>	165	171	1,520	1,820	9,190	10,640	3.4	7.7
38	Maldives <sup>1</sup>	140	145	20	20	140	150	4.0	n.a.
39	Kampuchea, Democratic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

<sup>1</sup> Estimates of GNP per capita and its growth rate are tentative.

<sup>2</sup> For estimation of GNP per capita, see Technical Note, page 22.

<sup>3</sup> GNP per capita relates to East Bank only. GNP per capita growth rate relates to 1972-77.

<sup>4</sup> Including the expatriate community, the GNP per capita amounts to US\$2,290 for 1977 and US\$2,620 for 1978.

<sup>5</sup> GNP per capita growth rate relates to 1973-77.

(P) Preliminary.

n.a. Not available.



Table A-2  
Population (mid-1977 and mid-1978), GNP at Market Prices (1977 and 1978), GNP per Capita (1977 and 1978), and Average Annual Growth Rate (1970-77)

## AFRICA

GNP at market prices rounded to US\$ tens of millions. GNP per capita rounded to nearest US\$10.

No.	Country	Population (000)		GNP at market prices (US\$ millions)		GNP per capita (US\$)		Growth rate (%)	
		mid-1977	mid-1978 (P)	1977	1978 (P)	1977	1978 (P)	1970-77	1970-77
1	Nigeria	78,982	81,039	40,540	45,720	510	560	2.6	4.4
2	Egypt, Arab Republic of	37,796	38,686	12,950	15,520	340	400	2.1	5.2
3	Ethiopia	30,245	31,011	3,280	3,640	110	120	2.5	0.2
4	South Africa	26,952	27,708	37,640	40,940	1,400	1,480	2.7	1.1
5	Zaire	25,694	26,410	5,290	5,510	210	210	2.7	-1.4
6	Morocco	18,310	18,914	11,140	12,610	610	670	2.7	4.2
7	Algeria	17,152	17,701	19,570	22,290	1,140	1,260	3.2	2.1
8	Sudan <sup>1</sup>	16,919	17,390	5,650	5,540	330	320	2.6	2.5
9	Tanzania <sup>2</sup>	16,363	16,871	3,440	3,880	210	230	3.0	2.1
10	Kenya	14,614	15,187	4,300	4,830	290	320	3.8	0.9
11	Uganda	12,049	12,421	n.a.	n.a.	n.a.	n.a.	3.0	n.a.
12	Ghana	10,634	10,972	3,940	4,250	370	390	3.0	-2.0
13	Mozambique <sup>1</sup>	9,691	9,945	1,320	1,360	140	140	2.5	-4.3
14	Madagascar	8,085	8,298	1,870	2,050	230	250	2.5	-2.7
15	Cameroon	7,882	8,065	3,280	3,700	420	460	2.2	1.0
16	Ivory Coast	7,463	7,836	5,710	6,580	770	840	6.0	1.1
17	Rhodesia <sup>1</sup>	6,683	6,913	3,070	3,320	460	480	3.3	-0.1
18	Angola <sup>1</sup>	6,575	6,739	1,840	2,000	280	300	2.3	-3.4
19	Mali	6,129	6,297	720	760	120	120	2.5	1.9
20	Tunisia	5,899	6,050	4,940	5,760	840	950	2.0	6.5
21	Malawi	5,597	5,780	860	1,010	150	180	3.1	3.1
22	Upper Volta	5,465	5,553	760	870	140	160	1.6	1.6
23	Senegal	5,240	5,377	1,980	1,830	380	340	2.6	0.4
24	Zambia	5,128	5,295	2,350	2,530	460	480	3.0	-0.2
25	Guinea	4,989	5,133	1,000	1,070	200	210	3.0	2.5
26	Niger	4,862	5,005	950	1,110	190	220	2.8	-1.8
27	Rwanda	4,379	4,514	710	830	160	180	2.9	1.3
28	Chad	4,221	4,320	560	620	130	140	2.2	-1.0
29	Burundi	4,156	4,271	550	610	130	140	1.9	0.6
30	Somalia <sup>1</sup>	3,660	3,743	430	470	120	130	2.3	-1.1
31	Benin	3,229	3,326	670	770	210	230	2.9	0.5
32	Sierra Leone	3,210	3,296	640	690	200	210	2.5	-1.3
33	Libya	2,636	2,745	17,189	18,960	6,520	6,920	4.2	-4.5
34	Togo	2,350	2,418	650	770	280	320	2.6	5.3
35	Central African Republic <sup>1</sup>	1,867	1,909	440	480	240	250	2.2	0.9
36	Liberia	1,684	1,742	740	820	410	470	3.4	1.1
37	Mauritania	1,503	1,545	410	420	270	270	2.7	-0.2
38	Congo, People's Republic of the	1,423	1,460	710	780	500	530	2.5	0.8
39	Lesotho <sup>1</sup>	1,250	1,279	320	360	260	280	2.4	0.9
40	Namibia <sup>1</sup>	926	953	960	1,020	1,030	1,070	2.2	0.9
41	Mauritius	906	918	670	760	740	830	1.3	6.9
42	Guinea-Bissau <sup>1</sup>	747	762	130	160	180	210	2.2	-1.2
43	Botswana	728	747	390	460	530	620	2.9	16.2
44	Gambia, The	554	570	120	130	210	230	2.1	2.2
45	Gabon	533	539	1,700	1,920	3,190	3,550	4.9	6.2
46	Swaziland <sup>1</sup>	511	526	270	310	530	590	2.5	5.6
47	Reunion <sup>1</sup>	499	507	1,450	1,550	2,900	3,050	2.7	-1.2
48	Comoros	370	390	70	70	180	180	2.2	-1.2
49	Equatorial Guinea	338	346	n.a.	n.a.	n.a.	n.a.	2.2	0.6
50	Cape Verde <sup>1</sup>	313	319	50	50	150	160	2.7	-2.2
51	Djibouti <sup>1</sup>	300	320	130	140	450	450	3.5	-0.2
52	Sao Tome and Principe <sup>1,2</sup>	82	85	40	40	460	490	1.2	2.0
53	Seychelles <sup>1</sup>	62	63	60	70	940	1,100	2.5	3.5

<sup>1</sup> Estimates of GNP per capita and its growth rate are tentative.<sup>2</sup> Mainland Tanzania.<sup>3</sup> GNP per capita growth rate relates to 1974-77.

(P)—Preliminary.

n.a.—Not available.

Table A-3

Population (mid-1977 and mid-1978), GNP at Market Prices (1977 and 1978), GNP per Capita (1977 and 1978), and Average Annual Growth Rate (1970-77)

## SOUTH AMERICA

GNP at market prices rounded to US\$ tens of millions. GNP per capita rounded to nearest US\$10.

No.	Country	Population (000)		GNP at market prices (US\$ millions)		GNP per capita (US\$)		Growth rate (%)	
		mid-1977	mid-1978 (P)	1977	1978 (P)	1977	1978 (P)	Popu- lation 1970-77	GNP per capita (real) 1970-77
1	Brazil	116,100	119,430	163,880	187,190	1,410	1,570	2.9	6.7
2	Argentina	26,036	26,371	48,710	50,250	1,870	1,910	1.3	1.8
3	Colombia	24,605	25,136	18,760	21,790	760	870	2.1	3.8
4	Peru	16,363	16,820	11,800	12,440	720	740	2.8	1.8
5	Venezuela	13,513	13,965	35,480	40,710	2,630	2,910	3.4	3.2
6	Chile	10,553	10,734	13,160	15,180	1,250	1,410	1.7	-1.8
7	Ecuador	7,324	7,550	6,000	6,890	820	910	3.0	6.1
8	Bolivia	5,154	5,290	2,460	2,690	480	510	2.7	2.9
9	Uruguay	2,876	2,892	4,170	4,660	1,450	1,610	0.2	1.3
10	Paraguay	2,810	2,893	2,100	2,450	750	850	2.9	4.3
11	Guyana	817	836	430	460	520	550	2.0	0.4
12	Suriname <sup>1,2</sup>	381	389	710	820	1,870	2,110	-1.1	6.3
13	French Guiana <sup>1</sup>	60	62	120	150	1,980	2,340	2.9	1.2

<sup>1</sup> Estimates of GNP per capita and its growth rate are tentative.

<sup>2</sup> GNP per capita growth rate relates to 1973-77.

(P)—Preliminary.

Table A-4

Population (mid-1977 and mid-1978), GNP at Market Prices (1977 and 1978), GNP per Capita (1977 and 1978), and Average Annual Growth Rate (1970-77)

## NORTH AND CENTRAL AMERICA

GNP at market prices rounded to US\$ tens of millions. GNP per capita rounded to nearest US\$10.

No	Country	Population (000)		GNP at market prices (US\$ millions)		GNP per capita (US\$)		Growth rate (%)	
		mid-1977	mid-1978 (P)	1977	1978 (P)	1977	1978 (P)	Population 1970-77	GNP per capita (real) 1970-77
1	United States	216,729	218,373	1,896,550	2,117,890	8,750	9,700	0.8	2.0
2	Mexico	63,319	65,470	73,720	84,150	1,160	1,290	3.3	1.2
3	Canada	23,320	23,568	194,660	216,090	8,350	9,170	1.2	3.4
4	Cuba <sup>1,2</sup>	9,590	9,718	7,220	7,860	750	810	1.6	-1.2
5	Guatemala	6,436	6,627	5,350	6,040	830	910	2.9	3.3
6	Dominican Republic	4,980	5,128	4,190	4,680	840	910	3.0	4.6
7	Haiti	4,749	4,831	1,090	1,240	230	260	1.7	2.1
8	El Salvador	4,256	4,382	2,510	2,810	590	600	3.1	2.1
9	Honduras	3,322	3,441	1,410	1,650	420	480	3.3	0.0
10	Puerto Rico	3,303	3,365	8,090	9,150	2,450	2,720	2.8	0.1
11	Nicaragua	2,411	2,490	2,090	2,100	870	840	3.3	2.5
12	Jamaica	2,101	2,131	2,230	2,350	1,060	1,110	1.7	-2.0
13	Costa Rica	2,061	2,110	2,870	3,250	1,390	1,540	2.5	3.2
14	Panama	1,771	1,826	2,120	2,350	1,200	1,290	3.1	-0.1
15	Trinidad and Tobago	1,118	1,137	2,930	3,310	2,620	2,910	1.2	1.5
16	Martinique <sup>1</sup>	322	321	1,120	1,270	3,470	3,950	0.1	5.7
17	Guadeloupe <sup>1</sup>	319	319	820	910	2,560	2,850	0.2	2.9
18	Netherlands Antilles <sup>1</sup>	244	246	680	780	2,780	3,150	1.3	0.5
19	Barbados	248	250	440	490	1,770	1,940	0.5	2.6
20	Bahamas <sup>1</sup>	213	218	520	570	2,450	2,620	2.7	-7.2
21	Belize <sup>1</sup>	130	132	100	110	750	840	0.9	4.7
22	St. Lucia <sup>1</sup>	118	120	70	80	560	630	2.3	0.7
23	Grenada <sup>1</sup>	105	106	50	60	470	530	1.8	-3.2
24	St. Vincent <sup>1</sup>	103	105	30	40	320	380	2.3	-2.2
25	Virgin Islands (US) <sup>1</sup>	98	101	510	540	5,190	5,350	3.6	0.6
26	Dominica <sup>1</sup>	77	77	30	30	400	440	1.2	-4.1
27	Antigua <sup>1</sup>	73	74	60	70	860	950	1.3	-3.7
28	Bermuda <sup>1</sup>	54	54	460	500	8,520	9,260	0.5	2.4
29	St. Kitts-Nevis <sup>1</sup>	50	50	30	30	610	660	0.9	1.6

<sup>1</sup> Estimates of GNP per capita and its growth rate are tentative.

<sup>2</sup> For estimation of GNP per capita, see Technical Note, page 22.

<sup>3</sup> Preliminary.

Table A-5

Population (mid-1977 and mid-1978), GNP at Market Prices (1977 and 1978), GNP per Capita (1977 and 1978), and Average Annual Growth Rate (1970-77)

## EUROPE

GNP at market prices rounded to US\$ tens of millions. GNP per capita rounded to nearest US\$10.

No.	Country	Population (000)		GNP at market prices (US\$ millions)		GNP per capita (US\$)		Growth rate (%)	
		mid-1977	mid-1978 (P)	1977	1978 (P)	1977	1978 (P)	Population 1970-77	GNP per capita (real) 1970-77
1	USSR <sup>1,2</sup>	258,932	261,234	861,210	965,520	3,330	3,700	0.9	4.4
2	Germany, Federal Republic of	61,418	61,212	529,380	587,700	8,620	9,600	0.2	2.2
3	Italy	56,468	56,800	199,270	218,320	3,530	3,840	0.7	2.0
4	United Kingdom	55,932	55,918	254,100	281,090	4,540	5,030	0.1	1.6
5	France	53,051	53,182	397,670	439,970	7,500	8,270	0.7	3.1
6	Turkey	41,949	42,925	46,580	51,750	1,110	1,210	2.5	4.5
7	Spain	36,298	36,655	118,170	128,920	3,260	3,520	1.0	3.6
8	Poland <sup>1,2</sup>	34,728	35,081	114,280	128,330	3,290	3,660	1.0	6.3
9	Yugoslavia	21,738	21,933	45,600	52,340	2,100	2,390	0.9	5.1
10	Romania <sup>1,3</sup>	21,648	21,853	33,030	38,170	1,530	1,750	0.9	9.9
11	German Democratic Republic <sup>1,2</sup>	16,857	16,859	85,400	95,490	5,070	5,660	-0.2	4.9
12	Czechoslovakia <sup>1,2</sup>	15,013	15,120	63,640	71,320	4,240	4,720	0.7	4.3
13	Netherlands	13,864	13,971	106,930	117,190	7,710	8,390	0.9	2.2
14	Hungary <sup>1,2</sup>	10,628	10,672	32,940	36,860	3,100	3,450	0.4	5.1
15	Belgium	9,845	9,870	81,550	89,520	8,280	9,070	0.3	3.5
16	Portugal	9,577	9,653	17,580	19,540	1,840	2,020	0.8	3.1
17	Greece	9,231	9,325	27,200	30,530	2,950	3,270	0.7	4.0
18	Bulgaria <sup>1,2</sup>	8,835	8,892	25,000	28,450	2,830	3,200	0.6	5.7
19	Sweden	8,263	8,297	77,200	84,750	9,340	10,210	0.4	1.2
20	Austria	7,506	7,498	48,390	52,720	6,450	7,030	0.2	3.8
21	Switzerland	6,327	6,286	70,110	76,050	11,080	12,100	0.2	0.1
22	Denmark	5,076	5,084	46,520	50,410	9,160	9,920	0.2	2.2
23	Finland	4,732	4,745	29,300	32,380	6,190	6,820	0.2	1.1
24	Norway	4,034	4,048	34,560	38,500	8,570	9,510	0.5	3.9
25	Ireland	3,198	3,234	9,770	11,210	3,060	3,470	0.2	2.1
26	Albania <sup>1,2</sup>	2,545	2,606	1,670	1,920	660	740	2.5	4.1
27	Cyprus	644	646	1,180	1,370	1,830	2,110	0.7	0.2
28	Luxembourg	357	358	3,440	3,730	9,640	10,410	0.8	8.6
29	Malta	333	335	620	730	1,870	2,180	0.2	1.0
30	Iceland	223	226	1,710	1,880	7,690	8,320	0.2	2.1
31	Channel Islands <sup>1</sup>	132	133	460	550	3,510	4,170	0.9	-0.2
32	Isle of Man <sup>1</sup>	61	62	180	210	2,940	3,380	0.5	-1.0
33	Greenland <sup>1</sup>	50	50	310	340	6,280	6,760	0.2	0.1
34	Faeroe Islands <sup>1</sup>	42	43	320	350	7,690	8,140	0.2	0.1
35	Gibraltar <sup>1</sup>	30	31	100	110	3,190	3,550	0.2	0.1

<sup>1</sup> Estimates of GNP per capita and its growth rate are tentative.

<sup>2</sup> For estimation of GNP per capita, see Technical Note, page 22.

<sup>3</sup> This estimate is not comparable to those for the other centrally planned economies. It has been arrived at, following the World Bank Atlas methodology, by adjusting official Romanian national accounts data and converting them to US dollars at the effective exchange rate for foreign trade transactions.

(P)—Preliminary.

Table A-6

Population (mid-1977 and mid-1978), GNP at Market Prices (1977 and 1978), GNP per Capita (1977 and 1978), and Average Annual Growth Rate (1970-77)

## OCEANIA AND INDONESIA

GNP at market prices rounded to US\$ tens of millions. GNP per capita rounded to nearest US\$10.

No.	Country	Population (000)		GNP at market prices (US\$ millions)		GNP per capita (US\$)		Growth rate (%)	
		mid-1977	mid 1978 (P)	1977	1978 (P)	1977	1978 (P)	1970-77	1970-77
1	Indonesia	133,505	135,993	42,680	48,820	320	360	1.8	5.7
2	Australia	14,074	14,366	102,570	113,830	7,290	7,920	1.7	1.6
3	New Zealand	3,148	3,187	14,110	15,270	4,480	4,790	1.7	0.9
4	Papua New Guinea	2,857	2,930	1,460	1,640	510	560	2.4	2.5
5	Fiji	589	599	780	860	1,330	1,440	1.8	3.7
6	Gilbert Islands <sup>1</sup>	205	213	80	90	390	430	3.5	1.7
7	Western Samoa	154	157	n.a.	n.a.	n.a.	n.a.	1.2	n.a.
8	New Caledonia <sup>1</sup>	145	150	650	700	4,470	4,650	3.3	-5.9
9	French Polynesia <sup>1</sup>	145	148	690	780	4,770	5,270	3.3	1.8
10	Pacific Islands, U.S. Trust Territory of the <sup>1</sup>	129	132	140	160	1,120	1,230	3.4	1.4
11	New Hebrides <sup>1</sup>	101	103	50	60	490	540	2.7	1.8
12	Guam <sup>1</sup>	94	95	590	680	6,270	7,130	1.2	5.1
13	Tonga <sup>1</sup>	92	93	40	40	400	430	1.9	0.9
14	Kiribati <sup>1,2</sup>	55	56	40	40	700	690	1.6	0.0
15	American Samoa <sup>1</sup>	31	32	210	240	6,830	7,400	2.0	8.4

<sup>1</sup> Estimates of GNP per capita and its growth rate are tentative.

<sup>2</sup> Formerly Gilbert Islands, which became independent on July 12, 1979.

(P)—Preliminary.

n.a.—Not available.

\* Formerly Ellice Islands, which became independent on October 1, 1978, and for which data are not available.

## Appendix B

Illustrative costs of urban travel by different modes and examples of the capacities of public transit modes and equipment.

Table B-1

Carrying Capacities of Varying Types of Roadway and Associated Areas  
Required per Person during Peak Period for a One-Mile Journey

Mode of transport	Flow (number of persons per foot width per hour)	Speed (mph)	$\lambda$ (feet)	Area required per person (square feet)
Automobiles on urban street 44 feet wide with 1.5 passengers per vehicle	67	15	0.0074	39
	95	10	0.00526	28
Automobiles on urban express- way with 1.5 passengers/ vehicle	187	40	0.0027	14
Pedestrian way	800	2.5	0.0006	3
Urban railway line	2900	18	0.00017	0.9
	2200	30	0.00023	1.2

Daily peak busy period:  $T = 2$  hours.

SOURCE: Smeed

Table B-2

## Illustrative Costs of Urban Travel by Different Modes

	<u>SPEED</u> (km/hr)	<u>PERSON CAPACITY</u> (Per foot) width per hour)	<u>TOTAL COSTS</u> in Nigeria (Kobo per Km.)
Footway, 4 feet wide	3.3	1,100	Negligible
Bicycle track, 4 feet wide	14	450	0.3
Urban street, 24 feet wide, mixed traffic			
Car with driver only	24	29	17.5
	16	51	17.4
Taxi with 4 passengers	19	120	4.5
	14	200	4.5
Mini-bus with 10 passengers	16	150	2.9
	12	250	3.0
Bus with 30 passengers	14	300	2.1
	11	500	2.2
Urban street, 44 feet wide, mixed traffic			
Car with driver only	24	39	16.5
	16	55	17.2
Taxi with 4 passengers	19	160	4.3
Mini-bus with 10 passengers	16	190	2.7
	12	280	2.9
Bus with 30 passengers	14	410	2.0
	11	550	2.2
Urban expressway (capacity per foot-width is independent of width)			
Car with driver only	64	180	16.4
Taxi with 4 passengers	64	720	4.1
Mini-bus with 10 passengers	64	1,200	2.6
Bus with 40 passengers	64	2,000	1.5
Metro (22,500 passengers per hour)	34	1,700	3.9
Urban railway (22,500 passengers per hour)	48	1,700	2.2

SOURCE: Based upon urban transport sector policy paper, World Bank, Washington, D.C., U.S.A., 1975.  
(1 Kobo = \$ .01)



Table B-3

## Capacities of Public Transport Equipment

TYPE OF EQUIPMENT	PER CENT <sup>1</sup> SEATED	PEAK SCHEDULED <sup>2</sup> CAPACITY		HOURLY ONE DIRECTION CAPACITY														
				HEADWAY <sup>3</sup> (minutes)														
				Per Vehicle	Per Train	10.0	7.5	6.0	5.0	3.3	3.0	2.0	1.5	0.92	0.75	0.6	0.27	0.12
Buses																		
Standard double deck	83	108	—	648	864	1,080	1,296	—	2,160	3,240	4,160	—	8,640	10,800	24,300			
Standard single deck	71	63	—	378	504	630	756	—	1,260	1,890	2,520	—	5,040	6,300	14,000			
Public light bus	100	13	—	78	104	130	156	—	260	390	520	—	1,040	1,300	2,925	6,500		
Trams																		
Two car tram train	52	—	260	1,560	2,080	2,600	3,120	—	5,200	7,700	10,400	17,000	—	—	—	—	—	—
Standard tram car	52	130	—	780	1,040	1,300	1,560	—	2,600	3,900	5,200	8,500	10,400	13,000	—	—	—	—
Ferries																		
Triple deck conventional	100	1,170	—	7,020	9,360	11,700	—	—	—	—	—	—	—	—	—	—	—	—
Standard double deck conventional	92	540	—	3,240	4,320	5,400	6,480	—	10,800 <sup>4</sup>	—	—	—	—	—	—	—	—	—
Water bus	100	270	—	1,620	2,160	2,700	3,240	—	5,400	8,100	—	—	—	—	—	—	—	—
Large sidewall hovermarine-high speed	100	180	—	1,080	1,440	1,800	2,160	—	3,600	—	—	—	—	—	—	—	—	—
Water taxi	100	60	—	360	480	600	720	—	1,200	1,800	—	—	—	—	—	—	—	—
Sidewall hovermarine-high speed	100	54	—	324	432	540	648	—	1,080	1,620	—	—	—	—	—	—	—	—
Kowloon-Canton Railway <sup>5</sup>																		
Ordinary class-14 car train	36	—	3,402	20,412	27,216	34,020	40,824	61,576 <sup>4</sup>	—	—	—	—	—	—	—	—	—	—
Ordinary class-12 car train	36	—	2,916	17,496	23,328	29,160	34,992	52,780 <sup>4</sup>	—	—	—	—	—	—	—	—	—	—
Mixed class-14 car train	42	—	2,718	16,308	21,744	27,180	32,616	49,195 <sup>4</sup>	—	—	—	—	—	—	—	—	—	—
Ordinary class-8 car train	36	—	1,914	11,664	15,522	19,440	23,328	35,106 <sup>4</sup>	—	—	—	—	—	—	—	—	—	—
Mixed class-10 car train	46	—	1,746	10,476	13,968	17,460	20,952	31,603 <sup>4</sup>	—	—	—	—	—	—	—	—	—	—
Mass Transit Railway <sup>7</sup>																		
8 car train	17	—	2,000	12,000	16,000	20,000	24,000	—	40,000	60,000	80,000 <sup>4</sup>	—	—	—	—	—	—	—
6 car train	17	—	1,500	9,000	12,000	15,000	18,000	—	30,000	45,000	60,000 <sup>4</sup>	—	—	—	—	—	—	—
4 car train	17	—	1,000	6,000	8,000	10,000	11,000	—	20,000	30,000	40,000 <sup>4</sup>	—	—	—	—	—	—	—

<sup>1</sup> At authorized or tolerable capacity.<sup>2</sup> Average load over the peak period; see Table 7-2.<sup>3</sup> Extreme values show minimum practical operating headway intervals for each type of equipment, taking into account (a) passenger boarding and alighting time, (b) equipment turnaround time, (c) terminal facilities, and (d) safe operating distances between successive vehicles or trains.**Note:** KCR suggest that train capacities could be increased by 40 per cent with double-deck coaches and that 1.5 minute headways would be achieved. This latter item however, may imply multi-platform stations if double-deck coaches were used, due to loading/unloading times. Train control systems would also have to be altered.<sup>4</sup> Based on minimum headway intervals achievable for short periods but not over whole peak period.<sup>5</sup> From twin berth pier for Star Ferry only; not possible with HYF ferries without redesign of vessels and piers.<sup>6</sup> Assumes station platform lengths of 1,000 feet to accommodate 14 car trains, full depth of track and electrification.<sup>7</sup> Assumes station platform lengths of 600 feet to accommodate 8 car trains.**SOURCE:** Hong Kong Transport Study, 1973,  
Wilbur Smith and Associates

Table B-4

## Maximum Scheduled Peak Directional Capacity of Public Transport Equipment

TYPE OF EQUIPMENT	SCHEDULED PEAK CAPACITY IN ONE DIRECTION	CONDITIONS ASSUMED FOR STATED CAPACITY		
		Minimum Headway (minutes)	Per Ccnt of Passenger Seated	Cars Per Train
Mass Transit — maximum, short periods	80,000	1.50	17	8
Suburban Railway — maximum, short periods	61,600	3.30	36	14
Mass Transit — sustained operation	60,000	2.00	17	8
Suburban Railway — sustained operation	40,800	5.00	36	14
Mass Transit — shortest train	30,000	2.00	17	4
Standard Double-deck Bus	24,300	0.27	83	1
Suburban Railway — shortest train	23,300	5.00	36	8
Tramways — two car trains	17,000	0.92	52	2
Standard Single-deck Bus	14,000	0.27	71	1
Tramways — single car	13,000	0.60	52	1
Triple-deck Ferry	11,700	6.00	100	1
Standard Double-deck Ferry	10,800	3.00	92	1
Water Bus	8,100	2.00	100	1
Public Light Bus	6,500	0.12	100	1
Sidewalk Movermatino Ferry	1,620	2.00	100	1
Cable Tram (Peak Tram)	632	7.50	82	1

SOURCE: Hong Kong Transport Study, 1973, Wilbur Smith and Associates

## APPENDIX C

Statistical information on poverty, the overall degree of inequality in the distribution of income, and the GNP growth rate in developing countries.

Table C-1

Estimated Numbers of People in Developing Market  
Economies Living in Poverty - 1972

Region	Total Population	Seriously Poor	Destitute	Seriously Poor	Destitute
		(millions of people)		(percentage of population)	
Asia	1,196	853	499	71	42
Africa	345	239	134	69	39
Latin America	274	118	73	43	27
TOTAL <sup>1</sup>	1,815	1,210	706	67	39

<sup>1</sup>Excluding developing countries in Europe and Oceania, with a total population of about 25 million.

SOURCE: International Labor Office, Growth and Basic Needs: A One-World Problem, Table 2.

Table C-2  
Increase in Poverty, 1963-72<sup>1</sup>

Region	Total Population	Seriously Poor	Destitute
Asia	195	92	34
Africa	68	26	5
Latin America	62	1	4
TOTAL	325	119	43

SOURCE: International Labor Office, Growth and Basic Needs: A One-World Problem, Table 3.

<sup>1</sup>Millions of persons.

Table C-3

Cross-Section Estimates of Income Shares and Average Absolute Income Levels of Low-Income Groups, Developing Countries, Various Years

<i>GNP per capita</i> (U.S. dollars, 1971)	<i>Lowest 40 percent</i>		<i>Lowest 20 percent</i>	
	<i>Income share</i> (percent)	<i>Absolute income</i> (U.S. dollars, 1971)	<i>Income share</i> (percent)	<i>Absolute income</i> (U.S. dollars, 1971)
75	22.42	42.04	8.68	32.55
100	20.07	50.16	7.66	38.30
200	15.47	77.34	5.63	56.31
300	13.49	101.15	4.72	70.84
400	12.40	123.97	4.20	84.05
500	11.73	146.65	3.87	96.76
600	11.31	169.59	3.65	109.36
700	11.03	193.00	3.49	122.06
800	10.85	216.98	3.38	134.98
900	10.74	241.59	3.29	148.21
1,000	10.68	266.87	3.24	161.79
1,500	10.76	403.62	3.14	235.74
3,000	15.00	909.14	4.38	519.13

*Note:* These estimates are based on regression equations predicting the income shares of the lowest income groups as estimated from cross country data. These predicted income shares are based on the assumption that explanatory variables other than per capita GNP in the regression equation are held constant at their mean value for the sample. When per capita GNP is used as the sole explanatory variable, the income shares are somewhat lower for the earlier stages, and the turning point occurs at about \$500. For details, see Ahluwalia (1976).

SOURCE: Reproduced from Ahluwalia and Duloy, 1976, Appendix.

Table C-4

GNP per Capita and Its Annual Growth Rate, by Region, 1950-75

Region	Population, 1975 (millions) (1)	GNP per capita		Annual growth rate, 1950-75 (percent) (4)
		1974 U.S. dollars		
		1950 (2)	1975 (3)	
South Asia	830	85	132	1.7
Africa	384	170	308	2.4
Latin America	304	495	944	2.6
East Asia	312	130	341	3.9
China, People's Republic of	820	113	320	4.2
Middle East	81	460	1,660	5.2
Developing countries	2,732	160	375	3.4
Developing countries excluding China	1,912	187	400	3.0
Developed countries <sup>a</sup>	654	2,378	5,238	3.2

a. All OECD countries except Greece, Portugal, Spain, and Turkey.

SOURCE: Reproduced from Morawetz, 1977, Table 1.

## Appendix D

Statistical data on employment in developing countries.



Table D-1

Preliminary estimates of unemployment and underemployment in developing countries, by region, 1975\*

Region	Unemployment <sup>1</sup>				Underemployment <sup>2</sup>				Total			
	Total		Urban		Total		Urban		Total		Urban	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Asia <sup>3</sup>	18	3.9	6	6.9	168	36.4	20	23.2	186	40.3	26	30.1
Africa	10	7.1	3	10.8	53	37.9	7	25.1	63	45.0	10	35.9
Latin America	5	5.1	5	6.5	28	28.9	14	22.8	33	34.0	19	29.3
Oceania	—	—	—	—	1	49.0	—	—	1	49.0	—	—
Total	33	4.7	14	8.0	250	35.7	41	23.3	283	40.4	55	31.3

<sup>1</sup> Defined as "persons without a job and looking for work". <sup>2</sup> Defined as "persons who are in employment of less than normal duration and who are seeking or would accept additional work" and "persons with a job yielding inadequate income". <sup>3</sup> Excluding China and other Asian centrally planned economies.

\*In millions

SOURCE: Reproduced from the International Labor Office (1977) Employment, Growth and Basic Needs: A One-World Problem, Table 1.

Table D-2

Estimates of Unemployment, September 1975

Major regions	Numbers of unemployed persons (millions)	Unemployment as percentage of total labour force
Asia and Oceania <sup>1</sup>	1.3	2.0
Northern Europe <sup>2</sup>	2.1	5.7
Western Europe <sup>3</sup>	2.9	4.4
Southern Europe <sup>4</sup>	2.7	4.0
North America <sup>5</sup>	8.1	8.1
Total	17.1	5.2

<sup>1</sup> Australia, Japan, New Zealand. <sup>2</sup> Denmark, Finland, Ireland, Norway, Sweden, United Kingdom. <sup>3</sup> Austria, Belgium, France, Federal Republic of Germany, Netherlands, Switzerland. <sup>4</sup> Greece, Italy, Portugal, Spain, Turkey and Yugoslavia. <sup>5</sup> Canada, United States.

SOURCE: Reproduced from the International Labor Office (1977) Employment, Growth and Basic Needs: A One-World Problem, Table 2.

Table D-3

## Open Unemployment Rates, Selected Countries, by Year 1960-74

Country	Average percentage of open unemployment														
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
<i>Africa</i>															
Egypt, Arab Republic of	4.8	3.2	1.8	n.a.	1.9	n.a.	n.a.	n.a.	3.1	2.7	2.4	1.5	n.a.	n.a.	n.a.
<i>Asia</i>															
China (Taiwan)	n.a.	n.a.	n.a.	n.a.	4.4	3.4	3.1	2.3	1.7	1.9	1.7	1.7	1.5	n.a.	n.a.
Korea	n.a.	n.a.	8.4	8.1	7.7	7.4	7.1	6.2	5.1	4.8	4.5	4.5	4.5	4.0	5.4
Philippines	6.3	7.5	8.0	6.3	6.4	8.2	7.2	8.2	7.8	6.7	n.a.	4.8	6.9	4.4	n.a.
<i>Middle East</i>															
Syrian Arab Republic	n.a.	8.5	6.0	10.6	11.4	7.4	5.5	5.3	7.4	4.3	6.4	7.5	4.7	4.5	n.a.
<i>Latin America</i>															
Argentina (Buenos Aires)	n.a.	n.a.	n.a.	n.a.	5.7	5.3	5.6	6.4	5.0	4.3	4.8	6.0	6.6	6.2	n.a.
Bolivia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	15.9	16.1	16.3	16.4	16.1
Chile (Gran Santiago)	7.4	6.7	5.3	5.1	5.3	5.4	5.4	6.1	6.1	6.2	7.2	5.5	4.8	4.4	9.7
Colombia (Bogotá)	n.a.	n.a.	n.a.	7.9	7.1	8.9	10.1	12.2	11.5	9.6	8.2	8.9	6.8	n.a.	10.0
Panama	n.a.	n.a.	n.a.	5.8	7.4	7.6	5.1	6.2	7.0	6.6	7.1	7.6	6.8	6.5	n.a.
Peru (Lima-Callao)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7.0	7.0	7.0	n.a.	n.a.	7.7	6.5
Trinidad and Tobago	n.a.	n.a.	n.a.	n.a.	n.a.	14.0	14.0	15.0	15.0	13.5	12.5	12.6	n.a.	14.0	n.a.
Uruguay (Montevideo)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	8.4	8.7	7.5	7.6	7.7	8.9	n.a.
Venezuela (urban)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7.7	6.3	6.5	6.3	6.0	n.a.	n.a.	n.a.

*Note:* Since different definitions of unemployment are applied by various countries, the figures do not provide a consistent basis of comparison. At best, they can only give a rough indication of the direction of change in open unemployment over time—if it can be assumed that the definition used by each country remains relatively constant over time.

n.a. Not available.

SOURCE: Reproduced from the World Bank, "Urban Poverty and Employment," Draft Issues Paper, 1976.

Table D-4

Open Unemployment Rates, Selected Countries,  
Specific Years, 1967-75

Country	Year	Open unemployment rate (percent)	
		Urban	Total
<i>Africa</i>			
Egypt, Arab Republic of	1971	n.a.	1.5
Ghana	1970	n.a.	6.0
Tanzania	1971	n.a.	10.0
Average, Africa <sup>a</sup>	1975	10.8	7.1
<i>Asia</i>			
China (Taiwan)	1972	n.a.	1.5
India	1971	n.a.	3.9
Indonesia	1971	4.8	2.2
Korea	1974	n.a.	5.4
Malaysia	1967/68	9.9	6.8
Pakistan	1972	n.a.	2.0
Philippines	1971	11.0	5.3
Sri Lanka	1969/70	16.9	13.2
Thailand	1969	1.3	0.2
Turkey	1969	4.9	n.a.
Average, Asia <sup>a, b</sup>	1975	6.9	3.9
<i>Middle East</i>			
Syrian Arab Republic	1973	n.a.	4.5
<i>Latin America</i>			
Bolivia	1974	n.a.	9.7
Brazil	1970	n.a.	2.0-2.4
Colombia	1974	10.0	n.a.
El Salvador	1975	4.9-8.6	5.2
Honduras	1972	n.a.	8.0
Mexico	1970	n.a.	3.7
Panama	1973	n.a.	6.5
Peru	1974	6.5	n.a.
Trinidad and Tobago	1973	n.a.	14.0
Uruguay	1973	8.9	n.a.
Venezuela	1971	6.0	n.a.
Average, Latin America <sup>a</sup>	1975	6.5	5.1

n.a. Not available.

a. ILO estimate.

b. Excluding the People's Republic of China and other Asian countries with centrally planned economies.

SOURCE: Reproduced from the World Bank, "Urban Poverty and Employment," Draft Issues Paper, 1976.

## Appendix E

Percentages of income spent on different commodities as related to the level of GNP per capita for a sample of seventeen countries.

Table E-1  
Characteristics of the Sample of Seventeen Countries

Country (1)	Sample period (2)	Sample midpoint (3)	National currency unit (NCU) (4)	Per capita GNP at midpoint of sample period in 1970 U.S. dollars <sup>a</sup> (5)	Per capita personal disposable income at midpoint of sample period		Per capita private consumption at mid- point of sample period		Implicit conver- sion ratio between NCU at sample midpoint and 1970 U.S. dollars (NCU per U.S. dollar) <sup>e</sup> (10)
					NCU's <sup>b</sup> (6)	1970 U.S. dollars (7)	NCU's <sup>b</sup> (8)	1970 U.S. dollars (9)	
Korea	1955-68	1962	Won	142	108 <sup>c</sup>	115	112 <sup>c</sup>	120	0.9366 <sup>c</sup>
Thailand	1960-69	1964	Baht	148	1,952	115	1,729	102	16.96
Philippines	1953-65 <sup>d</sup>	1961	Peso	161	—	—	407	125	3.248
Taiwan	1955-68	1962	New Taiwan dollar	216	4,598	146	5,099	162	31.50
Jamaica	1959-68	1964	Jamaican dollar	541	273	436	271	432	0.6266
Panama	1960-68	1964	Balboa	564	—	—	390	447	0.8723
South Africa	1955-68	1962	Rand	596	260	461	226	401	0.5637
Greece	1958-68	1963	Drachma	676	13,883	564	12,325	501	24.61
Ireland	1955-68	1962	Irish pound	1,014	220	820	209	779	0.2682
Puerto Rico	1955-67	1961	U.S. dollar	1,023	—	—	683	828	0.8250
Italy	1955-68	1962	Lira	1,207	4,124 <sup>c</sup>	916	3,520 <sup>c</sup>	782	4.503 <sup>c</sup>
Israel	1959-68	1964	Israeli pound	1,468	2,917	1,228	2,513	1,058	2.376
United Kingdom	1955-68	1962	Pound	1,900	379	1,331	352	1,236	0.2847
Australia	1955-66	1961	Australian dollar	2,192	1,015	1,622	932	1,489	0.6259
West Germany	1955-68	1962	Deutsche mark	2,203	4,229	1,474	3,665	1,277	2.870
Sweden	1955-68	1962	Krona	2,962	7,023	1,956	6,083	1,694	3.590
United States	1955-68	1962	U.S. dollar	3,669	2,030	2,481	1,840	2,249	0.8182

— Data unavailable or unsatisfactory.

a. Per capita GNP for 1970 as reported in *World Bank Atlas 1972*, projected backward to sample midpoints using growth rates from the same source.

b. Sources: UN *Yearbook of National Accounts Statistics*, *National Accounts of OECD countries, 1953-69*, and country national accounts.

c. Per capita GNP in NCU's at sample midpoint divided by column 5. Source: International Monetary Fund, *International Financial Statistics, 1972 Supplement*. Column 10 is used to derive columns 7 and 9.

d. Years 1954, 1956, 1957, 1959 omitted.

e. 10<sup>3</sup> NCU's.

SOURCE: C. Lluch, A. A. Powell, and R. A. Williams, *Patterns in Household Demand and Saving, 1977*, Published for the World Bank, Oxford University Press, Table 3.2.

Table E-2  
Average Budget Shares at Sample Mean Values

Country	Sample period	Commodity							
		Food	Clothing	Housing	Durables	Personal care	Transport	Recreation	Other services
Korea	1955-68	0.599	0.104	0.114	0.028	0.042	0.047	0.044	0.022
Thailand	1960-69	0.576	0.084	0.080	0.032	0.056	0.079	0.075	0.018
Philippines	1953-65 <sup>a</sup>	0.598	0.074	0.147	0.020	0.035	0.023	0.018	0.084
Taiwan	1955-68	0.563	0.055	0.183		0.057	0.018	0.026	0.097
Jamaica	1959-68	0.433	0.107	0.145	0.060	0.026	0.106	0.074	0.049
Panama	1960-68	0.455	0.074	0.167	0.064	0.047	0.094	0.075	0.023
South Africa	1955-68	0.368	0.118	0.167	0.078	0.048	0.132	0.047	0.041
Greece	1958-68	0.468	0.122	0.183	0.039	0.036	0.069	0.061	0.023
Ireland	1955-68	0.492	0.100	0.128	0.057	0.013	0.088	0.063	0.059
Puerto Rico	1955-67	0.356	0.106	0.153	0.069	0.069	0.123	0.088	0.037
Italy	1955-68	0.463	0.101	0.166	0.032	0.063	0.081	0.075	0.018
Israel	1959-68	0.319	0.094	0.192	0.074	0.066	0.073	0.081	0.100
United Kingdom	1955-68	0.397	0.107	0.183	0.066	0.023	0.109	0.075	0.040
Australia	1955-66	0.333	0.110	0.127	0.078	0.057	0.131	0.043	0.121
West Germany	1955-68	0.366	0.123	0.263		0.037	0.080	0.077	0.054
Sweden	1955-68	0.366	0.115	0.159	0.070	0.037	0.142	0.089	0.024
United States	1955-68	0.267	0.095	0.227	0.073	0.081	0.152	0.055	0.049

<sup>a</sup>. Excluding 1954, 1956, 1957, 1959.

SOURCE: C. Lluch, A. A. Powell, and R. A. Williams, Patterns in Household Demand and Saving, 1977, Published for the World Bank, Oxford University Press, Table 3.3.

Table E-3

## Changes in Average Budget Shares over the Sample Period

Country	Sample period	Commodity							
		Food	Clothing	Housing	Durables	Personal care	Transport	Recreation	Other services
Korea	1955-68	0.883	1.128	0.710	1.524	2.040	2.857	1.560	1.287
Thailand	1960-69	1.015	1.025	0.543	1.347	0.983	1.133	1.288	1.428
Philippines	1953-65	0.920	0.961	1.143	1.176	1.129	1.368	1.125	1.260
Taiwan	1955-68	0.870	0.841	1.184		1.290	1.923	1.186	1.303
Jamaica	1959-68	0.862	1.169	1.037	1.270	1.190	1.020	1.039	1.577
Panama	1960-68	1.046	0.987	0.885	1.100	1.067	0.857	1.114	0.913
South Africa	1955-68	0.929	0.825	1.025	0.955	1.269	1.270	0.978	1.295
Greece	1958-68	0.912	1.160	0.995	0.947	1.054	1.375	1.106	0.955
Ireland	1955-68	0.882	0.963	1.058	1.466	0.769	1.366	1.182	1.089
Puerto Rico	1955-67	0.745	1.070	0.968	1.061	1.328	1.385	1.485	1.533
Italy	1955-68	0.863	0.883	1.070	1.081	1.377	1.680	1.082	1.126
Israel	1959-68	0.791	0.951	1.109	1.148	1.031	1.600	1.250	1.029
United Kingdom	1955-68	0.807	0.852	1.182	0.925	1.210	1.494	1.034	1.893
Australia	1955-66	0.883	0.786	1.388	0.935	1.392	1.097	0.875	1.077
West Germany	1955-68	0.781	0.837	1.223		1.243	1.349	1.111	1.538
Sweden	1955-68	0.900	0.740	1.039	1.097	1.322	1.377	1.022	1.200
United States	1955-68	0.821	0.960	1.019	0.987	1.400	0.994	1.118	1.594

Note: Ratio of average budget shares in last year of sample to the one in first year of sample.

SOURCE: C. Lluch, A. A. Powell, and R. A. Williams, Patterns in Household Demand and Saving, 1977, Published for the World Bank, Oxford University Press, Table 3.4.

Table E-4

## Changes in Implicit Price Deflators and Income over the Sample Period

Country	Sample period	Prices									Income	
		Food	Clothing	Housing	Durables	Personal care	Transport	Recreation	Other services	Total	Money	Real
Korea	1955-68	5.617	6.802	4.329	5.102	8.771	5.208	6.097	6.849	5.707	8.187	1.435
Thailand	1960-69	1.338	1.017	0.789	0.863	1.127	1.005	1.245	1.199	1.183	1.599	1.351
Philippines	1953-65	1.416	1.419	1.415	1.418	1.420	1.411	1.401	1.417	1.416	1.678 <sup>a</sup>	1.185 <sup>a</sup>
Taiwan	1955-68	2.087	1.310	1.865		1.531	1.805	1.642	1.347	1.901	3.461	1.821
Jamaica	1959-68	1.303	1.210	1.633	1.002	1.261	1.044	0.750	1.912	1.235	1.609	1.302
Panama	1960-68	1.169	1.048	1.044	1.009	1.196	1.033	1.081	1.000	1.169	1.375 <sup>a</sup>	1.176 <sup>a</sup>
South Africa	1955-68	1.344	1.027	1.577	1.042	1.661	1.366	1.383	1.555	1.327	1.657	1.249
Greece	1958-68	1.293	1.127	1.172	1.069	1.282	1.206	1.057	1.071	1.207	2.144	1.776
Ireland	1955-68	1.512	1.122	1.677	1.506	1.189	1.503	1.602	1.736	1.495	2.198	1.470
Puerto Rico	1955-67	1.369	1.189	1.165	1.105	1.995	1.330	1.468	1.343	1.369	1.777 <sup>a</sup>	1.298 <sup>a</sup>
Italy	1955-68	1.388	1.326	1.607	0.979	1.736	1.344	1.697	1.724	1.449	2.737	1.889
Israel	1959-68	1.547	1.519	2.020	1.191	1.788	2.066	1.712	1.915	1.681	2.965	1.764
United Kingdom	1955-68	1.315	1.248	1.838	1.246	1.494	1.464	1.824	1.639	1.484	2.011	1.355
Australia	1955-66	1.291	1.165	1.709	1.054	1.414	1.240	1.379	1.394	1.316	1.593	1.211
West Germany	1955-68	1.248	1.298	1.524		1.533	1.168	1.349	1.706	1.360	2.432	1.788
Sweden	1955-68	1.683	1.340	1.650	1.262	1.449	1.569	1.730	1.618	1.574	2.276	1.446
United States	1955-68	1.272	1.234	1.248	1.074	1.485	1.219	1.358	1.751	1.275	1.761	1.381

Note: Ratio of implicit price deflators and per capita personal disposable income in last year of sample to first year of sample.

a. Per capita total consumption expenditure.

SOURCE: C. Lluch, A. A. Powell, and R. A. Williams, Patterns in Household Demand and Saving, 1977, Published for the World Bank, Oxford University Press, Table 3.5.



Table E-5

Relation between Marginal Budget Shares ( $B_i$ ) and Level of GNP per Capita

Item	Food	Clothing	Housing	Durables	Personal care	Transport	Recreation	Other services
<i>Mean values of <math>\beta_i</math></i>								
GNP per capita <sup>a</sup>								
100-500	0.386	0.074	0.122	0.074	0.071	0.094	0.076	0.105
500-1,000	0.351	0.138	0.118	0.092	0.047	0.133	0.085	0.035
1,000-1,500	0.276	0.109	0.149	0.093	0.065	0.145	0.100	0.065
1,500 and over	0.175	0.078	0.209	0.090	0.079	0.209	0.064	0.095
Overall mean	0.286	0.096	0.155	0.087	0.068	0.150	0.080	0.079
<i>Regressions of <math>\beta_i = a + b \log_{10} \text{GNP per capita}^b</math></i>								
<i>a</i>	0.805 <sup>c</sup> (0.132)	0.081 (0.059)	-0.049 (0.102)	0.040 (0.042)	0.030 (0.058)	-0.092 (0.088)	0.097 (0.064)	0.089 (0.088)
<i>b</i>	-0.179 <sup>c</sup> (0.045)	0.005 (0.020)	0.070 <sup>d</sup> (0.035)	0.016 (0.014)	0.013 (0.020)	0.083 <sup>c</sup> (0.030)	-0.006 (0.022)	-0.004 (0.030)
<i>R</i> <sup>2</sup>	0.531	0.005	0.228	0.084	0.029	0.354	0.005	0.001
<i>d</i>	2.45	1.00	2.36	2.41	2.50	2.32	2.60	1.78

Note: Based on table 3.6; Jamaica excluded. ( $\beta_i + \beta_i$ ) divided 1:1 for Taiwan, 2:1 for West Germany.

a. In 1970 U.S. dollars at sample midpoints.

b. Standard errors in parentheses. Data ranked in order of increasing GNP per

capita so that Durbin-Watson *d* statistic indicates appropriateness of functional form.

c. Significant at 5 percent level.

d. Significant at 10 percent level.

SOURCE: C. Lluch, A. A. Powell, and R. A. Williams, Patterns in Household Demand and Saving, 1977, Published for the World Bank, Oxford University Press, Table 3.11.

## Appendix F

Expenditures on travel and other travel characteristics in the United States.

Table F-1

## Vehicle Ownership and Gasoline Expenditures July 1973-June 1974

	Percent of Families	Average Income Before Taxes	Percent Owning at Least One Vehicle	Average Weekly Expenditures for Gasoline		Gasoline Expenditures as Percent of Family Income(2)	
				All Families	Vehicle Owners(1)	All Families	Vehicle Owners
Annual Family Income Before Taxes by Deciles							
Lowest.....	10%	\$ 1,198	38%	\$ 2.14	\$ 5.63	9.3%	24.4%
Second.....	10	2,957	50	3.18	6.36	5.6	11.2
Third.....	10	4,626	71	4.84	6.82	5.4	7.7
Fourth.....	10	6,447	81	6.24	7.70	5.0	6.2
Fifth.....	10	8,360	88	7.56	8.59	4.7	5.3
Sixth.....	10	10,307	93	8.81	9.47	4.4	4.8
Seventh.....	10	12,330	93	8.82	9.48	3.7	4.0
Eighth.....	10	14,916	96	10.20	10.63	3.6	3.7
Ninth.....	10	18,654	98	10.87	11.09	3.0	3.1
Highest.....	10	30,079	98	12.37	12.62	2.1	2.2
Family Size							
Single Person.....	24%	\$ 5,167	56%	\$ 3.57	\$ 6.38	3.6%	6.4%
2 Persons.....	28	9,525	85	6.81	8.01	3.7	4.4
3 Persons.....	16	11,266	88	8.79	9.99	4.1	4.6
4 Persons.....	15	13,213	92	10.13	11.01	4.0	4.3
5 Persons.....	9	12,650	91	9.86	10.84	4.1	4.5
6 Persons or more.....	8	12,985	88	10.46	11.89	4.2	4.8
Age of Head							
Under 25.....	9%	\$ 6,772	78%	\$ 6.35	\$ 8.14	4.9%	6.3%
25-34.....	20	10,990	87	8.47	9.74	4.0	4.6
35-44.....	16	12,906	90	9.45	10.50	3.8	4.2
45-54.....	18	12,612	87	9.48	10.90	3.9	4.5
55-64.....	16	9,653	81	7.18	8.86	3.9	4.8
65 and Over.....	20	5,317	60	3.43	5.72	3.4	5.6
Type of Area*							
Inside SMSA							
Central City.....	32%	\$ 9,050	69%	\$ 5.78	\$ 8.38	3.3%	4.8%
Other Urban.....	31	11,372	87	8.35	9.70	3.8	4.4
Total Urban, Inside.....	64	10,169	77	7.02	9.12	3.6	4.7
Total Rural, Inside.....	7	10,944	92	10.51	11.42	5.0	5.4
Total Inside.....	70	10,244	79	7.36	9.32	3.7	4.7
Outside SMSA							
Outside SMSA Urban.....	13	9,108	81	6.75	8.33	3.9	4.8
Rural.....	17	8,750	86	8.05	9.36	4.8	5.6
Total Outside.....	30	8,903	84	7.49	8.92	4.4	5.2
All Families.....	100%	\$ 9,847	80%	\$ 7.40	\$ 9.25	3.9%	4.9%

\*SMSA: Standard Metropolitan Statistical Area.

(1) Calculated by Motor Vehicle Manufacturers Association of the U.S., Inc.

(2) Annualized weekly expenditures as percent of average income before taxes.

SOURCE: MVMA, Motor Vehicles Facts and Figures, 1976, p. 50.

Table F-2

Percent of Employed Persons' Home-to-Work Trips by Major Mode of Transportation and Place of Residence (Excl. those who work at home and at no fixed address)

	Driver	Automobile Passenger	Total	Truck	Bus or Streetcar	Train or Subway	Other	Total
<b>Place of Residence</b>								
All Unincorporated Areas .....	65.0%	18.8%	83.8%	12.9%	1.4%	1.1%	.8%	100.0%
Incorporated Places								
Under 5,000 .....	64.0	18.4	82.4	13.7	2.8	0.3	.8	100.0
5,000—24,999 .....	69.4	20.2	89.6	6.2	3.4	0.4	.4	100.0
25,000—49,999 .....	67.0	16.5	83.5	7.1	6.7	1.2	1.5	100.0
50,000—99,999 .....	68.8	18.5	87.3	3.5	8.2	0.5	.5	100.0
100,000—999,999 .....	61.9	19.8	81.7	4.5	12.9	*	.6	100.0
1,000,000 and Over .....	49.5	11.5	61.0	1.4	16.5	19.3	1.8	100.0
Subtotal .....	64.1%	18.2%	82.3%	5.8%	8.2%	2.8%	.9%	100.0%
All Areas and Places .....	64.4%	18.3%	82.7%	8.1%	5.9%	2.2%	1.1%	100.0%

**PERCENT OF EMPLOYED PERSONS BY MODE OF HOME-TO-WORK TRANSPORTATION BY INCOME, AND OCCUPATION (Excl. Those Who Work at Home & at No Fixed Address)**

<b>Household Income</b>								
Under \$3,000 .....	31.7%	24.8%	56.5%	5.4%	15.5%	.4%	22.1%	100.0%
\$3,000—\$3,999 .....	35.3	22.4	57.7	5.3	14.1	.9	22.0	100.0
\$4,000—\$4,999 .....	42.6	26.3	68.9	5.4	12.9	1.4	11.4	100.0
\$5,000—\$5,999 .....	50.9	20.9	71.8	6.9	7.2	3.4	10.7	100.0
\$6,000—\$7,499 .....	50.9	22.7	73.6	7.6	6.1	1.5	11.3	100.0
\$7,500—\$9,999 .....	53.7	22.0	75.7	9.0	5.0	1.3	9.1	100.0
\$10,000—\$14,999 .....	59.3	20.7	80.0	5.9	4.2	1.3	8.6	100.0
\$15,000 & Over .....	62.5	17.3	79.8	3.7	4.1	2.8	9.5	100.0
Not Applicable .....	60.2	18.2	78.4	3.7	4.9	2.7	10.4	100.0
Total .....	53.6%	21.2%	74.8%	6.3%	6.3%	1.7%	11.0%	100.0%
<b>Occupation</b>								
Professional and Semi-professional .....	66.5%	18.1%	84.6%	2.5%	2.6%	2.2%	8.0%	100.0%
Farmers .....	39.5	5.7	45.2	26.0	0	0	28.8	100.0
Other Proprietors .....	60.0	15.9	75.9	10.8	1.4	1.4	10.6	100.0
Store & Office Clerks .....	53.9	22.4	76.3	1.6	8.2	2.3	11.5	100.0
Craftsmen and Skilled Laborers .....	51.5	21.8	73.3	14.0	2.4	1.2	9.0	100.0
Operators, Semi-skilled and Unskilled Laborers .....	47.5	24.8	72.3	8.8	7.8	1.2	9.9	100.0
Protective Services .....	64.0	12.1	76.1	6.8	3.0	2.3	11.9	100.0
Personal Services .....	40.4	23.1	63.5	2.0	15.2	1.5	17.9	100.0
Not Available .....	62.3	9.3	71.6	1.2	8.5	1.8	16.8	100.0
Total .....	53.6%	21.2%	74.8%	6.3%	6.3%	1.7%	11.0%	100.0%

\*Less than one half of one percent.

NOTE: Other includes taxi, motorcycle, other including bicycle, combined modes and walk.

SOURCE: MVMA, Motor Vehicles Facts and Figures 76, p. 54.

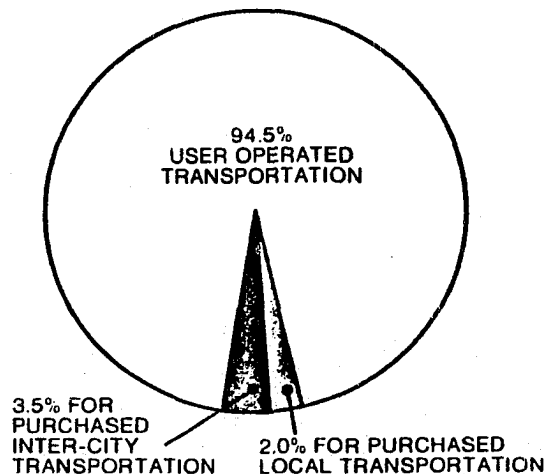
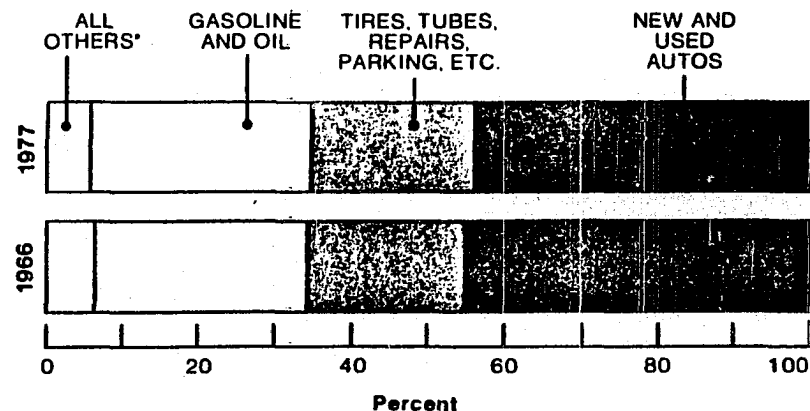
Table F-3

## Personal Consumption Expenditures for Transportation (in millions)

	1966	1968	1970	1972	1974	1975*	1976*	1977
<b>User-Operated Transportation</b>								
New Autos.....	\$ 21,029	\$ 24,638	\$ 22,119	\$ 32,106	\$ 27,520	\$ 30,030	\$ 39,211	\$ 46,259
Net Purchases of Used Autos.....	4,067	4,919	5,675	7,300	8,824	10,193	13,562	15,504
Other Motor Vehicles (1).....	1,540	2,304	2,549	5,454	4,731	5,681	8,744	10,233
Tires, Tubes, Accessories and Parts.....	3,434	3,944	4,587	5,691	6,911	7,490	8,210	9,495
Repair, Greasing, Washing, Parking, Storage and Rental.....	7,393	8,864	11,248	13,922	17,610	20,388	23,124	25,882
Gasoline and Oil.....	15,962	18,422	21,997	24,879	36,431	39,509	42,825	46,457
Bridge, Tunnel, Ferry and Road Tolls.....	495	563	643	745	764	798	841	879
Insurance Premiums Less Claims Paid.....	2,839	3,017	3,685	5,248	4,939	3,771	5,302	7,943
<b>Total User-Operated Transportation.....</b>	<b>\$ 56,759</b>	<b>\$ 66,671</b>	<b>\$ 72,503</b>	<b>\$ 95,345</b>	<b>\$107,730</b>	<b>\$117,860</b>	<b>\$ 141,819</b>	<b>\$ 162,652</b>
<b>Purchased Local Transportation</b>								
Transit Systems.....	\$ 1,343	\$ 1,411	\$ 1,573	\$ 1,585	\$ 1,733	\$ 1,787	\$ 1,945	\$ 2,071
Taxicab.....	638	729	776	842	875	1,006	1,112	1,196
Railway Commutation.....	140	153	172	177	200	206	224	230
<b>Total Purchased Local Transportation.....</b>	<b>\$ 2,121</b>	<b>\$ 2,293</b>	<b>\$ 2,521</b>	<b>\$ 2,604</b>	<b>\$ 2,808</b>	<b>\$ 2,999</b>	<b>\$ 3,281</b>	<b>\$ 3,497</b>
<b>Purchased Intercity Transportation</b>								
Railway Excluding Commutation.....	\$ 297	\$ 227	\$ 185	\$ 176	\$ 259	\$ 254	\$ 281	\$ 292
Bus.....	429	475	496	523	617	605	608	640
Airline.....	1,329	1,838	2,166	2,637	3,484	3,595	4,206	4,780
Other.....	73	123	161	153	192	180	209	243
<b>Total Purchased Intercity Transportation.....</b>	<b>\$ 2,128</b>	<b>\$ 2,663</b>	<b>\$ 3,008</b>	<b>\$ 3,489</b>	<b>\$ 4,552</b>	<b>\$ 4,634</b>	<b>\$ 5,304</b>	<b>\$ 5,955</b>
<b>Total Transportation.....</b>	<b>\$ 61,008</b>	<b>\$ 71,627</b>	<b>\$ 78,032</b>	<b>\$101,438</b>	<b>\$115,090</b>	<b>\$125,493</b>	<b>\$ 150,404</b>	<b>\$ 172,104</b>
<b>Total Personal Consumption Expenditures.....</b>	<b>\$464,793</b>	<b>\$535,932</b>	<b>\$618,796</b>	<b>\$773,034</b>	<b>\$889,603</b>	<b>\$979,070</b>	<b>\$1,090,244</b>	<b>\$1,206,507</b>

(1) New and net used trucks, recreation vehicles, etc.

\*—Revised.

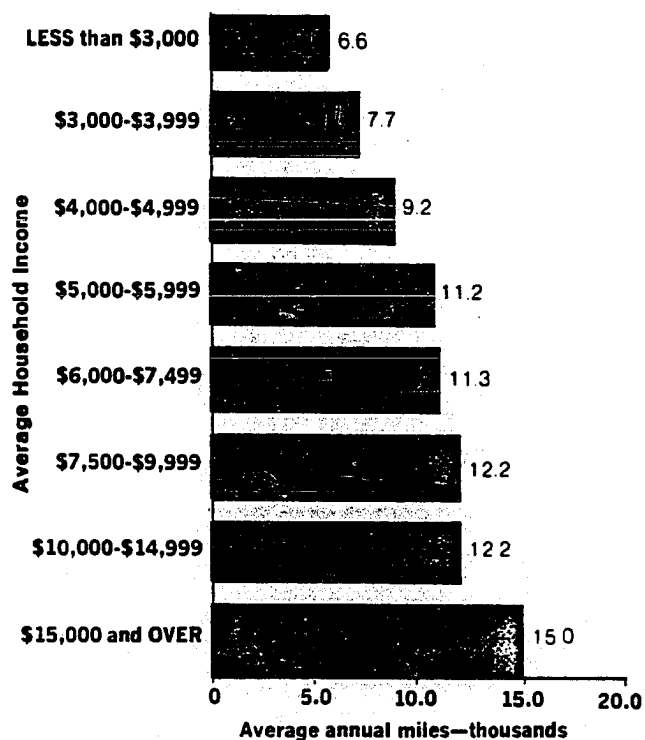
SOURCE: U.S. Bureau of Economic Analysis, *The National Income and Product Accounts of the U.S.: Revised Estimates, 1929-74, and Survey of Current Business, July 1978.*PERSONAL CONSUMPTION EXPENDITURES  
FOR TRANSPORTATION BY MODE, 1977PERSONAL CONSUMPTION EXPENDITURES  
FOR USER-OPERATED TRANSPORTATION

\*All other includes bridge tunnel ferry and road tolls and insurance premiums less claims

SOURCE: MVMA, *Motor Vehicle Facts and Figures 79*, p. 91.

Figure F-4

Average Annual Miles per Automobile by Annual Household Income



SOURCE: MVMA, Motor Vehicles Facts and Figures, 1979, p. 59.

## Appendix G

Expenditures on travel and other travel characteristics,  
before and after the household survey of Singapore's Area  
License Scheme, 1975.

Table G-1

"Before Surveys" Cost Estimates<sup>1</sup> and Other Travel Characteristics Per Traveler  
and Per Household, Nonvehicle-Owning Households - Singapore 1975

MONTHLY INCOME S\$ (100)	0-2	2-4	4-7	7-10	10-15	15-20	20-25	25 & OVER	AVERAGE
Households	16.00	106.00	171.00	89.00	49.00	20.00	4.00	-	455.00
Traveler	36.00	257.00	581.00	324.00	232.00	97.00	20.00	-	1565.00
Traveler/hh	2.25	2.38	3.40	3.85	4.74	4.85	5.00	-	3.44
Distance/hh-km	17.17	22.72	38.07	45.07	67.87	70.51	77.83	-	40.29
Distance/tr-km	7.63	9.53	11.20	11.71	14.33	14.54	15.57	-	11.31
Trip Rate/hh	4.50	5.05	7.07	8.05	10.10	10.62	11.75	-	7.16
Trip Rate/tr	2.00	2.12	2.08	2.09	2.13	2.19	2.35	-	2.08
Travel Time/hh-hr	2.91	3.34	4.41	5.81	7.04	6.88	8.27	-	4.75
Travel Time/tr-hr	1.29	1.40	7.30	1.51	1.49	1.42	1.65	-	1.40
Speed/kph	5.91	6.80	8.63	7.75	9.65	10.25	9.41	-	8.20
Trip Distance/km	3.82	4.50	5.38	5.60	6.73	6.64	6.63	-	5.54
Trip Time/min	38.8	39.70	37.40	43.4	41.80	38.9	42.20	-	39.90
Car									
Distance/km	-	0.28	2.11	1.48	1.25	11.18	15.64	-	5.32
Speed/kph	-	9.26	17.02	6.95	12.98	20.75	18.76	-	14.28
Cost (¢)	-	1.26	9.49	6.66	5.63	50.31	70.30	-	23.95
Motorcycle									
Distance/km	-	0.08	0.27	-	-	-	-	-	0.31
Speed/kph	-	8.24	29.45	-	-	-	-	-	18.84
Cost (¢)	-	0.086	0.29	-	-	-	-	-	0.33
Bus									
Distance/km	14.47	20.37	34.43	41.45	65.40	58.04	59.19	-	36.42
Speed/kph	6.27	7.07	8.58	8.24	9.84	9.99	8.60	-	8.72
Cost (¢)	90.00	151.50	212.10	322.00	404.00	424.80	470.00	-	286.40
Total Cost Per hh	90.00	152.85	221.88	328.66	409.63	475.11	540.38	-	310.68
Total Cost Per tr	40.00	64.22	65.26	85.37	86.42	97.96	108.08	-	90.31
Total Cost as % of Monthly Income	27.00%	15.28%	12.10%	11.59%	9.83%	8.14%	7.20%	-	13.02%

hh - household  
tr - traveler

<sup>1</sup>In Singapore dollars (S\$) and cents (¢).



Table G-2

"After Surveys" Cost Estimates<sup>1</sup> and Other Travel Characteristics Per Traveler  
and Per Household, Nonvehicle-Owning Households - Singapore 1975

MONTHLY INCOME S\$ (100)	0-2	2-4	4-7	7-10	10-15	15-20	20-25	25 & OVER	AVERAGE
Households	17.00	86.00	159.00	113.00	66.00	14.00	8.00	-	463.00
Traveler	38.00	184.00	521.00	463.00	312.00	64.00	49.00	-	1635.00
Traveler/hh	2.23	2.14	3.26	4.10	4.72	4.57	6.12	-	3.52
Distance/hh-km	17.14	19.06	34.70	47.49	67.00	66.51	81.95	-	40.65
Distance/tr-km	7.67	8.90	10.65	11.59	14.19	14.55	13.38	-	11.11
Trip Rate/hh	4.28	4.30	6.62	8.36	9.63	9.28	12.00	-	7.15
Trip Rate/tr	1.97	2.01	2.03	2.04	2.04	2.03	1.96	-	2.03
Travel Time/hh-hr	2.50	2.57	4.08	5.56	6.36	6.71	9.57	-	4.61
Travel Time/tr-hr	1.12	1.20	1.25	1.35	1.348	1.468	1.56	-	1.31
Speed/kph	6.84	7.40	8.50	8.55	10.52	9.91	8.56	-	8.48
Trip Distance/km	3.99	4.43	5.25	5.68	6.96	7.17	6.83	-	5.47
Trip Time/min	35.10	35.00	37.00	39.90	39.70	43.40	47.90	-	39.71
Car									
Distance/km	0.28	0.45	1.54	5.36	6.49	9.71	2.85	-	3.20
Speed/kph	11.49	12.27	10.95	14.38	18.09	19.24	10.51	-	14.48
Cost (¢)	1.26	1.025	6.93	24.12	29.21	43.69	12.83	-	14.40
Motorcycle									
Distance/km	-	-	1.09	0.10	1.36	-	-	-	0.59
Speed/kph	-	-	24.41	18.80	23.41	-	-	-	22.20
Cost (¢)	-	-	1.18	0.108	1.47	-	-	-	0.64
Bus									
Distance/km	16.15	17.20	30.63	39.80	58.35	56.23	78.43	-	35.39
Speed/kph	7.32	7.84	8.56	8.48	10.11	9.22	8.77	-	8.61
Cost (¢)	85.60	129.00	198.60	334.40	385.20	371.20	480.00	-	286.00
Total Cost Per hh	86.86	131.03	206.71	358.63	415.88	414.89	492.83	-	301.04
Total Cost Per tr	38.95	61.22	63.41	87.47	88.11	90.79	80.53	-	85.52
Total Cost as % of Monthly Income	26.06	13.10	11.28	12.65%	9.98%	7.11%	6.57%	-	12.39%

hh - household  
tr - traveler

<sup>1</sup>In Singapore dollars (S\$) and cents (¢).

Table G-3

"Before Surveys" Cost Estimates<sup>1</sup> and Other Travel Characteristics Per Traveler  
and Per Household, Vehicle-Owning<sup>2</sup> Households - Singapore 1975

MONTHLY INCOME S\$ (100)	0-2	2-4	4-7	7-10	10-15	15-20	20-25	25 & OVER	AVERAGE
Households	-	57.00	201.00	169.00	236.00	139.00	100.00	172.00	1,074.00
Traveler	-	136.00	612.00	630.00	1036.00	618.00	473.00	838.00	4,343.00
Traveler/hh	-	2.39	3.05	3.72	4.34	4.49	4.74	4.86	4.13
Distance/hh-km	-	28.64	42.13	55.47	69.91	76.96	80.10	96.11	66.31
Distance/tr-km	-	12.00	13.80	14.91	16.12	17.14	16.90	19.78	16.07
Trip Rate/hh	-	5.14	6.53	8.11	9.46	10.46	11.28	11.62	9.33
Trip Rate/tr	-	2.15	2.14	2.18	2.10	2.33	2.38	2.39	2.26
Travel Time/hh-hr	-	2.79	3.81	4.89	5.57	5.63	5.80	6.17	5.25
Travel Time/tr-hr	-	1.16	1.25	1.31	1.28	1.25	1.22	1.23	1.27
Speed/kph	-	10.28	11.04	11.34	12.57	13.67	13.80	15.59	12.65
Trip Distance/km	-	5.58	6.45	6.84	7.39	7.36	7.10	8.28	7.11
Trip Time/min	-	32.60	35.10	36.20	35.30	32.30	30.90	31.90	33.50
Car									
Distance/km	-	4.36	11.21	18.14	29.69	43.33	47.72	66.76	32.45
Speed/kph	-	13.82	15.30	16.59	18.51	18.67	18.80	19.97	16.63
Cost (¢)	-	19.62	50.44	81.63	133.60	194.98	214.74	300.42	146.025
Motorcycle									
Distance/km	-	11.32	8.66	7.60	5.80	5.12	4.42	2.18	6.12
Speed/kph	-	15.98	17.94	17.55	20.11	21.62	23.54	19.43	19.73
Cost (¢)	-	12.23	9.35	8.20	6.26	5.53	4.77	2.35	6.60
Bus									
Distance/km	-	12.56	21.08	28.70	33.40	27.86	27.53	26.81	26.93
Speed/kph	-	8.07	8.96	9.22	9.62	9.55	9.34	10.27	9.078
Cost (¢)	-	102.80	195.90	243.30	283.80	313.80	338.40	348.60	279.90
Total Cost Per hh	-	134.65	255.69	333.13	423.66	514.31	557.91	651.37	525.82
Total Cost Per tr	-	56.34	83.83	89.55	97.62	114.55	117.70	134.03	127.31
Total Cost as % of Monthly Income	-	13.46%	13.94%	11.76%	10.17%	8.82%	7.44%	7.11%	10.38%

hh - household  
tr - traveler

<sup>1</sup>In Singapore dollars (S\$) and cents (¢).

<sup>2</sup>Vehicle-owning households are defined as those having the use of a motor vehicle (car and/or motorcycle) based at this household . . . even if owned by a firm.

Table G-4

"After Surveys" Cost Estimates<sup>1</sup> and Other Travel Characteristics Per Traveler  
and Per Household, Vehicle-Owning<sup>2</sup> Households - Singapore 1975

MONTHLY INCOME S\$ (100)	0-2	2-4	4-7	7-10	10-15	15-20	20-25	25 & OVER	AVERAGE
Households	-	55.00	149.00	192.00	259.00	188.00	85.00	146.00	1074.00
Traveler	-	129.00	403.00	669.00	971.00	812.00	392.00	678.00	4054.00
Traveler/hh	-	2.31	2.71	3.50	3.75	4.33	4.61	4.66	3.86
Distance/hh-km	-	22.77	34.15	47.93	59.51	73.19	72.89	79.54	58.22
Distance/tr-km	-	9.85	12.62	13.71	15.88	16.92	15.80	17.07	15.07
Trip Rate/hh	-	4.74	5.77	7.39	7.95	9.27	10.00	10.30	8.26
Trip Rate/tr	-	2.05	2.13	2.11	2.12	2.14	2.17	2.21	2.14
Travel Time/hh-hr	-	2.70	3.38	4.69	4.83	5.40	5.53	5.27	4.83
Travel Time/tr-hr	-	1.17	1.25	1.34	1.29	1.25	1.20	1.13	1.25
Speed/kph	-	8.42	10.10	10.23	12.34	13.58	13.13	15.09	12.06
Trip Distance/km	-	4.80	5.92	6.50	7.49	7.91	7.28	7.72	7.04
Trip Time/min	-	34.20	35.20	38.10	36.40	34.90	33.30	30.70	34.90
Car									
Distance/km	-	2.35	9.33	12.60	25.22	36.32	38.53	51.57	26.17
Speed/kph	-	9.49	17.20	17.32	18.10	19.41	18.73	20.59	17.26
Cost (¢)	-	10.58	41.99	56.70	113.49	163.44	173.39	232.07	117.77
Motorcycle									
Distance/km	-	8.35	6.43	4.86	5.91	4.59	3.67	1.86	4.96
Speed/kph	-	14.69	17.53	14.75	18.61	23.56	21.14	21.76	17.97
Cost (¢)	-	9.02	6.94	5.25	6.38	4.96	3.96	2.01	5.35
Bus									
Distance/km	-	11.75	17.80	29.34	27.66	31.94	30.25	25.89	26.49
Speed/kph	-	6.89	7.70	8.54	9.32	9.81	9.43	9.89	8.76
Cost (¢)	-	94.80	115.40	221.17	238.50	278.10	300.00	309.00	247.80
Total Cost Per hh	-	114.40	164.33	283.12	358.37	446.50	477.35	543.71	370.92
Total Cost Per tr	-	49.52	60.64	80.89	95.57	103.12	103.55	116.68	96.09
Total Cost as % of Monthly Income	-	11.44	8.96	9.99	12.65%	7.65%	6.36%	5.93%	8.98%

hh - household  
tr - traveler

<sup>1</sup>In Singapore dollars (S\$) and cents (¢).

<sup>2</sup>Vehicle-owning households are defined as those having the use of a motor vehicle (car and/or motorcycle) based at this household . . . even if owned by a firm.

## Appendix H

A summary of some of the tabulated data of the household interview surveys that were collected before and after the implementation of the Area License Scheme in Singapore, 1975.

Tables 1 through 4 were reproduced from a paper by Zahavi and Roth titled "Measuring the Effectiveness of High Occupancy Vehicles Priority Schemes." The paper was presented at the Transportation Research Board Meeting in Washington, D.C., January 1980.

Table H-1

Summary table of travel characteristics per traveler and per household, by vehicle ownership, before-and-after surveys, Singapore 1975

Characteristic	VEHICLE OWNING				NON VEHICLE OWNING			
	Travelers		Households		Travelers		Households	
	B	A	B	A	B	A	B	A
Monthly Income (S\$)	-	-	1,380	1,383	-	-	680	728
Travelers/hh	-	-	4.13	3.86	-	-	3.44	3.52
Trip Rate	2.26	2.14	9.33	8.26	2.08	2.03	7.16	7.15
Travel Distance-km	16.07	15.07	66.31	58.22	11.31	11.11	40.29	40.65
Travel Time-hr	1.27	1.25	5.25	4.83	1.38	1.31	4.75	4.61
Speed-kph	12.7	12.1	12.7	12.1	8.2	8.5	8.2	8.5
Trip Distance-km	7.11	7.04	7.11	7.04	5.44	5.47	5.44	5.47
Trip Time-min	33.6	34.9	33.6	34.9	39.9	38.7	39.9	38.7
Mobility	209	186	861	720	96	102	336	359

Table H-2

Daily travel distance per household, by motorized mode, before and after surveys, Singapore 1975

## VEHICLE OWNING

Income S\$ (100)	0 - 2	2 - 4	4 - 7	7 - 10	10 - 15	15 - 20	20 - 25	25 & Over	Average
BEFORE: Car	-	4.36	11.21	18.14	29.69	43.33	47.72	66.76	32.45
M/c	-	11.32	8.66	7.60	5.80	5.12	4.42	2.18	6.12
Bus	-	12.56	21.08	28.70	33.40	27.86	27.53	26.81	26.93
Total	-	28.24	40.95	54.44	68.89	76.31	79.67	95.75	65.50
AFTER : Car	-	2.35	9.33	12.60	25.22	36.32	38.53	51.57	26.17
M/c	-	8.35	6.43	4.86	5.91	4.59	3.67	1.86	4.96
Bus	-	11.75	17.80	29.34	27.66	31.94	30.25	25.89	26.49
Total	-	22.45	33.56	46.80	58.79	72.85	72.45	79.32	57.62

## NON-VEHICLE OWNING

BEFORE: Car	-	0.28	2.11	1.48	1.25	11.18	15.64	-	1.91
M/c	-	0.08	0.27	-	-	-	-	-	0.12
Bus	14.47	20.37	34.43	41.45	65.40	58.04	59.19	-	36.42
Total	14.47	20.73	36.81	42.93	66.65	69.22	74.83	-	38.45
AFTER : Car	0.28	0.45	1.54	5.36	6.49	9.71	2.85	-	3.20
M/c	-	-	1.09	0.10	1.36	-	-	-	0.59
Bus	16.15	17.20	30.63	39.80	58.35	56.23	78.43	-	35.39
Total	16.43	17.65	33.26	45.26	66.20	65.94	81.28	-	39.18

Table H-3

Modal shares, by distance, vehicle-owning households, before-and-after surveys, Singapore 1975

Mode	Distance-km	Share-%
BEFORE:		
Car	32.45	49.6
Motorcycle	6.12	9.3
Bus	26.93	41.1
Total	65.50	100.0
AFTER:		
Car	26.17	45.4
Motorcycle	4.96	8.6
Bus	26.49	46.0
Total	57.62	100.0

Table H-4

Daily travel distance per traveler, by trip purpose, before-and-after surveys, Singapore 1975

Trip Purpose	Vehicle		Non-Vehicle	
	Before	After	Before	After
Home	7.65	7.22	5.42	5.40
Work + Business	5.56	5.35	3.47	3.75
School	1.68	1.76	1.64	1.48
Personal + Social	1.00	0.62	0.61	0.39
Shopping	0.18	0.12	0.17	0.09
Total	16.07	15.07	11.31	11.11



## Appendix I

Amman Household Interview Survey Forms, 1980



## AMMAN REGION TRANSPORTATION STUDY

عملية المقابلات المنزلية  
Household Interview Survey

SURVEY No

1

Travel Information

معلومات عن التنقل

SERIAL No

2

INTERVIEWER: ..... CODED BY: ..... CHECKED BY: ..... TRAVEL DATE: ..... PAGE No: .....

رقم الشخص PERSON No	رقم الرحلة TRIP No	وقت البدء START TIME	وقت الانتهاء END TIME	ORIGIN المصدر WHERE DID YOU START FROM? من أي منطقة بدأت؟ WHAT PART?	DESTINATION الوجهة WHERE DID YOU GO TO? إلى أي منطقة ذهبت؟ WHAT PART?	الوسيلة MODE	الهدف PURPOSE من إلى
						CAR 1 MOTORCYCLE 2 VAN/PICKUP 3 TAXI 4 SERVICE TAXI 5 SCHEDULED BUS 6 WORKS BUS 7 SCHOOL BUS 8 OTHER 9	1 HOME 1 2 WORK 2 3 EDUCATION 3 4 SHOPPING 4 PERS. BUS 4 5 EMPLOYERS 5 BUSINESS 5 6 SOCIAL 6 RECREATION 6 7 OTHER 7
						CAR 1 MOTORCYCLE 2 VAN/PICKUP 3 TAXI 4 SERVICE TAXI 5 SCHEDULED BUS 6 WORKS BUS 7 SCHOOL BUS 8 OTHER 9	1 HOME 1 2 WORK 2 3 EDUCATION 3 4 SHOPPING 4 PERS. BUS 4 5 EMPLOYERS 5 BUSINESS 5 6 SOCIAL 6 RECREATION 6 7 OTHER 7
						CAR 1 MOTORCYCLE 2 VAN/PICKUP 3 TAXI 4 SERVICE TAXI 5 SCHEDULED BUS 6 WORKS BUS 7 SCHOOL BUS 8 OTHER 9	1 HOME 1 2 WORK 2 3 EDUCATION 3 4 SHOPPING 4 PERS. BUS 4 5 EMPLOYERS 5 BUSINESS 5 6 SOCIAL 6 RECREATION 6 7 OTHER 7
						١- سيارة ٢- دراجة نارية ٣- بلك أب/فان ٤- تاكسي ٥- سرفيس ٦- باصات منتظمة ٧- باصات العمل ٨- باصات المدرسة ٩- أخرى	١- البيت ٢- العمل ٣- التعليم ٤- التسوق والأعمال ٥- الترفيه ٦- أعمال الخدمة ٧- العمل ٨- ترفيه الأطفال ٩- أخرى

Hakrow Fox and Associates, Jozzy &amp; Partners

Form H2

## Appendix J

The data obtained from the Amman household survey was used to build a number of simplified graphs for household characteristics by household size, income and car ownership. The graphs are useful for the analysis of existing conditions.

## THE HOUSEHOLD SIZE GRAPH

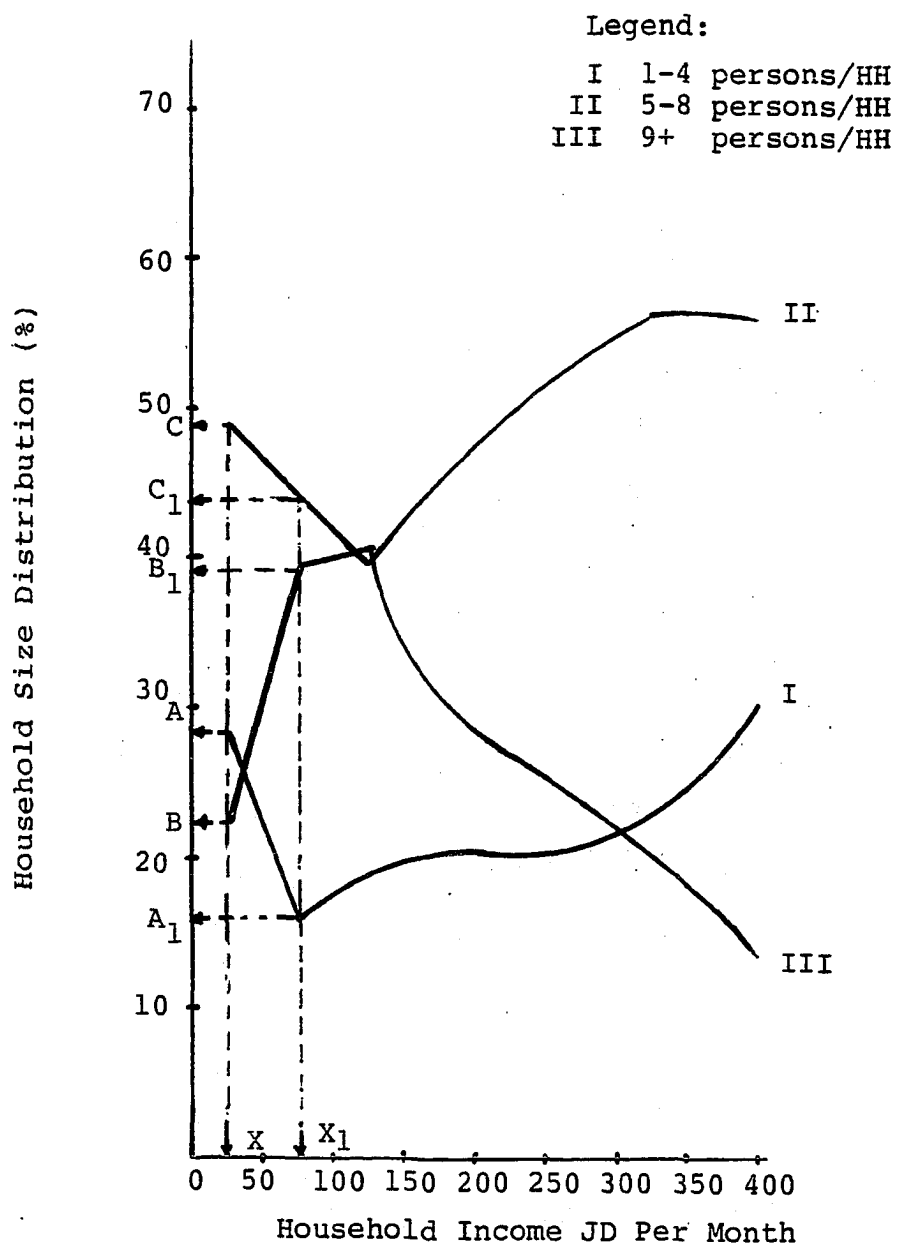


Fig. J1. Household Size Graph for Amman, Jordan, 1980

## THE CAR OWNERSHIP GRAPH

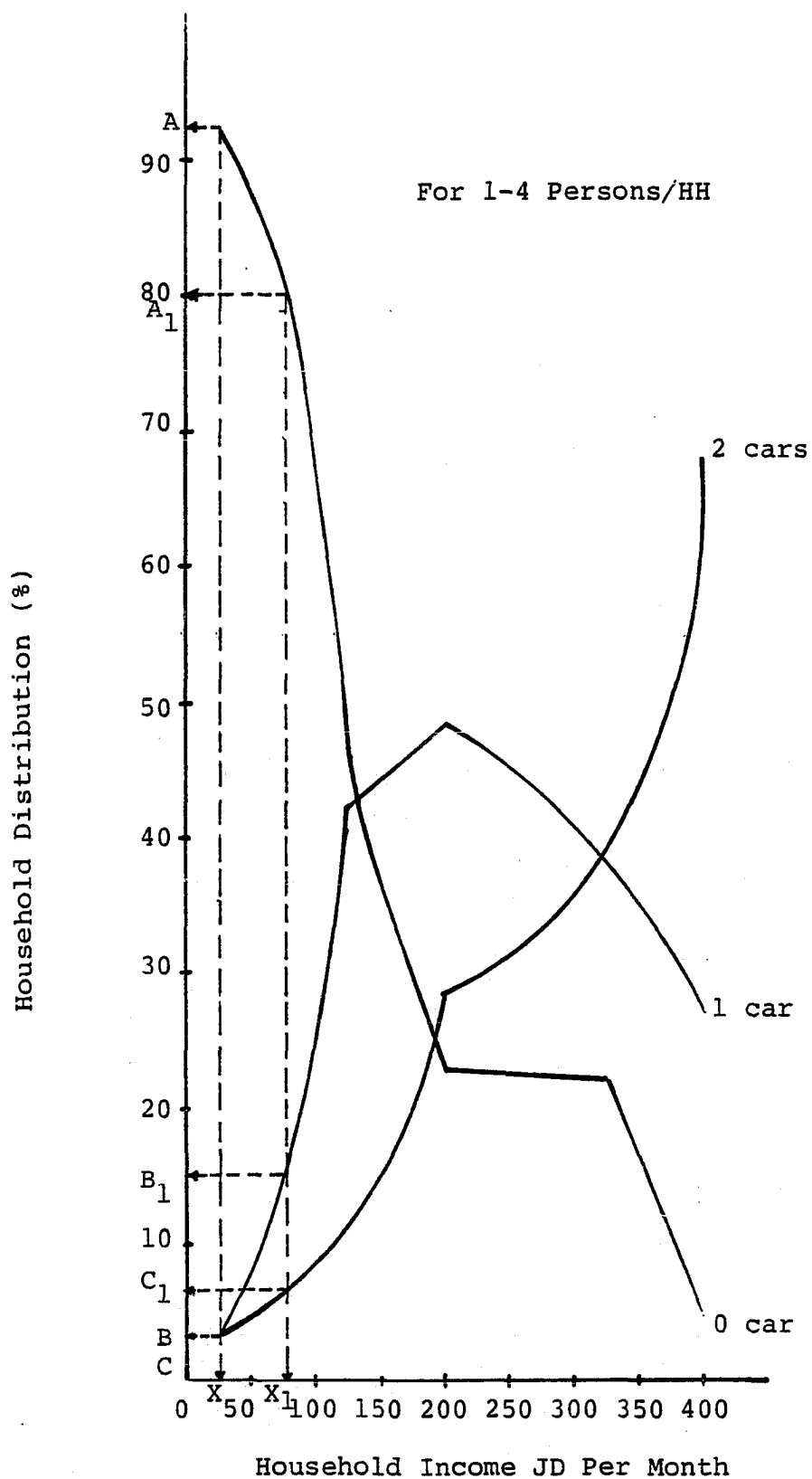


Fig. J2. Car Ownership Graph for Amman, Jordan, 1980



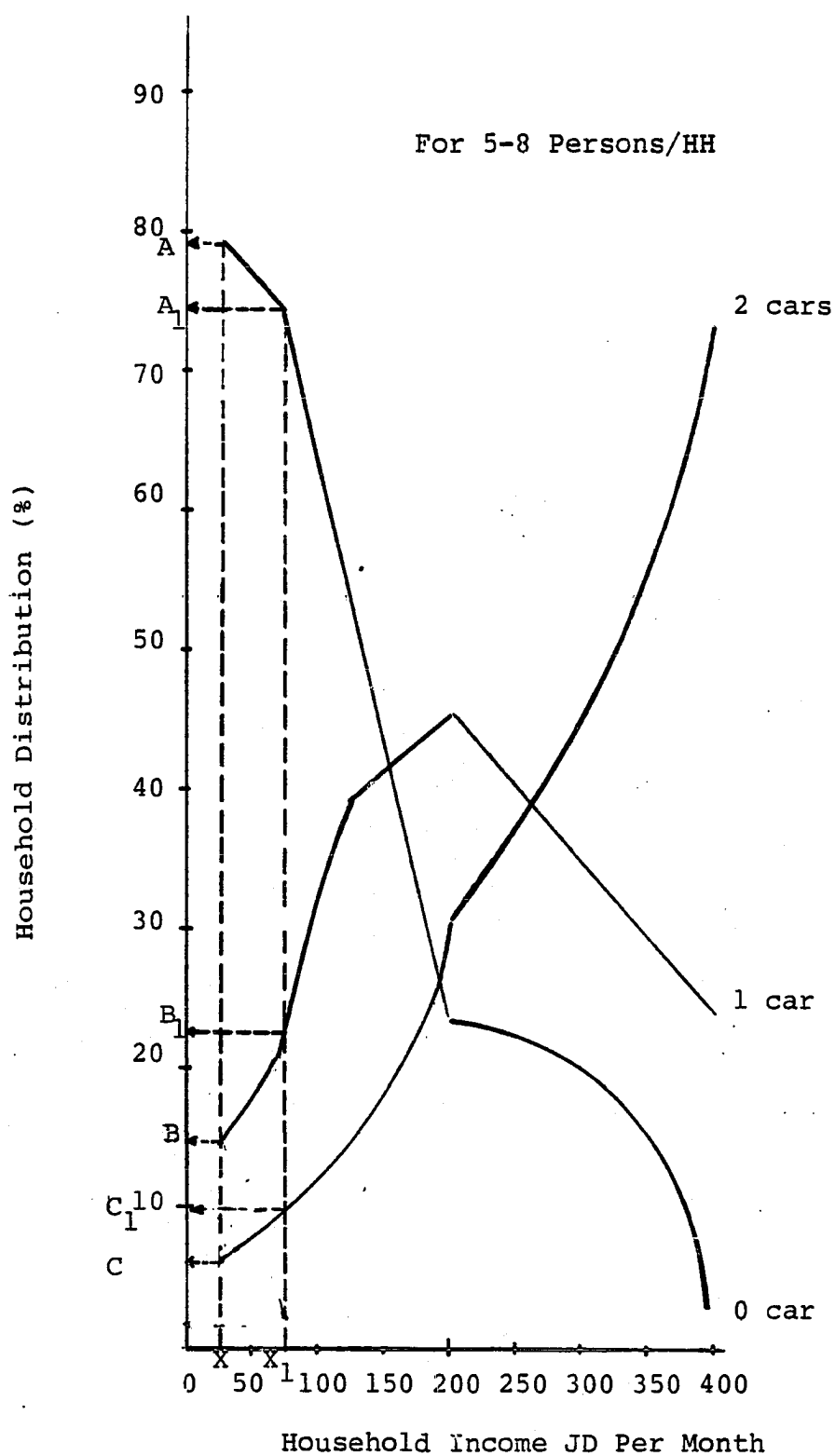


Fig. J3. Car Ownership Graph for Amman, Jordan, 1980

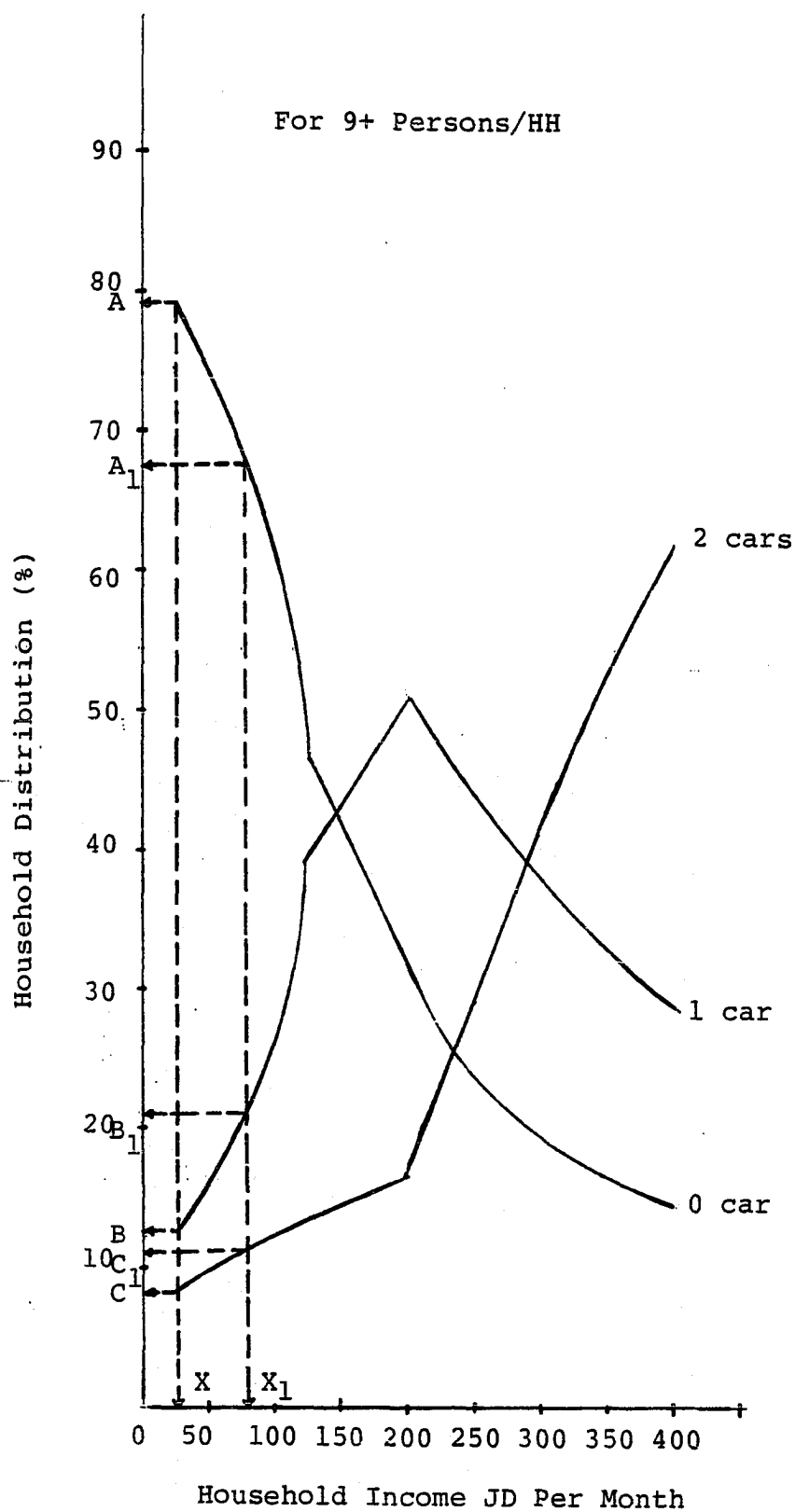


Fig. J4. Car Ownership Graph for Amman, Jordan, 1980

## **Appendix K**

**Analysis of Travel in Amman Urban Region, 1980**

TABLE K-1

ANALYSIS OF TRAVEL IN AMMAN URBAN REGION BY MODE AND PURPOSE, 1980  
(For Households Income Group JD 0-50)

Journey Purpose	Mode of Journey									Total
	Private Car	Motor-Cycle	Vans/ Pickup	Call Taxi	Servis Taxi	Scheduled Bus	Works Bus	School Bus	Other Mode	
Work	6(15.79) * (17.14)	0(0) (0)	0(0) (0)	6(15.79) (26.08)	22(57.89) (37.28)	3(7.89) (8.57)	1(2.63) (25)	0(0) (0)	0(0) (0)	38(100) (24.36)
Educa- tion	10(37.04) (28.57)	0(0) (0)	0(0) (0)	1(3.7) (4.34)	7(25.92) (11.86)	8(29.64) (22.85)	1(3.7) (25)	0(0) (0)	0(0) (0)	27(100) (17.3)
Home Based	Shopping/ Personal Business	4(11.43) (11.43)	0(0) (0)	0(0) (0)	8(22.85) (34.78)	11(31.43) (18.64)	12(34.29) (34.28)	0(0) (0)	0(0) (0)	35(100) (22.43)
	Employers Business	2(16.66) (5.71)	0(0) (0)	0(0) (0)	0(0) (0)	5(41.66) (8.47)	4(33.33) (11.42)	1(8.35) (25)	0(0) (0)	12(100) (7.69)
	Social/ recreation	5(20) (14.29)	0(0) (0)	0(0) (0)	4(16) (17.39)	10(40) (16.95)	6(24) (17.14)	0(0) (0)	0(0) (0)	25(100) (16.02)
	Other	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(100) (0)
Non Home Based	8(42.10) (22.87)	0(0) (0)	0(0) (0)	4(21.05) (17.39)	4(21.05) (6.77)	2(10.52) (5.71)	1(5.28) (25)	0(0) (0)	0(0) (0)	19(100) (12.17)
Total	35(22.43) (100)	0(0) (100)	0(0) (100)	23(14.74) (100)	59(37.82) (100)	35(22.43) (100)	4(2.56) (100)	0(0) (100)	0(0) (100)	156(100) (100)

\*6(15.79) ← % of trips by mode

(17.14) ← % of trips by purpose

TABLE K-2

ANALYSIS OF TRAVEL IN AMMAN URBAN REGION BY MODE AND PURPOSE, 1980  
(For Households Income Group JD 50-100)

Journey Purpose	Mode of Journey									Total
	Private Car	Motor-Cycle	Vans/ Pickup	Call Taxi	Servis Taxi	Scheduled Bus	Works Bus	School Bus	Other Mode	
Work	48(15.63)* (33.33)	0(0) (0)	14(4.56) (70)	21(6.84) (30.43)	149(48.53) (49.17)	34(11.07) (30.08)	41(13.35) (62.12)	0(0) (0)	0(0) (0)	307(100) (42.63)
Educa- tion	18(13.04) (12.5)	0(0) (0)	0(0) (0)	10(7.25) (14.49)	52(37.68) (17.16)	41(29.71) (36.28)	12(8.69) (18.18)	5(3.62) (100)	0(0) (0)	138(100) (19.16)
Shopping/ Personal Business	19(19.38) (13.19)	0(0) (0)	2(2.04) (10)	13(13.26) (18.84)	44(31.88) (14.52)	17(17.34) (15.04)	3(3.06) (4.54)	0(0) (0)	0(0) (0)	98(100) (13.61)
Employers Business	5(25) (3.47)	0(0) (0)	2(10) (10)	4(20) (5.79)	7(35) (2.31)	1(5) (.88)	1(5) (1.51)	0(0) (0)	0(0) (0)	20(100) (2.77)
Social/ recrea- tion	14(17.5) (9.72)	0(0) (0)	2(2.47) (10)	16(19.75) (23.18)	36(44.44) (11.88)	12(14.81) (10.61)	1(1.23) (1.51)	0(0) (0)	0(0) (0)	81(100) (11.25)
Other	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(100) (0)
Non Home Based	40(52.63) (27.77)	0(0) (0)	20(2.77) (100)	5(6.57) (7.24)	15(19.73) (4.95)	8(10.52) (7.08)	8(10.52) (12.12)	0(0) (0)	0(0) (0)	76(100) (10.55)
Total	144(20) (100)	0(0) (100)		69(9.58) (100)	303(42.08) (100)	113(15.69) (100)	66(9.16) (100)	5(.69) (100)	0(0) (100)	720(100) (100)

\*48(15.63) ← % of trips by mode

(17.14) ← % of trips by purpose

TABLE K-3

ANALYSIS OF TRAVEL IN AMMAN URBAN REGION BY MODE, TRIP MAKING, TIME, AND  
COST OF TRAVEL PER DAY (For Household Income Group JD 0-50)

	Mode of Journey									Total
	Private Car	Motor- Cycle	Vans/ Pickup	Call Taxi	Servis Taxi	Scheduled Bus	Works Bus	School Bus	Other Mode	
# of trips of the average household	00.61	0	0	00.400	01.04	00.610	0.070	0	0	002.730
% of total trips of the average household	22.43	0	0	14.740	37.82	22.430	2.560	0	0	100.000
Time of travel of the average household	00.28	0	0	00.310	00.91	00.560	0.010	0	0	002.070
% of total time of the average household	13.52	0	0	14.970	43.96	27.050	0.480	0	0	100.000
Cost of travel of the average household per day	00.10	0	0	00.165	00.08	00.035	0.004	0	0	001.384
% of total cost of the average household	26.04	0	0	42.960	20.83	09.120	1.050	0	0	100.000
Cost as a % of monthly family income	05.20	0	0	08.580	01.82	01.820	0.200	0	0	019.960

TABLE K-4

ANALYSIS OF TRAVEL IN AMMAN URBAN REGION BY MODE, TRIP MAKING, TIME, AND  
COST OF TRAVEL PER DAY (For Household Income Group JD 50-100)

	Mode of Journey									Total
	Private Car	Motor- Cycle	Vans/ Pickup	Call Taxi	Servis Taxi	Scheduled Bus	Works Bus	School Bus	Other Mode	
# of trips of the average household	00.68	0	0.09	00.32	01.430	00.53	0.31	.020	0	003.38
% of total trips of the average household	20.00	0	2.77	09.58	42.080	15.69	9.16	.690	0	100.00
Time of travel of the average household	00.48	0	0.08	00.29	01.350	00.43	0.20	.009	0	002.84
% of total time of the average household	16.90	0	2.81	10.21	47.530	15.14	7.04	.320	0	100.00
Cost of travel of the average household per day	00.17	0	0.02	00.12	00.110	00.03	0.01	.001	0	000.46
% of total cost of the average household	36.95	0	4.34	26.08	23.910	06.52	2.17	.210	0	100.000
Cost as a % of monthly family income	05.89	0	0.69	04.16	03.810	01.04	0.34	.030	0	015.94

TABLE K-5

PRELIMINARY ANALYSIS OF TRAVEL IN THE STUDY AREA BY MODE AND PURPOSE  
(Data represents the average of households in all income groups living in Amman region.)

Journey Purpose	Mode of Journey									Total
	Private Car	Motor-Cycle	Vans/ Pickup	Call Taxi	Servis Taxi	Scheduled Bus	Works Bus	School Bus	Other Mode	
Work	*152,402 (43%) (36%)	42 (0%) (10%)	8,172 (2%) (46%)	19,974 (6%) (28%)	103,458 (29%) (43%)	29,090 (8%) (39%)	34,866 (10%) (76%)	2,044 (1%) (5%)	2,322 (1%) (26%)	352,370 (100%) (38%)
Educa- tion	53,107 (31%) (12%)	0	835 (0%) (5%)	9,912 (6%) (14%)	46,074 (27%) (19%)	20,887 (13%) (28%)	36 (0%) (0%)	39,434 (23%) (94%)	136 (0%) (2%)	169,421 (100%) (18%)
Shopping/ personal business	52,048 (45%) (12%)	67 (0%) (15%)	1,472 (1%) (8%)	11,135 (10%) (15%)	38,606 (33%) (16%)	12,216 (11%) (17%)	0	0	148 (0%) (2%)	115,692 (100%) (13%)
Employers business	12,724 (54%) (3%)	0	2,092 (9%) (12%)	1,177 (5%) (2%)	3,968 (16%) (2%)	1,639 (7%) (2%)	1,406 (6%) (3%)	0	755 (3%) (8%)	23,761 (100%) (3%)
Social/ recrea- tion	77,255 (59%) (19%)	285 (0%) (65%)	766 (1%) (4%)	18,476 (14%) (26%)	28,174 (21%) (12%)	6,882 (5%) (9%)	51 (0%) (0%)	59 (0%) (0%)	26 (0%) (0%)	131,974 (100%) (14%)
Other	521 (96%) (0%)	0	0	0	0	19 (4%) (0%)	0	0	0	531 (100%) (0%)
Non home based	73,304 (58%) (18%)	42 (0%) (10%)	4,530 (4%) (25%)	9,542 (8%) (13%)	18,262 (15%) (8%)	3,721 (3%) (5%)	9,582 (8%) (21%)	616 (0%) (1%)	5,611 (4%) (62%)	125,210 (100%) (14%)
Total	420,352 (46%) (100%)	436 (0%) (100%)	17,867 (2%) (100%)	70,216 (8%) (100%)	238,542 (26%) (100%)	74,454 (8%) (100%)	45,941 (5%) (100%)	42,153 (4%) (100%)	8,998 (1%) (100%)	918,959 (100%) (100%)

\*Each unit contains: number of trips  
(% of row)  
(% of column)

Source: Amman Region Transportation Study; Transport Modeling Report, Table 2.1. Halcrow Fox & Associates, Jouzy & Partners. June 1980.



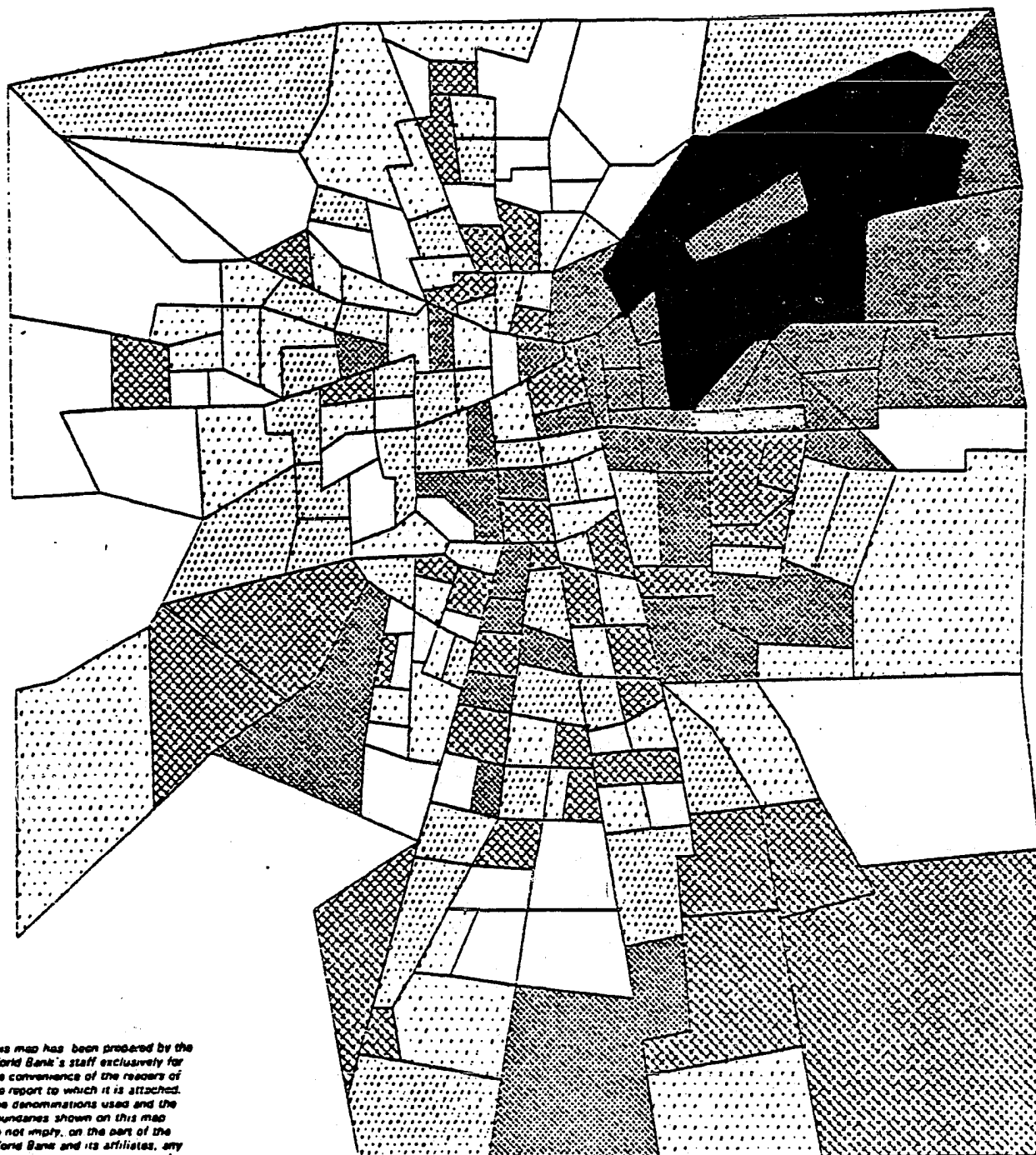
## Appendix L

The maps included in this appendix are of Santiago areas' travel characteristics. They were obtained with other data on Santiago, Chile, from the World Bank.

The maps were manipulated to illustrate the need approach to spatial analysis. The data on each factor were transformed to new values as shown on the maps and discussed in Chapter Seven.

Figure L-1

Transformed	6.33	0.80 - 3.00
Values	2.00	0.40 - 0.80
Chile	1.12	0.27 - 0.40
Santiago	0.75	0.18 - 0.27
	0.50	0.12 - 0.19
Vehicles per Household	0.20	0.00 - 0.12



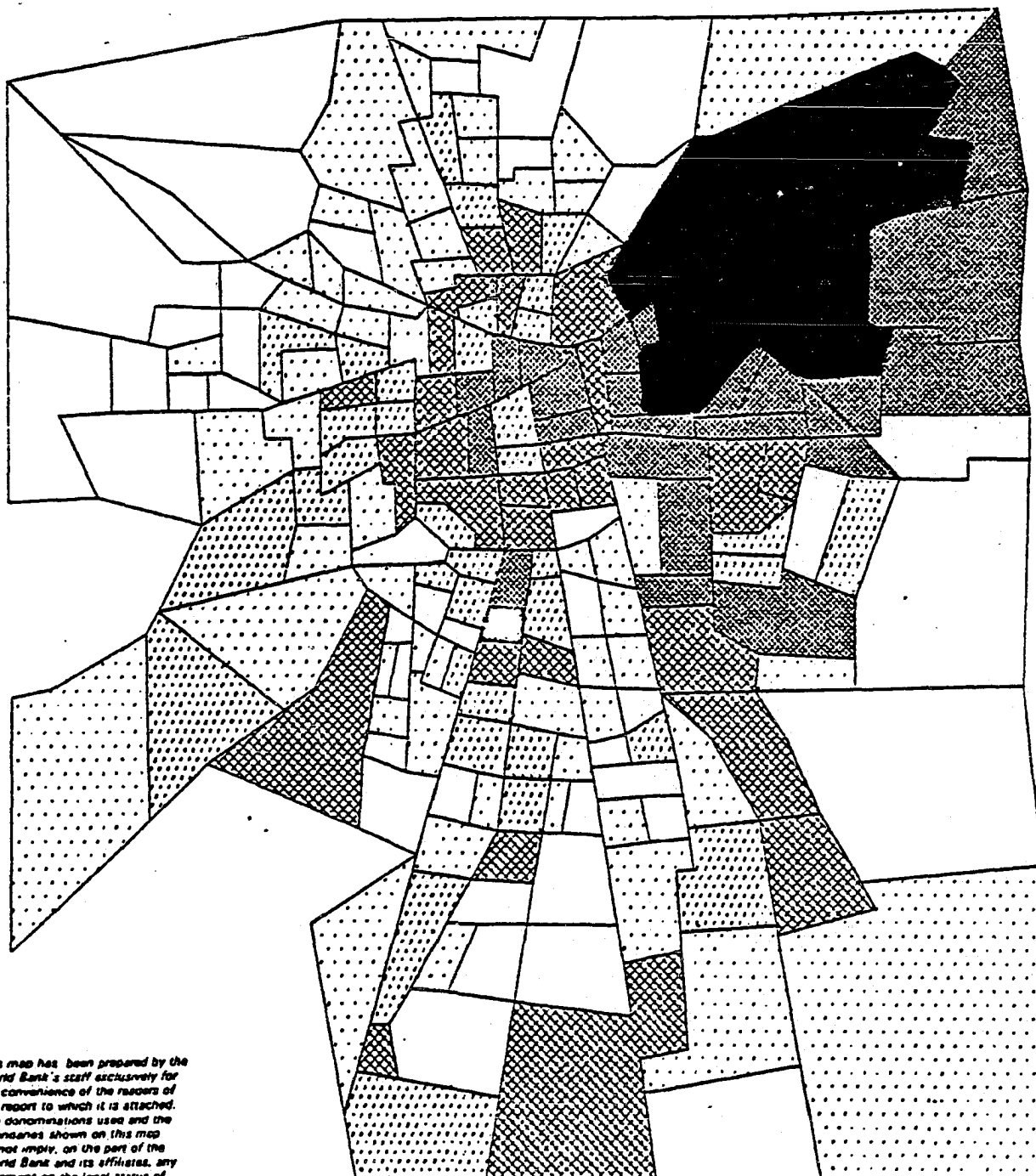
This map has been prepared by the World Bank's staff exclusively for the convenience of the readers of the report to which it is attached. The denominations used and the boundaries shown on this map do not imply, on the part of the World Bank and its affiliates, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

Figure L-2

Transformed 8.25  
 Values 4.50  
 Chile  
 Santiago  
 Household Income

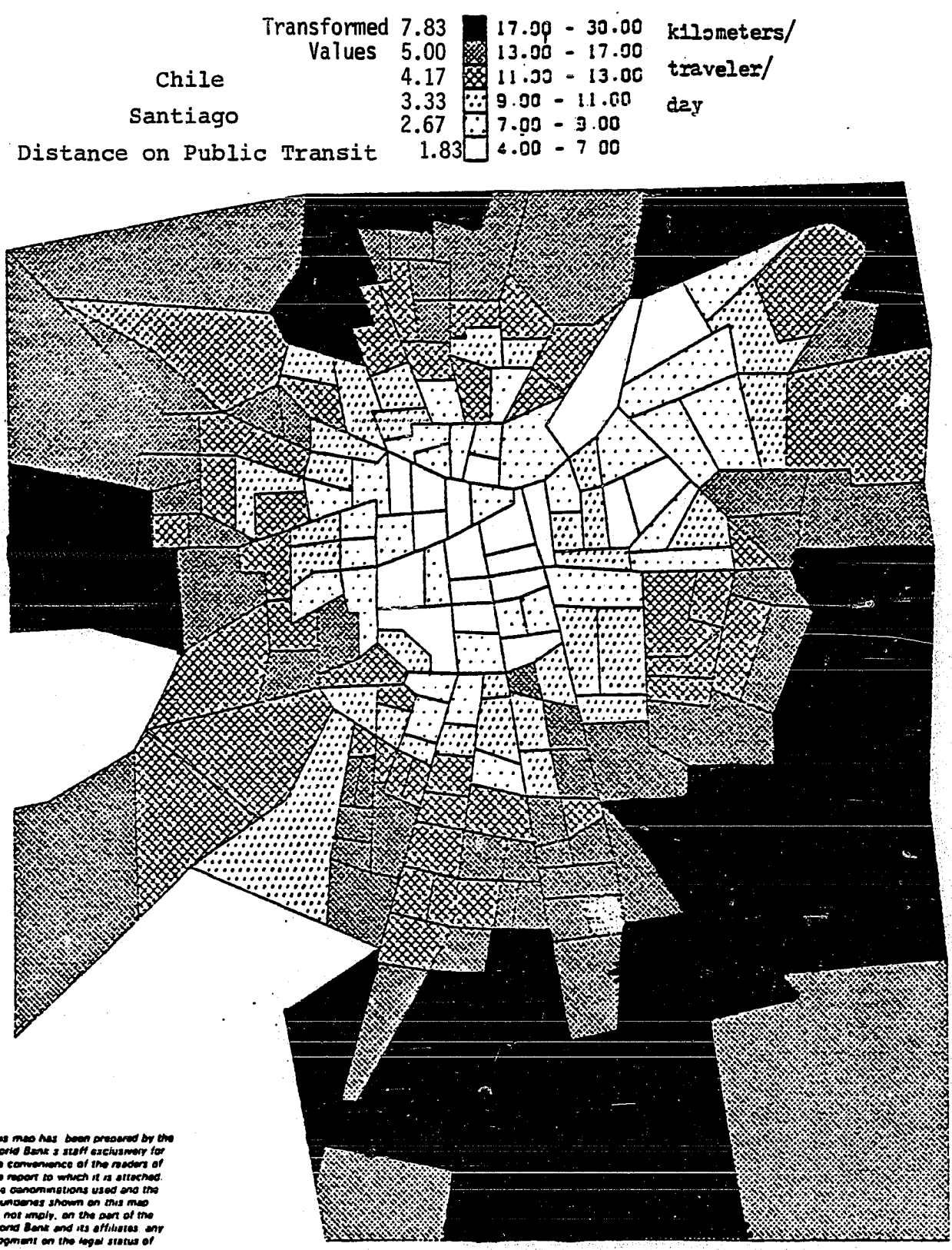
11000.00 - 20000.00
7000.00 - 11000.00
5000.00 - 7000.00
4000.00 - 5000.00
3000.00 - 4000.00
1000.00 - 3000.00

1977 Pesos/Month



This map has been prepared by the  
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 do not imply, on the part of the  
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 any territory or any endorsement  
 or acceptance of such boundaries.

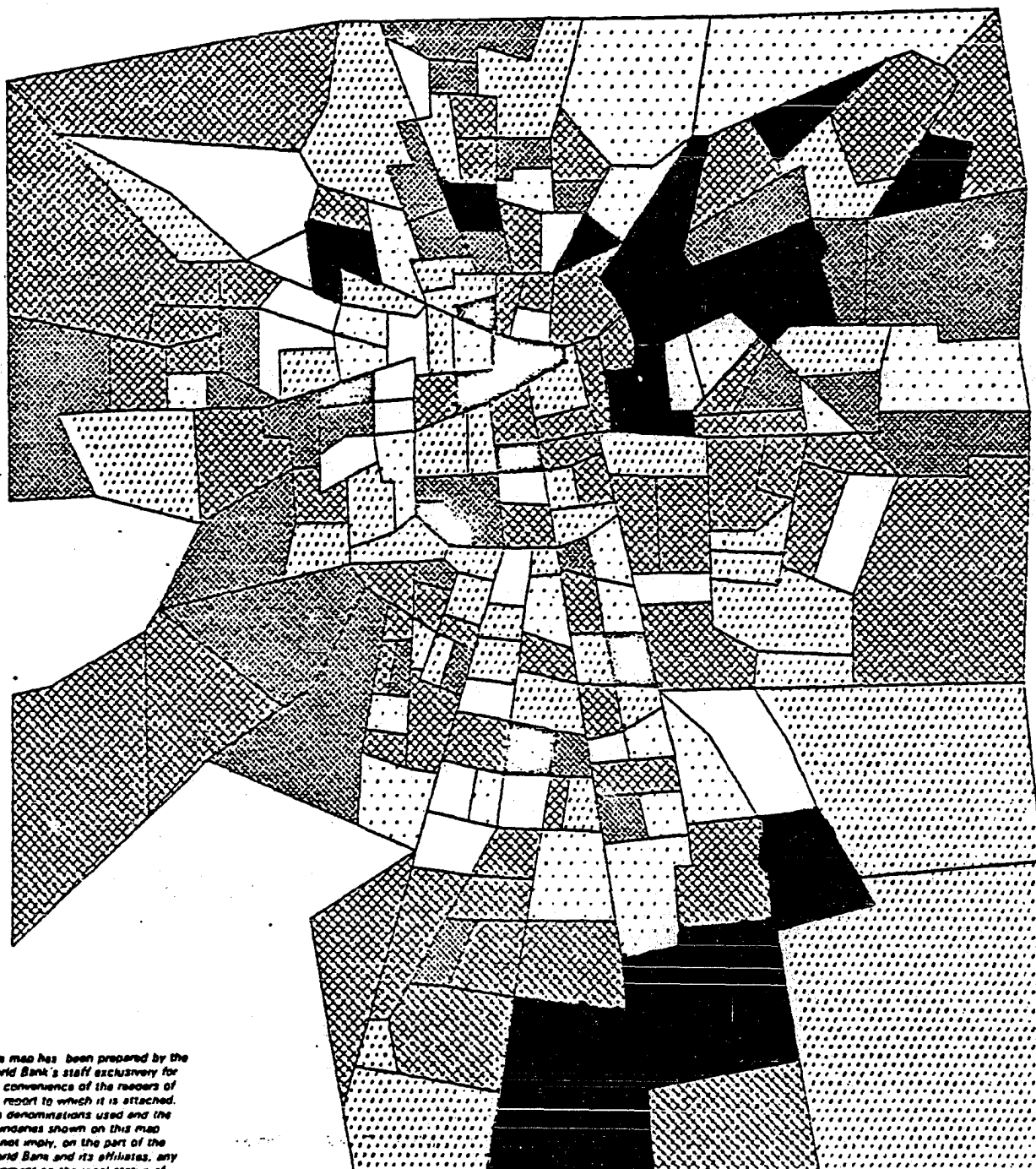
Figure L-3



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Figure L-4

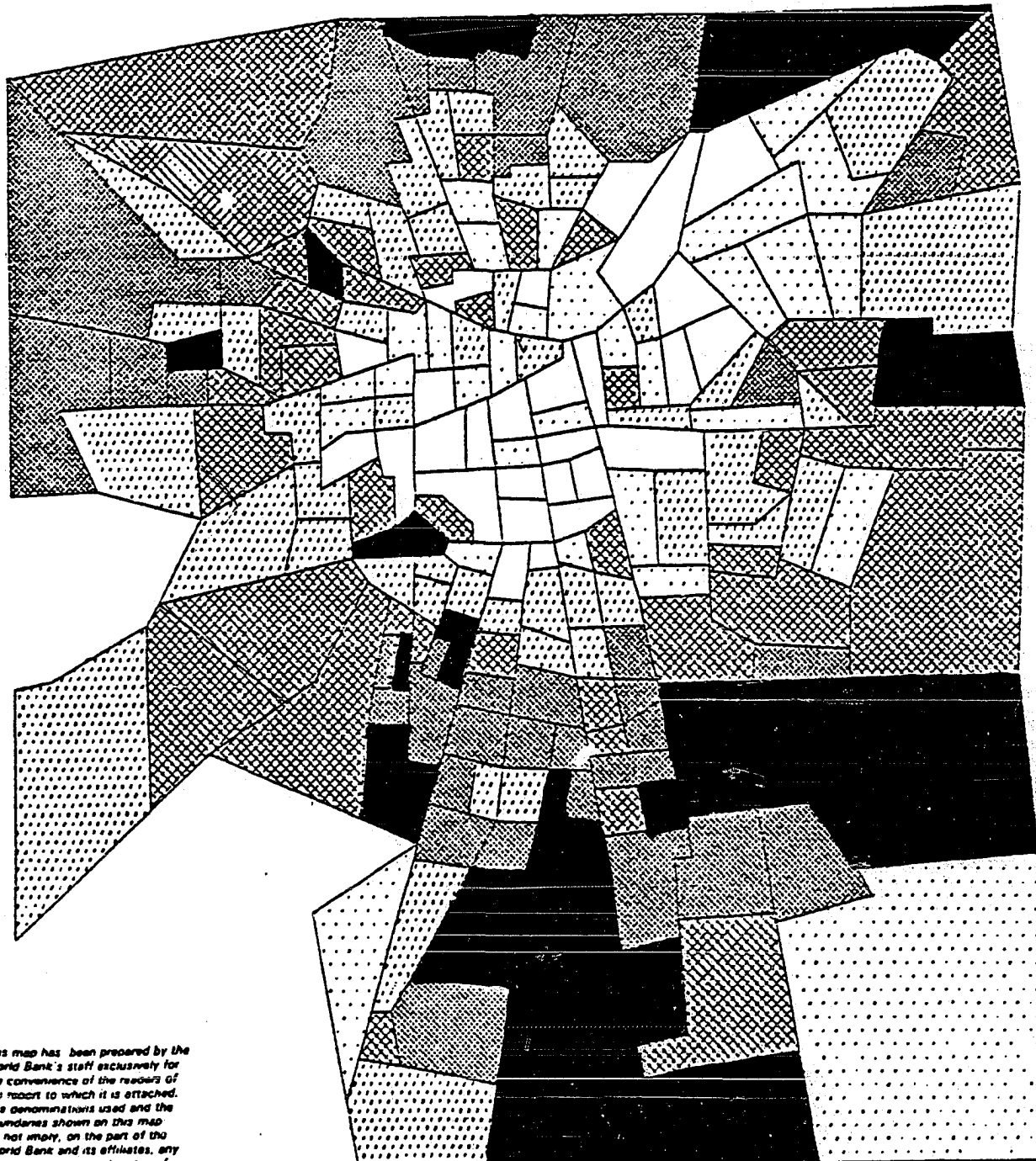
Chile Santiago Trips per Day	Transformed	8.50	2.80 - 4.00	trips per traveler per day
	Values	6.81	2.65 - 2.90	
		6.44	2.50 - 2.65	
		6.13	2.40 - 2.50	
		5.88	2.30 - 2.40	
		5.38	2.00 - 2.30	



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Figure L-5

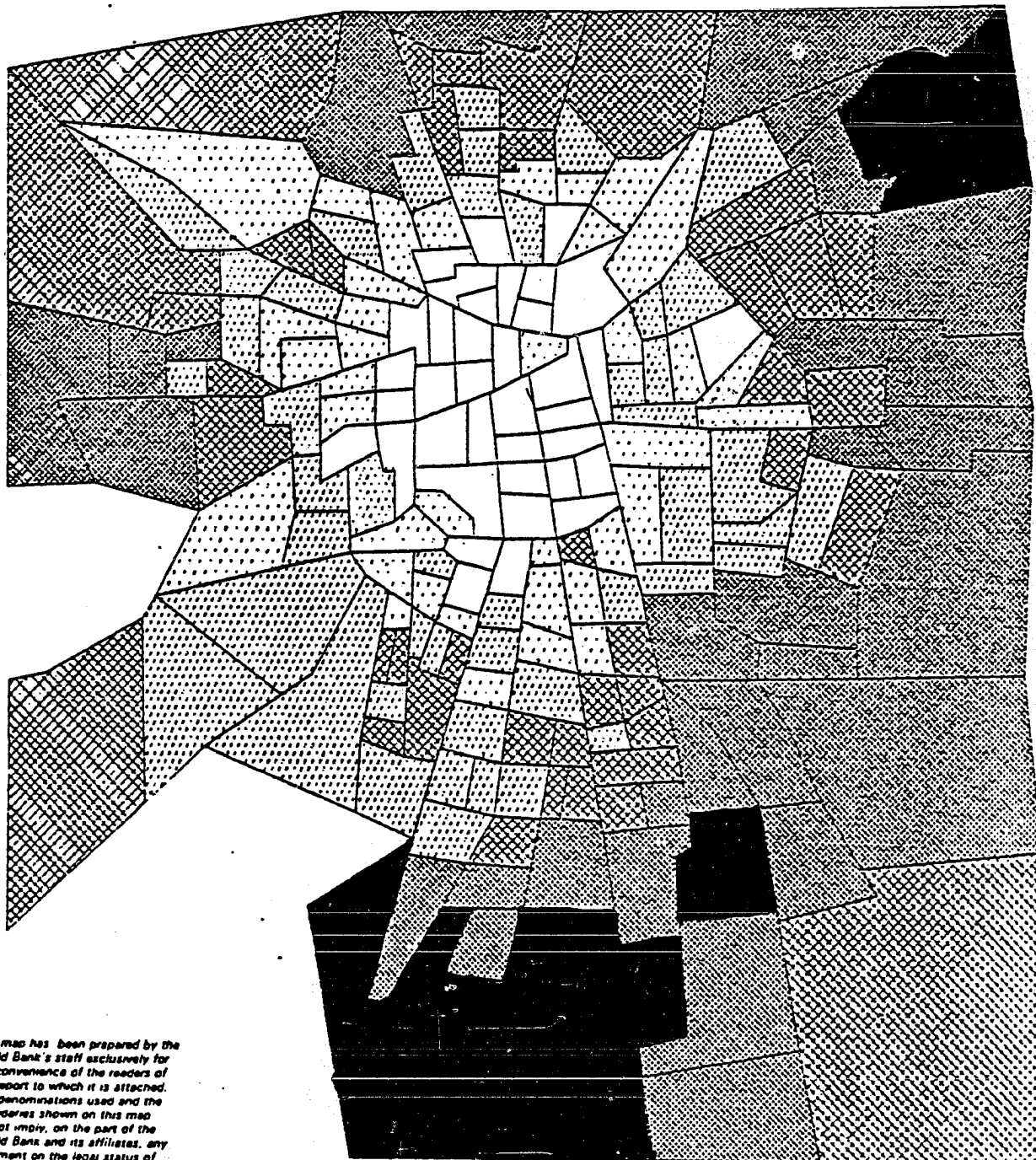
Chile Santiago Travel Time per Day	Transformed	8.59	115.00 - 160.00	minutes per traveler per day
	Values	6.86	105.00 - 115.00	
		6.25	95.00 - 105.00	
		3.63	85.00 - 95.00	
		5.00	75.00 - 85.00	
		4.22	60.00 - 75.00	



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Figure L-6

Chile	Transformed	7.75	22.00 - 40.00	kilometers per traveler per day
Santiago	Values	5.00	19.00 - 22.00	
		4.13	15.00 - 18.00	
		3.50	13.00 - 15.00	
		3.00	11.00 - 13.00	
Distance per Day		1.88	4.00 - 11.00	

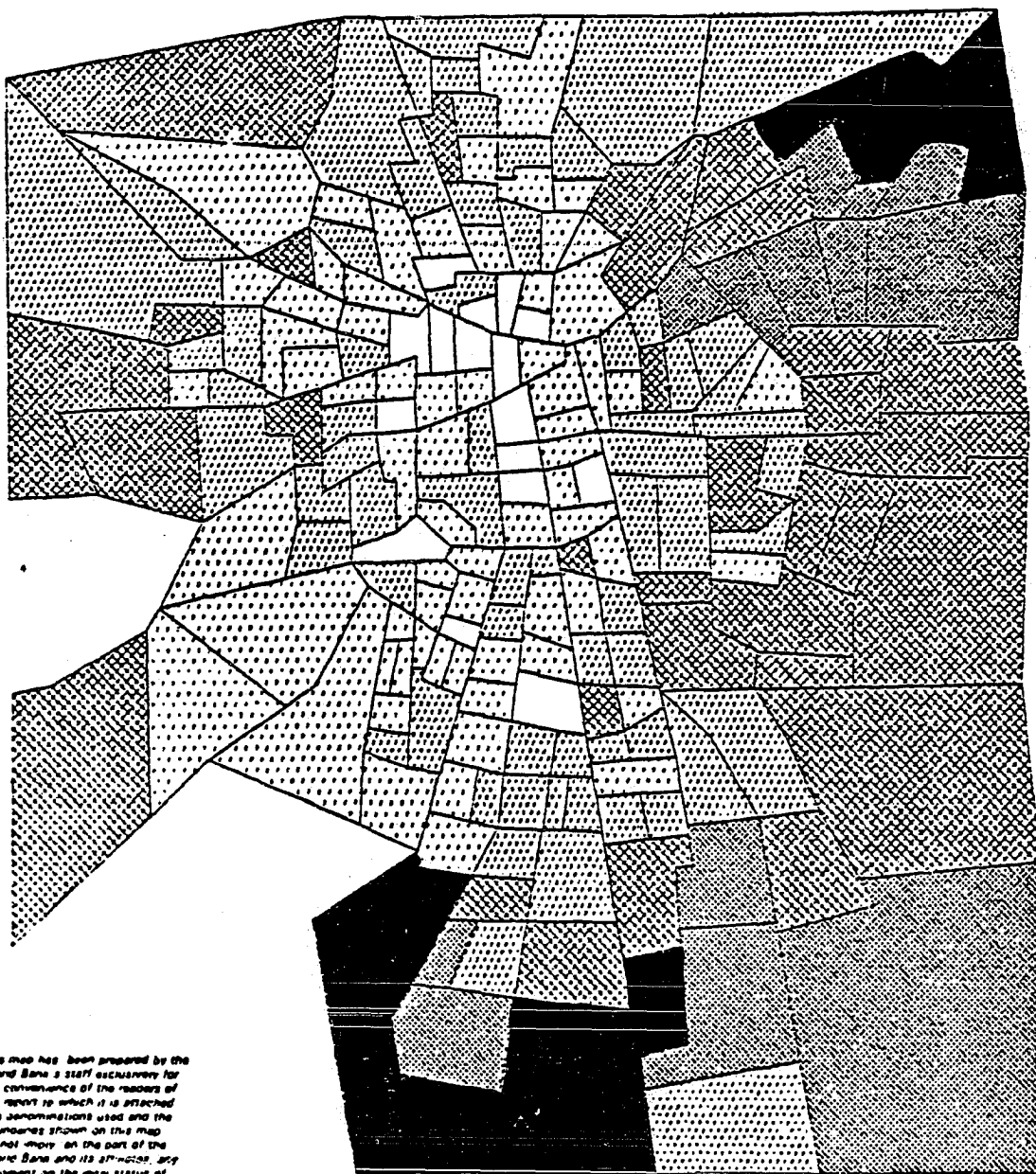


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Figure L-7

	Transformed	8.18	14.00 - 22.00
	Values	5.90	12.00 - 14.00
Chile		5.00	10.00 - 12.00
Santiago		4.20	9.50 - 10.00
		3.52	7.00 - 9.50
Mean Travel Speed		1.59	0.00 - 7.00



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