

**AN INTERNATIONAL COMPARATIVE PERSPECTIVE ON
URBAN TRANSPORT AND URBAN FORM IN PACIFIC ASIA:
THE CHALLENGE OF RAPID MOTORISATION IN DENSE CITIES**

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**This thesis is presented for the degree of Doctor of Philosophy
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I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary institution.

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Abstract

Recent decades have seen rapid change in the urban transport of many eastern Asian cities. Some cities have been hailed internationally as transport success stories while others have become known for their intense traffic crises to the extent of threatening both their environmental qualities and economic performance. Accordingly, there is great interest in better understanding urban transport patterns in the large cities of eastern Asia. However, the literature lacks clear internationally comparable information on these cities and their transport systems. A review of the literature on land use and transport in Asian cities reveals many misunderstandings and inaccurate interpretations of the current situation in these cities. This thesis attempts to redress this lack of sound urban data and to improve policy interpretations by focusing on nine major cities in Pacific Asia (Bangkok, Hong Kong, Jakarta, Kuala Lumpur, Manila, Seoul, Singapore, Surabaya and Tokyo). The study provides an international comparative perspective on these cities using a large set of data on urban transport, land use and economic factors, as part of a wider study on 46 international cities.

A historical review of transport and urban development between 1900 and the 1960s found that, by the end of the period, most of the Asian cities were more vulnerable to problems from an influx of private vehicles than Western cities had been at the equivalent stage in their motorisation. This greater vulnerability was primarily due to higher densities and greater dependence on road-based public transport in most Asian cities, which could be described as “bus cities”, an archetype that is developed in the thesis. This archetype is found to be useful in better understanding Asian cities in relation to more Western-based theories of city evolution based on the dominant transport technology, as well as helping to interpret past and present transport problems.

Analysis of comparative transport and other data for 1990 found that the Asian cities in the sample generally had much lower levels of private vehicle use than European, Canadian, Australian and American cities in the international sample. This is in line perhaps with general expectations, though not without significant variations within the group. The Asian cities also generally had greater roles for public transport and non-motorised transport and much higher urban densities than cities in the other regions, though variations were again significant. A detailed investigation of the special opportunities and challenges for transport of the high-density urban forms of most of the Asian cities reveals new insights on the root causes of transport problems in such cities. High density offers the opportunity to foster successful public transport and non-motorised accessibility. However, it also means that very high levels of motorised traffic per unit of land area (and hence intense traffic impacts) can emerge quickly, even if vehicle use per capita remains low. Traffic congestion can also emerge rapidly as dense cities motorise. This is a result, not just of poorly developed road systems, but of the fact that road capacity per capita is inherently low in dense cities. This research thus challenges notions in the literature that congestion problems in Asian cities can be solved by road expansion. It

establishes, through sound comparative urban data, that there are inherent limits to road provision in dense cities.

Contrasting urban transport strategies or models were identified within the Asian sample of cities. In particular, upper-middle-income cities, Bangkok and Kuala Lumpur, were shown to have experienced very rapid motorisation and to have had little success in increasing the relative roles of public transport and non-motorised modes. These trends have led to a severe mismatch between emerging car and motorcycle-oriented transport patterns and the pre-existing high-density urban form, especially in Bangkok. This “unrestrained motorisation” model is contrasted with the experiences of wealthier Seoul, Singapore, Hong Kong and Tokyo, which have all restrained and slowed the pace of motorisation to some extent and enhanced the role of public transport. In all four cities, 1990 levels of motorisation and vehicle use were low relative to their levels of income. This “restraint” model takes advantage of the transport opportunities that are inherent in existing dense urban forms while avoiding many of the problems. It is also shown to have encouraged, or complemented, the evolution of public transport-oriented patterns of urban development. Jakarta, Surabaya and Manila face the choice of following either of these models, but appear more likely to follow Bangkok and Kuala Lumpur, unless policy changes are made.

The study then reviews key choices and policies in urban transport in the nine Asian cities over recent decades. It identifies which have been most decisive in defining the models “chosen” by each city. Although many decisions are important, the thesis argues that a particularly crucial choice is the decision of whether or not to restrain private vehicle ownership and use. The Asian cities following the “restraint” model began to restrain private vehicles at an early stage in their motorisation and generally well before they had developed high-quality or high-capacity public transport systems. This challenges the common view that a city must already have a first-class public transport system before traffic restraint can be effective or politically acceptable. In fact, this study suggests that early introduction of traffic restraint can facilitate the gradual development of well-functioning transport systems, including mass transit systems.

Insights drawn from the results of this study potentially have important implications for transport and urban policy debates in low-income and middle-income cities everywhere, particularly those that are beginning to motorise quickly from previously low levels of vehicle ownership.

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Glossary and Abbreviations

ALS	Area Licensing Scheme - a form of traffic restraint implemented in Singapore; motorists must pay to enter the central area of the city
<i>Angguna</i>	Four-wheeled taxi-like vehicle in Surabaya that also has a tray-top at the back for a significant load of goods
<i>Angkut</i>	In Surabaya, paratransit microbus, fixed route, stop on demand service
ASEAN	Association of South East Asian Nations
<i>Bajaj</i>	Indonesian motorised tricycle taxi
<i>Becak</i>	Indonesian pedicab
<i>Beca</i>	Malaysian pedicab
<i>Bemo</i>	In Indonesia, generic term for small vans for public transport (usually 8-12 passenger capacity) with fixed route, stop on demand service. In Jakarta, 6-seater motor pedicab but usually fixed route, stop on demand service
BMA	Bangkok Metropolitan Administration
BOTABEK	Acronym for the region immediately surrounding Jakarta, consisting of the regencies of Bogor, Tangerang and Bekasi
CAAD	“Cities and Automobile Dependence: An International Sourcebook”, the precursor study to this one, by Newman and Kenworthy (1989)
CBD	Central Business District
CKD kit	Completely knocked down kit - a vehicle imported for local assembly
CO	Carbon monoxide
CO ₂	Carbon dioxide
COE	Certificate of Entitlement - prospective vehicle buyers in Singapore bid for a limited number of COEs that allow them to purchase a vehicle
DKI Jakarta	<i>Daerah Khusus Ibukota</i> Jakarta (Special Capital Region of Jakarta)
EDSA	Epifanio de los Santos Avenue, Manila’s most important arterial road
East Asia	Generally includes greater China, Japan, Mongolia and the Koreas
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific, with headquarters in Bangkok
footpath	In Australian usage, footpath is equivalent to the North American term, sidewalk, and the British term, pavement
GDP, GNP	Gross Domestic Product, Gross National Product
GRP	Gross Regional Product
ha	Hectare
HC	Hydrocarbons
ISTP	Institute for Science and Technology Policy, Murdoch University
Jabotabek	Acronym for Jakarta and its three neighbouring regencies, Bogor, Tangerang and Bekasi
<i>Jalan</i>	Malay and Indonesian for “street” - appears in many place names
jeepney	Paratransit minibuses of the Philippines. In Manila they operate on fixed routes but mostly stop on demand
JICA	Japan International Cooperation Agency
jitney	Generic term for any non-corporate (paratransit) public transport service operating on a fixed route, usually stopping on demand
<i>kampung</i>	A Malay/Indonesian word for village which is also used to refer to urban low-income vernacular-style settlements

Continued overleaf

Glossary and Abbreviations continued

<i>Kijang</i>	Toyota mini-van in Indonesia. Used as private cars, as goods vehicles and as public transport vehicles (e.g. as <i>mikrolet</i>)
km	Kilometre(s)
km/h	Kilometres per hour
Love Bus	Air-conditioned, premium bus service in Manila
LRT	Light rail transit
<i>mikrolet</i>	In Jakarta, paratransit microbus, fixed route, stop on demand service
minibus	Buses with medium capacity, generally between 15 and 35 seats
MJ	Megajoules
mode split, modal split	Measures of the role of a mode of transport according to percentage of trips
mosquito buses	Seven-seater jitneys in pre-war Singapore and Kuala Lumpur
MRT	Mass Rapid Transit
MTR	Hong Kong's Mass Transit Railway
NGO	Non-governmental organisation
NMT	Non-motorised transport
NMV	Non-motorised vehicle
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
<i>opelet</i>	Small jitneys in Jakarta that were phased out during the 1980s
Pb	Lead
Pacific Asia	The countries of eastern Asia, including both East and Southeast Asia
paratransit	Generic term for a wide range of transport modes, including taxi-like modes, bus-type modes and hybrids, which have in common that they are owned and run by non-corporate entities or individuals
pcu	Passenger car unit
pedicab	Non-motorised tricycle in taxi-operation
pph	Persons per hectare
rickshaw, <i>jinrikisha</i>	Hand-pulled vehicle to carry passengers in a taxi-style of operation, now in use only in Calcutta. "Rickshaw" sometimes refers to pedicabs
<i>samlor</i>	Motorised tricycles used as taxis in Bangkok (also called <i>tuk-tuk</i>)
<i>silor-lek</i>	Six-seater paratransit vehicles in Bangkok
SPM	Suspended particulate matter
SO ₂	Sulfur dioxide
Southeast Asia	Burma, Brunei, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam
<i>Tamaraw FX</i>	Philippine model of Toyota mini-van (similar to Indonesia's <i>Kijang</i>) that, by the mid-1990s, has become widely used in taxi and jitney services in Metro Manila
TDM	Transport demand management
transit	Public Transport (in North American usage)
tricycle	In the Philippines, motorcycles with sidecar used as short-haul taxis
trishaw	a pedicab
UITP	International Union (Association) of Public Transport, an umbrella body of public transport operators
VKT	Vehicle kilometres of travel
VOC	Volatile organic compounds

Abbreviations of City Names

City	Abbreviation	City	Abbreviation
Australia		Europe	
Adelaide	AD	Amsterdam	AM
Brisbane	BB	Brussels	BR
Canberra	CB	Copenhagen	KH
Melbourne	MB	Frankfurt	FF
Perth	PE	Hamburg	HH
Sydney	SY	London	LD
		Munich	MU
United States		Paris	PA
Boston	BO	Stockholm	SH
Chicago	CH	Vienna	WI
Denver	DV	Zurich	ZH
Detroit	DT		
Houston	HO	Asia	
Los Angeles	LA	Bangkok	BK
New York	NY	Hong Kong	HK
Phoenix	PH	Jakarta	JA
Portland (Oregon)	PL	Kuala Lumpur	KL
Sacramento	SA	Manila	MA
San Diego	SD	Seoul	SE
San Francisco	SF	Singapore	SP
Washington	WA	Surabaya	SU
		Tokyo	TK
Canada			
Calgary	CA		
Edmonton	ED		
Montreal	MO		
Ottawa	OT		
Toronto	TT		
Vancouver	VC		
Winnipeg	WP		

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

This study focuses on urban transport and its recent evolution in nine large cities in Asia. Urban transport is a pressing concern in most large cities around the world. The environmental and social impacts of urban transport are increasingly being seen as a threat to urban health, safety, economic efficiency, quality of life and even the sustainability of the global ecology itself (Faiz, 1993; Nadis and MacKenzie, 1993).

Many of the cities of Asia face urban transport problems and impacts as critical as anywhere (Dolven et al., 1997; Kidokoro and Hanh, 1993; Midgley, 1994). A 1992-93 survey of 133 Asian urban municipalities found transport problems at the top of the list of serious problems (Asian Urban Information Centre of Kobe, 1993). Bangkok especially has become notorious as a “traffic disaster” (Bodell, 1995; Poboon, Kenworthy, Newman, and Barter, 1994; Stickland, 1993; Tanaboriboon, 1993) but increasingly Taipei, Jakarta, Manila, and Seoul are also referred to with similar labels (Dolven et al., 1997). In stark contrast, a small number of middle-income cities and newly industrialised high-income cities have become famous for their decisive actions to move towards efficient, effective, relatively low-impact urban transport systems. These include Singapore and Hong Kong (Bernick and Cervero, 1997; Hau, 1995; Kenworthy, Newman, Barter, and Poboon, 1995).

The enormity of the recent traffic crises afflicting many middle-income cities, especially in Asia and Latin America, have focused increasing attention on transport in rapidly motorising cities (Gakenheimer, 1995; Hook and Replogle, 1996). The focus of this thesis is on Asian cities that by the early 1990s had reached income levels that were potentially able to support high rates of car and motorcycle ownership. Their reactions to this situation have been diverse and it is hoped that an analysis of the contrasting experiences will be both relevant and valuable to other low-income and middle-income cities around the world.

The detailed comparative study of Asian cities to be presented in this thesis, is part of a wider international comparative study which had a precursor in the earlier research by

Newman and Kenworthy (1989). The earlier work included three high-income Asian cities, Tokyo, Hong Kong and Singapore. The Asian cities included in this present study are the lower-middle-income cities, Surabaya, Manila, and Jakarta; the upper-middle-income cities, Bangkok, Kuala Lumpur, and Seoul; and the high-income cities, Singapore, Hong Kong and Tokyo¹.

All of these cities are located in Pacific Asia² where many countries have experienced very high rates of economic growth during most of the last two decades or more. Recent trends in transport and land use development in these diverse cities provide a variety of patterns and processes for comparison. A central concern of the thesis is to identify and evaluate any distinct emerging models or paths of transport development in this rapidly motorising region.

In this introductory chapter, some important motivations for the study are outlined. Then the specific aims of the thesis are presented in the form of a series of research questions. There is a discussion of the scope and limitations of the study. This is followed by an overview of the structure of the thesis and brief outlines of the purpose and content of each chapter.

1.2 Importance of and Motivations for the Study

This section outlines the intellectual significance of the topic and the main motivations for undertaking the study and for asking the research questions presented in Section 1.4 below. Answers to the questions raised in this thesis have a bearing on enormous expenditures, on the quality of life of many millions of people, and on potentially large environmental impacts at local, regional and global scales.

1.2.1 Rapid change in the region

A number of motivations centre on the speed of the changes that have been occurring in the Pacific Asia region. The 1980s and early 1990s were a time of accelerated change in urban transport in the region, flowing from great economic changes in recent decades (Drakakis-Smith, 1992; ESCAP, 1993; Forbes, 1996). Therefore understandings based on information from the 1970s and early 1980s may need reassessment. Change has been particularly rapid in upper-middle-income cities, such as Kuala Lumpur, Bangkok and Seoul (Kidokoro and Hanh, 1993; Lim, 1993). The most obvious transport change

¹ These income-based descriptions are adapted from the World Bank's categories for grouping nations based on their 1990 Gross National Products (GNP) per capita (World Bank, 1992: 307). The same ranges and category names have been applied to cities by using their 1990 Gross Regional Products (GRP) per capita. See Chapter 4 for details.

² The term Pacific Asia refers to both East Asia and Southeast Asia (Drakakis-Smith, 1992).

is an increase in the potential for ownership of motor vehicles. As will be seen in later chapters, many Asian cities have experienced very rapid motorisation since the 1970s. Annual increases in vehicle numbers of 15 to 20 percent have been common, compared with urban population increases of generally less than 5 percent (ESCAP and ADB, 1995: 190; Midgley, 1994).

It is likely that choices made during periods of high growth (both economic and population) may have a disproportionate impact in the long term. This is simply because so much urban infrastructure tends to be built during such growth periods. For example, a very large proportion of Singapore's, Hong Kong's and Seoul's urban fabric is less than 30 years old. The future urban form and transport patterns of many of the cities considered here will probably be substantially influenced by choices made during the recent period of very rapid growth.

At the time that this thesis is being finalised in 1998, a financial and economic crisis has struck the region, affecting every city in this study to some extent. The crisis probably means some respite from recent high rates of growth in vehicle numbers. The most likely scenario for the next several years is apparently for slight declines in vehicle ownership in several cities and slowed rates of growth in the others.

Much of the data presented in this study is for 1990, the reasons for which are explained later in the thesis. The high rates of change through the 1990s had threatened to make this reference year seem obsolete but the economic slowdown has reduced this danger. This year, 1998, is an interesting vantage from which to look back on the transport patterns and trends of the boom period³.

Rapid urbanisation is another dimension of change that provides a motivation for a focus on cities in this region. The middle-income countries of Pacific Asia are in the midst of the so-called urban transition. In 1990 most of the region remained predominantly rural and Indonesia, the Philippines, Thailand and Malaysia each had less than 50 percent of their populations in urban areas (United Nations, 1993). However, in each case, rates of increase in urban populations of above 5 percent were experienced during the 1980s and were expected to continue into the first two decades of the new millennium (United Nations, 1993). The populous regions of South Asia, China and Indochina are now also facing accelerating urbanisation. Asia as a whole thus has a high potential for large increases in urban populations.

³ The primary body of solid, comparable data for this study applies to 1990 but a limited amount of additional information has also been gathered for years that are more recent.

1.2.2 Urban transport problems and opportunities

Inappropriate transport patterns represent one of several important threats to global ecological sustainability. Worries have long been expressed over both the local and global environmental impacts of the existing motor vehicle fleet, which has until recently been concentrated in high-income countries. Such fears are now more keenly felt with the prospect of large parts of Asia becoming highly motorised (Hook and Replogle, 1996). Debate on this issue is part of a wider debate over the implications of the sustainability imperative for international equity issues (and vice versa). Many cities in Asia, and in the developing world in general, suffer greatly from local environmental impacts of transport, despite relatively low levels of motorisation (Faiz, 1993; Maddison et al., 1996; Nadis and MacKenzie, 1993; Varma, Souba, Faiz, and Sinha, 1992a; Varma, Souba, Faiz, and Sinha, 1992b). There is no need to reiterate in detail the issue of the environmental damage from urban transport on which there is a large and growing literature. Data on some of these issues will be presented in Chapter 5.

Urban transport choices also have substantial social impacts that include severance of communities, low mobility and accessibility by low-income people, and appalling safety problems. Transport has deep implications for the well being of vulnerable sections of urban society. Equity in urban areas can be strongly affected by transport policies and trends (Litman, 1996). Urban alienation, atomisation of society and “privatism” have also been blamed to some extent on transport patterns (Appleyard and Lintell, 1981; Engwicht, 1992). The various impacts of transport have provoked increasing interest from community organisations, and by civil society in general, in several of the Asian cities in this study. This has included media interest, engagement by existing non-governmental organisations (NGOs) and, in the 1990s, the emergence in Japan, Korea, Thailand, the Philippines and Malaysia of organisations devoted to a “watch-dog” role on transport issues.

Pacific Asia has become a large and (until recently) growing market for urban transport-related goods, services and infrastructure. Indeed, transport investments, maintenance and operations often involve huge levels of initial and ongoing expenditure by governments, businesses and the public. If only for this reason, such decisions are of great consequence. This is particularly important in low and middle-income countries, where the resources to invest in transport are necessarily limited.

Plate 1.1 Traffic has become a nightmare for the residents of many Asian cities



Traffic congestion near Siam Square in Bangkok, 1996



View from inside a bus stuck in traffic on Kuala Lumpur's Federal Highway, 1995

1.2.3 Search for locally appropriate policies

A primary motivation of the study is a desire to provide policy-related insights to decision-makers and communities in the region. An aim is to help in the selection of workable urban transport-related policies that can support successful urban areas at reasonable cost while minimising environmental impacts. It is hoped that a broad understanding of how these cities compare with each other and others around the world will be an important contribution towards finding such policies and informing public debates on transport issues. This study is also motivated by a hope that this search might yield insights of value for other low-income and middle-income cities even if they are not included in the comparisons. Many of the transport challenges being faced in middle and high-income eastern Asian cities may emerge in the future in many others that currently have low levels of motorisation.

1.2.4 Lack of reliable and comparable information on Asian cities

There is a serious lack of reliable and internationally comparable information with which to get a balanced perspective on the transport trends and characteristics of the cities of the region. Deficiencies of the existing comparative literature on Asian urban transport are discussed in Chapter 2. Corollaries of poor data on cities in Asia are poor understanding and sometimes a mistrust of all data. There are indeed great difficulties in compiling reliable data on low or middle-income cities but the data set presented in this study (on 46 cities including nine in Asia) has been exposed to detailed scrutiny and cross-checking. It represents probably the most reliable and carefully compiled database on this topic to date. The reader can assess the quality of the data set presented here by referring to Chapter 4 on the methodology that has been used. Appendices 1 to 4 have further details on the data and their sources.

1.2.5 Spatial issues

A further motivation for the study is to redress another deficiency of previous literature on urban transport in low-income or middle-income countries, namely a lack of attention to spatial issues and urban form. The spatial implications of urban transport patterns have long been an important theme in planning (Hansen, 1959; Mumford, 1961; Thomson, 1977). A particular inspiration for this study was the work of Newman and Kenworthy (1989). Their work, although still debated in policy circles, provided evidence on the importance of urban form, especially urban population density, in understanding urban transport characteristics at the city-wide level within an international sample of high income cities. From previous studies, such as Hogan (1978), and from the three Asian cities considered by Newman and Kenworthy (1989), it was already known that many Asian cities have high urban population densities. This suggested that spatial issues for Asian urban transport might be distinctive. Therefore, a further motivation for this study was the need for urban form to be carefully examined for its impact on transport policy formulation.

1.2.6 Long term perspective

A long-term perspective and concern for the future is another important motivation. Awareness by decision-makers and by the public of alternative long-term visions for cities and their transport systems can be a valuable antidote to the pitfalls of reacting to immediate problems and their apparent short-term solutions. Change is so rapid in some of the Asian cities that scenarios for decades ahead are very difficult to assess. Nevertheless, it is clear that present-day urban transport decisions, especially major infrastructure decisions, can have large long-term effects on urban development and on future transport patterns (Cervero, 1991a; Gakenheimer, 1993; Hall, 1983). Urban transport changes are often irreversible, in the sense that they may lead to system-wide changes that may not reverse even if the original change itself is reversed. An example is the long-term impact on cities of the mutual influences between transport patterns and urban form (Brindle, 1995; Brotchie, Hall, and Newton, 1987; Newman and Hogan, 1987).

1.3 Brief Background to the International Comparisons

This dissertation takes a broad perspective in time and space. An attempt has been made to gather data for the last few decades on each city and a brief historical review of 20th century urban transport evolution is provided. Nine cities from 8 Pacific Asian nations are compared with 11 European cities from 9 nations, 7 Canadian cities, 13 cities in the

USA and 6 Australian cities. Although this leaves out significant regions of the globe, an effort has also been made to collect some information on a number of other cities in Pacific Asia, South Asia, Latin America, the Middle East, southern and eastern Europe and Africa.

The study presents a large set of urban data that has been compiled by the author and by a number of other researchers under the supervision of Dr Jeffrey Kenworthy in the Institute for Science and Technology Policy (ISTP) of Murdoch University in Perth, Western Australia. The data on the Asian cities have been subjected to detailed scrutiny and quality control by the author, and the data for the other cities have undergone a similar process through the work of others. Although no such large compilation can ever be totally free of inaccuracy, this study provides a more comprehensive, comparable and reliable set of data on Asian cities than has been compiled before. This allows important comparisons of the characteristics of these cities with each other and with those of many others around the world. This research involves a team effort, so it is important to state clearly that the author has been wholly responsible for the collection and checking of all data on Surabaya, Jakarta, Kuala Lumpur and Seoul and has been strongly involved in data collected for Manila, Bangkok and Singapore. Further information on the division of effort in the larger study is provided in Chapter 4.

The study attempts to remedy the problem that, in the absence of sufficient reliable information, few commentators on Asian cities have shown a clear understanding of the nature of the transport/land-use systems of Asian cities, nor have they been able to gain a well-informed international comparative perspective.

1.4 Research Questions

The emphasis in the thesis is on making reliable comparisons of urban transport characteristics, on comparing the distinctive features and development paths found in Asian cities, and on understanding the implications of these results for the choices available to decision makers. These issues have been brought into focus using a small number of research questions that arose from the motivations and issues raised so far in this chapter. The following four questions are central to the thesis and have been refined over time from somewhat simpler questions that have guided the study from the beginning.

Research Question 1:

How do the urban transport and urban form characteristics and development trends of selected Southeast and East Asian cities compare with each other and with a large sample of international cities?

Research Question 2:

Are Asian cities faced with unusual or unique urban transport challenges or opportunities? Can distinctive Asian models of urban transport and land-use be identified?

Research Question 3:

What are the most significant transport-related choices in Asian cities over recent decades? How do these choices relate to the urban transport and land-use comparisons and to the transport challenges and opportunities faced by each city?

Research Question 4:

What do the comparisons and the answers to the above questions imply about future choices on urban transport and urban form in each of these Asian cities? What are the implications for other low and middle-income cities that may also be facing, or may soon face, a similar set of circumstances?

Question 1 is the starting point and the central focus of the research. The purpose is to seek an international comparative perspective on the urban transport and relevant aspects of urban form of Asian cities. The data collection on 46 cities and the analysis of those data are the primary means by which the question will be answered. The main features of the data are presented in Chapters 5 and 6. The same data, the historical perspective in Chapter 3, the broader literature, and most importantly, the answers to Question 1, provide the basis for answering the other three questions.

1.5 Scope of the Study

The questions above, together with the data collection task, set an ambitious agenda. There are many tempting side issues that are of great importance but which, in order to achieve clarity and focus, need to be excluded from the scope of the thesis. The focus of the dissertation is on the large-scale, city-wide features of the transport and land use of each city. Other issues receive attention only in as much as they are relevant to the development of transport at metropolitan scale. Furthermore, the emphasis is on features and changes that have long term impact. Thus, the aim is to look at the macro-level transport orientation of each city, with an eye to likely scenarios over a scale of decades.

This thesis does not try to statistically explain the urban transport patterns found in the region. Instead, the literature⁴ is drawn upon for an indication of the important influences on urban transport development. Awareness of these influences and analysis of the global data set, together provide the main tools for achieving the primary goals of the thesis. These goals are to identify the developmental paths being followed by the urban transport and land-use systems of these Asian cities, to put them into an international comparative perspective and to understand their implications for these and other cities.

Several examples of important issues that are largely outside the scope of the thesis need to be mentioned. These include vehicle emissions rates and vehicle fuel efficiency. The details of public transport policy, management, financing and organisation are also not discussed in any depth. Nor is there discussion of options for the funding of transport infrastructure, including private-sector involvement. The field of full-cost accounting and cost-benefit analysis in urban transport could not be explored here. Most details of road planning or transport planning practice, such as most questions of design, assessment procedures for proposed investments and details of traffic management, are beyond the scope of this study.

Policy choices are an important focus for the thesis. However, the underlying processes for making such choices are complex and depend upon the political and decision-making realities of each city. These issues are beyond the scope of the study and there will no detailed treatment of the administrative and political arrangements for transport and urban decision-making in each city. Sociological issues, such as gender dimensions of urban transport, are also beyond the scope of this study. Finally, while large-scale features of land use and urban form are considered in detail, there is relatively little discussion of urban land use patterns at a fine scale.

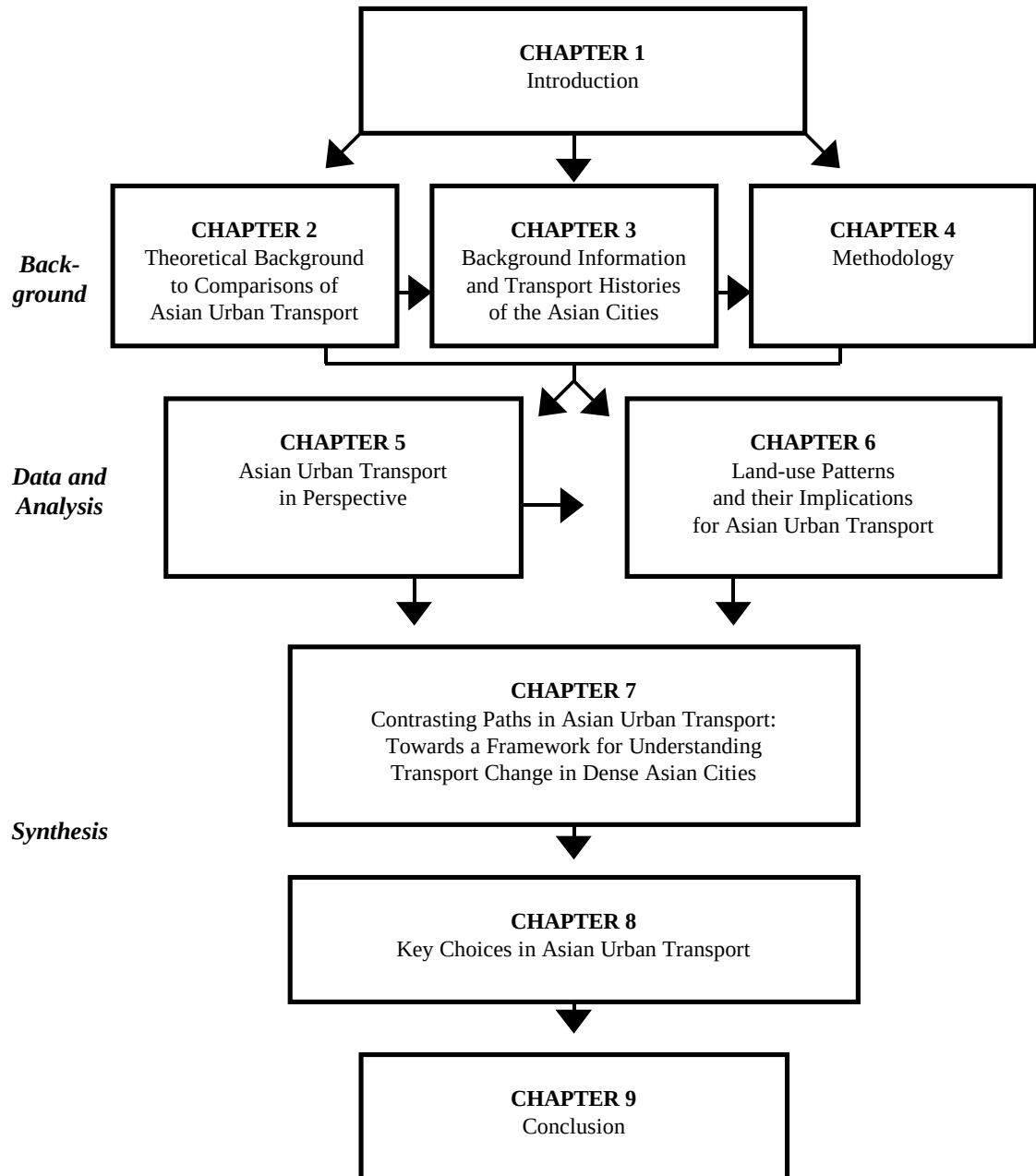
1.6 Summary of the Thesis

The thesis is organised into nine chapters, as shown in Figure 1.1. This introductory chapter has presented some context, motivations, research questions, the scope of the study and an outline of the thesis. **Chapter 2** examines the theoretical background to central issues of the thesis. Previous similar and relevant work is examined and assessed. The chapter reviews important choices and influences on urban transport as

⁴ Including insights from the wider study of which this thesis is part (Kenworthy and Laube et al., 1999, forthcoming).

identified and debated in the literature. There is also a review of previous attempts to identify typologies or descriptive models of city-wide urban transport and land use.

Figure 1.1 Structure of the thesis



Chapter 3, “Background Information and Transport Histories of the Asian Cities”, provides pertinent information on the historical, economic, demographic, cultural, political, and geographical background on the Asian cities that have been included in the sample. A small number of background issues are identified as being of particular relevance and are discussed in some detail. An extensive discussion is provided of the historical development of urban transport in the Asian cities from around 1900 until the

1960s. Pertinent comparisons with the transport histories of Western cities are also made. **Chapter 4**, “Methodology”, presents and critically examines the methodology that has been adopted to collect and analyse the information on urban transport, land use and economic factors on the cities in the international sample. The focus is on methodological issues that presented a special challenge in the Asian cities.

Chapter 5 is entitled “Asian Urban Transport in Perspective”. It gives a concise presentation of important transport data and information (mostly from the main data set). It provides an international comparative overview in answer to Research Question 1. Important themes are highlighted. The comparative perspective leads into an investigation of how the Asian cities fall into distinct groups based on similar transport characteristics, which begins to address Research Question 2. **Chapter 6**, “Land-use Patterns and their Implications for Asian Urban Transport” presents indicators on urban land use patterns in the Asian cities and puts them into an international perspective. This is also in answer to Research Question 1. It then begins to explore the issue of the interaction between land-use patterns and urban transport in the context of these Asian cities. The special opportunities and challenges for transport of the urban forms of the Asian cities are investigated. Thus the chapter also addresses Research Question 2.

Chapter 7, “Contrasting Paths in Asian Urban Transport: Towards a Framework for Understanding Transport Change in Dense Asian Cities”, elaborates on how the comparative data and theoretical perspectives from earlier chapters contribute to a deeper understanding of contrasting urban transport “strategies” or models found in the Asian sample of cities. This is in answer to Research Question 2 and leads into an investigation of the major transport choices that underpin different strategies. **Chapter 8**, “Key Choices in Asian Urban Transport”, identifies and discusses in detail the pivotal choices, policies or events that have been decisive in defining the model “chosen” by each city, and shows how these relate to the comparative perspective provided by Chapters 5 and 6 and to the synthesising framework of Chapter 7. This is achieved partly through proposing a generic framework of Asian urban transport and land-use evolution. A focus on choices addresses Research Question 3. The chapter also addresses Research Question 4, on the future choices that are open to the Asian cities and the implications for other low and middle-income cities.

Chapter 9 is the conclusion where the analysis is tied together and where the central findings and arguments are reiterated. Important policy implications are highlighted. Suggestions are made for further research to answer questions raised by this study.

CHAPTER TWO

THEORETICAL BACKGROUND TO COMPARISONS OF ASIAN URBAN TRANSPORT

2.1 Introduction

This chapter examines the theoretical context of the central issues addressed by this thesis. Firstly, there is a discussion of previous comparisons and compilations of data on urban areas (especially of transport data). Secondly, there is a brief review of the key choices and influences that are considered to be decisive in influencing transport patterns in cities over the long term. Mention is then made of some of the major debates on urban transport in Asia and in low and middle-income cities in general. Finally, the chapter reviews typologies of urban transport and urban form patterns that have been suggested in the literature, especially focusing on schemes that highlight the connections between transport and urban land use systems. Thus, the theoretical review addresses each of the main issues raised in the research questions that were presented in Chapter 1, namely international comparisons of urban transport and land use, alternative models or strategies of transport and land use development, and the issue of choices in urban transport.

2.2 Urban Transport Comparisons

This section reviews important previous comparative studies of urban transport issues that have included Asian cities and/or low or middle-income cities. The review highlights the need for a systematic, comparative study with a broad international perspective, the major focus of this dissertation.

It immediately becomes apparent from this review that a lack of comprehensive and comparable data on the main cities of the region has led to confusion in the literature. For example, some authors list a litany of urban transport problems and issues without making it clear how they compare in any quantitative way between different cities. Impressions concerning the relative position of a city compared to others are often based on appearances rather than on adequate evidence. In particular, the relative importance of cars in the overall transport system and the density of an urban area are issues where first impressions can be misleading.

Although a great deal of transport data exists on cities in the region, especially in consultants' studies, such data are not easily accessible and in some cases are considered secret. Occasionally consultants have published summaries of their studies in journals or presented results at conferences, however the practice is not widespread and the amount of data presented is very limited (Kirby, Tagell, and Ogden, 1986; Mogridge, 1983; Mogridge, 1997; Mogridge, 1992). Such reports do not provide much of a basis for detailed international comparisons.

Another problem is that government departments often do not have effective mechanisms for sharing their valuable information in comprehensible form with relevant bodies even within each city, let alone to an international audience. Statistics departments publish some relevant urban data but these are often not presented in the forms appropriate for urban analysis.

There have been a number of previous published studies or compilations of data on urban transport in the Pacific Asia region. Table 2.1 leads to the conclusion that little readily available data exist in the literature for any genuine and reliable comparison of the Asian cities on a wide range of transport, land use and economic variables. This shortcoming underpins one of the major thrusts of this thesis; to provide a reliable and useful basis for comparing Asian cities among themselves and with other international cities in order to better understand the realities of land use and urban transport systems in this important region.

The other obvious conclusion is that too many studies appear to essentially "give up" on getting good comparative data. Where it is provided, it is often not properly checked and hence has obvious problems. There appears to be no other way of developing reliable comparative urban data than to undertake the very time-consuming and often painful exercise used in the research for this thesis.

Table 2.1 Relevant comparative studies of urban transport and land use

Author(s), Title	Main Focus and Aims	Data: Comments on Scope and Quality	Key Conclusions of Relevance to this Study
Flood (1997) The Habitat Indicators Programme 1994-96.	Major international effort to compile a large number of key urban indicators for cities in most countries of the world. Purpose: "to strengthen capacity of institutions at all levels to monitor shelter conditions and urbanisation processes using a minimum set of substantially uniform and consistent indicators". Data on many aspects of urban development from a large number of cities for the year 1993.	Data quality higher than previous very large international compilations of this type but still with some problems (e.g. in the density data). In most countries, consultants were employed to compile data. Data of relevance to this study include: areas under different land uses, population (which together provide density), city product per person, income distribution, modal split for work trips, travel time for work trips, road spending, and vehicle ownership. Number of cities with response to these items ranged from 136 to 199. Asia under-represented in the study, particularly high growth economies of Pacific Asia. Overall, data were suspect in many areas.	Transport variables "tend to reflect local practices and customs and are more dependent on the policy environment than on objective conditions". Urban residential densities (not strictly comparable with urban densities quoted in this study) were highest in Asia (>3 times the developed city average). Arab cities were almost as high density. African and Latin American densities were about double the developed city average. Motorcycle use is high in much of Asia (and some African cities) but not in Latin America or the Arab world. Bicycles important in much of Asia. Buses provide most public transport in almost all developing cities and are the predominant form of transport overall in Latin American cities. Public transport mode-share tends to increase with city size. Car ownership tends to rise with city product per capita (although with a surprising amount of scatter). Use of cars to go to work tends to decrease with density.
Ingram and Liu (1997), Motorization and Road Provision in Countries and Cities (World Bank).	Assesses influences on motorisation and road provision at the national level and at the urban area level. Uses panel data from 50 countries and 35 cities to assess motorisation and road provision with respect to a number of other variables. Assesses whether national patterns differ significantly from urban patterns.	Most of the urban data consists of a very small subset of the high-quality 1980 data set of Newman and Kenworthy (1989) (see below). Six Asian cities are added (Bandung, Bangkok, Guangzhou, Jakarta, Manila, Seoul and Surabaya). However, density figures for several of these Asian cities appear to be inaccurate (using gross densities, a definition not compatible with the Newman and Kenworthy data). National income data are used as proxy for urban income levels.	Finds strong regularities in the influences on motorisation and road provision across countries, cities and over time. Income is an important explanatory variable, but slightly less important at the urban level than at the national. Vehicle ownership and road length per person both vary inversely with urban population density. Road provision (per person) expands more slowly than income at the urban level and is negatively associated with urban density. Urban road provision is influenced by past physical endowments; per capita road provision and population densities vary substantially across cities with high incomes. There is a saturation level for urban road network density (of about 23 km of road per square kilometre).
UITP (1985-6) and (1979), UITP Handbook of Public Transport and UITP (1997), Urban Public Transport Statistics 1997.	Large amount of public transport data from a very large number of cities, including many in Pacific Asia. Strongest with respect to large corporate or government-run systems.	Comprehensive set of data although very few items on anything besides public transport. Significant worries about quality control (especially in low and middle-income cities) and difficulties in establishing per capita figures. Poor consistency on what is collected for each city.	Not applicable.

Author(s), Title	Main Focus and Aims	Data: Comments on Scope and Quality	Key Conclusions of Relevance to this Study
Hook (1996), Motorization and non-motorized transport in Asia: Transport system evolution in China, Japan and Indonesia	Reviews the range of modal orientations of contemporary cities and uses case studies from Japan, Indonesia and China to illustrate how motorisation is influenced by public policies.	Emphasis on non-motorised transport. Not strongly data oriented but draws on some of the 1980s data in Replogle (1992) -see below- with some more recent information. Useful observations on urban form related to transport patterns.	Elaborates Replogle's classification: NMT dominant cities; mixed traffic cities; public transport dominated cities; and private motor vehicle dominated cities. High-density, non-automobile oriented cities are economically efficient and "the spatial manifestation of the export-oriented growth model".
OECD (1995), Urban Travel and Sustainable Development	Analysed transport-environment policies in 20 high-income countries and 132 cities. Japanese cities the only Asian ones. Variety of transport and urban form data.	Data are from questionnaires answered by officials in each city. Apparently, there were little or no cross-checks or consistency safeguards. Therefore likely to be of only moderate quality.	Present land-use and transport policies in OECD/ECMT countries are leading to excessive travel by car in cities and their immediate surroundings. Car dependency can only be reduced by the combined effect of land-use and transport policies.
Servant (1995), The Car in the City: Main conclusions from the Metropolis Survey among its member cities.	Based on a survey of Metropolis members by the Metropolis organisation's working group on "the car in the city". The cited paper is a preliminary report.	Thirty cities but only Seoul and Tokyo from Pacific Asia. Surveys yielded poor quality data, e.g. many density figures were nonsensical (apparently a mix of gross, residential and urban densities were provided). Percentage of travel on foot is also problematic.	The paper provides a plot of density against motorisation rate (cars per 1000 inhabitants) but because of the problems with the density data the outcome is nonsensical.
Hayashi (1994), Urbanization, Motorization and the Environmental Nexus - An International Comparative Study of London, Tokyo, Nagoya and Bangkok.	Aims to identify mechanisms and provide a scenario analysis of the ways in which transport develops into a large contributor to energy consumption and environmental degradation.	Focuses on London, Tokyo, Nagoya and Bangkok. Some detailed comparative data on urban form, motorisation, motorisation versus incomes, infrastructure investment, transport energy consumption and vehicle travel of the four cities over several decades. Apparently reasonably high quality data but with a narrow scope and few cities included.	Similar processes of urbanisation, motorisation and environmental degradation among the four cities. The later a metropolis grows, the faster the urbanisation cycle (urbanisation, suburbanisation, disurbanisation, reurbanisation). Bangkok centralised but suburbanising rapidly. Relationship between per capita product and car ownership has been similar in each. Bangkok lags in transport infrastructure investment relative.
Birk (1993), Moving Toward Integrated Transport Planning: Energy, Environment, and Mobility in Four Asian Cities.	Four case study research projects by local experts. Aimed to analyse the problems encountered in meeting their transport needs and to create a matrix of options that could be used by cities around the world.	The four cities were Bangkok, Surabaya, Varanasi and Islamabad. Comparisons were largely policy oriented and qualitative. Some erroneous quantitative comparisons because of wrong density data (using gross densities). However, there are also a few valuable quantitative comparisons.	Policies in all four cities have been overly road-based and have neglected non-motorised transport and public transport. Emphasis on promoting the development of new "Integrated Transportation Planning" methods (by analogy with Integrated Resource Planning by power utilities). Groups cities into three "tiers" based on the extent of their transport problems and with different policies proposed for each.
Seoul Metropolitan Government (1994), Comparative Statistics of Major Cities.	Large compilation of data on cities around the world, with a small amount of transport data. Apparently used questionnaires.	Unknown quality control efforts. Often difficult to be sure what administrative area is referred to by each item of data. Useful but difficult to use without great effort and must be used with caution.	Not applicable.

Author(s), Title	Main Focus and Aims	Data: Comments on Scope and Quality	Key Conclusions of Relevance to this Study
Midgley (1994), Urban Transport in Asia: An Operational Strategy for the 1990s	Diagnoses Asia's urban transport problems and outlines an agenda for World Bank lending and technical assistance. Draws on a number of more focused background studies.	A wealth of facts and comparisons in tables, boxes and graphs, including some comparative data. Mostly draws (too uncritically) on earlier published studies and on sources such as Jane's Urban Transport System, with most data from the late 1980s (the latter source was found to be of little use to this study).	Urban transport challenges in Asia are unique in their scope, scale and pace of change. The report highlights the great diversity in the region. Provides a detailed but broad overview of the problems and a very valuable outline of the main policy choices available. However there is little mention of current urban form characteristics in the region nor of prospective urban form and transport interaction.
Padeco Co. Ltd. (1993), Non-Motorized Vehicles in Asian Cities	Focuses on the use of non-motorised vehicles and policies and practices towards them in a sample of Asian cities.	A small range of data, especially on non-motorised vehicle ownership, use, mode-share in the traffic streams, and prices. The cities included were Phnom Penh, Hanoi, Dhaka, Kanpur, Shanghai, Surabaya, Manila, Chiang Mai, Georgetown, and Tokyo.	Non-motorised vehicles are very important in most of the cities in the study. Qualitative discussion of the main factors influencing the ownership and use of NMVs. Recommendations take a very positive view of the potential role of NMVs and aim to reduce barriers to their use.
Tokyo Metro. Govt. (1993), Statistics of World Large Cities 1993	Much like the Seoul Government compilation - they may be sharing this information?	See comments on Seoul Metropolitan Government (1994) above.	Not applicable.
Bushell (1993), Jane's Urban Transport Systems 1993	Major compilation of information and figures on public transport in cities around the world.	Wealth of data but difficult to standardise and not comprehensive, even on parameters covered. Little data on any other aspects. Little information on non-corporate public transport ("paratransit").	Not applicable.
Replogle (1992), Non-Motorised Vehicles in Asian Cities	Overview of use of non-motorised vehicles in Asian cities. Identifies conditions under which NMV use should be encouraged and obstacles to their development.	Extensive information and data on non-motorised vehicles in Asia as well as modal split. Data mostly for years between 1980 and 1987. Data compiled from many previous studies and reports. Unavoidably, the inaccuracy of much data on non-motorised transport in the literature affects some of the data presented here.	NMVs important in many Asian cities. Ownership of all vehicles, including NMVs, is growing rapidly in most parts of Asia. NMVs threatened by motorisation, loss of street space for safe NMV use, and changes in urban form prompted by motorisation. Japan, Netherlands, etc. show that modernisation does not require total motorisation. Calls for NMV emphasis in World Bank lending.
Miyamoto (1992), Integrated Land-use and Transportation Planning and Implementation for Developing Metropolises	This special edition of Regional Development Dialogue provided a compilation of data drawn from case studies on Bangkok, Manila, Kuala Lumpur, Seoul, Osaka and Jakarta.	Small number of relevant items. However, few of them are useable for quantitative comparisons. Many raw numbers presented with few standardised, per capita figures. Kuala Lumpur, Osaka and Seoul data are on the central cores only of larger metropolitan regions.	Not applicable.

Author(s), Title	Main Focus and Aims	Data: Comments on Scope and Quality	Key Conclusions of Relevance to this Study
Cervero (1991b), Paratransit in Southeast Asia: a Market Response to Poor Roads?	Investigates the diversity of transport modes in Southeast Asian cities and relates this to poor roads. Cities include Bandung, Bangkok, Jakarta, Kuala Lumpur, Manila, Medan, Singapore, and Surabaya.	Data from 1970s and 1980s on vehicle numbers and capacities for each vehicle type, and on road lengths in each road category. Raw figures but few per capita derived figures are provided. Indices of mode type diversity, capacity diversity, road hierarchy, and road capacity variety (or balance).	Greatest variety of urban transport modes (both in terms of types and of seating capacities) exists in the cities with the least road capacity per capita and a poor road hierarchy. High diversity of urban transport types and capacities (including paratransit) may have evolved to compensate for poor roads (inadequate capacity and weak hierarchy).
Spencer (1989), Urban Transport (in ASEAN)	Useful overview and review of the urban transport scene in Southeast Asian cities. Primarily qualitative and policy oriented rather than quantitative.	Only a small amount of data but some useful comparisons (data from mid 1970s to mid 1980s) on public transport systems, modal splits, and motorisation per capita (with good quality control). No urban form data.	Reviews Rimmer's conclusions on public transport policy (conventional and unconventional wisdoms and related debate). Debates relative merits of car ownership restraint, usage restraint and traffic management approaches.
Newman and Kenworthy (1989), Cities and Automobile Dependence: An International Sourcebook.	Focus on comparing city-wide urban transport characteristics with urban form characteristics for many cities.	High quality data set for 1960, 1970 and 1980 on urban transport, transport energy use, and urban form. Included 32 large cities in Europe, Australia, North America and Asia (Tokyo, Singapore, and Hong Kong). Most items were carefully standardised and checked.	Highly systematic variations among the 32 cities in land use intensity, orientation to non-automobile modes of transport, the level of traffic restraint, the degree of centralisation, performance of public transport, and levels of automobile usage per capita. Most debate on the study has focused on urban density and its relationships to transport variables.
OECD (1988), Cities and Transport	Case studies on urban transport including only Osaka, Hong Kong and Singapore in Pacific Asia.	Most data not in a form intended to help international comparison. Includes only the City of Osaka, which is just the core of metropolitan area.	Not applicable.
Rimmer (1986c), Rikisha ⁵ to Rapid Transit: Urban Public Transport Systems and Policy in Southeast Asia.	An historical account of public transport in Southeast Asian cities since late last century. Emphasis is on policies and events concerning choice of technologies (modes) and organisation (ownership and scale).	Wealth of historical and recent (up to early 1980s) data and information mainly on public transport on Singapore, Kuala Lumpur, Manila, Jakarta, Bangkok, Surabaya, Chiang Mai, Georgetown, Tokyo, Hong Kong, London, Boston and Belfast. However, the book lacks systematic quantitative comparisons of the cities involved.	Policy tendency in Southeast Asian urban public transport has been to force modernisation of technology (e.g. elimination of paratransit modes) and "incorporation" (from small to large-scale organisation). Contrasts the "conventional" approach of modernisation and incorporation with an "unconventional" approach, which embraces intermediate technology and smaller scale organisation (which he favours).

⁵ 'Jinrikisha' is the original Japanese name for the hand-pulled rickshaw.

Author(s), Title	Main Focus and Aims	Data: Comments on Scope and Quality	Key Conclusions of Relevance to this Study
(Allport and Thomson, 1990; Case and Latchford, 1981; Fouracre, 1977; Gardner, Cornwell, and Cracknell, 1992; Gardner, Kuhn, and Rutter, 1994; Jacobs, Maunder, and Fouracre, 1986)	There have been several separate comparative studies by the Transport Research Laboratory in the United Kingdom. Each investigated a specific issue in urban transport in low and middle-income countries.	These are mostly high quality studies with data that were apparently carefully compiled and checked. They provide useful comparative insights. However, since each study had a tight focus and included different cities at different times, they did not provide a basis for systematic and holistic comparisons of many cities.	Each of these studies had policy-oriented goals. The data and comparisons sought to address important controversies related to urban transport, especially public transport, such as conventional buses, paratransit, busways, light rail, and mass transit.
Pendakur (1984), Urban Transport in ASEAN	Survey/review of urban transport conditions and policy in ASEAN, with a focus on public transport. Includes Bandung, Jakarta, Surabaya, Kuala Lumpur, Manila, Bangkok, and Chiang Mai.	Most comparisons are qualitative and policy oriented but a very small set of comparative data from the late 1970s and very early 1980s is presented on public transport types, motorisation, modal split for motorised trips. Major consultants' studies are the main source of the figures.	Suggests an emphasis on restraint of car ownership and use, reduced emphasis on road expansion, pricing reform such as congestion pricing, discouraging consolidation or nationalisation of bus fleet. Urged that urban transport studies include all modes (walking, bicycle, motorcycle, etc.) and that comparisons be made with comparable Asian and ASEAN cities and not with Western cities.
Hogan (1978); Urban Density: Trends, Causes and Implications; see also (Newman and Hogan, 1987)	Examined urban density data and a series of other items for a range of cities including many low and middle-income cities. Focused on transport and density.	Relied primarily on secondary published sources. Author acknowledged great difficulty in getting sufficient data and problems with quality.	Connection between density and transport variables among many cities. Categorised cities into walking cities, public transport cities and automobile cities with characteristic density ranges.
Thomson (1977), Great Cities and Their Traffic.	The transport problems, policies and plans of large cities. Highly relevant to this study. Comparative perspective on 30 large cities used as case studies (including seven in Asia - Teheran, Karachi, Calcutta, Singapore, Hong Kong, Tokyo and Manila).	Some useful comparative data are presented on the cities from the late 1960s and early 1970s. However, most comparisons are qualitative.	Transport problems (accidents, peak crowding and off-peak inadequacy of public transport, difficulties for pedestrians, environmental impact, parking problems and traffic congestion) are severe in large cities of all kinds. There is a complex interaction between city structure and relative accessibility. He presents five "solutions" or "archetypes" intended to be an internally consistent and viable solution to urban transport problems. The key elements of each archetype are the land-use pattern and the transport network structure.

Author(s), Title	Main Focus and Aims	Data: Comments on Scope and Quality	Key Conclusions of Relevance to this Study
Zahavi (1976), Travel Characteristics in Cities of Developing and Developed Countries.	Compared travel characteristics in cities of both high-income and poorer countries. Aimed to identify trends that are similar and to isolate tendencies that are specific to each group.	Relevant. Data on major aspects of urban transport. Mostly drawn from previous major urban transport studies of specific cities in the 1960s and early 1970s (including Bangkok 1972, Kuala Lumpur 1973 and Singapore 1972). In most cases, the data quality is fairly high. Graphs and tables of various relationships include data on between 9 and 30 cities.	There is a basic similarity in the relationships among travel characteristics and behaviour patterns in both high-income and poorer cities, implying that stable and predictable effects follow from the fundamental restraints of time budgets, money budgets and system supply. Suggested the existence of a basic mechanism relating the demand for, and the supply of, urban transport facilities, and the arrangement of land uses in urban areas.
Arthur D. Little and Associates (1972), Southeast Asian Regional Transport Survey	This regional survey of transport issues for the Asian Development Bank included a short section on urban transport.	Some useful information and data on the larger cities of Southeast Asia but no systematic or rigorous comparisons.	Many of the issues and remedies mentioned are the same as those from every study since then. Bangkok was already described as having the most serious congestion in the region.

Note: This table excludes studies in the following categories: those that have focused only on western cities; studies that have used only national or provincial level data rather than urban data; studies with comparative transport data on cities within one country; and studies of very specific aspects of urban transport. The exclusion of studies does not necessarily imply that they are of less value. The purpose here is to consider only those studies that have greatest relevance for this present study.

Although most of the studies shown in Table 2.1 were unsuccessful at quantitative comparisons of many cities, the large number of them nevertheless attests to the fact that a comparative perspective is widely felt to be of value in trying to understand transport patterns and processes. The limitations of most previous surveys create difficulties in achieving a clear understanding of recent processes in Pacific Asian cities. The main problem is the unavailability of reliable, comparable data. Thomson (1977) agreed that this deficiency was the main obstacle to clear insights in this arena. The problem of data is particularly acute for low-income and middle-income cities.

This lack of an adequate basis for reliable international comparisons in the urban arena is also increasingly being acknowledged by major international organisations around the world. The recent Urban Indicators Programme co-ordinated by the United Nations Centre for Human Settlements (Habitat) is an example of a major effort to address this problem (Flood, 1997).

In the transport arena, another new effort to compile reliable and recent data on 100 urban areas was occurring throughout 1998. It is co-ordinated and funded by the International Union (Association) for Public Transport (UITP) and is due for completion in 1999. The methodology in this thesis, which has been developed to ensure the proper inclusion of a set of middle-income Asian cities in the update of the Newman and Kenworthy (1989) data set, has been important in influencing the methodology and data collected in the new UITP study⁶. In fact, the project involves most members of this Murdoch University study team, including this author, as consultants. The new study lends support to the methodology presented in this thesis and helps to confirm the value of, and need for, careful international comparisons of urban transport.

Several of the studies that are mentioned in Table 2.1 have made important contributions to debate on urban transport in the region. However, none adequately meets the requirements to address the questions posed by this study. For example, very few of the comparative studies have attempted to be strongly quantitative. Partly this is the result of the formidable difficulties of compiling reliable data on many of the cities in this region.

⁶ The UITP project will also include over 30 low or middle-income cities, including 12 in Asia. The experience of this Asian study has been an important influence on the approach that is being taken in low and middle-income cities by the UITP project. This author was primarily responsible for the adaptation of the standard 'Cities and Automobile Dependence' methodology to be feasible and suitable in middle-income Asian cities. The lessons learned through the research for this thesis have also prompted further refinement and adaptation.

The large compilations by the Tokyo or Seoul City Governments, by the International Union of Public Transport (UITP) and by Jane's do present a great deal of data but for various reasons they are difficult and unreliable to use. For example, in many cases it is unclear exactly which population relates to each item of data. This makes it difficult to compile comparative variables on a per capita basis. Frequently data are presented for administrative areas that cover only a small proportion of a full metropolitan area. This gives rise to misleading figures, since the older inner areas of most cities have quite distinct transport and urban form characteristics from the metropolitan area as a whole. In addition, the quality control of the figures themselves appears sometimes to be inadequate. These compilations have usually relied on replies to questionnaires. To give reliable results, such an approach would require lengthy follow up procedures to clear up problems. Experience with this study and its precursor by Newman and Kenworthy (1989) has shown that many erroneous numbers only become obvious when per capita variables are calculated and after checking their consistency with many other items of data from the same city and from other comparable cities. Attempts to use these large compilations as sources, and comparing their data with the data gathered by this study, have revealed many obviously erroneous figures. One of the most limiting aspects however, of all these studies, apart from the relatively small scope of data presented, is the fact that even on the data typically covered, it is not consistently provided for all public transport operators. So for cities with a large number of public transport systems and operators, one is still left far short of being able to specify the overall levels of public transport usage and supply⁷.

Special mention should be made of the recent Urban Indicators Programme which it is hoped will be a valuable resource (Flood, 1997). It has a large number of cities and the data quality, although far from perfect, appears to be better than for many previous large compilations. Quality control has been more rigorous, with professional consultants being engaged in many of the countries involved. The emphasis on capacity building in the programme has also helped to improve the quality. Unfortunately, such a large and comprehensive compilation could not gather very many variables on any one aspect, such as urban form or transport. In addition, few middle-income Pacific Asian cities responded to the study. This study also suffers from serious problems, for example in its density data. There are many anomalies in the density figures on graphs in the report, suggesting that possibly a series of different errors have been made in different cities.

⁷ Nevertheless, such sources have occasionally been used (with caution) later in this thesis to provide information on some other relevant cities that are not in the main sample of this study.

One problem is the use of net residential densities rather than urban densities⁸. To be fair, Flood acknowledges problems with the density data. This study, which is more detailed, regionally focused and land-use and transport-oriented, will provide a complement (and perhaps a corrective) to the broad picture afforded by the Indicators Programme.

Some of the studies shown in Table 2.1 presented high quality data and a wide range of variables but unfortunately included few cities or very few Asian cities. Admittedly, this present study with nine Asian cities is also relatively small but the scope of its data set is extensive. Several others presented high quality data which have obviously been carefully checked but had a narrow focus. Examples included many of the studies done through the Transport Research Laboratory in the United Kingdom.

In summary, none of the studies that have been reviewed in Table 2.1 provides a really reliable, comparative or comprehensive quantitative overview of urban transport together with urban form and economic patterns of cities in Pacific Asia. Certainly none comes close to such a perspective for the rapidly growing middle-income cities of the region. This study has attempted to remedy this gap in the literature.

2.3 Key Choices and Influences on Urban Transport Patterns

This section briefly introduces and reviews the main factors that are widely believed to influence urban transport patterns, especially over the medium to long term and especially in low and middle-income cities. Such factors are mentioned here even though this thesis does not necessarily seek to provide a comprehensive explanation of current transport patterns in the Pacific Asian cities. As mentioned previously, the emphasis is on providing a comparative perspective and on comparing and contrasting different transport approaches, “models” or strategies to be found in the region. Nevertheless, this requires some understanding of the main influences on transport in order to focus attention on the most relevant issues and to help explore the range of choices and which of them have the greatest long-term impact on transport patterns.

Major influences on transport patterns at the city-wide level that are identified in the literature include:

- infrastructure investment choices;
- income changes and economic development;

⁸ Net residential densities (population divided by residential area) are more prone to inaccuracy than urban densities (population divided by total urbanised area). This is problematic in developing cities where there is intense mixing of

- interaction of transport and urban form and the influence of urban planning policy;
- prices and economic instruments;
- technology choice.

There is widespread agreement that these factors are important in influencing transport patterns in cities. However, there is disagreement over their relative importance and the exact forms and mechanisms for the relationships. Furthermore, these influences often interact with each other and all operate at the same time. It is notoriously difficult to disentangle the chains of cause and effect in this field of study. It must also be pointed out that the impact of some of these influences may operate over a long term so that their historical patterns may be relevant as well as their contemporary levels. Clearly, present transport conditions of most cities are as much a product of events over the past several decades as they are a function of the present-day values of the various explanatory variables.

The review of factors here does not consider in any detail the body of literature that discusses influences at the neighbourhood level or at the individual or household levels. The emphasis here and throughout this dissertation is on patterns and processes observed at the level of the whole metropolitan area.

2.3.1 Infrastructure investment

The level of infrastructure investment for a particular mode of transport is obviously likely to influence the use of that mode. The transport infrastructure decisions that are most widely believed to have an important influence are the levels of investment in main roads and expressways and the investment in dedicated, high-capacity, public transport systems (railways and busways) (Laube, 1998). To some extent, it may seem obvious that infrastructure building affects transport demand. For example, as Goodwin (1994) points out, the enormous growth in traffic volumes over the course of this century could not possibly have occurred without a huge amount of road building. In the United States, the huge investment in the interstate freeway system since the 1950s was clearly a factor in producing the present automobile oriented urban transport patterns in that country.

Downs (1992: 26-31) points out that expanded road capacity influences travel patterns in both time and space in such a way that peak hour congestion on expressways can never be eliminated completely through capacity increases alone. Recent research into the phenomenon of generated traffic suggests that much of the benefit of many new

land uses and it is difficult to clearly distinguish residential from non-residential areas.

roads may be swallowed up by new traffic that would not have otherwise occurred (Hansen and Huang, 1997; SACTRA, 1994). Rail and other public transport investments will also have their own impacts on demand. As alluded to already, one mechanism by which new infrastructure induces new demand over the medium to long term is by its influence on accessibility patterns and hence on subsequent urban development and land use patterns.

2.3.2 Income changes and economic development

Income levels certainly have a major influence on transport. A number of the major urban transport modes (especially the private car and urban rail) are expensive, so wealth is a key factor in a city's ability to use such modes widely. Although no-one doubts the relevance of income to urban transport, there is debate between those who emphasise it as the central factor and those who also emphasise other factors to a great extent.

Many authors on urban transport take the view that in modern times car domination is an inevitable outcome of successful economic development in market economies (Gomez-Ibanez, 1991; Lave, 1992). A correlation between income levels and motorisation has indeed been widely observed and reported (Ingram and Liu, 1997; World Bank, 1986). This perspective would imply that high car use and declining public transport and non-motorised transport use will be unavoidable in Asian cities as incomes rise. Others have questioned whether the link between car use and incomes is necessarily as automatic or as simple as is usually assumed. For example, high income cities in the USA, Australia, Canada, Europe, and Japan have a widely varying balances between urban transport modes despite similarly high incomes (Kenworthy et al., 1995; Pucher and Lefevre, 1996). Such authors argue that many other factors can substantially modify the scenario for urban transport even as incomes rise. This debate and its relevance to this region was a motivation for this study of Pacific Asian cities where incomes had been rising rapidly in most cases. It will be discussed further in a number of places in the thesis.

2.3.3 Transport-urban form interaction and influence of urban planning policy

Many authors have discussed links between urban form and transport (the "land-use transport feedback cycle") (Hall, 1983; Hansen, 1959; Manning, 1984; Owens, 1993; Thomson, 1977: 93-97). The term "urban form" is used broadly to refer to the various patterns of location, character and intensity of urban land-uses and activities in an urban area. Transport patterns and infrastructure influence the urban form that evolves in any

particular city and, conversely, the urban form of a city influences its transport patterns and further infrastructure investments.

The relatively predictable generation of trips from particular land uses in any particular city is the basis for most modelling in transport planning. The effects of transport patterns and investments on the distribution of land uses are less predictable but are clearly significant over the long term. Transport appears in one form or another in all of the main theories which attempt to explain the spatial distribution of activities within regions, such as the variants of Location Theory and Central Place Theory.

The distribution of accessibility in a city, which is strongly influenced by the transport system, itself influences location decisions and hence land-use patterns. In simple terms, accessibility is a measure of the ease with which people and goods can reach a location and is an attribute of the location. The impact of a given change in transport patterns on development patterns will depend on many factors, including the state of the land market, regulations on land-use changes, and how much the change actually affects accessibility patterns. The land-use impact of a particular new piece of transport infrastructure is likely to be strongest in cities where accessibility is “a scarce resource”, due to lack of infrastructure or congestion (Brindle, 1995; Wegener, 1995). Low accessibility by motorised vehicles (due to congestion and low-quality transport links) seems to be a feature of large parts of low and middle-income Asian cities. Therefore, transport patterns and infrastructure will probably be strong influences on Asian urban development patterns, even in the absence of active land-use planning measures.

There has also been much debate over the policy implications of the effects of land-use patterns on transport, especially the proposition that urban planning policy can be used to reduce reliance on private cars. Thus in recent years there has been criticism of the low-density suburban development that is typical of North American and Australian cities and the difficulties of providing viable public transport in such dispersed urban areas (Newman and Kenworthy, 1996). Arguments have raged over the pros and cons of encouraging a more “European-style” of urban development, such as localised higher suburban densities in nodes close to improved rail systems (Bernick and Cervero, 1997). However, this debate in the West may not be particularly relevant to most cities in Asia. In these cities, high urban densities (generally higher than European densities) seem simply to be a fact of life and the challenge is more likely to be to implement transport arrangements to suit this existing situation⁹.

⁹ However, it will be shown in Chapter 6 that much of the new development that is being added at the fringes of

Such issues require investigation in the Pacific Asian context where both urban form and transport conditions are different from those in North America, Australia and Britain, where these debates have been most hard fought and contentious. The need is made more urgent because some of the arguments from the Western-oriented debates have begun to be used with reference to Asia and to poorer countries in general. For example, the World Bank (1996: 59-60) discusses the danger of low-density development and whether active measures to avoid such development are possible or advisable.

2.3.4 Prices and economic instruments

Another widely recognised factor influencing urban transport patterns is the level of relevant prices, especially of fuel and of private vehicles and their use. It is widely held that such prices are a crucial influence, especially in the long term. The effort to influence transport prices, especially on vehicle ownership, usage and fuels, is an important arena of public policy. Singapore offers a spectacular and widely known example of a place which has explicitly raised the price of owning and driving cars in order to prevent an unmanageable rise in traffic (Land Transport Authority, 1996).

Some commentators place a high emphasis on fuel prices (Kirwan, 1992; Schipper, Steiner, Figueroa, and Dolan, 1993). Others have also focused on other car-related prices, such as parking charges (Shoup, 1994). Recently there has been much study of the issue of “getting the prices right”, which focuses on internalising costs of transport including social and environmental costs (Litman, 1995; Maddison et al., 1996). Some of this literature includes discussion of changing the balance between fixed costs and variable costs in order to make consumers more aware of the true costs of their travel and to “level the playing field” between public and private transport.

There is also debate over the importance of prices to policy. Most critics of an emphasis on prices do not necessarily disagree that prices have an impact on transport patterns. However, some question the political feasibility of relying on pricing policy alone to achieve changes in urban transport behaviour and fear that an over-emphasis on pricing policy will cause a neglect of other complementary policies (Newman, Kenworthy, and Vintila, 1995).

some Asian cities is somewhat lower in density and may need to be carefully considered in relation to this debate.

2.3.5 Technology choice

The choice between the transport technologies is clearly an important factor in urban transport. However, in a sense, almost all discussion of transport policy can be seen as a discussion of technology choices. A technology choice perspective is thus at a rather high level of abstraction, to be kept in mind but not a specific focus in itself.

Nevertheless, some pertinent comments should be made here.

At various places and times active policy choices have clearly influenced the adoption or rejection of particular transport technologies. In Asian cities, the enforced phasing out of hand-pulled rickshaws and pedicabs in various cities is an example. Government decisions to promote specific vehicle industries can be, in effect, technology choices. An example is the rise of industries producing small motorcycles in Asia. The relative emphasis on building of arterial roads, expressways or urban railways can also be viewed as a decisive choice between technologies with far reaching, long-term effects. Active efforts to replace individually owned, jitney-style public transport services in small vehicles with more conventional large buses has been a recurring theme of Asian urban transport history that has an element of technology choice.

It is over the long term that the importance of choices between different technologies can be seen to be particularly relevant to explaining the different paths taken by different cities. This is because of the cumulative and irreversible effects of the adoption of certain transport technologies, which may involve large investments in capital equipment and infrastructure and can in turn lead to changes in land use patterns and to induced demand for further mobility. Such changes take place over a time scale of one to several decades. The rise of the freeway and of the private automobile in the United State is a dramatic example, well known in the transport literature.

2.4 Key Debates on Urban Transport in Pacific Asia

A number of important debates have raged over urban transport and urban policy in low-income and middle-income countries in the last two decades. Much of the policy discussion has centred on elements of what Rimmer (1987: 1571) calls the “unconventional approach” to urban transport policy, as advocated by the World Bank among others (Linn, 1983; World Bank, 1986). This approach calls for a low-cost strategy of reduced emphasis on large infrastructure projects (whether expressway or rail), encouragement of non-corporate public transport (jitneys or paratransit), removal of subsidies, increased cost recovery from both roads and public transport and the use of demand management measures to restrain the growth of traffic to manageable levels.

Some of the most prominent policy debates have arisen from this agenda and have involved the World Bank. Examples include debates over the relative merits of rail versus buses in low-income cities and of corporate public transport enterprises using large buses versus non-corporate, jitney-style public transport using smaller vehicles¹⁰.

Some of these debate are highly relevant to the focus this thesis (such as the debate over traffic restraint) while others are more peripheral (such as the organisational style of public transport). The debate over the relative merits of buses versus rail is relevant, since it touches strongly on different perceptions about existing and desirable urban forms in the region and also relates to the debate over traffic restraint. However, it is argued later in the thesis that much of the rail-bus debate has been somewhat misguided. In particular, the debate lacked a long-term perspective and a deep awareness of evolving land use patterns. Many commentators have taken the overly simplistic view that any investment at all in urban rail in low-income or middle-income cities conflicts with the low-cost or “unconventional” approach that was being promoted by the World Bank. Chapters 7 and 8 provide additional perspective on the choice of when and whether to build urban rail systems. Rail is placed it into a broader context among the many other choices in the urban land-use and transport arena and in a longer-term view.

2.4.1 Awareness of urban form in transport policy debates

Important as the debates just mentioned are, in the context of low income and middle-income countries they have been largely ignoring a major dimension of the urban transport system, namely its interaction with urban form. Zahavi (1976) and Thomson (1977) did highlight some of the connections of density and urban form with urban transport in low-income or middle-income cities but subsequent debate has almost totally ignored these aspects. Linn (1983: 102) mentions the importance of density as one of three main influences on car use (along with motorisation level and income). However, like the World Bank’s 1980s transport policy review (World Bank, 1986), he does not go on to consider density as a relevant factor when discussing policy. Neglect of the urban form and density dimension may be partly because much previous data on density in low-income and middle-income cities have been scant or misleading (see Chapter 4).

¹⁰ A number of the cities in this study have been important arenas for the playing out of these debates, including: bus versus rail in Singapore (MRT Review Team (also known as the Hansen Review Team), 1980; Wilbur Smith and Associates, 1977; Wildermuth, 1980); the pros and cons of minibuses in Kuala Lumpur (Roth and Wynne, 1982; Walters, 1980; Walters, 1981; White, 1981); the merits or impacts of paratransit in Jakarta (Mogridge, 1983; Rimmer, 1986a); and the need for traffic restraint or road pricing in almost every city (Hau, 1995; JICA, 1986; Kirby et al., 1986; Pendakur, Menon, and Yee, 1989).

Even the debate over the relative merits of bus and rail systems for low and middle-income countries has not had any strong focus on the relevance of urban density. The primary focus has been on the issue of affordability along with the characteristics of the technologies themselves (Gardner et al., 1992; Gardner et al., 1994; Lindau and Willumsen, 1988; Nisar and Khan, 1992). The connections between this issue and urban form (existing or emerging) have been made surprisingly rarely. This is despite the well-known work of Pushkarev and Zupan (1977) which (in the North American context) highlighted the importance of corridor density to the prospects of mass transit. However, in the literature on poorer cities, city size and income, but not density, have been much more widely seen as central factors in whether a city can support rail mass transit (Allport and Thomson, 1990; Rimmer, 1986b). The role of the city centre (its size, significance and job densities) is the only aspect of urban form that has been widely acknowledged as a factor in the debate (Allport and Thomson, 1990). For example, in Singapore disagreement over the future of the central area was an underlying factor in the heated debate over whether Singapore should build a rail-based mass rapid transit system. This debate involved World Bank staff, consultants, and the Singapore Government (MRT Review Team, 1980: 11-14; Wildermuth, 1980: 38).

It is not just that the transport literature on lower-income cities has neglected urban form. The planning literature on such cities has generally shown little awareness of the potential role of transport patterns and transport infrastructure in influencing urban development¹¹. Most of the planning literature on low-income or middle-income cities has focused on housing and on improving the delivery of basic infrastructure and services. This is natural given the huge shortfalls in these areas in most such cities.

2.4.2 Transport problems in Asian cities: causes and remedies

Experts differ over what are the root causes of transport problems in Asian cities and over why they have become so serious so quickly. Perceptions also vary over which problems are most worthy of attention. Much urban transport planning is problem focused, and often congestion focused. Beliefs about problems and their root causes invariably have a great influence over the remedies that are promoted. This thesis challenges some widely accepted views on the root causes of transport problems in Asian cities. In particular, the view that a lack of roads is the fundamental cause of

¹¹ This may be changing however. A strategic management approach to planning has probably increased awareness of the potential for development to be guided by strategic transport infrastructure and also of the dangers when such infrastructure is built without sufficient awareness of its influence on development patterns (Allport, 1993; Douglass, 1989; Hall, 1983; World Bank, 1996: 60).

traffic problems is shown to be misleading. Attempts to solve the problem through road expansions are shown to be infeasible in most of these cities.

2.5 Typologies of Urban Transport and Urban Form Patterns

Later in this thesis it will become important to describe and characterise the different models of urban transport and land use development revealed by the comparative data. Therefore, it is useful to briefly review previous examples of descriptive models that characterise urban transport/land-use systems.

The land-use transport cycle that was mentioned previously helps to introduce the concept of the “transport orientation” of different urban land-use patterns. This is based on the idea that each major mode of transportation is best suited to serving particular land use patterns. In addition, it is based on the fact that different land use arrangements encourage different transport modes to flourish. A land-use pattern that is encouraged by, and is well-suited to, a particular mode of transport could be said to be “oriented” to that mode of transport. Thus, historically the urban forms that have tended to arise in association with the dominant transport modes have been so characteristic of those modes that transport-based descriptive labels have been suggested for their urban form patterns or urban structures. There are several descriptive schemes that are based on different criteria and approaches and which reveal somewhat different insights. Later in this dissertation, the characteristics of Asian cities in this study will be compared with some of these typologies.

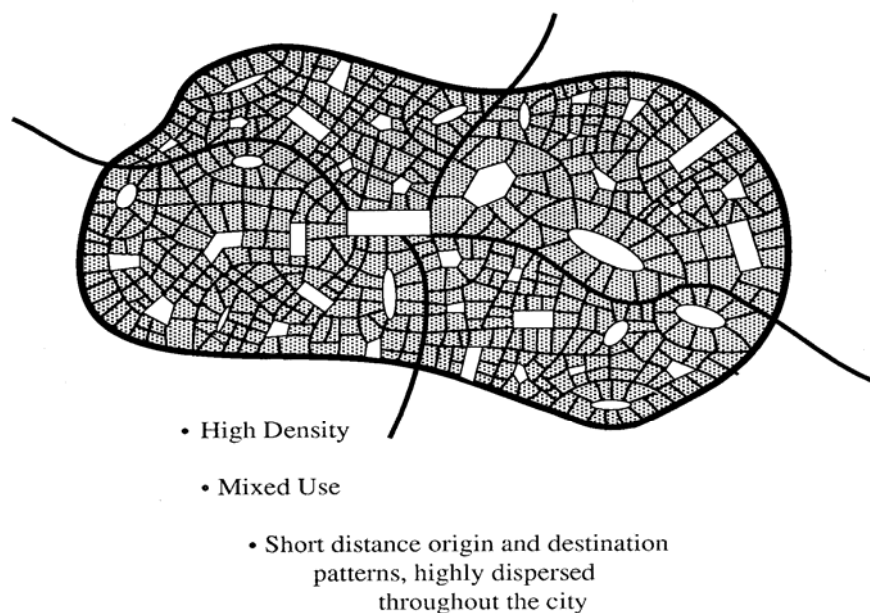
2.5.1 Walking cities, transit cities and automobile cities

Shaeffer (1975) and Hogan (1978) (then elaborated in Newman and Hogan (1987) and by Newman and Kenworthy in various later publications) built upon a body of research in the 1960s and 1970s to identify three idealised city types (Figures 2.1, 2.2 and 2.3). These are seen to have successively emerged as the dominant transport technology has changed from walking to public transport to cars. It is emphasised that many modern cities are hybrids, having elements of two or more types. In practice, many western cities still have a walking-oriented core, a largely transit-oriented inner area and automobile-oriented outer suburbs.

All cities prior to about 1850, relied primarily on walking, with small contributions from animal drawn vehicles and water transport in some cities. Newman and Hogan label this city type “the walking city” but other names include the “pre-public transport city”, and the “foot city” (Hall, 1983; Newman and Hogan, 1987; Shaeffer and Sclar,

1975). The outward spread of any city is constrained by the distances that can comfortably be covered by the modes of transport that are widely available at the time. Thus a walking city cannot be anything but compact and is generally unable to extend more than about 5 kilometres in diameter (meaning that all destinations can be reached within about a half-hour walk). Such cities have tended to attain high density as their populations increased. Newman and Hogan (1987) suggested that densities of 100 to 200 people per hectare were typical and higher densities probably occurred in the largest ancient cities. Walking cities also tended to have narrow streets and alleyways, since they needed little else. Different land-uses in such cities were mixed with a fine-grained scale throughout.

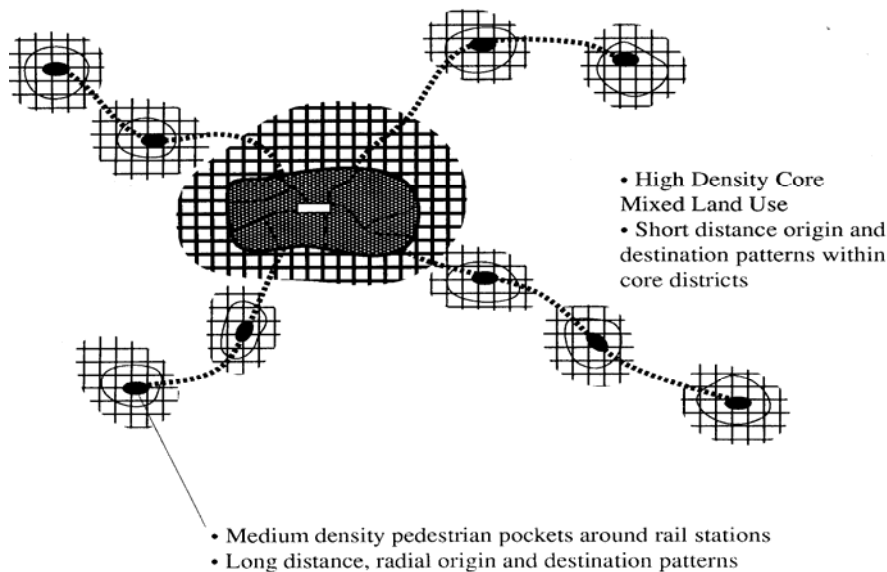
Figure 2.1 The walking city



Source: Newman (1995)

In the Newman and Hogan view, the advent of bicycles, trams and urban rail between 1860 and 1940 allowed “public transport cities” (or “transit cities”) to emerge. These generally spread 10 to 20 kilometres in a star shape along rail and tram corridors and could have lower densities of between 50 and 100 pph. Activities and residential areas tended to string out in a long series of nodal “rail suburbs” along railways and in shorter strips of development along tram lines. Transit cities tended to have important, concentrated central business districts (CBDs), which emerged as a result of the accessibility pattern created by the mainly radial public transport.

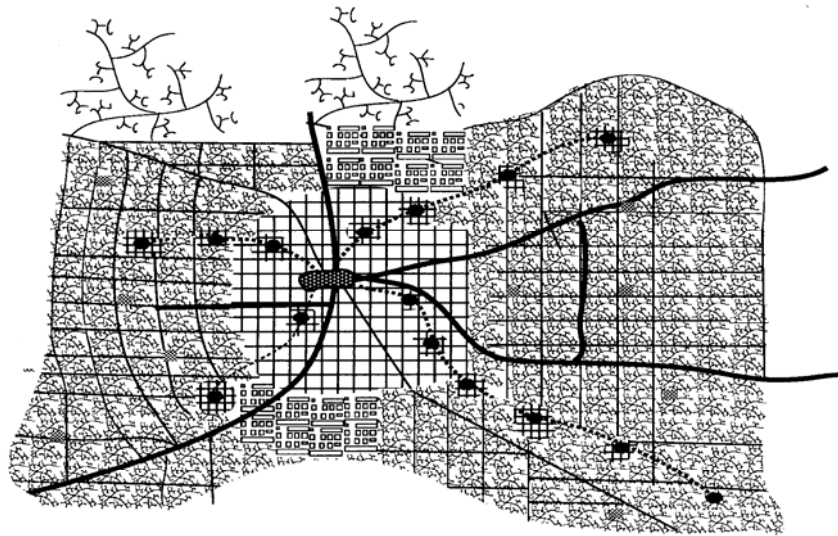
Figure 2.2 The public transport city or transit city



Source: Newman (1995)

Finally, in many wealthy Western cities, diesel buses, mass car-ownership and widespread road building after the Second World War facilitated the extreme dispersal of development up to 50 kilometres from the centre and with densities of only 10 to 20 pph. The car became the mode of transport that shaped new urban development and this new city type is labelled the “automobile city” by Newman and Hogan. Gradually, employment has also dispersed and the central area, which in this city type may be little more accessible than many other locations, has lost much of its dominance as a centre of activities. This type reaches its purest form in American cities, such as Phoenix, Arizona, where the automobile dominates to an extreme extent. In other automobile cities, such as New York, San Francisco or Sydney, a radial rail system may continue to support a large and highly-accessible CBD. Although suburbs first flourished with the rise of the railways and then the trams, the uniform and extensive belts of suburban “sprawl” that surround most Western cities are intimately associated with the prevalence of the private car (Hall, 1988; Mumford, 1961).

Figure 2.3 The automobile city



- High Density Commercial Use Core
- Commercial, Retail and Industrial Land Use separated and dispersed throughout metropolitan area
- Long distance origin and destination patterns highly dispersed throughout the metropolitan area

Source: Newman (1995)

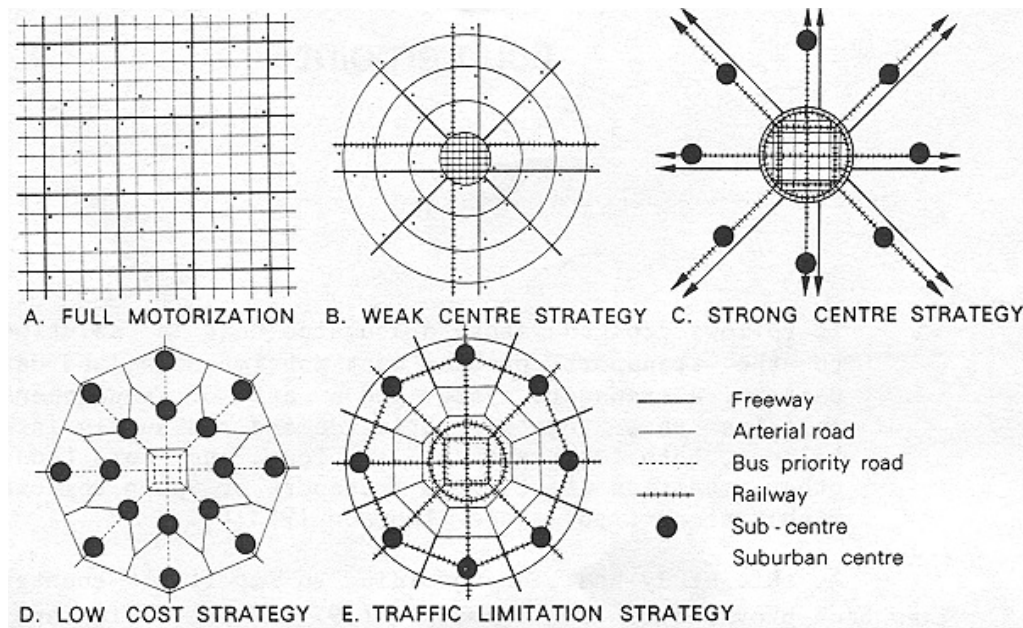
In trying to apply them to real cities, these three types, the walking city, transit city and the automobile city, can potentially be interpreted in at least two different ways. Firstly, they can be understood as referring only to the “pure” historical types. So any particular modern city must then be interpreted as a hybrid of the three pure city types combined in varying proportions. In this view for example, most American cities could be viewed as predominantly automobile cities with vestigial elements of the walking city and transit city remaining.

A second, less comfortable way to look at these city types is to use them as broad categories and apply them even to modern cities that only roughly approximate the “pure” types. For example, a city with many of the transit city characteristics could be so labelled, even if cars may have made some inroads into the city and its structure. Thus, for example, Hogan (1978) applied the walking city label to modern low-income cities where motorised public transport and cars also played a significant role, in addition to walking and non-motorised vehicles. In Hogan’s scheme, even though public transport accounted for most of the motorised travel in such cities, this did not make them transit cities since overall motorised mobility in such cities was low (Hogan, 1978: 93). This raises something of a problem with this scheme. It provided a useful way to look at the evolution of urban transport and land use systems in the West but many modern cities in low and middle-income countries cannot easily be fitted into the scheme.

2.5.2 Thomson's urban transport and land use strategies

Thomson (1977) proposed a rather different typology of idealised urban transport and urban structure “strategies” or possible viable solutions to the challenges of modern urban transport in large cities. Five land-use and transport strategies were identified in his scheme, namely “strong-centre”, “weak-centre”, “full motorisation”, “low-cost” and “traffic limitation” strategies (Figure 2.4). Thomson’s main criteria for distinguishing the different strategies were: a) the location of employment (the number of jobs in the central business district, in sub-centres or in dispersed locations); b) the density and centralisation of population; c) the transport infrastructure (rail, road) and its network structure (radial/ring or grid); and d) the level of motorisation along with the relative use of private and public modes. His scheme has been influential and often cited. Thomson emphasised that no real cities exactly conform to any of the archetypes but nevertheless offers case studies of real cities that come close to being examples of each strategy. This has prompted others to use the scheme as a way of categorising cities in a descriptive way.

Figure 2.4 Thomson's archetypes of urban land use and transport strategies



Source: Thomson (1977) as adapted by Rimmer (1986c: 262).

The full motorisation strategy was conceived as the most extremely car-oriented archetype. Such a city has a less significant central business district than other strategies, highly dispersed employment locations, uniformly very low residential densities, a grid system of freeways at about 6.5 kilometre intervals, a grid system of arterial roads at about 1 kilometre intervals, and a bus system only for non-car users. Los Angeles, Detroit, Denver and Salt Lake City were given as examples.

Thomson's weak centre strategy describes a city which shares much of the freedom for car travel of the full motorisation city but with a more significant city centre (about 250,000 workers), a radial main road network (with some ring roads) and some commuter rail service. Melbourne, Copenhagen, San Francisco, Chicago and Boston are mentioned as examples. Thomson saw this archetype as somewhat unstable with a tendency to move towards either full motorisation or towards the strong centre strategy. The strong centre strategy envisages a city with a very large central business district (of possibly well over 500,000 workers) and a high-capacity radial rail network. Any high-capacity roads must be mainly radial (since any other kind of road network would begin to weaken the dominance of the city centre). Paris, Tokyo, New York, and Athens are listed as examples of cities that come close to following this strategy.

Thomson's first three strategies describe cities in which transport infrastructure and urban form are the important elements of each strategy and other policies are not mentioned. A further strategy (or set of strategies) suggested by Thomson, "traffic limitation strategies" is defined by policies that actively discourage the use of private cars, at least for those trips which impose heavy social costs. The urban structure he suggests for this strategy is akin to the strong centre strategy, with quite a large central business district and radial railways, except that more suburban sub-centres can be tolerated by this strategy. The sub-centres are oriented in such a way that high corridor flows can be accommodated on public transport. Thomson mentions that this system does not absolutely require high residential densities but that if densities are too low, then such a transport system would be very costly. Cities that are listed as possible examples, include London, Singapore, Hong Kong, Stockholm and Vienna.

Thomson's "low cost strategy" is of particular relevance to this dissertation. Unlike the other strategies, this one does without large investments in road or rail infrastructure and minimises private consumer spending on transport. All of the examples used by Thomson for the low cost strategy, including Calcutta, Karachi, Manila and Teheran, were in low or middle-income countries. The main features of the low cost strategy include the following. High cost freeways and railways are ruled out. Buses (and perhaps trams) are expected to carry most traffic and roads must be managed to make this possible. The city must be high density, with a large centre of up to a little over 500,000 workers, with an approximately equal number of residents within walking distance of the centre. In very large cities (of much over 2 million) other sub-centres will then be needed. Thomson says that to minimise transport costs, these would be

located along radial roads as near to the centre as practical without further overloading the radial road and bus network.

The low cost strategy reflects Thomson's ideas on how cities might solve their transport problems cheaply. He points out that no city actually followed the strategy in its entirety. However, many low-income cities have some or all of the features out of sheer necessity. It is interesting to note that many of Thomson's suggestions for the low cost strategy mirror the World Bank's "unconventional wisdom" as mentioned earlier.

There are some problems with Thomson's scheme. For one, it emphasises the role of the city centre and its transport problems and the nature of the transport network, but does not show much awareness of urban density variations. This led to some slightly strange results. For example, New York clearly fits the strong centre strategy along with Tokyo as both have huge central business districts that are overwhelmingly accessed by railways. But in many other respects, the urban transport and urban form characteristics of the New York and Tokyo metropolitan areas are extremely different, with New York being very much more car-oriented and low-density overall than Tokyo.

Another problem is that the archetypes were intended as idealised types of strategies rather than descriptive models of real cities. If one is to use Thomson's scheme as a typology of cities, then any city in the traffic limitation strategy must be understood to also belong to one of the other categories as well (Hall, 1983: 60). Nevertheless, the fact that Thomson used real cities as examples and developed the model out of his experience of many real cities, means that the framework does offer the potential of being modified to be a descriptive typology or model.

A further problem may be that the low-cost archetype was the only one applied to low-income and middle-income cities. Variations among low-income cities are likely to be sufficient to warrant more types. For example, another type may be needed to account for those cities in China, Vietnam and South Asia where non-motorised vehicles have been very important for a number of decades. Another example might be the recent advent of cities where vehicular transport is now dominated by motorcycles.

2.5.3 A typology based on modal splits

Replogle (1992: 3-4) provides a typology, later elaborated by Hook and Replogle (1996), which was applied to a study of Asian cities and which pays more attention to non-motorised vehicles than those above. The criterion for categories is mode split data (all trip purposes and including non-motorised modes). Four modal orientations of cities are named:

1) Non-motorised transport (NMT) dominant cities (with examples in both high-income and low-income countries) are those where walking and non-motorised vehicles (NMVs) account for a greater share of trips than public or private motorised transport. Low income examples included all Chinese and Vietnamese cities, and secondary cities in India, Indonesia, Bangladesh and Nepal. Such cities are high-density and compact. High-income examples included Japanese cities and number of Dutch, Danish and German cities. Densities are again described as “high”.

2) Mixed traffic cities are described as “those in which neither public nor private transportation dominates in the share of trips, and where non-motorised modes generally account for less than a third of all trips”. Bangkok, Kuala Lumpur, Manila, and Jakarta are listed as examples and as having “sprawling land use patterns but at much higher densities than the private motor vehicle dominated cities of the USA and Australia”.

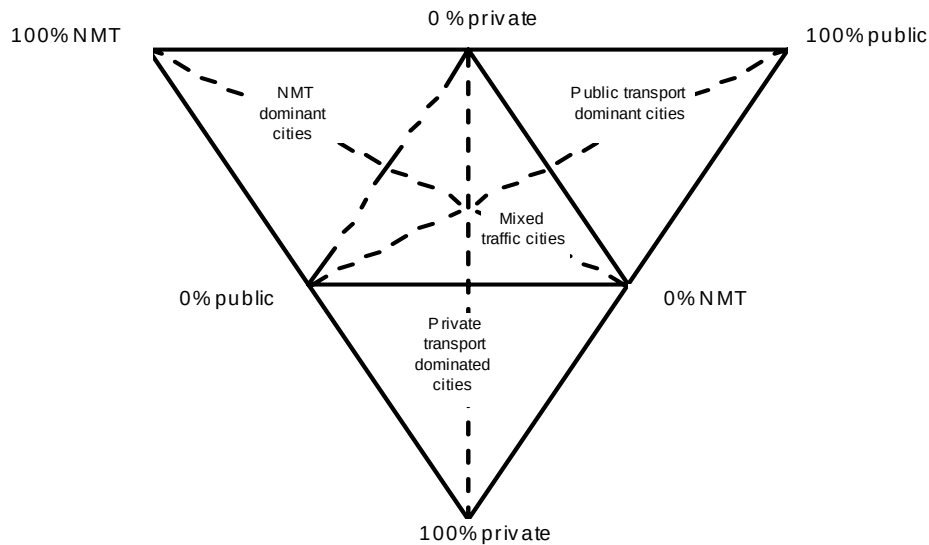
3) Public transportation dominated cities are cities where public transport carries more than 50 percent of all trips. Singapore, Seoul, Pusan and Hong Kong are mentioned, along with some major Indian cities, such as Bombay. High densities throughout the urban areas are attributed to these cities.

4) Private motor vehicle dominated cities. These are cities where private motor vehicles (cars, motorcycles, trucks) carry a majority of trips as in American and Australian cities. Densities are very low, rarely more than 20 people per hectare.

Figure 2.5 shows this author’s attempt to provide a graphical representation¹² of how cities can be grouped according to modal split, as in Hook and Replogle’s scheme.

¹² The percentages of trips by each mode are plotted on axes which follow the bisecting lines on an equilateral triangle. On each axis, 100 percent falls at a corner of the triangle and zero percent falls at the mid-point of an edge line of the triangle. The three smaller equilateral triangles in the corners of the larger one represent the cases where any one of non-motorised transport, public transport or private transport has 50 percent or more of all trips. For example, “NMT dominant” cities will fall in the top-left corner of the triangle. This then leaves a fourth city type, “mixed traffic” cities, for the case where no one of the three groups of modes dominates. This is represented by the small equilateral triangle in the middle. One problem with such a typology is that the mixed traffic category is potentially a very diverse group of cities. For example, public transport use in such cities could potentially range between a tiny percentage and almost 50 percent.

Figure 2.5 Graphical representation of a city typology based on modal splits for all trips



This typology seems potentially useful but it is purely descriptive of the modal split of each city rather than necessarily a description of the land use and transport systems. Although Hook and Replogle do offer brief descriptions of land use and transport-system features of each city type, these are additional to, rather than an intrinsic part of, the definitions of the types. One advantage of such a typology is that the criterion for assigning a city to a particular city type can be clear and explicit, although the necessary mode split data may not always be available or reliable¹³.

2.5.4 Other typologies

In another typology, Peter Hall (1983) has used Thomson's scheme as a basis for categories. Later he develops this and combines it with a historical and technology change approach (akin to the walking city, transit city and automobile city scheme).

Hall (1994) thus identifies the following categories of city:

- 1) pre-public transport cities;
- 2) early public transport cities (tram + commuter rail influenced);
- 3) late public transport cities (electric trains and urban mass transit influenced);
- 4) auto-oriented cities;
- 5) strong-centre cities (able to withstand the car to some extent and dependent on railways to serve their large CBDs);
- 6) weak-centre cities (a hybrid of the auto-oriented and strong-centre types).

¹³ Mode split data for non-motorised trips can be particularly problematic, since different sources sometimes exclude very short trips and trips made by children below a certain age. Variations in exactly which exclusions are made can affect the comparability of non-motorised transport percentages between different studies.

It is not clear if this scheme is intended to include modern low-income cities. Perhaps they were considered to fit into his first or second categories, albeit with trams replaced by buses. With further elaboration and a clarification of how modern low-income cities fit into it, this model would seem to have the potential to offer useful insights.

This sub-section has reviewed some of the descriptive models of urban structure that most explicitly make the link with transport. Some of these provide a useful basis for descriptive models of Asian cities and their transport to be presented later in this thesis. There have been many other descriptive models of urban form. For example, McGee (1967) suggested a model of the land use zones of the Southeast Asian city. Banjo and Dimitriou (1983) describe a schematic layout of the colonial city and illustrate some of the transport challenges that this structure generated in the immediate post-independence era. The transport-focused models described in this section have tended to ignore social divisions within each city, such as between rich and poor. Other models illustrate such issues and provide a reminder of complexities, such as that within each city there may be exceptional zones that contrast with the overall character of the city. For example, high-income sectors can be very different from low-income areas in terms of infrastructure and density. Gakenheimer (1993: 315) points out that travel in the high-income fan of a city is usually much faster than in low-income directions. Nevertheless, the complexities that these other models discuss are generally beyond the scope of this study. Many useful insights emerge from the city-wide approach taken here, despite the fact that this largely ignores many of these other issues.

2.6 Chapter Concluding Remarks

This chapter began by discussing previous compilations of information on Asian cities and their transport and land-use characteristics. Strengths and shortcomings of these studies were assessed. Various deficiencies prevent them from placing Asian cities' characteristics into a clear internationally comparable framework, as is required to provide an answer to Research Question 1 of this thesis. This review showed the importance other researchers have assigned to developing the data on the transport and land use systems of Asian cities, but it also showed how previous data compilations have fallen short in either their scope or reliability. The review thus justified the importance of the comparative data that have been collected in this study and for which great care has been taken to ensure comparability and reliability. Details of the methods used in collecting, processing and checking the data are described in Chapter 4.

This chapter then turned to a brief discussion of some of the important influences on urban transport. An understanding of key influences and choices is important background for answering Research Questions 2, 3 and 4 which relate to the transport challenges and opportunities in Asian cities, and to the major choices that they have faced and have taken. A number of influences on urban transport and various views on their relative importance were canvassed which will be important to the analyses in Chapters 7 and 8.

A third section of this chapter considered debates in the literature on urban transport in this region that are relevant to the approach taken in this study. Again, these debates relate to the issue of the choices that are available and feasible in Asian cities. It was argued that the debates have lacked a keen awareness of urban form, and in particular, of how land-use patterns compare in a broad international perspective and the implications of such comparisons for transport choices.

The final section of the chapter reviewed a number of descriptive models of urban transport and urban form. The emphasis was on typologies that provide insight on the connections between transport and land-use patterns. This review of typologies will provide the basis for descriptive frameworks for Asian urban transport and land use development, to be developed later in the thesis.

CHAPTER THREE

BACKGROUND INFORMATION AND TRANSPORT HISTORIES OF THE ASIAN CITIES

3.1 Introduction

The purpose of this chapter is firstly, to present some background information on the nine Asian cities to allow the data that is presented and discussed in the next few chapters to be understood in its proper context. This is followed by an outline of the historical development of urban transport and urban form in each of the Asian cities from around 1900 until the 1960s. These histories are compared briefly with certain aspects of the histories of Western cities. The historical discussion focuses, of course, on issues that relate to the core themes and questions of the thesis.

3.2 Social, Cultural and Economic Background

This section will briefly introduce a small number of background issues that serve to provide context for the detailed work on transport and urban form in the thesis.

3.2.1 Cultural background

Although an in-depth analysis is beyond the scope of this study, some brief cultural and social background information is presented here for reference and because these issues are sometimes raised in debates as being crucial to transport and urban development trends. Cultural, social and political issues may have some influence on policy choices made in each city but, in general, these factors are not the focus of this thesis.

A great diversity of ethnic groups are present in the nine Asian cities and often several are significant within the one city. The six Southeast Asian cities are generally much more multicultural than the three East Asian cities. Mixes of various “Malay” ethnic groups speaking distantly related languages, form majorities in Jakarta, Surabaya and Kuala Lumpur with most being Muslims. Manila is also populated predominantly by people of “Malay stock”. Most residents are Catholic with a small Muslim minority. In both Indonesia and the Philippines, the indigenous population is made up of many different ethnic groups with many different languages. Bangkok is somewhat more homogenous than the other large Southeast Asian cities, being populated mostly by the Thai ethnic group, most of whom are Buddhist.

People of Chinese ethnic origins and, to a lesser extent, people of South Asian origin, are important minority groups in Southeast Asia. In fact, Singapore has an ethnic Chinese majority (approximately 75 percent), with Malay and South Asian minorities. In Kuala Lumpur there is a large ethnic Chinese minority (only a few decades ago the city had a Chinese majority). There are smaller but still significant Chinese minorities in Bangkok, Manila, Jakarta and Surabaya. In Kuala Lumpur there is also an important minority of people of South Asian descent.

The populations of Tokyo, Seoul and Hong Kong are more homogenous than the Southeast Asian cities. Each has distinct Japanese, Korean and Chinese dominant ethnic groups whose cultures share common influences from Buddhism and from Chinese culture over many centuries, especially Confucianism. Hong Kong's Cantonese speaking population shares much in common culturally and linguistically with the Southeast Asian Chinese communities, which originated in southern China.

The political histories of the Asian cities have also had a profound influence on their present characteristics. The Asian cities in this study have had diverse experiences of colonial rule and/or Western influence since the Portuguese, Spanish and Dutch first arrived in the region in the 16th century. Japan and Thailand were never directly colonised but both suffered incursions by Western powers seeking trading opportunities. Both countries eventually undertook "Westernisation" programs last century in response to increased contact with and pressure from the West. In Japan, this built upon an already strong economy and allowed Japan to become a powerful colonial power itself, by the early 1900s. Singapore (from the early 19th century) and Kuala Lumpur (from the late-19th century) were under British colonial rule, which lasted until the late 1950s. Hong Kong, which has been a British colony since 1841, reverted to Chinese sovereignty in June 1997. The Indonesian cities of Jakarta¹⁴ (from the early 17th century) and Surabaya (from the late 18th century) were part of the Dutch East Indies until the successful struggle for Indonesian independence in the late 1940s. Korea largely escaped Western domination but came under Japanese colonial rule for most of the first half of the century. Manila was a Spanish colonial centre from the late 16th century until 1898, when Spanish rule was replaced with rule by the USA until the Second World War. All of the Asian cities came under Japanese occupation during the Second World War.

¹⁴ Prior to independence Jakarta was known by the Dutch colonial name of Batavia.

In the post-war and post-independence eras, all of the Asian countries in this sample were market economies, although most of the governments played a large role in the economy, and most had strongly anti-Communist governments throughout much of this period. A wide range of types of government have held power in the various countries at different times since independence, with a spectrum from democratically-elected multi-party systems in some, to so-called “soft authoritarianism” or “guided democracy” in others, and military regimes of various kinds in still others.

3.2.2 Economic status

The economic status of each city and, in particular, the level of income in each city, is a key background issue to the study. Table 3.1 shows changes in Gross National Product (GNP) per capita for the countries in the Asian sample between 1965 and 1990. Using these national data it is clear that all of the Asian cities in this international sample had much lower real income levels in the 1950s and 1960s than today. In 1965, Japan was already most prosperous, followed distantly by Singapore and Hong Kong. Then came Malaysia and Korea, then the Philippines and Thailand (which had yet to overtake the Philippines). In 1965, Indonesia was much poorer than the others.

Table 3.1 Gross National Product (GNP) per capita, 1965-90 (US\$, 1990)

	1965	1990	Average annual growth, %
Indonesia	190	570	4.5
Philippines	529	730	1.3
Thailand	484	1,420	4.4
Malaysia	870	2,320	4.0
South Korea	972	5,400	7.1
Singapore	2,312	11,160	6.5
Hong Kong	2,554	11,490	6.2
Japan	9,313	25,430	4.1

Source: World Bank (1992: 218-19).

Economic change since 1965 has been dramatic throughout most of the region (Drakakis-Smith, 1992). Tokyo is now the hub of an industrialised, very high-income economy. It industrialised over a long period from the beginning of the century with a massive economic leap in the post-war reconstruction of the 1950s and 1960s. Singapore, Hong Kong and Korea are three of the four so-called “Asian tiger” economies (the other being Taiwan) that were newly industrialising nations beginning in the 1960s. All three had average annual GNP growth rates of over 6 percent per annum for the period 1965 to 1990. Starting a little later, Thailand and Malaysia have also had rapid industrial and economic growth in recent decades. Indonesia’s economy also grew quickly, although from a very low base. It had particularly rapid growth in the 1970s (Pernia, 1992). The Philippines, after leading Indonesia and Thailand in the

1950s, has lagged those countries in economic growth terms since the early 1970s. The early and mid-1980s were especially gloomy for the Philippine economy with the impact of the international recession coming on top of local political turmoil.

Urban income levels tend to be higher than national averages, especially in low-income and middle-income countries. Table 3.2 shows the 1990 Gross Regional Product (GRP) per capita for each of the Asian cities and regional averages for the other cities in the sample.

Table 3.2 Gross Regional Product (GRP) per capita of the Asian cities in an international sample of cities, 1990

	GRP per capita (US\$ 1990)
Surabaya	726
Manila	1,099
Jakarta	1,508
Bangkok	3,826
Kuala Lumpur	4,066
Seoul	5,942
Singapore	12,939
Hong Kong ^a	14,101
Tokyo	36,953
European Average	31,721
Toronto, Canada	22,572
Australian Average ^b	19,761
American Average ^b	26,822

Notes: a. Hong Kong's figure is for 1991.

b. The Australian and American averages are for the slightly restricted sample of cities for which variables for the World Bank were collected (as will be explained in Chapter 4).

The World Bank (1992: 307) provides names for income-based groupings of nations. These can be adopted to describe urban areas also. The World Bank describes countries with a 1990 GNP per capita of US \$610 or less as low-income (this included Indonesia), those with \$611 to \$2,465 as lower-middle-income (including the Philippines, Thailand and Malaysia), those with \$2,466 to \$7,619 as upper-middle-income (including South Korea), and those with \$7,619 and over as high-income (including Singapore, Hong Kong and Japan). For the purpose of this study, the same cut-off figures have been adopted to apply to cities using their 1990 GRP per capita figures. **Therefore, in this thesis Surabaya, Manila and Jakarta are labelled as lower-middle-income cities. Bangkok, Kuala Lumpur and Seoul are upper-middle-income cities and Singapore, Hong Kong and Tokyo are high-income cities.**

Since 1990, Japan has seen very slow economic growth. However, the rest of the Asian countries with cities in this sample have seen very high rates of growth between 1990

and 1996 when the current slowdown began to emerge. For example, in 1994 and 1995, Korea, Malaysia, Thailand, and Singapore each had GDP growth rates of between 7 and 10 percent. Indonesia had between 6 and 8 percent growth in GDP, while Hong Kong and the Philippines had between 4 and 6 percent (Economist Intelligence Unit, 1996b; Economist Intelligence Unit, 1996c). These high rates of growth were, of course, also reflected in rapidly rising levels of purchasing power in the Asian cities of the sample, which were reflected in, among other things, high growth rates of vehicle ownership in many cities.

3.2.3 Population size and growth

All of the Pacific Asian cities in this study are rather large cities. The smallest is Surabaya, with a 1990 population of 2.5 million, then Singapore with 2.7 million and Kuala Lumpur, with about 3 million. Tokyo is the largest city in the Asian sample and is also the largest in the global sample and indeed in the world with a metropolitan population in excess of 30 million. Seoul is the third largest city in our global sample, being slightly below New York in population in 1990. Six of the nine cities in the Asian sample are now very large cities, with more than 5 million people.

Providing time series for metropolitan population is always somewhat problematic because populations tend to spill over administrative boundaries over time.

Nevertheless, a reasonably accurate picture is presented in Table 3.3 and Table 3.4 that combine data from this study and from Moriconi-Ebrard (1993). In 1900, only Tokyo exceeded one million people and most of the others had below 300,000. Most of these Asian cities had a very large jump in population between 1930 and 1950. By 1950, all of the Asian cities in the sample, with the exception of Kuala Lumpur, were already significant cities of more than 500,000 people, and furthermore, all except Kuala Lumpur and Surabaya had more than one million people. Tokyo had more than 10 million people by 1950 and was already one of the largest cities in the world. Since 1950, the greatest proportional increases in population size have been in Kuala Lumpur and Seoul, with 1990 populations more than seven times their 1950 levels. Jakarta, Manila and Bangkok have all expanded in population by a factor of between four and five since 1950. The three richest Asian cities and Surabaya have had growth that is more moderate and have increased to between 2.5 and 3.5 times their 1950 levels.

Table 3.3 Populations of Asian cities in an international sample, 1900 - 1990 (in millions)

	1900	1930	1950	1960	1970	1980	1990
Tokyo-to	-	-	-	9.68	11.41	11.62	11.86
Greater Tokyo	1.50	6.06	10.43	15.52	21.47	25.84	31.80
Seoul City	-	-	1.69	2.72	5.54	8.36	10.90
Seoul Metropolitan Area	0.20	0.34	2.27	4.06	7.25	11.59	16.73
DKI Jakarta	-	-	-	-	4.76	6.48	8.22
Metropolitan Jakarta	0.12	0.53	2.50	4.19	6.07	8.99	12.50
Metro Manila	-	-	-	2.46	3.97	5.93	7.95
Manila metropolitan region	0.23	0.60	2.53	3.62	5.76	8.70	12.09
Bangkok (BMA)	-	-	-	2.17	3.57	4.98	5.88
Greater Bangkok	0.54	0.60	1.80	2.73	3.88	5.80	7.54
Hong Kong	0.28	0.84	2.24	3.13	3.94	4.99	5.52
Singapore	0.23	0.56	1.07	1.65	2.08	2.41	2.71
Kuala Lumpur Conurbation	0.08	?	0.35	0.70	0.91	1.46	2.66
Klang Valley	-	-	-	-	-	2.02	3.13
Surabaya	0.13	0.37	0.72	1.01	1.52	2.02	2.47

Notes: 1. Sources: Moriconi-Ebrard (1993), Annexe A, is the source of most of the earlier period population figures and many of the recent figures for full metropolitan populations. These include Tokyo 1900-1950, Seoul Metropolitan 1900 - 1960, Metropolitan Jakarta for all years, Manila's full metropolitan area for all years, Greater Bangkok for all years, Hong Kong 1900-1950, Singapore 1900-1950, Kuala Lumpur Conurbation for all years, and Surabaya, 1900-1950. Seoul City figures for 1950 and 1960 are from Kim (1997). All other figures are from the updated CAAD data set (Appendix 1).

2. Seoul Metropolitan for 1950 to 1990 includes Seoul, Inch'on and Seoul's satellite cities in Kyonggi Province. Greater Tokyo for 1960 to 1990 is the Tokyo Metropolitan Transportation Area (Tokyo-to, Chiba, Saitama and Kanagawa prefectures). The population figures for Singapore, Hong Kong and Surabaya for 1960 to 1990 are those within their administrative borders (which differ slightly from the Moriconi-Ebrard figures).

Table 3.4 Urban populations from 1900 to 1980 as a percentage of their 1990 population, for Asian cities in an international sample of cities

	1900	1930	1950	1960	1970	1980	1990
Singapore	8%	21%	40%	61%	77%	89%	100%
Hong Kong	5%	15%	41%	57%	71%	90%	100%
Greater Tokyo	5%	19%	33%	49%	68%	81%	100%
Surabaya	5%	15%	29%	41%	62%	82%	100%
Greater Bangkok	7%	8%	24%	36%	51%	77%	100%
Greater Jakarta	1%	4%	20%	33%	49%	72%	100%
Greater Manila	2%	5%	21%	30%	48%	72%	100%
Greater Seoul	1%	2%	14%	24%	43%	69%	100%
Kuala Lumpur Conurbation	3%	?	13%	26%	34%	55%	100%

Note: These are based on the populations in Table 3.3 in each case and at each date for the area that best reflects the full metropolitan area.

City size, in itself, is often emphasised as being centrally important for urban transport (Thomson, 1977; Zahavi, 1976). However, when a broad global perspective is taken, it is found that city size is not nearly so decisive an explanatory factor as many other variables. Newman and Kenworthy (1989) found little or no connection between city size and transport patterns using their 1980 sample of 32 cities. City size probably has some influence on transport patterns but it is overwhelmed by other variables and only

becomes apparent when cities that are otherwise similar to each other are compared. For example, reasonably regular variations in the use of public transport are observed among samples of cities of different sizes within Japan, Germany or India (City Bureau and Building Research Institute, 1990; Pucher, 1994). A useful perspective on the evolution of these cities this century is to show what percentage of their 1990 population had been reached at a number of earlier dates. Table 3.4 allows a quick assessment of when the greatest jumps in population occurred in each city. It shows that Kuala Lumpur has grown most recently, followed by Seoul and then the other middle-income cities. For comparison, Table 3.5 shows the history of population growth of a number of the larger Western cities in the international sample.

Within this Western group of cities, there is a contrast between the European cities and the other cities of the sample. Several of the European cities were already large by early this century and have had relatively slow growth since then. On the other hand a number of the Australian and American cities have, like most of the Asian cities, become large cities only since the Second World War and have had very high rates of population growth throughout the post-war era.

Table 3.5 Urban populations from 1900 to 1960 as a percentage of their 1990 populations, for large Western cities in an international sample of cities

	1900	1930	1960	1990
London	88%	110%	121%	100%
Vienna	100%	104%	102%	100%
Hamburg	44%	83%	100%	100%
Brussels	33%	65%	93%	100%
Frankfurt	25%	63%	89%	100%
Paris	39%	63%	77%	100%
Copenhagen	35%	59%	102%	100%
Stockholm	29%	58%	95%	100%
Munich	31%	48%	78%	100%
Sydney	16%	40%	70%	100%
New York	9%	38%	88%	100%
Toronto	5%	22%	52%	100%
Vancouver	2%	18%	56%	100%
Los Angeles	1%	15%	54%	100%
Houston	1%	9%	40%	100%
Phoenix	0%	2%	28%	100%

Note: All of these figures are based on data from Moriconi-Ebrard (1993), Annexe A, except for New York for 1960 and 1990 which are the "urbanised area" population figures from CAAD. For some cities, the 1990 figures may not match exactly the populations of the metropolitan areas used in this study because of different metropolitan definitions employed by the authors. In some cases, the difference is significant because it has not always been easy to collect reliable data for the full functional metropolitan area. Examples include Los Angeles, Toronto, Hamburg, Brussels, Munich, Frankfurt and Stockholm.

This thesis is very much concerned with the long-term and large-scale features of transport and land-use development in cities and their interactions. It is reasonable to

expect that the rates of change of both transport and land use and their observable impacts on each other will probably be greatest during eras of rapid growth. The data presented here suggest that the period since 1960 has seen a very large proportion of the total population growth of most of the Asian cities in this sample. The urbanisation cycles theory¹⁵ would also suggest that slower growth can be expected at some point in the future as these cities enter a “mature” stage in the cycle. Just as Vienna can, even now, be considered in many ways to be a late 19th Century city, or London to be an early 20th Century city, it is likely that future observers will look back on the events and trends of these recent decades of rapid growth in Asian cities as having been pivotal in establishing the long-term character of each city. The rapid economic growth that has also occurred in recent decades makes it even more likely that the period of about 1960 to the late 1990s has been a particularly significant era for these cities.

Thus, transport and land-use decisions taken during the recent period have been shaping each city in fundamental ways and for many decades to come. The next sections, which focus on historical background, reflect this point. The treatment of the period up to the 1940s is relatively brief and greater detail is provided for the period from the 1940s to the late 1960s. Chapters 5, 6 and 7 are devoted to understanding the current situation and trends during the 1970s, 1980s and 1990s.

3.3 Evolution of Asian Urban Transport and Urban Form to the 1940s

The purpose of this section is to describe the key features of the historical evolution of urban transport in the Asian cities in this study. This section’s focus is the period from around 1900 until the 1940s. The history from the 1940s to the late 1960s is considered in the next section. The Asian cities’ evolution will then briefly be compared with the experience of other cities in the international sample.

3.3.1 Non-motorised transport

In the late 19th century, the urban transport needs of the Asian cities were largely satisfied by walking. Other modes were poorly developed at that time and most of the cities (except Tokyo) were small and compact. Even by the 1940s, walking is likely to

¹⁵ A theoretical framework has been advanced for understanding phases of urbanisation in terms of “urbanisation cycles” (Klaassen, 1981). In simplified terms, this framework describes cities as going through several well-defined stages in their evolution. These stages are specified as urbanisation (with strong population growth in the urban core), suburbanisation (with strong growth in outer/suburban areas of a metropolis), disurbanisation (with an overall decline in population) and reurbanisation (with some renewal of the core). The data in this section can be interpreted as being consistent with the Asian cities since the Second World War having been passing through the first and (recently) the second stages, urbanisation and suburbanisation. At the other extreme, by 1990 the European cities tend to have entered the later stages and have not been in an urbanisation stage since before the Second World War.

have accounted for more than half of all trips in most of these cities. Manning (1984: 40) points out that even in Australia (which was already very wealthy) it was not until the early 20th century that most urban citizens could afford to use public transport daily.

The first relatively affordable alternative to walking in many of these Asian cities arrived in the last decades of the 19th century when hand-pulled rickshaws began to appear in several cities. These were apparently invented in Japan in the 1860s (named *jinrikisha*). They reached a peak in around 1900 in Tokyo and in the early 1920s in Hong Kong, Singapore, Kuala Lumpur and Bangkok (Rimmer, 1986c).

Horse-pulled vehicles offering taxi-like services also existed in all of the cities in the first half of this century (and earlier) but seem to have been most numerous in Manila (where they are known as *Calesa*) and in Surabaya and Jakarta (where they are known as *Andong* and *Dokar*) (Dick, 1981; Rimmer, 1986c). In these cities, hand-pulled rickshaws never seem to have been important. In Manila, the horse-drawn vehicles were numerous enough to be competing effectively with the trams (Rimmer, 1986a: 1566-67).

Bicycles had become popular in the West from the 1890s but they were initially expensive in Asia and few in numbers. However, Japan developed its own bicycle industry and they rapidly became widely used in Tokyo. In other Asian cities in the 1920s, bicycles were still expensive and so were initially used by middle-income people (Gallagher, 1992). They then gradually made greater inroads and by the 1930s in Surabaya their numbers were reputedly large enough to be affecting ridership of the tram system (combined with competition from illegal motor buses) (Rimmer, 1986a). Manila appears to be the only city where bicycles never became very popular in this era.

Pedicabs were also slow to gain a foothold, partly because of resistance from the rickshaw pullers, partly due to the lack of smooth, hard road surfaces and partly due to the expense of the necessary imported bicycle components. The invention of pedicabs has been wrongly attributed to various cities, including Bangkok and Jakarta (Abeyasekere, 1989: 91; Poboorn, 1997: 40). Gallagher (1992: 46) shows that they were invented in Europe not long after the bicycle became popular, but that for various reasons they never caught on there. Pedicabs were introduced to Singapore in 1914 but did not take hold (Rimmer, 1986c: 113). Nevertheless, Singapore became the first city where pedicabs became widely used after another introduction in 1929 (Gallagher, 1992). They then quickly appeared in Bangkok in 1933, Jakarta in 1936, and Surabaya in 1942. They presumably reached Kuala Lumpur soon after their introduction to

Singapore¹⁶. In each case, pedicabs tended to displace the hand-pulled rickshaw and horse-drawn cabs, although regulation also played a role in the decline of rickshaws. Pedicabs did not become widely used in Hong Kong or Tokyo (although there were a few in Tokyo briefly during the immediate post-war chaos). Rimmer (1986c) reports that pedicabs were replaced in the 1950s in Manila by motorised tricycles operating as mini-taxis. Pedicabs became numerous in Singapore, Bangkok and Jakarta in the 1930s but it was not until the 1950s that they existed in large numbers in many countries of Southeast Asia. Indeed, it will be seen later in this chapter that, in most of the Asian cities in this study, non-motorised vehicles reached the height of their importance in the early post-war era.

3.3.2 Public transport

The period from about 1880 to 1940 saw the rise of collective public transport services in Asian cities¹⁷. Trams were the most significant mode of motorised urban transport in most large Asian cities between 1910 and the 1930s but the systems were relatively limited compared to those in Western cities of the era. Of the cities in this sample, only Kuala Lumpur never had a tram service, since it was a small town of much less than 300,000 people during the pre-war era. Tokyo had 116 kilometres of electric tram route by 1912 in a city of about 3 million people (Rimmer, 1986c: 51). Seoul in 1945 had 40 kilometres of route with 257 streetcars (Kim and Choe, 1997: 90). At the same time, Bangkok had 49 km of electric tram route with 200 trams, Manila had 45 km before their destruction during the Second World War, Jakarta had 28 km of route, and Singapore had 26 km before the system's closure in the late 1920s. Surabaya had 19 km of electric tram route (excluding the steam tram used mainly for freight) (Poboon, 1997: 38; Rimmer, 1986a: 1565). For perspective, it needs to be remembered that Seoul, Bangkok, Singapore, Jakarta, Surabaya and Manila were all cities of between 340,000 and 600,000 people in 1930 (by which time these tram systems had been completed). For comparison, Brisbane in Australia had 53 km of tramway by 1904 for a population of only about 130,000 (Lawson, 1978). Zurich today has a tram system of 120 km of route and the system in the 1940s was little different, serving a city of less than 500,000

¹⁶ The fact that different designs of pedicab emerged in different Southeast Asian cities suggests that it was probably the idea and the news of their success in Singapore that was being disseminated, rather than the pedicab vehicles themselves.

¹⁷ Horse drawn omnibuses began service in Tokyo in 1869 (Rimmer, 1986c: 48). Horse trams began in Jakarta in 1869, in Manila in 1881, in Tokyo in 1882. Steam trams began in Singapore in 1886, in Surabaya in 1889, and a steam-driven cable tramway (the Peak tramway) began in Hong Kong in 1888. More significantly, electric trams began operating in Bangkok in 1893, in Jakarta and Seoul in 1899, in Tokyo in 1903, in Hong Kong in 1904, in Singapore and Manila in 1906, and in Surabaya in 1923 (Kim and Choe, 1997: 61; Rimmer, 1986a: 1563; Rimmer, 1986c).

people (Taplin, 1992). These comparisons suggest that trams influenced smaller areas of the Asian cities than in Western cities in the same era. The influence of trams in allowing the cities to spread out would also have been accordingly less important in most of the Asian cities.

In Bangkok and Hong Kong water transport of different kinds were important public transport modes, especially pre-war. In Bangkok, which had in the 19th century been a highly water-based city, the first half of the 20th century saw water transport in steady decline along with the canal system itself and due to the increasing importance of road transport (Poboon, 1997). In Hong Kong, the cross harbour ferries remained highly significant until well into the post-war era. Right up until the late 1950s much of the development in Hong Kong had been within a short distance of the harbour (on Hong Kong Island and in Kowloon) (Dimitriou, 1994: 141).

Motor buses of various kinds began to become important in most of the Asian cities from the 1920s onwards. Tokyo was the exception, in that buses never became significant. Hong Kong bus services began in the 1920s in an unregulated way by small operators but in 1933 franchises were given to two large concerns to operate in Hong Kong and Kowloon respectively (Rimmer, 1986c: 77). These then dominated land-based transport for many decades. Bus services began in Seoul in 1928 but were not important until the post-war era and became dominant by the late 1950s (Kim and Choe, 1997: 90).

In Singapore, “mosquito buses”, which were small 7-seater buses operated by individual or very small enterprises became very important by 1921. They became the dominant public transport mode by the 1930s (having amalgamated into eleven “Chinese bus companies” in 1935), along with buses run by the former tram company (Singapore’s tram services ceased in 1926) (Rimmer, 1986c). Kuala Lumpur was a very small city before the war and never had trams as mentioned above. As with Singapore, privately run mosquito buses (later Chinese bus companies) became the main mode of fixed-route public transport in Kuala Lumpur by the early 1930s. Jakarta and Surabaya also had motor bus services by the 1930s, provided by small vehicles in sufficient numbers that their competition caused concern to the tram operators (Rimmer, 1986a). It is not clear whether any significant number of buses of any kind began to operate in Manila or Bangkok before the war.

Among the Asian cities in this sample, only in Tokyo did suburban rail or urban rail become important before the Second World War. Steam railways had connected Tokyo

with nearby towns from 1869, when the Tokyo-Yokohama railway was opened, but these did not at first provide effective suburban services and did not generate much suburbanisation (Cybriwsky, 1991: 131). From 1915 or so, these lines were gradually electrified and became important for suburban services (Rimmer, 1986c: 55). Many new suburban rail lines were built before the war, mostly by companies involved in land development (Cybriwsky, 1991: 131).

Rail systems existed in most of the other Asian cities but none were in significant use for short-distance passenger travel. Jakarta may have been an exception. Its system was electrified before the war and may have been beginning to play some short-haul role by that time. However, in the early post-independence era, Jakarta's rail system became dilapidated, slow and a minor part of the city's transport system (Spencer, 1989: 195). Thus, in summary, buses, mosquito buses and/or trams had become the dominant forms of public transport in the Asian cities of the sample, except for Tokyo where suburban rail was already significant along with the trams.

Plate 3.1 Asian city street scenes early in the 20th Century



Rickshaws and bullock carts, New Bridge Road Singapore, circa 1900. Source: Archives and Oral History Department Singapore (1984).



Surabaya street scene with the steam tram, hand carts, pony cabs and bicycles, circa 1908. Source: Duparc (1972).

3.3.3 Private transport

As early as the 1920s, cars had become commonplace among the elite in the Asian cities and had reached sufficient numbers to already be causing some congestion problems in city centres. There were significant numbers of cars owned by the European elite in colonial cities such as Singapore, Kuala Lumpur, Jakarta and Hong Kong from early in the century. Despite their use only by the rich, cars already dominated traffic by the 1930s in a number of Asian cities. For example, in 1936 there were 3,267 cars in Hong Kong compared with only 97 trams and 185 buses. Traffic counts in Singapore in 1930 show motor cars accounting for about half or more of the vehicles crossing two important bridges (having overtaken hand-pulled rickshaws as the

most numerous vehicle type (Rimmer, 1986c: 117). In Seoul and Tokyo, car ownership levels were extremely low before the war. Likewise, Bangkok in 1947 still had only 3,000 private cars and about 700 motorcycles (Poboon, 1997: 38).

3.3.4 Urban form¹⁸

Urban population densities¹⁹ in the Asian cities in this sample were probably all within a range between about 140 persons per hectare (pph) and 250 pph in the first half of the 20th century. Typical Japanese built-up area population densities have been estimated as about 210 pph in 1850 and about 150 pph in 1920 (Masai, 1994: 122). Poboon (1997) provides various estimates for Bangkok's historical densities. In 1882, the city of 169,000 people had a density of approximately 150 pph. By 1910, the population had increased greatly to 440,000 and the density had risen to 243 pph. In 1919, the urban density was about 208 pph, and in 1936 Bangkok's 650,000 population lived at about 151 pph. Perhaps this drop in density reflects increased mobility due to trams, buses and bicycles along with a slower population growth rate in that period (1910-36). However, by 1958 the population had surged upward to about 2 million and density had risen again to 209 pph. These figures give an idea of the range of densities to be expected in the larger cities of the region earlier this century.

Although walking remained dominant in most cities in the pre-war era, the rise of public transport and non-motorised vehicles extended the range of travel that was affordable to much of the population. This apparently allowed population increases to occur in Asian cities without dramatic rises in density. Strips of handsome shop-houses along former tram routes in Singapore are one example of the influence of public transport on urban form (Rimmer, 1986a). Similar patterns occurred in the other large Asian cities. Significant rail-suburb development began in earnest in Tokyo in the late 1920s and the 1930s (Bernick and Cervero, 1997; Cybriwsky, 1991).

By the 1930s in colonial cities, such as Singapore, Kuala Lumpur and Jakarta, private cars probably played a role in allowing suburbs for European residents to be built outside the dense cores and in styles oriented to access by car. Examples include Menteng in Jakarta (Abeyasekere, 1989: 115), and the hilly suburbs to the west of

¹⁸ In 1900, none of the Asian cities had more than 8 percent of their present populations. Even by 1930, populations remained below 21 percent of their present totals. Hong Kong, Singapore, and Tokyo were the only cities that by 1950 had around 40 percent of their 1990 population levels, while the other Asian cities all had 29 percent or less (Table 3.4). These figures are mentioned again here to put into perspective how much or little of the influence from the transport and urban form patterns of the pre-war period is likely to remain today. Nevertheless, pre-war transport patterns have a legacy in the urban form of the inner cores of each city.

¹⁹ Please see Section 4.8.2 for the definition of urban density and for discussion of the care required in its calculation.

Kuala Lumpur's city centre. Such areas took up a sizeable proportion of the urban land but catered to a tiny fraction of the population. The ability of the elite colonial officials to travel by private modes also allowed expanding administrative districts to be surprisingly sprawling in colonial cities, such as Jakarta (which tied in nicely with the desire to project colonial power and prestige).

In 1900, all of the Asian cities in the sample had still conformed closely to the walking city description of urban form (introduced in Chapter 2), especially with their high densities. Even by around 1940, the Asian cities, except Tokyo, had not yet deviated very much from the characteristics of the walking city, although some influence from trams, buses and cars could be seen by then. Motorised mobility remained generally very low in these cities and the influence of motorised modes on land-use patterns was accordingly rather low. All were still rather compact, except for Tokyo, whose suburban development by 1935 already extended over 10 kilometres from the centre along rail lines (Inoue, 1994). By 1940 Tokyo was well on the way to becoming a "transit city".

In the other Asian cities, development tended to stretch less than 7 kilometres from their geographical centres. Bangkok in 1936 was mostly contained within a radius of about 6 kilometres, with several slightly longer tram-based corridors to the south-east, north-east and south-west (ESCAP, Yokohama, and Habitat, 1982: 27). In 1945, Seoul had spread less than 5 kilometres in most directions, with only one longer tram-based corridor stretching about 7 kilometres to the south-west towards Inch'on (Seoul Development Institute, ca. 1995). Manila by 1948 had extended less than about 6 kilometres in any direction from its old centre (ESCAP et al., 1982: 91). Kuala Lumpur in 1945 was mostly within a radius of about 4 kilometres, but already stretched about 6 kilometres in several corridors that must have been served by mosquito buses.

Singapore in 1950 was mostly within 6 kilometres of its centre but two corridors to the east and west extended to about 10 kilometres (ESCAP et al., 1982: 123). These must also have been served by buses. By 1955, Jakarta had spread only about 7 kilometres from its old centre, primarily along tram corridors (Jakarta Government, 1991: 2).

Thus, by the middle of the 20th Century, the Asian cities in this sample, with the exception of Tokyo, remained compact, dense, low-income cities. Non-motorised vehicles were plentiful in most cities. Motorised modes of transport, especially trams, had made their presence felt but overall, these cities still had very low levels of motorised mobility, even by the standards of the time. Only Tokyo had achieved higher mobility with its suburban rail system.

3.4 Evolution of Asian Urban Transport and Urban Form from the 1940s to the late 1960s²⁰

The Second World War was a discontinuity in the transport and urban development of most of the Asian cities, all of which experienced wartime disruption²¹. In most Asian cities the early post-war period was a time of rapid population growth. In this section, it is often useful to talk about Tokyo on its own and to discuss all the other Asian cities together. The Asian cities other than Tokyo are referred to together in this section as “the developing Asian cities”, including Singapore and Hong Kong at that time. This era saw Tokyo continue its development as a strongly rail-based city with an urban form to match. The developing Asian cities on the other hand, were served by a mixture of bus and/or jitney-based public transport, walking and non-motorised vehicles. In the 1950s and 1960s, all of them developed urban forms that largely reflected this transport pattern, with many features of Thomson’s low-cost strategy.

3.4.1 Non-motorised transport

Walking remained important in most Asian cities in this sample, especially the poorest of them, even up to the 1960s. This is clear, despite the lack of solid data on this from the period. For example, it was estimated that in around 1970, 60 percent of Jakarta’s work trips were on foot (Arthur D. Little and Associates, 1972). Even in much wealthier and larger Tokyo, walking and cycling still accounted for almost 51 percent of all trips in 1968 (City Bureau and Building Research Institute, 1990). Since then, the role of walking has declined but remains significant. In 1985, walking still accounted for 40 percent of all trips in Jakarta (JICA, 1987a). In Surabaya, even in 1981, non-motorised modes still accounted for 53 percent of all trips (35 percent were on foot, 9 percent by bicycle and 9 percent by pedicab) (JICA, 1983). Like Jakarta, non-motorised transport probably accounted for two-thirds or more of all trips in Surabaya prior to 1970 when private vehicle ownership (especially motorcycle ownership) was much lower than in 1981 and when public transport service was less plentiful. The other Asian cities in the sample had higher incomes in 1965 than the Indonesian cities, so their roles for walking and non-motorised vehicles were probably already slightly lower than in Jakarta and Surabaya at that time.

²⁰ Some of the data for 1960 and 1970 that are presented in this section are part of the main data set of this study. Relevant definitions and the methodology for the collection of this data set are described in Chapter 4.

²¹ Manila and Tokyo especially, suffered great destruction in the final stages of the Second World War. In Seoul, the greatest disruption to urban life came a little later in the form of the Korean War, which almost completely destroyed the city.

By the 1950s, bicycles had become important in all of the Asian cities, except perhaps Manila. For example, in 1960 Singapore had 268,000 bicycles, compared with only 63,000 cars and 19,000 motorcycles. Even in 1970, there were more than 360,000 bicycles compared to around 260,000 motorised vehicles (Arthur D. Little and Associates, 1972:293). Old photographs, films and other anecdotal sources from the 1950s and 1960s suggest that Kuala Lumpur had similarly high numbers of bicycles. There were also more bicycles than private cars in Jakarta and in Seoul in around 1970 (McNeill, ca. 1977). Photographs from this period of street scenes in Seoul confirm significant use of bicycles (Clark and Clark, 1969). Photographs from the 1950s of Jakarta, Bangkok and Surabaya street scenes show large numbers of bicycles and pedicabs sharing the streets with small numbers of motor vehicles (Duparc, 1972: 52-53, 92-93; Poboon, 1997: 72). In Tokyo, bicycles continued to gain in numbers, despite rising motorisation after 1960 (Replogle, 1992; Yamakawa, 1994). They carried 8 percent of all trips in the Tokyo region in 1968 (City Bureau and Building Research Institute, 1990).

Pedicabs were very important in Jakarta and Surabaya and quite numerous in Bangkok, Kuala Lumpur, and Singapore in the 1950s. However, by the 1960s, there was a trend among decision-makers to view pedicabs in a negative light and their use began to be restricted. For example, they were banned from Bangkok in 1961 and gradually restricted in Singapore and Kuala Lumpur from the early 1960s so that their numbers began to drop quickly (Gallagher, 1992). Restrictions on pedicabs came later in the Indonesian cities.

3.4.2 Public transport

With rather low incomes, very low ownership of private vehicles and rapidly expanding cities (and hence travel distances), one might think that this period from 1945 to 1970 would have been a golden age for public transport in this region. A majority of the populations depended on public transport and non-motorised transport, but buses and jitneys struggled to provide a plentiful and affordable public transport service. A large proportion of the population of most of these cities probably could not afford to use public transport regularly, as is commonly the case in low-income cities (White, 1990).

One trend that was common to most of the Asian cities in the sample was the removal of tram services, as was also occurring in most other regions of the world in the same

period²². In the developing Asian cities, the removal of trams left public transport dependent upon buses and jitneys.

In Tokyo, the trams were largely phased out between 1965 and 1971 and subways were aggressively developed, especially between 1957 and the early 1970s, to replace the trams' inner city distribution role (City Bureau and Building Research Institute, 1990; Rimmer, 1986c). The subways complemented the large network of suburban railways that had largely been put in place by the 1940s. By 1960, subways and suburban rail accounted for 90 percent of public transport passenger kilometres and almost four times the occupant kilometres carried by cars (Newman and Kenworthy, 1989). Peak-hour overcrowding on the trains was world famous by the 1960s. Demand continued to rise so fast that even constant expansion of the existing railways' capacity and construction of a few new lines could only gradually reduce the problem²³ (Hall, 1977: 229-231).

Japan had explicit policies in the pre-war decades of promoting rail investment, which was dominated by local companies, rather than road based transport which was dominated by foreign firms (Hook, 1994). This national emphasis on rail investment continued until the late 1960s. According to Hook (1994), this was related to the power of large corporate conglomerates (*keiretsu*) which at that time were strong in the rail industry and had almost no investments in the motor vehicle industries. They also had large real estate interests in the central cities, which would have been threatened by dispersed auto-oriented development (Hook and Replogle, 1996). This partly explains the vigour with which radial transportation infrastructure was provided in Tokyo. This infrastructure was mainly rail-based, but even the expressway network that was begun in the 1950s was highly radial at first, so that Tokyo's development in this era continued to epitomise Thomson's strong centre strategy (Rimmer, 1986b).

By contrast with Tokyo, in Kuala Lumpur, Singapore, Bangkok, Seoul and Hong Kong, conventional buses provided most fixed-route public transport by the 1960s. In Manila from soon after the war and in Jakarta and Surabaya by the mid-1960s, jitneys (in their various local forms) had become the dominant form of public transport. In Seoul, in conditions of very low car ownership, buses carried a high proportion of trips at reasonable speeds in a very high-density urban environment. By 1970, buses carried

²² Tram services were closed in Jakarta in the early 1960s, in Bangkok between 1961 and 1968, in Seoul by the mid-1960s, in Surabaya in the mid-1960s and in Manila the trams did not reopen after war damage (Abeyasekera, 1989: 176; Dick, 1981: 78; Kim and Choe, 1997: 62; Poboon, 1997: 60; Rimmer, 1986a). Only in Hong Kong did a significant tramway continue to operate right up until the present day (in Tokyo only two minor lines continued).

²³ Between 1965 and 1970, peak-hour crowding on Tokyo trains (both suburban and subway) dropped from over 240 percent of design "capacity" to about 220 percent (Cybriwsky, 1991: 102). Such crowding is only possible through intense packing of standing passengers.

more than 80 percent of motorised passenger trips in the city (Table 3.6). These were operated by some 90 companies and had remarkably efficient operations (Liu, 1994). In this period prior to the 1970s, most of the bus routes were radial, serving the old CBD area. This characteristic, along with the large number of buses, led to very serious bus congestion in the inner city by the early 1970s, and complaints that the service was deteriorating (Kim and Choe, 1997: 90).

Bus operations in Singapore, Kuala Lumpur and Bangkok were less effective than Seoul's in meeting the growing needs of their cities. In Bangkok prior to 1972, 22 private and 2 state-owned companies operated unsubsidised bus services which unfortunately, by the early 1970s, provided a poor service that fell far short of meeting demand (Rimmer, 1986c: 192). Bangkok's number of buses per 1000 persons jumped from 0.19 in 1947 to 0.9 in 1960 but then remained almost static, only rising to 1.2 buses per 1000 persons by 1970 (Poboon, 1997: 61). Kuala Lumpur in the 1960s and early 1970s had eight "Chinese" bus companies and one larger Malay-owned operator, Sri Jaya. These operated under franchise agreements with the government and remained profitable in the 1950s and 60s, despite heavy taxation levied upon them. However, a squeeze of rising costs, controlled fares and rising private vehicle ownership caused profits and services to deteriorate by the 1970s (Roth, 1977). Rimmer (1986c) describes an almost identical scenario in Singapore in the 1960s with regard to the bus services of the Chinese bus companies and by the larger former tram company. With controlled fares and high taxation, bus services there deteriorated to such an extent that in the 1960s there were an increasing number of "pirate taxis" (private cars illegally offering shared-taxi or hybrid-type services mostly along the bus routes).

Hong Kong had plentiful bus and ferry service but there too, the franchised operators failed to keep up with demand and illegal fixed route or on-demand services emerged in the 1960s. These were later legalised to become the public light buses (Meakin, 1993). These provided a significant fraction of the total public transport service. In Manila, the demise of the trams in the war and the lack of buses in the immediate post-war period left a need that was filled by the conversion of war-surplus jeeps to serve as minibuses (Rimmer, 1986c). At first, these had a capacity of only seven passengers but this has gradually been increased over the years and by 1970 many had a passenger capacity of 13 (Arthur D. Little and Associates, 1972: 289). They became known as "jeepneys" and have been the predominant form of public transport ever since, although conventional buses have also become important.

Post-war Indonesia was poorer than the other Asian countries in this study. As a result, even the public modes of transport developed more slowly in Jakarta and Surabaya than elsewhere in this sample. These cities had very low motorised mobility and non-motorised transport was very important in the 1950s. By that time, Jakarta's trams had become slow, crowded, and dilapidated. The pre-war private bus fleet had not been upgraded and was inadequate and dilapidated. The nationalised tram company acquired new buses but never enough of them and they also suffered from lack of maintenance. During the 1950s, and even more so in the 1960s, Jakarta's fixed route public transport was increasingly provided by *opelet* (cars converted into "microbuses" for 6 to 8 passengers) and *bemo* (which were slightly smaller and usually with three wheels) (Dick, 1981). Surabaya had a similar experience. The tram service deteriorated and closed in 1966. In the mid-1960s, 70 private mini-buses were introduced but only lasted until 1971 because of intense competition from a growing fleet of *bemo* (either three or four-wheeled jitneys), which also became much more numerous after import restrictions on such vehicle types were lifted in the mid-1960s. *Bemo* (also known as *Angkut*) provided the only fixed-route public transport from 1971 until 1976 when large buses were reintroduced by the National Government and operated by a state enterprise, PN Damri (Dick, 1981; Rimmer, 1986c: 245).

Giving a quantitative picture of public transport in Asian cities in this period is not easy, however a number of figures for 1970 have been gathered (Table 3.6).

Table 3.6 Public transport use in Asian cities in an international sample of cities, 1970

	Percent of all motorised trips	Passenger km per person
Tokyo	65	5,161
Hong Kong	? (~>70)	1,806
Seoul	81	?
Singapore	42	?
Manila	? (~70)	?
Bangkok	53	1,683
Kuala Lumpur	37	936
Jakarta	61	1,084
Surabaya	?	?
European average	-	1,430
Canadian average	-	667
Australian average	-	949
USA average	-	332

Note: No 1970 mode split data are available for Hong Kong and Manila but data that are presented later in the dissertation suggest that in 1970, public transport probably accounted for at least 70 percent of motorised trips in both of these cities.

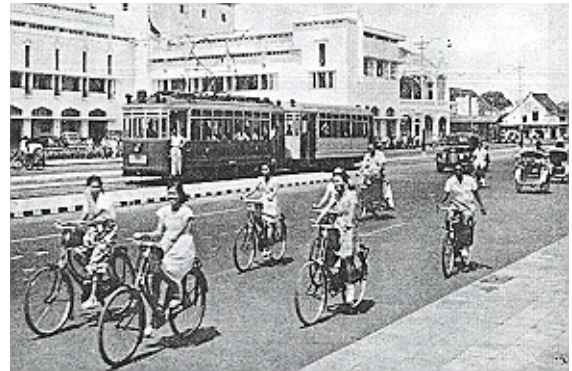
Sources for the figures on mode split for all motorised trips (which is not a standard CAAD data item): Jakarta - Mogridge (1992) citing earlier studies; Kuala Lumpur - Wilbur Smith and Associates (1974); Singapore - (Rimmer, 1979); Seoul - (Lim, 1993); Bangkok - (Poboon, 1997).

The mode split figures for public transport in Kuala Lumpur, Bangkok and Singapore may seem surprisingly low. In Kuala Lumpur even the 1963 mode split was only 45 percent to buses (Wilbur Smith and Associates, 1974). However, the rich minority of the population with private vehicles make more trips per person (and make many more motorised trips per person) than low-income people. Therefore a disproportionate number of the trips counted in the modal split figures are trips that are made by high-income people who own private vehicles. This is likely to be especially significant in low-income cities with highly skewed distributions of income. Very low-income people make few motorised trips in such cities, even by public transport. Therefore, each of the mode split figures cited in Table 3.6 actually imply that a somewhat larger percentage of the population lacked access to private motorised modes in these cities at that time²⁴.

Plate 3.2 Asian city street scenes in the 1950s



Jakarta in the early 1950s. Source: Duparc (1972).



Surabaya, early 1950s. Source: Duparc (1972).



Singapore, 1950s. Source: Archives and Oral History Department Singapore (1984)



Singapore, cars beginning to dominate traffic flows, late 1950s. Source: Archives and Oral History Department Singapore (1984)

²⁴ Data from Jakarta in 1985 illustrates this point (JICA, 1987). 'Low income' people, who were 47.5 % of the sample, took only 0.61 motorised trips per day (0.20 private and 0.41 public) on average. On the other hand, those with lower-middle, upper-middle, or high incomes (altogether 52.5 percent of the sample) took 1.11 motorised trips per day on average (0.63 private and 0.48 public). This implies that the richer 52.5 % of the population took 67% of all motorised trips and the poorer 47.5% of the population had only 33 % of all motorised trips. Incidentally, the low-income people were not making many more non-motorised trips than the richer people. The low income 'half' of the population took 0.91 non-motorised trips per day compared to 0.70 non-motorised trips per day by the richer 'half'.

3.4.3 Private transport

The ownership of private vehicles had not extended beyond a small elite in the 1950s. Although the number of vehicles was rising in every city, these rises were from very low base lines. For example, Bangkok had only 4.8 motor vehicles per 1000 persons in 1947 and this rose to 33 per 1000 by 1960; still a very low level by today's standards (Poboon, 1997: 57). Thus in 1960, private vehicle ownership was still low in all of the Asian cities. However, by 1970 the beginnings of an upsurge towards mass car and motorcycle ownership could be seen in Tokyo, Singapore, Kuala Lumpur and Hong Kong (Table 3.7 and Table 3.8).

Table 3.7 Car ownership in Asian cities (1960 and 1970)

	Cars per 1000 persons	
	1960	1970
Seoul City	?	6
Surabaya	?	14
Jakarta	?	22
Hong Kong	11	27
Manila	?	38
Bangkok	14	54
Singapore	39	69
Kuala Lumpur	46	72
Tokyo	16	105
European	122	243
Australian	223	321
Canadian	274	348
United States	376	460

Table 3.8 Motorcycle ownership in Asian cities (1960 and 1970)

	Motorcycles per 1000 persons	
	1960	1970
Hong Kong	1	4
Seoul City	?	?
Manila	?	6
Tokyo	16	9
Bangkok	6	20
Jakarta	?	32
Surabaya	?	35
Kuala Lumpur	?	50
Singapore	12	51

Notes for Table 3.7 and Table 3.8:

The 1970 figures for Kuala Lumpur are actually for 1972, Surabaya's for 1971 and Jakarta's for 1972. Kuala Lumpur's 1960 car ownership data is for 1963.

All of the Asian cities had low levels of car ownership in 1960²⁵. Singapore and Kuala Lumpur had the highest rates of car ownership in the Asian sample, but neither had

²⁵The Asian cities for which the 1960 data are missing still had low motorisation by 1970. Their 1960 levels can be presumed to have been lower still.

more than 50 cars per 1000 people²⁶. By comparison, the European average was already over 100 cars per 1000 and the US average was already close to 400 cars per 1000 persons. Ownership rates increased during the 1960s so that by 1970, Bangkok, Kuala Lumpur and Singapore each had more than 50 cars per 1000 people and Tokyo's car numbers had shot up from only 16 per 1000 people in 1960 to just over 100 cars per 1000 people in 1970.

In 1960 motorcycles were still unimportant in Asian cities. However, by 1970, motorcycle ownership had risen dramatically in Singapore, Kuala Lumpur, and the Indonesian cities. It was thus in the 1960s that motorcycles first made an appearance in large numbers in Asian cities.

Despite relatively small numbers of private vehicles even in the 1960s, cars and motorcycles already dominated traffic flows in most cities. Already by 1970 or so, congestion was seen as a serious problem in Bangkok and Manila (Arthur D. Little and Associates, 1972: 288-289). Congestion also appeared quickly in Tokyo as vehicle numbers rose, and despite the dominance of rail for passenger travel. The 1956 Asian games in Tokyo had already seen traffic chaos and by the early 1970s, Tokyo's traffic jams were described as among the worst in the world (Hall, 1977: 231-232).

Motorised taxi-like modes also began to become important in the late 1950s and 1960s as incomes rose, as trips lengths increased and especially after governments began to seriously restrict non-motorised taxi modes. Seoul, Kuala Lumpur, Hong Kong, Singapore and Bangkok all saw steep rises in the numbers of motorised taxis and their role (McNeill, ca. 1977; Poboan, 1997: 65; Rimmer, 1986c: 155). McNeill (ca. 1977) cites figures²⁷ showing that taxis carried 22 percent of motorised trips in Singapore in 1972, carried 21 percent in Seoul in 1970, almost eight percent in Hong Kong in 1965, five percent in Kuala Lumpur in 1970 and four percent in Bangkok in the same year.

3.4.4 Car and road-oriented planning begins

In addition to the growing importance of private motor vehicles in the traffic mix, the influence of car-oriented transport and urban planning also began to be felt throughout the region during the 1950s and 1960s. This influence was felt both indirectly and directly. An indirect influence was the enormous prestige of the United States, and the West in general, which tended to cause local elites all over the world to see highways

²⁶ In fact, Spencer (1989) suggests that the ownership figures in Kuala Lumpur and Singapore before the mid-1970s were slightly over-estimated due to a failure to remove old cars from the totals.

²⁷ McNeill was citing Owen, 'Automobiles and Cities', 1973.

and cars as the way of the future. Jakarta's emphasis on the building of grand new arterial roads began in the late 1950s in line with President Sukarno's ideas about the ideal "modern" metropolis (even if his grandiose plans were not completed until much later) (Abeyasekere, 1989).

The influence of Western car-oriented ideas was also felt directly, through foreign aid for highway development, as for example American financing for major highways between Bangkok and regional centres in Thailand (Poboorn, 1997). Jakarta's major thoroughfare (the Thamrin/Sudirman corridor) and the Jakarta Bypass were completed quickly with foreign aid assistance in time for the 1962 Asian Games (Abeyasekere, 1989: 201).

Another important direct influence was through the Western consulting firms that conducted most transport or urban planning studies in Asian cities in this period. They used the standard, and largely inappropriate, urban transport planning (UTP) process developed in and for car-oriented, suburban-style cities (Dimitriou, 1992; Kenworthy, 1990a; Kenworthy, 1990b). These studies set the agenda for the major transport investments, even if many of their recommendations often went unfulfilled for many years, due to lack of financial capacity in the region. As suggested above, prior to the early 1970s, the mainstream urban transport planning methodology used by the consulting firms was especially weighted towards roads and car-oriented approaches. It simply attempted to supply all of the road capacity needed to match the predicted traffic demand.

Many studies recommended grandiose road-building plans in Asian cities. One example was the 1964 First Kuala Lumpur Transportation Study by an Australian firm, which emphasised capital intensive road building projects but had no measures to encourage public transport (Jamilah Mohamed, 1992). Between 1956 and 1960, Western staff helped to prepare a Master Plan for Jakarta, which included a system of ring roads (Abeyasekere, 1989). Another prominent example was the 1960 Greater Bangkok Plan by the American consulting firms, Litchfield Whiting Bowne and Associates and Adams Howard and Greeley. This plan proposed the construction of three ring roads around Bangkok, two expressways to pass through Bangkok's inner area, and thirty-eight new main roads (Poboorn, 1997). Manila's 1954 master plan prepared by the Philippines National Planning Commission incorporated many proposals made during the earlier American colonial administration and also proposed a complex regional highway network (United Nations, 1986a: 20). Capital intensive expressways and major

arterial roads were even emphasised by Japanese consultants in their 1970 study for Manila, albeit along with large rail investments (Rimmer, 1986b).

3.4.5 Urban form

The urban land-use patterns of most of the Asian cities in around 1970 were heavily influenced by the transport patterns that prevailed during the post-war period. It has been shown that in the 1950s and the 1960s the vast majority of the residents of the developing Asian cities in the sample were dependent on buses (including jitneys) and on walking and non-motorised vehicles. The 1960s saw the beginnings of the upsurge in vehicle numbers, but it had not yet created high motorisation levels by 1970. In Tokyo, rail remained dominant, along with walking and cycling.

The era from 1945 to 1970 was a time of enormous population growth for all of these cities, fuelled partly by large influxes of people at the end of the Second World War (Table 3.3). All except Hong Kong at least doubled their populations between 1950 and 1970 (and Hong Kong almost doubled its population). Therefore population growth alone led to substantial expansions of the urban fabric in each Asian city in this period. The post-war period up to 1970 accounted for a substantial proportion of all post-war population growth in most of the Asian cities (Table 3.4). As mentioned earlier, the evolution of urban form in this post-war period can be discussed by first assessing Tokyo's unique situation and then the other Asian cities as a group.

3.4.5.1 Tokyo's rail-influenced urban form

In Tokyo, rail was by far the primary influence on the post-war urban form that evolved there, as it had been in the 1930s and 40s and as it still is (Bernick and Cervero, 1997; Cybriwsky, 1991: 130-133). Land use control and urban planning were weak in Japan and had a relatively minor role in Tokyo's development²⁸ (Hall, 1977: 236; Hook, 1994). Therefore, it was the transport system's influence that dominated. Rail dominance in Tokyo has also progressively reinforced the importance of the central area as the dominant employment centre. By 1970, the central three wards of Minato-ku, Chuo-ku and Chiyoda-ku had a daily inflow of almost 1.7 million commuters and

²⁸ However, one major success of Japanese urban planning practice (and one that has been exported to Korea and other countries) is "land readjustment" which was introduced to Japan in 1909 and became widely used in the post-war period (Inoue, 1994; Kim and Choe, 1997: 122). Under this system, the layout and services of an area, owned by many small landowners of irregular plots, can be redeveloped with a new, more regular layout. It has been widely used under the leadership of private railway companies in the vicinities of rail stations and has thus played an important role in allowing intensive, transit-oriented land-use patterns to develop around stations (Bernick and Cervero, 1997: 317).

within a 40 kilometre zone, about 40 percent of workers commuted to central Tokyo (Hall, 1977: 229).

3.4.5.2 Land-use patterns in the developing Asian cities

In all of the other Asian cities in the sample, land use patterns that developed in the post-war era up to 1970, largely reflected the prevailing transport systems buses (and jitneys), walking and non-motorised vehicles were predominant.

In the 1960s all of the developing Asian cities had relatively centralised employment but nevertheless had no compact, high-intensity central business district. The CBDs of developing Asian cities tended to have a spread out, low-rise form, but with high densities of residents and employment intermixed at a fine scale. For example, Seoul's employment was much more centralised than it is now and, as late as 1976, the two central wards had a very high proportion of service sector employment (United Nations, 1986b: 14). Hong Kong in 1966 was also highly monocentric with intense mixing of residences and jobs even in the core central area, which included the port areas (Lo, 1992: 151).

McGee (1967: 126-131) characterised the typical 1960s pattern of land uses in large Southeast Asian cities. His examples included Bangkok, Kuala Lumpur, Singapore, Manila and his model was monocentric with both jobs and residents having their highest densities in the very cores of the cities. Within the core, he identified a port zone, a government zone, a Western commercial zone, "alien" commercial zones (Chinatowns and "Little Indias"), with the rest of the core consisting of a so-called "mixed land-use zone". There were very high residential densities throughout the core except in the government and Western commercial zones. McGee also emphasised that almost all zones of the city, even beyond the core, had tremendous mixing of economic activities and land uses at that time.

Despite the centralisation of employment and high population densities of central areas, there were very few high-rise buildings until the 1970s in these cities. High densities of residences were interspersed at a fine scale with commercial enterprises within the central areas. Thomson (1977: 253) observed that low-income cities often have CBDs that are a matter of "intensity of land use rather than type". That is, the density of population, jobs and services all reach a peak in the central area but this area is not qualitatively different from surrounding areas and there may be no sharp boundary. Indeed, it has been said that Jakarta in the 1950s and '60s did not have any clearly defined CBD (Webster, 1992).

In Jakarta, Surabaya, Manila, Bangkok and Kuala Lumpur most of the modern office and other high-rise developments since the 1970s have occurred beyond the old central areas. So, despite some gradual changes (increased commercial uses and decreased residential population), much of the highly mixed character of early post-war central areas can still be seen in these cities. As discussed later in the thesis, the evolution of this central city form is closely allied to the dominant forms of transport, namely buses (and jitneys) and non-motorised transport. Unlike high-capacity rail systems, buses do not permit very high spot concentrations of activities to develop. Rather, activities tend to spread along major roads where access by low to medium-capacity jitneys and buses can reasonably be maintained.

It is difficult to generalise about the development of residential areas in this period, and any detailed examination of their character would go beyond the purpose of this historical review. Some very brief comments on this are sufficient. Much high-income housing tended to be low or middle-density and to locate in elite neighbourhoods. However, in certain cities, such as Jakarta and Surabaya, a pattern emerged whereby the rich lived on streets that had four-wheeled access and the poor lived behind such houses in vernacular settlements (known as *kampung*) served only by alleyways (Silas, 1983).

In the post-war period up to the 1960s, low-income housing in all of the developing Asian cities was usually in the form of vernacular, unplanned settlements. Such settlements held high proportions of Jakarta's, Surabaya's, and Manila's populations and somewhat lower proportions in Kuala Lumpur, Seoul and Hong Kong. In 1969, *kampung* occupied about 60 percent of the inner city area of Jakarta and housed a very high percentage of the population at residential densities of around 500 persons per hectare within their boundaries (Sivaramakrishnan and Green, 1986: 196). Even in Singapore, "squatters" accounted for 26 percent of the population in 1963 (McGee, 1967). Existing vernacular settlements in inner areas tended to gradually increase in density as every spare space was gradually built on. This, combined with a high average household size (more than 5 per household) meant that many such settlements reached extraordinarily high population densities, despite their low-rise form. The same cycle began with new squatter settlements further out. Mid-rise tenements and flats also began to appear in the inner areas of most cities.

New middle-income housing was usually in the formal real-estate sector and in this period an increasing number of such developments on the urban fringe were middle-density in some cities. An example is Petaling Jaya which was begun in the 1950s as a satellite town for Kuala Lumpur in the style of the British New Towns. Quezon City in

Manila and Kebayoran Baru in Jakarta were other important examples. These were prestige projects with government backing and included major new roads or road expansions to complement them. Some government-promoted, high-rise housing also began to be seen in the 1960s and was vigorously pursued from that time onwards in Singapore and Hong Kong, in satellite “new towns”. However, in the 1960s these had yet to become a dominant feature of these cities’ landscapes.

3.4.5.3 Urban densities in the 1960s

In the 1960s most of the Asian cities seem to have had urban densities similar to or slightly higher than in 1990. Data collected for this study (and its predecessor, Newman and Kenworthy (1989)), show that in 1960, Tokyo had 86 persons per hectare (pph) compared with 71 in 1990, Singapore had 105 pph (87 in 1990), and Bangkok had 168 (149 in 1990). In 1970 Hong Kong’s density was 333 persons per hectare (but 300 in 1990), Kuala Lumpur was 79 pph in 1970 (but 59 in 1990), and Jakarta and Surabaya both had 178 pph compared with 171 and 177 respectively in 1990. Only Manila appears to have increased slightly in density since 1970, although the time series may not be absolutely reliable, since Manila’s density apparently dropped from 178 pph in 1970 to 167 in 1980 but then rose to 198 pph in 1990. No accurate data from Seoul in the 1960s are available but its urban density in 1965 was certainly considerably higher than 170 pph (a figure calculated using zoned land uses, which almost always understates the urban density because of the inclusion of some land which is still not developed) (Kim and Choe, 1997: 22, 78). Thus Seoul was already among the densest of the Asian cities, despite the fact that in 1970, 88.4 percent of dwellings in Seoul were detached houses (Kim and Choe, 1997: 107). This high density was achieved through intense clustering of buildings, high household sizes and low amounts of land allocated to public purposes.

Transport patterns and city size can go some way towards explaining these variations in density. The mechanism for such an explanation is the observation that throughout history, urban dwellers have typically tolerated (on average) a trip to work of not much more than 30 minutes duration (Manning, 1978; SACTRA, 1994: 40; Zahavi and Ryan, 1980). Thus it has been suggested that any change in urban or transport conditions that causes the average trip-to-work time to rise much higher than 30 minutes, will tend to spur changes in land use and demands for faster transport, in order to bring trip times down again. Conversely, increases in transport speeds will tend to allow cities to spread out without increasing typical trip-to-work times unreasonably. Thus in Tokyo for example, the development of the extensive rail system with much higher speeds than the

earlier trams allowed densities there to decrease from perhaps 140 or 150 pph in the 1920s (Masai, 1994: 122) to less than 100 pph in the post-war era, despite an enormous growth in population.

It has been shown that in all of the developing Asian cities in the post-war era up to the 1960s, buses and jitneys were the fastest modes that were affordable to the bulk of the populations. Buses and jitneys tend to have a maximum operational speed of about 20 kilometres per hour and are often much slower (as low as 8 km/hr) (Appendix 1). Only on high-speed roads can bus services go faster, and such roads were almost non-existent in developing Asia in this period. Therefore, it is expected that these cities would have been able to expand no further than about 15 kilometres in any direction from their geographic centres (based on a maximum of a 45-minute journey at 20 km/h). Indeed, historical maps of Jakarta, Bangkok, Manila, Seoul, and Kuala Lumpur show that by around 1970 they extended little or no more than this distance (ESCAP et al., 1982; Seoul Development Institute, ca. 1995; Wilbur Smith and Associates, 1974).

The smaller cities, such as Kuala Lumpur at that time, could have expanded at quite a low density without facing this time constraint. Thus Kuala Lumpur's small population size at the time that motorised public modes had already become dominant is probably part of the explanation for that city's lower density than the other, larger Asian cities in this sample. Surabaya was also small (reaching 1.5 million people by 1970) but it was shown previously that until the 1960s, Surabaya had a very low supply of public transport and a very high role for non-motorised transport, so typical travel speeds there were even lower.

Other, non-transport reasons have also been suggested for some of the most extreme variations in density. For example, transport alone seems unable to explain why Hong Kong and Seoul reached such very high densities. Hong Kong's extremely high density is often attributed primarily to the hilly topography of the area around the harbour, which made land for building scarce and expensive, and to the extremely rapid influx of population during the 1950s (Lo, 1992). In Seoul, the imposition of a green belt has often been seen as a cause of its very high density, but this was not imposed until the 1970s. Seoul's surroundings are also rather hilly but not as much as Hong Kong's. Like Hong Kong, Seoul also had a rapid influx of population at the end of the Korean civil war in the mid-1950s (United Nations, 1986b: 3). The population of the City of Seoul grew from 900,000 in 1945 to about 3.5 million people in 1965 (Kim and Choe, 1997). With the city largely destroyed in the war, it is probable that neither land for building nor transport links could be opened up fast enough to allow a more spread out

development pattern. The very low incomes in the city prior to 1960 would have also contributed to low levels of mobility (even by tram and bus) and to the modest and tightly packed style of housing. Probably also significant was South Korea's national economic strategy that since the early 1960s has consistently given top priority to the development of industry. This resulted among other things, in a very low percentage of national income going into housing (Kim and Choe, 1997: 115) or, presumably, into urban mobility. This pattern of high density, compact cities developing where capital is directed into industry rather than into urban infrastructure, is consistent with theories put forward by Frost (1991).

Are there non-transport explanations for Singapore and Kuala Lumpur having rather lower urban densities by Asian standards by the post-war period? One possible factor aiding urban spread in Singapore and Kuala Lumpur is that the rural hinterlands of both cities consisted of rather low-value, tree-crop plantations and small-holdings on infertile soil (rather than more valuable land devoted to intensive rice, market gardening and orchards as around most of the other Asian cities in the sample). Another factor is that these cities were already more prosperous by the 1950s than most other places in Asia. This was an era in which Malaya's rubber and tin industries boomed, despite the turmoil due to the communist insurgency in the country, known as the Emergency. These factors would have allowed cheaper land development, higher mobility, and somewhat greater investment in transport infrastructure in these cities than elsewhere in Asia. Having said that, Kuala Lumpur's 1970 density figure may not have been quite as low as previously suggested. The figure for 1970 of 79 pph was for the whole of the Klang Valley which at that time consisted of the conurbation of Kuala Lumpur and Petaling Jaya plus several independent small towns and townships. The density for the conurbation alone would probably have been somewhat higher than 79 pph. The figure for 1960, prior to most of the development of suburban-style Petaling Jaya, would probably have been higher again, possibly around 100 pph. Nevertheless, Kuala Lumpur would still have been at the low end of the Asian city densities.

In summary, by the 1960s the developing Asian cities in the sample had developed up to a radius of about 15 kilometres, due primarily to the relatively low speed of the dominant transport modes, and their densities ranged from just under 100 pph to just over 300 pph.

3.4.5.4 Influence of roads on urban form

It has been observed that arterial roads were a dominant influence on both the outward expansion of urban areas and on the location of commercial land uses in developing Asian cities in this period. The major roads were the primary arteries for both the masses using buses or NMVs and for the elites in their private vehicles. In the absence of strict planning control, commercial land uses naturally emerged along such main roads (Hamzah Sendut, 1969; Leinbach and Ulack, 1983; Lo, 1992:149-155; McGee, 1967; Poboorn, 1997:49; Webster, 1992:7-8). In many of the Asian cities, the government and regulatory influence over the character of urban expansion was exceedingly weak. Development tended to follow corridors defined by large roads. As mentioned previously, in this period this development pattern was largely a result of the bus-oriented pattern of access. For example, Bangkok's urban expansion (Figure 3.1) followed major roads with long and narrow corridors of development (Poboorn, 1997).

Figure 3.1 Bangkok's urban area in 1958 or so



Source: Adapted from ESCAP (1982: 27)

This era also saw the concentration of commercial land uses along important roads that had been expanded within existing urban areas. Prominent examples are Jakarta's

Thamrin/Sudirman corridor that was completed in the early 1960s between the old CBD and the post-war suburb of Kebayoran Baru. Office and hotel development quickly began to concentrate along this road in the 1960s (Abeyasekere, 1989: 199, 201; Sivaramakrishnan and Green, 1986: 196). In Manila, major radial roads also attracted concentrations of commercial land use, well beyond the old CBD. Further concentrations of jobs and services began to appear during this period where these radial roads intersected with EDSA (the major orbital road about 8 kilometres from the centre). The successful privately planned and developed sub-centres of Makati and Cubao, which began to thrive in the 1960s, occupied such strategic locations (Electrowatt Engineering Services and Pak-Poy & Kneebone, 1985; Thomson, 1977; United Nations, 1986a). Similar patterns also began to emerge in other developing Asian cities.

3.4.5.5 Influence of urban planning on urban form

The direct influence of major roads on land use development was moderated only by the action of urban planning controls, where these were strong enough. However, in most of the cities, government control over land-use was weak. In most of the low-income cities where urban plans were prepared, it was through their infrastructure plans that they eventually had an influence on development patterns, rather than by any direct influence on land use planning.

In those few cities that did develop strong planning controls, the full impact of urban planning efforts was not strongly felt until the late 1960s. The main well-known examples of this were Hong Kong and Singapore, where housing provision and urban expansion became dominated by the public sector in the 1960s. In these “city-states” the governments had almost total control over the location and character of urban development from that time onwards. Nevertheless, up until the early 1960s, the main influences on urban development patterns in these two cities were similar to those in the other developing Asian cities, namely the transport system (and natural topography).

Korea also gradually developed stronger planning control than elsewhere in the region beginning in the 1960s with a city planning law in 1962, followed by the Land Readjustment Law in 1966, the 1966 Master Plan, a 1971 strengthening of the city planning law, and the 1972 National Land Use and Management Law. Nevertheless, here too there was relatively little government initiated urban development or influence over development location until the 1970s (Kim and Choe, 1997: 170).

In Kuala Lumpur's emerging metropolitan area, formal planning based on the British post-war "new towns" had a strong influence on the layout and housing styles of some new middle-class areas from the 1950s onwards, the major one being Petaling Jaya (Arthur D. Little and Associates, 1972: 297). But a large proportion of urban development before the 1970s continued to be built in more ad-hoc, incremental patterns, influenced most strongly by road corridors. Most development in this period occurred on the immediate fringe of the city centre or strung out along corridors from the city centre south-west towards Klang (including Petaling Jaya), south towards Sungai Besi, south-east towards Kajang and north-west towards Kepong and Rawang (Wilbur Smith and Associates, 1974).

3.4.6 Descriptive models of 1960s land-use and transport systems: the "bus city"

By the 1960s, the characteristics of the developing Asian cities no longer conformed closely to Newman and Hogan's walking city type, since development extended up to 15 kilometres from the centre, about six times further than the pure walking city. Public transport, in the form of buses and jitneys, accounted for most motorised passenger transport. Although non-motorised transport, especially walking, remained very important for many local trip purposes, public transport probably carried more work trips than walking or non-motorised vehicles by the 1960s in most of this sample of Asian cities.

Bus and jitney-based transport systems also have rather different features from the rail and tram-oriented systems that characterised Western cities earlier in the twentieth century. Such Western cities formed the basis for the transit city type, described in Chapter 2. The land use and transport systems of the developing Asian cities in the 1960s have features in common with Thomson's low-cost strategy, which was described in Chapter 2. So Thomson's low-cost city type could possibly be used as a descriptive label for cities (perhaps as an addition to the walking city, transit city and automobile city framework). However, as mentioned in Chapter 2, Thomson's archetypes were originally intended as idealised "strategies", rather than as descriptive city types.

Therefore, the term "bus city" (where the word "bus" is taken to include jitneys) has been chosen here to describe the main features of the developing Asian cities in this sample in the 1960s²⁹. The use of this term follows and extends the nomenclature

²⁹ Another possible city type in Asia might be labelled as NMV cities, although no examples were encountered in this Asian sample. These would be distinct from the walking city in that their physical extent could exceed the typical 5 km diameter of the traditional walking city. To confirm that there is value in using a NMV city label would

of Newman and Hogan's typology in naming the city type after the mode of transport that is felt to have most influence on land-use patterns. Bus cities can be seen to be distinct from transit cities, which were optimised around the various rail-based modes. The word "bus" is taken to include jitneys or minibuses. In Chapters 7 and 8 there will be further development of ideas on how the evolution of Asian cities over the last several decades can best be described in terms of city types. The value of such an exercise will be assessed at that time. The principal features of bus cities can be specified by using the discussions above, by following Thomson's description of the low-cost strategy and with some reference to other descriptions of transport in low-income cities by about the early 1970s (Dimitriou, 1992; Fouracre, 1977; Jacobs et al., 1986; White, 1990; Zahavi, 1976).

In bus cities, non-motorised transport may still be very important for short trips but a majority of the population depends on buses for long trips. Public transport does not meet the potential peak-hour demand, and as a result activities (and trip making) in a bus city must spread out in time over much of the day and throughout the week. Bus or jitney services tend to serve almost every major street (in cities where jitneys are common they can also serve many relatively minor streets). In inner areas, service frequencies and the spatial density of services can be very high. Low-cost taxi-like modes (either motorised or non-motorised) tend to provide feeder services to bus and jitney routes. A small high-income elite own and use private cars in the bus city. Congestion from these and from goods vehicles further slows the buses. A schematic map of the main features of an idealised bus city is shown in Figure 3.2.

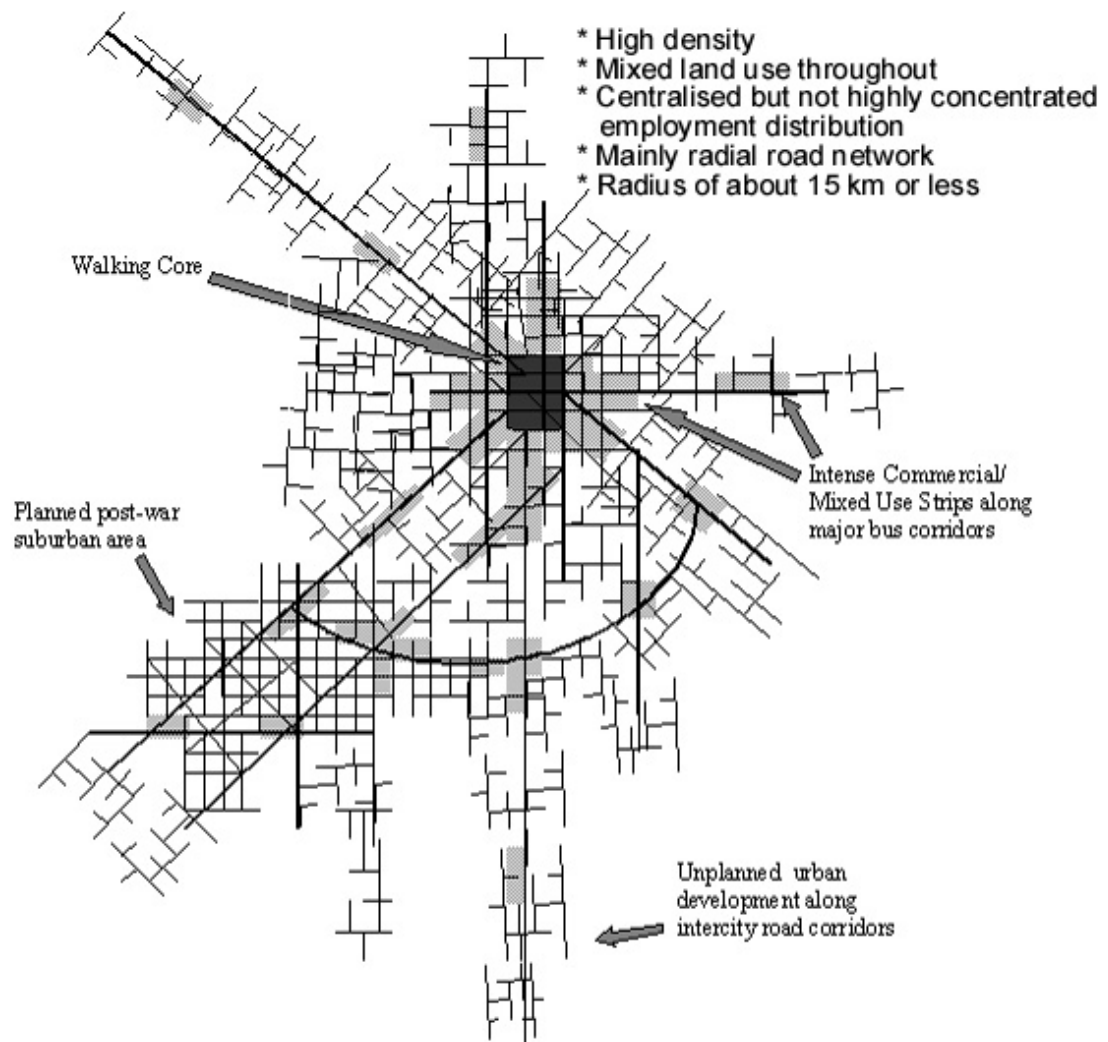
Bus cities tend to have a large proportion of all employment concentrated in the extensive central area and in linear strips or sub-centres located along main roads extending from the central area. As suggested earlier, employment in the city centre tends to be more dispersed than in the transit city because buses cannot easily service a highly concentrated node of employment without congestion and loading problems. The tendency to have mixed land use extends to most parts of the bus city, although to a lesser extent than in walking cities.

A bus city can apparently extend to about 15 kilometres from its centre (slightly more in directions with higher-speed roads and less in directions with poor radial road provision) without resulting in long travel times. Typical travel speeds in bus cities, of

require some analysis to show that large non-motorised-vehicle dominated cities had land use patterns and transport network characteristics that are distinct from either walking cities or 'bus cities'. This does seem likely. Large cities where non-motorised vehicles carry most non-walk trips include Tianjin in China or Dhaka in Bangladesh (PPK Consultants, 1993; Replogle, 1992).

between 10 to 20 kilometres per hour, are much slower than in the more rail-based transit city. These lower speeds (along with continued high roles for non-motorised transport) are an important reason behind the larger Asian bus cities retaining higher densities than similar sized transit cities. The post-war bus cities of this Asian sample tended to have densities above about 100 pph, compared to densities of between about 60 and 100 pph in transit cities during the same period. The central areas of bus cities are not empty of population and often have as many residents as they do jobs. However, as with many city types, elite housing areas are often exceptional and tend to be much lower density than the rest of the city. Such areas also have the highest level of road provision, and may be located far from the centre.

Figure 3.2 Schematic map of the bus city



Note: All figures, graphs and plates were prepared by the author unless specifically credited to others.

Although most of the Asian cities in the sample other than Tokyo, shared many of these characteristics during the 1960s, there were variations of course. Surabaya only developed extensive jitney services in the late 1960s and depended more than the other

cities on non-motorised transport. In Kuala Lumpur and Singapore, the bus-city label probably fitted best in the early 1960s. By the late 1960s, cars and motorcycles were becoming very numerous in both cities, threatening the dominance of buses (and quickly displacing bicycles and other non-motorised vehicles). Hong Kong was unusual in other ways. The peculiarities of its location meant that it had exceptionally high densities and a high role for ferries, along with buses and walking. Ferries can provide very high passenger capacities and hence have somewhat different implications for land use patterns compared with buses. Nevertheless, despite these variations, it is not misleading to say that all of these cities were essentially bus cities during the 1960s.

It should be pointed out that by the 1960s, bus cities probably accounted for most large cities outside the rich, industrialised world and outside the then Communist block in Eastern Europe and the Soviet Union. The exceptions were probably the very few low-income cities in which rail systems played a large role (Bombay being one of the few examples) and the many very-low-income and small cities, where no motorised transport of any kind was dominant. Nevertheless, there were clearly already many bus cities throughout Latin America and a number in Asia, the Middle East, and southern Europe. Some of the largest African cities may also have fitted the description. Rio de Janeiro, Mexico City, Bogota, Athens, Istanbul, Tehran and Lagos all conformed well to the bus city model, with high average urban densities, centralised employment, very high proportions of all motorised trips being carried by buses, and vehicle ownership rates of much less than 100 per 1000 persons at that time (Gilbert, 1995; Poole, Pacheco, and de Melo, 1994; Thomson, 1977; Ward, 1990; Zahavi, 1976).

3.5 Comparison with Transport Histories in Western Cities

In the previous section, the presentation of the historical development of the transport and land use systems of the Asian cities in the international sample of cities ended in the 1960s. As will be shown in Chapter 5, the next three decades were a period of very rapid increases in motor vehicle ownership for most of these Asian cities. This section therefore focuses on that part of the history of cities in western Europe, North America and Australia when similar conditions prevailed. The purpose is to examine the urban transport and land use systems in such cities just prior to and during their own periods of early rapid motorisation (roughly the periods when car ownership went from below 50 per 1000 to above 200 per 1000 people). The questions that are asked are:

- 1) What kinds of public transport systems existed in these cities at the time that their levels of car ownership were rising through these levels?

2) What were the main urban form characteristics and approximate urban densities of Western cities during their early motorisation eras?

3) What are the implications of any differences in 1) and 2) between Western cities and the Asian cities?

An examination of Western cities at those particular times is a relevant comparison to the situations in the Asian cities in the 1960s. A more complete examination of the urban transport histories of Western cities is unnecessary for the purposes of this study.

First, there is a need to establish when the various cities in the sample had car ownership levels between about 50 per 1000 and about 200 per 1000. The earliest major city to achieve mass car ownership (by which is meant that a large proportion of households own a car) was Los Angeles. By 1919, it already had about 110 cars per 1000 people (Brindle, 1995: 38) and by 1940 had over 350 cars per 1000 people (Thomson, 1977: 80). Other American cities lagged behind Los Angeles' motorisation by varying lengths of time, with the large, older cities, such as New York and Chicago, motorising more slowly than most others. For example, by 1940 Chicago had about 160 cars per 1000 (Thomson, 1977) rising to 307 by 1960 (Newman and Kenworthy, 1989). New York's motorisation was a little slower and its metropolitan area still had only 271 cars per 1000 people in 1960 (Newman and Kenworthy, 1989). Thus Los Angeles was highly motorised well before the Second World War and most other American cities had achieved high levels of motorisation by the time of the Second World War or soon after. Australian cities all had less than 100 cars per 1000 persons in 1947 and most had a little over 200 per 1000 by 1960 (Moriarty, 1996; Newman and Kenworthy, 1989). Thus the 1940s and 1950s were the time of Australian cities rapid early motorisation. The European cities in the sample had car ownership levels in 1960 that ranged from 65 to 160 cars per 1000 persons (Newman and Kenworthy, 1989). This suggests that mass motorisation was not significant in European cities until at least the 1950s.

In order to focus the discussion, a small selection of cities has been made. These are Los Angeles in the 1920s or so, New York in the 1940s, and Sydney in the early 1950s. In addition, European cities in the sample can be discussed for 1960, since 1960s data were collected on these cities for the original CAAD study (Newman and Kenworthy, 1989). Large cities are chosen in order to be most comparable with the large Asian cities in the sample. Each of these cities outside Asia had extensive public transport systems at the times in question and had rather high levels of mobility by public transport. In almost every case, rail systems of some kind were already very significant,

although road-based public transport (tram and/or bus) was also important in many cities. In almost every city, densities were already below 100 persons per hectare, or well below that level in the US and Australian cases.

Los Angeles by the 1920s was renowned for its extensive network of over 2000 kilometres of electric tram and rail track. The system had been an integral part of its spread into a multi-centred metropolitan area of more than 2 million people by 1930. It was also already a rather low-density city by the 1920s, having grown from an extremely small settlement in 1870, with some of the highest per capita incomes in the world during that period, and with the high mobility offered by the large rail and tram system (Bernick and Cervero, 1997: 19-22; Wachs, 1984). The 1960 population density figure for the City of Los Angeles (at the heart of the region) was only 27 pph (Newman and Kenworthy, 1989). This area is larger than the area developed by the 1920s. Nevertheless, allowing for this and for declining household sizes and possible displacement of residents by other land uses since the 1920s, this figure suggests that Los Angeles in the 1920s probably had a density of no more than about 50 pph.

Sydney in 1947 was a tram and suburban-rail-oriented city of 1.6 million people. Mobility on public transport was high in early post-war Sydney, with the system carrying 3,550 passenger kilometres per capita (Manning, 1984). The extensive suburban rail system carried the majority of motorised passenger kilometres. That this level of public transport mobility was high can be seen when it is compared with 1990 figures of 2,775 passenger kilometres per capita by public transport in Singapore and 3,784 per capita in Hong Kong (Appendix 1). Australian cities enjoyed, like Los Angeles, some of the highest per capita incomes in the world during the first half of this century. Sydney grew in population from under 500,000 in 1901 to 1.63 million in 1947 (Moriarty, 1996). The extensive public transport system allowed this growth to extend at relatively low densities so that by 1947, Sydney's urban density was only about 30 persons per hectare (Manning, 1984: 70).

New York was also a public transport-oriented city in the 1940s. It was a much larger and denser city than Los Angeles or Sydney when it began to motorise rapidly. Although New York already had an urban expressway by that time, most of the present huge freeway network in the region was built much later, in the 1950s and 1960s (Thomson, 1977). Transport in 1940s New York was dominated by the subway system which served the New York City area, which is now considered as the inner area. Suburban rail services were also important (but much less so than the subways). This inner area (New York City) still had a population density of 116 persons per hectare by

1960 (Newman and Kenworthy, 1989). In about 1940, the urban density of New York's metropolitan area is likely to have been similar to this figure, that is, not much more or less than 100 pph. Urban densities within New York City were probably somewhat higher in the 1940s than in 1960 but some rail suburb development at lower densities had already taken place beyond the New York City boundaries (Bernick and Cervero, 1997). Thus at the time that motorisation began to surge upward in New York, it had a density that was high by Western standards, although still near the lower end of the range of Asian densities in this study. However, in contrast with the developing Asian cities, New York had an extensive public transport system that was predominantly segregated from the impact of congestion and achieved relatively high speeds.

By 1960, rapid motorisation was well under way in most western European cities in the sample. Table 3.9 shows the relevant features of these cities in 1960. All had urban densities of 100 persons per hectare or less. These figures may have included a certain amount of car-oriented development built in the 1950s, so density figures for these cities as they first began to motorise rapidly (in the early 1950s) would have been slightly higher than these 1960 figures. Two or three of them may have been a little denser than 100 persons per hectare in the early 1950s. By 1960, before car ownership had passed 160 per 1000 persons, most of the European cities had highly developed rail systems, as illustrated by the percentages of public transport passenger kilometres that were by rail (Table 3.9). Trams were also important in most cities, except London and Paris. The only cities without significant rail in this group in 1960 were Vienna, which was highly dependent on trams, and Amsterdam, which depended on non-motorised transport and trams.

Table 3.9 Key urban transport and land use characteristics of European cities, 1960

City	Population (millions)	Urban Density (pph)	Cars per 1000 persons	Total public transport passenger km per capita	% of public transport pass. km on rail
Paris	8.4	69	153	1,846	72%
London	8.0	65	156	2,229	46%
Hamburg	1.8	68	96	1,959	59%
Vienna	1.6	91	94	1,705	0%
Copenhagen	1.3	40	89	1,548	56%
Stockholm	1.3	66	143	731	46%
Munich	1.0	57	131	?	?
Brussels	1.0	100	157	1,788	47%
Amsterdam*	0.9	98	65	569	14%
Zurich	0.7	60	126	1,945	47%
Frankfurt	0.7	87	133	?	?

Note: Amsterdam in 1960 had a very high role for non-motorised transport (walking and bicycles). In 1960, 56% of work trips in the city were by non-motorised transport.

In most of the cities with important urban rail systems, it had been an important mode for many years, but there were exceptions, notably Stockholm, where major urban rail developments were primarily in the post-war period. Nevertheless, the European cities at this stage generally had much better developed public transport systems than the developing Asian cities in this study. European public transport systems were generally less extensive and public transport mobility lower than in the large Australian and American cities at the equivalent stage in their motorisation. The Australian and American cities had invested more in transport infrastructure and had spread out at lower densities, leading to longer public transport trips and higher public transport mobility. For example, Sydney's 1947 mobility on public transport, at 3,550 passenger km per capita, was much higher than any of the 1960 European figures (Table 3.9).

Vienna is worthy of further comment. As a relatively large city with a density close to 100 pph and with all of its public transport on road-based modes (mostly trams), it was perhaps the European city in the sample that in 1960 had most similarities to the situation in some of the bus cities in the Asian sample at the end of the 1960s (at least the lower density, and smaller ones, such as Kuala Lumpur and Singapore). Despite Vienna's much lower rate of population growth compared to Asian cities, it is significant for the Asian cities that in subsequent decades Vienna decision-makers balked at the impact of cars on their city and felt the need to adopt a vigorous policy of restraint of private cars. Vienna was identified by Thomson (1977) as pursuing a traffic limitation strategy.

To conclude the comparison, and in answer to the three questions posed at the beginning of this section, it is possible to generalise about a number of contrasts between the developing Asian cities and Western cities at the early stages in their motorisation. Compared with the Asian bus cities in the late 1960s, most Western cities had better developed public transport (especially rail) systems at a similar point in their motorisation histories (just before rapid motorisation commenced). The Western cities also generally had much lower urban densities than the Asian cities. The full implications of these contrasts will be explored further later in the thesis but it is already clear that the Western cities were generally in a better position to cope with an influx of cars than the developing Asian cities. Lower densities tended to allow cars to be accommodated more easily, especially in those cities with very low densities. Where strong rail systems existed these tended to offer a reasonable alternative to the car at least for travel to central areas. This rail alternative was largely immune to congestion and probably prevented traffic increases from being as much of a crisis as they would

otherwise have been for these cities. Neither low densities nor extensive segregated public transport rights-of-way existed in most Asian cities in the sample. This suggests that rising vehicle ownership presented more of a threat to the bus cities of Asia in the late 1960s than it had at earlier dates in Western cities. This idea as to the origins of traffic problems in Asian cities is developed further in subsequent chapters.

3.6 Chapter Conclusion

This chapter has provided some relevant background information and a historical review of urban land use and transport for the Asian cities in this study. First, cultural and socio-political background information was presented which served mainly to highlight diversity within this Asian sample of cities. A review of the economic development status of each city came next. This was of relevance to the core issues of this study, namely important city-wide characteristics and trends in transport and urban land use. Almost all of the Asian cities in the sample have seen rapid economic growth since the 1960s and it remains to be seen whether the current Asian economic crisis will mark an end to the high-growth era or a temporary setback. Rising affluence has implications for the range of choices available in each city and forms the backdrop to many of the recent transport and urban form trends that are discussed in Chapters 5 and 6.

Each of the Asian cities' populations have also been growing, in many cases very rapidly, during recent decades. The next section of background information provided a perspective on the population size of each city and on the rates and timing of their growth since the beginning of the 20th century. These were placed into a comparative perspective alongside those of the other cities in the international sample. Like many of the North American and Australian cities, most of the Asian cities can be considered to be relatively "young" cities, in the sense that much of their population growth has occurred since the Second World War.

The rest of the chapter provided an historical review of urban transport and land-use trends in the Asian cities up until the 1960s, along with some comparisons with trends elsewhere. These discussions began to address Research Question 1, which asked: "How do the urban transport and urban form characteristics and development trends of selected Southeast and East Asian cities compare with each other and with a large sample of international cities?"

The evolution of urban transport and urban form in the Asian cities from late in the 19th century up to the 1940s was reviewed in Section 3.3. It was found that most of the

trends seen in large Western cities during this period, could also be seen to some extent in the Asian cities, although motorised mobility remained low in the Asian cities, except for Tokyo. Bicycles became popular later in Asia than they had in the West. Hand-pulled rickshaws and pedicabs flourished in most of the Asian cities in this era, but such human-powered taxi-like modes were never important in the West. This was the era that motorised public transport became important. Tram systems were built in large Asian cities, just as they were in the West, although lower levels of prosperity generally meant that the Asian systems were less extensive relative to population size. Motor buses also emerged late in the period, just as in the West. However, among the Asian cities only Tokyo developed an extensive rail system, as did most large Western cities. Private cars were already present in the Asian cities in the pre-war era, and although their use was confined to a very small minority of the population, they already presented a traffic problem in some cities. Most Western cities, except in North America, also had very low car ownership until the 1940s.

Beginning as traditional walking cities in the late 19th century, the land use patterns of the Asian cities developed in the first half of the 20th century under the influence of the higher mobility offered by the new non-motorised vehicles and motorised modes of public transport. In the West and in Tokyo, rail offered higher speeds than trams and buses, so these cities were able to spread out to greater distances than was possible in the poorer Asian cities, where public transport was slower. These poorer Asian cities were developing the characteristics that have been identified in this chapter as those of bus cities rather than the rail-oriented transit city pattern in Tokyo and Western cities.

Section 3.4 discussed transport and urban form trends in the early post-war period, up until the late 1960s, setting the scene for the detailed comparisons and discussions of recent trends that are presented in Chapters 5 and 6. In the West, these decades saw the dramatic and rapid rise of ownership of private motor cars. However, in the Asian cities in this sample, the mass motorisation process only began to gather momentum at the end of this period. Non-motorised vehicles remained important in most cities and road-based public transport continued to be predominant in the motorised transport of the Asian cities, except in Tokyo, where rail became overwhelmingly the main mode of motorised transport. Trams were eliminated almost completely from Asian cities and buses and jitneys became the primary modes in all of the developing Asian cities, including Hong Kong and Singapore. Despite the fact that private car ownership remained low in this period, it was anticipated to rise and car-oriented planning, with

Western assistance, began to have an impact on the urban plans of a number of the Asian cities and their road network proposals.

Tokyo's land-use patterns continued to develop with strongly rail-oriented features but Sections 3.4.5 and 3.4.6 found that most of the Asian cities had developed as bus cities and could still be described as such into the 1960s. The concept of the bus city was developed by building upon the typologies of cities that were presented in Chapter 2. In addition to the preponderance of buses in the transport systems, key land use features of these bus cities included:

- a centralised, but not highly concentrated, distribution of jobs;
- generally high urban densities;
- mixed land use in most areas;
- commercial activity in long strips along major roads; and
- a radius of at most 15 km or so.

This situation that the developing Asian cities were in by the 1960s, was then compared in Section 3.5 with the patterns in Western cities at earlier dates, just before the mass motorisation process began in earnest in each city. This section made an important start in answering Research Question 2, which asked, "Are Asian cities faced with unusual or unique urban transport challenges or opportunities? Can distinctive Asian models of urban transport and land-use be identified?" Two important contrasts were identified that have a bearing on the ability of the large developing Asian cities (relative to Western cities) to deal with an influx of private cars. Firstly, the developing Asian cities were highly dependent on bus-based public transport and lacked significant traffic-segregated public transport, such as rail, that had been common in the West. Secondly, most of the Asian cities had much higher urban densities than had been the case in Western cities at the equivalent stage in their motorisation. Both of these factors made the developing Asian cities in this study more vulnerable to the impacts of increasing private motor traffic than Western cities had been when cars began to intrude in large numbers. This theme will be returned to and developed in later chapters, which present the detailed, quantitative story of what happened next in the development of the transport and land use systems in this group of Asian cities during the 1970s, 1980s and early 1990s.

The next chapter presents the range of data items that were collected for this study and provides detailed information on the methodology that was employed in obtaining them. This will show the degree of reliability which may be attached to the data and

demonstrate the effort that has been made in ensuring the data are comparable and suited to the purposes to which they are put in this study.

CHAPTER FOUR

METHODOLOGY OF CITY DATA COLLECTION

4.1 Introduction

This study relies to a significant extent on a large body of comparative data on 46 cities in North America, Australia, Europe and Asia, which has been painstakingly compiled by members of the research team, including the research on low and middle-income Asian cities by this author. This large data set was collected for the purpose of updating and extending a data set first presented in the 1989 study, “Cities and Automobile Dependence: An International Sourcebook” by Peter Newman and Jeff Kenworthy (referred to hereafter as CAAD).

The importance placed in this thesis on data, and on the comparative perspective provided by the data, means that it is particularly important to critically discuss the methodology used to prepare the data set. Chapter 2 has already mentioned the deficiencies of the comparative data previously presented in the literature. This chapter will discuss the definitions, approaches and dilemmas involved in choosing, collecting, checking and analysing the data. This focus is most intensely on data issues that are of greatest relevance to the Asian cities, especially the middle-income Asian cities for which this author has been responsible. In addition, greatest attention is paid to those items of data that are used to reach important conclusions later in the thesis. It should be stressed that the extension of the international comparative approach in Newman and Kenworthy (1989) to the middle-income Asian cities in this thesis is an original contribution by the author to deal with the very different types of cities and data-keeping situations, compared with those in Western cities. A somewhat more detailed description of the methodology used in the wider CAAD update study (and one with less emphasis on the Asian cities) is provided by Kenworthy and Laube, et al (1999).

The main data set of the international study, including that developed by the author, is the primary resource for this dissertation, but other sources of information have also been drawn upon. Another resource is, of course, the body of academic and professional literature on these cities and on the key issues of the study. Further critical insights and understanding have been gained from the documents, maps, news clippings, photographs, and personal experiences that were collected by the author in the course of visiting the Asian cities for the study. In addition, an effort has been made to compile

selected data from the published literature on relevant cities in other parts of the world that could not be included in the main international sample of this study.

4.2 The Approach to the Data

The data set and the methodology used for the Asian cities are based on those used for the wider study of which this Asian city study is a part. However, a significant amount of skill and effort was required in applying the methodology to cities where the transport systems and land use development are very different from those of Western cities.

The wider international study had two main components. First, it updated and extended the “Cities and Automobile Dependence” (CAAD) data set for 46 cities in Asia, Australia, Canada, Europe and the United States. The original CAAD study by Newman and Kenworthy (1989) presented data on transport patterns, urban land use patterns and other important characteristics for 1960, 1970 and 1980 on 32 global cities. The 1990 update and extension of the CAAD study adds 1990 data, corrects a small number of inaccuracies that were detected in the earlier data and takes in a larger sample of cities. Secondly, a small number of important additional variables on the economic and environmental aspects of urban transport were requested by the World Bank as part of a separate study which ISTP was commissioned to do for 37 of the cities, including all of the Asian cities.

In this thesis, any data that are quoted in tables or figures without listing specific sources are from the data sets to which the author has contributed, namely the main data set of the CAAD update (Kenworthy and Laube et al., 1999, forthcoming) or from the data set prepared for the World Bank (Kenworthy, Laube, Newman, and Barter, 1997). Wherever other information or data are quoted, then the specific sources will be listed.

4.2.1 Cities included in the study

The cities covered in the CAAD update are set out in Table 4.1, with the fourteen cities that are new to the comparisons marked with an asterisk³⁰. The extra variables requested as part of the study for the World Bank were collected for 1990 only and were not collected from any of the new cities, except the Asian ones. All of the data collected as part of the CAAD update and the study for the World Bank are listed and discussed in Section 4.5.

³⁰ A modified set of CAAD data and the full set of data for the study for the World Bank were collected from Beijing. However, Beijing is not included in the core sample of nine Asian cities in this particular study. Beijing and a number of other Chinese cities are being studied in depth by Hu Gang, another PhD student in ISTP.

The data collection task for the middle-income Asian cities was thus larger than in any of the other cities in the international sample. All “new” cities required data for earlier years (1960,1970, 1980) to be sought in addition to 1990, whereas this earlier data had already been collected as part of the earlier study for the original set of cities.

Furthermore, unlike the other “new” cities, the middle-income Asian cities required the additional economic and environmental data items to be collected for 1990, as part of the study for the World Bank.

Table 4.1 Cities in the international sample for this study and used in comparisons of transport and land use in this dissertation

US cities	Australian cities	Canadian cities	European cities	High-income Asian cities	Middle-income Asian cities
Boston	Adelaide	Toronto	Amsterdam	Hong Kong	Bangkok*
Chicago	Brisbane	Calgary*	Brussels	Singapore	Jakarta*
Denver	Melbourne	Edmonton*	Copenhagen	Tokyo	Kuala Lumpur*
Detroit	Perth	Montreal*	Frankfurt		Manila*
Houston	Sydney	Ottawa*	Hamburg		Seoul*
Los Angeles	Canberra*	Vancouver*	Munich		Surabaya*
New York		Winnipeg*	London		
Phoenix			Paris		
San Francisco			Stockholm		
Washington			Vienna		
Portland*			Zurich		
Sacramento*					
San Diego*					

Note: West Berlin and Moscow were included in the earlier CAAD study but were dropped from the update.

4.2.2 Data collectors

This author has been responsible for all data collection and processing on four of these Asian cities, Kuala Lumpur, Jakarta, Surabaya and Seoul, and assisted in collection and processing of a number of data items from Manila and Singapore. The author has also been involved to a significant extent in assisting with the processing and analysis of data on Bangkok and to some extent on Tokyo and Hong Kong. This dissertation is concerned with all nine of the Asian cities in the sample.

An important improvement to the data collection process for this study over the earlier one, was to enlarge the study team into a multi-cultural and multi-lingual group (Table 4.3).

Table 4.2 The main data collectors for the international sample of cities.

Cities	Main data collector(s)
Australian cities	Jeff Kenworthy
United States cities	Jeff Kenworthy and Felix Laube
Canadian cities	Kenworthy, Laube and Tamim Raad
European cities	Laube and Kenworthy
Asian Cities	
Surabaya	Paul Barter
Jakarta	Paul Barter
Kuala Lumpur	Paul Barter
Seoul	Paul Barter
Manila	Benedicto Guia, Jnr. and Barter
Singapore	Kenworthy and Barter
Bangkok	Chamlong Poboon
Hong Kong	Jeff Kenworthy
Tokyo	Jeff Kenworthy

Table 4.3 Nationalities and relevant languages spoken by data collectors

Name	Nationality	Languages relevant to the study
Jeff Kenworthy	Australian	English
Felix Laube	Swiss	German, English, French
Paul Barter	Australian	English, Malay/Indonesian
Chamlong Poboon	Thai	Thai, English
Benedicto Guia, Jnr.	Filipino	Tagalog, English
Tamim Raad	Canadian	English

4.2.3 The metropolitan area as the unit of study

This study takes metropolitan areas as its primary focus of attention, so that in general where the word “city” is used, it means the larger metropolitan area, rather than a more confined administrative area. A small number of variables apply to specific parts of each urban area, such as the central business district (CBD), the inner area and the outer area, but most variables refer to the whole of the metropolitan area for each city. Thus none of the other possible scales of analysis, such as the nation, state or province, corridor, neighbourhood or household levels, receives significant attention in this dissertation.

Previous research confirms that cities are economic entities in their own right and that there are important transport-related dynamics and interactions that manifest themselves only at the level of whole metropolitan areas (Jacobs, 1984; Laube, 1998; Newman and Kenworthy, 1989; Zeibots, 1994). This is not to deny the importance of studying other levels as well, but simply to make the point that the city or metropolitan area is a level of organisation that is worthy of study in its own right. An example is that few of the dynamics that influence the usage of urban public transport can be explained with variables measured at a national or provincial level since, for example, the influence of urban land use patterns would be impossible to account for. Spatial limits, such as a

threshold on the density of roads, become important only at the urban area level (Ingram and Liu, 1997).

4.3 Choice of Cities

The initial group of additional Asian cities that was proposed to be collected by this author included Kuala Lumpur, Jakarta, Surabaya, Bangkok, and Manila. These are the major cities of Southeast Asia, a region with which the author was familiar. The authors of the original study, Jeff Kenworthy and Peter Newman, agreed to include such a group of lower-income Asian cities in the study. This represented the first extension beyond the industrialised countries of the methodology that had been pioneered in the earlier CAAD study and was something of a test of its applicability in a developing city context.

Subsequently, PhD students from Thailand and the Philippines were invited to take on the data collection for Bangkok and Manila (as identified above in Table 4.2), and to develop theses focused on and peculiar to their respective cities. After most of the data on the Southeast Asian cities had already been collected, Seoul was also added to the sample. This was done because, with Seoul's 1990 income sitting between those of the three rich cities and the other five Asian cities in the sample, its experiences were expected to be highly relevant. For the same reasons, Taipei was seriously considered for inclusion but this proved not to be practicable, although some selective reference to the city is made, where relevant, in this dissertation.

4.4 Quality Control Procedures

Though not without its critics, the Newman and Kenworthy (1989) data compilation has been quite widely hailed and cited. It has been acknowledged, even by many of its critics, as a significant contribution to the literature and as a very useful reference resource for urban researchers (Gomez-Ibañez, 1991; Kirwan, 1992). Newman and Kenworthy realised early in the previous data compilation process that simply relying on questionnaires sent to the cities involved was totally inadequate and unreliable. They therefore adopted a procedure of actually visiting each city and meeting with many officials and experts holding urban land-use and transport data. Such visits often required later follow up by letter, telephone, and fax.

The same basic procedure was repeated in this study. The need to actually visit and meet with relevant officials and experts was particularly important in the middle-income cities in Asia. In fact, for Surabaya and Jakarta, two separate two or three-week

data-collection visits were necessary for each city and these were preceded and followed by intensive communications to make contacts and follow up on missing items and problems. These efforts extended over a period of two years. For Seoul, a two-week visit was made and despite formidable language barriers, this proved to be sufficient when combined with a large number of detailed follow-up communications with contacts over the following year to clarify problems and seek additional items. This author was based in Kuala Lumpur for most of the data collection process so data on Kuala Lumpur could be gathered gradually over a period of two years. This proved to be fortunate as Kuala Lumpur's data collection turned out to be the most difficult and time consuming of the four cities for which the author was primarily responsible. This was partly because of administrative complexity and also partly because of a tendency towards secrecy in government matters in Malaysia. This level of time and effort in visiting Asian cities to establish data collection contacts and processes can be compared with an average of 3 days spent in each of the high income cities in the large study. Greater reliance on follow-up communications was possible in higher-income cities. The difficulty of such communications in the middle-income cities made longer visits vital. In a number of cities, a low level of co-ordination and communication between different government departments meant that many different agencies needed to be consulted individually.

Like the original study, the main thrust of the approach to data in this study is that a great effort has been made to ensure comparability of the data across the whole sample of cities. Data were collected in as consistent a manner as possible so that they can legitimately be compared. As mentioned, data were assembled and processed by the team itself based on information supplied by local officials and experts or documents, rather than relying on informants totally. One outcome of this is that the results are frequently a revelation even to local experts, since in some cities there has not been such a body of data assembled in one place and made available before, or data have been incorrect in previous exercises. The fragmentation of information between organisations and sources and sometimes undue secrecy with regard to data sharing are two reasons for this.

Data supplied were never taken on faith. Many procedures were used to try to verify data, to check plausibility or to choose among conflicting figures. For example, cross-checks were made for consistency with other similar cities. Checks were made to verify that the trends in time series made sense and that they were not contradicted by background factors (such as the economic fortunes of each city). Checks were made on

the internal consistency of data on each city. Figures that were particularly unusual given all of the other data could often be identified. An unusual or surprising figure was not necessarily erroneous, but did require scrutiny and verification. Some items of data were particularly problematic and required certain assumptions or estimates to be made. In such cases, more than one independent method was used wherever possible. Some examples of such procedures are presented later in the chapter.

In the middle-income Asian cities, certain extensions to the data set were desirable. Some of the Asian cities also presented special challenges for the collection and processing of many of the data items, so slightly different strategies were often required. These are detailed in this chapter. In some cases, the Asian context requires a somewhat distinct interpretation of the significance of certain data items.

4.5 The Data Set

This section lists the items of data that have been systematically compiled for this study. The choice of the variables was largely determined by the choices made earlier for the wider study of which this Asian study is a part. Table 4.4 lists the main set of “raw” or “primary” data items that were collected for this study. These primary data items are used to calculate standardised items, such as per capita figures, that can be compared between cities. The standardised items in this study are listed in Table 4.5.

In addition, for the middle-income Asian cities only, an extra effort was made to provide a breakdown of private mobility parameters. This was done in order to explore the roles of taxi-like modes and motorcycles which are often more important in Asian cities than in Western cities (Table 4.6).

The additional items compiled as part of the study for the World Bank are also listed. The actual set of data for the Asian cities is assembled in Appendix 1. A selection of important standardised data items for the whole international sample of cities is set out in Appendix 2. The sources of the data are listed in Appendix 3.

Table 4.4 The primary data items collected for the CAAD project

POPULATION AND AREA	AVERAGE TRIP LENGTHS (km)	PUBLIC TRANSPORT INDICATORS continued
Total population	Journey-to-work	
Urbanised area (ha)	- on private modes of transport	AVERAGE TRIP LENGTH (km)
Population of the CBD	- on public modes of transport	- Buses
Area of the CBD (ha)	All trip purposes	- Trains
Population of the inner city		- Trams
Area of the inner city		- Ferries
EMPLOYMENT	PUBLIC TRANSPORT INDICATORS	PASSENGER KILOMETRES
Number of jobs in the CBD	VEHICLE KILOMETRES	- Buses
Number of jobs in the inner city	- Buses	- Trains
Number of jobs in the outer area	- Trains	- Trams
Total jobs in metropolitan region	- Trams	- Ferries
	- Ferries	Grand Total
PARKING SUPPLY IN THE CBD	Grand Total	
Car, motorcycle, on-street and off-street parking	PASSENGER BOARDINGS	AVERAGE SPEED (km/h)
Total (weighted if appropriate)	- Buses	- Buses
ROAD NETWORK (km)	- Trains	categories
Categories	- Trams	Overall bus speed
Total roads	- Ferries	- Trains
MOTOR VEHICLES ON REGISTER	Grand Total	categories
Categories	AVERAGE TRIP LENGTH (km)	Overall train speed
Total vehicles on register	- Buses	- Trams
PRIVATE TRANSPORT INDICATORS	- Trains	- Ferries
Total annual Vehicle Kilometres Travelled (VKT)	- Trams	All modes average
Annual VKT in motorcycles	- Ferries	ENERGY CONSUMPTION
Annual VKT in cars	PASSENGER KILOMETRES	- Buses
Annual VKT in taxis	- Buses	For each category:
Annual VKT in cars + motorcycles + taxis	- Trains	Diesel (litres)
Average vehicle occupancy	- Trams	Petrol (litres)
Car and motorcycle occupant km	- Ferries	Total (Joules)
Average road network speed (km/h)	Grand Total	- Trains
TRANSPORT ENERGY USE	VEHICLE KILOMETRES	For each category:
Private passenger [Petrol] (Joules)	- Buses	Electricity (Joules)
Private passenger [Diesel] (Joules)	- Trains	Diesel (litres)
Non-passenger [Petrol] (Joules)	- Trams	- Trams
Non-passenger [Diesel] (Joules)	- Ferries	Electricity (Joules)
Total fuel consumption (Joules)	Grand Total	- Ferries
MODE SPLIT: JOURNEY-TO-WORK (%)	PASSENGER BOARDINGS	Diesel (litres)
Public transport	- Buses	Total (Joules)
Private transport	- Trains	Grand Total (Joules)
Walking and cycling	- Trams	
	- Ferries	
	Grand Total	

Table 4.5 The standardised data items in the CAAD project

POPULATION PARAMETERS	TRAFFIC RESTRAINT PARAMETERS
Urban density (persons/ha)	Parking spaces / 1000 CBD workers
Inner area density (persons/ha)	Length of road per person (m)
Outer area density (persons/ha)	Total vehicles per km of road
CBD density (persons/ha)	Total vehicle kilometres per km of road
Proportion of population in CBD	Car kilometres per km of road
Proportion of population in inner area	PER CAPITA TRANSPORT ENERGY PARAMETERS (MJ)
EMPLOYMENT PARAMETERS	Private passenger transport energy
Job density (jobs/ha)	Total private energy use/person
Inner area job density (jobs/ha)	Public transport energy use/person
Outer area job density (jobs/ha)	Total energy use/person
CBD job density (jobs/ha)	PUBLIC TRANSPORT PARAMETERS
Proportion of jobs in CBD	Vehicle kilometres per person
Proportion of jobs in inner area	Passenger boardings per person
ACTIVITY INTENSITY PARAMETERS	Passenger boardings per vehicle km
(Population and Jobs/ha)	Passenger kilometres per person
CBD activity density	Average public transport speed (km/h)
Inner area activity density	Vehicular energy efficiency (MJ/km)
Outer area activity density	Modal energy efficiency (MJ/pass km)
City-wide activity density	
VEHICLE OWNERSHIP PARAMETERS	In each case, public transport data are supplied
Total vehicles/1000 people	for the following categories (where appropriate):
Passenger cars/1000 people	Buses
PRIVATE MOBILITY PARAMETERS	Rail
Total per capita vehicle kilometres	Trams
Per capita car kilometres	Ferries
Total per capita occupant kilometres	<i>Total</i>
Per capita car occupant kilometres	
Total vehicle kilometres per vehicle	
Car kilometres per car	

Table 4.6 Items providing a breakdown of private mobility parameters between cars, taxi-modes and motorcycles

PASSENGER CAR PARAMETERS (excluding motorcycles and taxis)	MOTORCYCLE PARAMETERS
Per capita car kilometres	Motorcycles/1000 people
Average car occupancy	Per capita motorcycle kilometres
Per capita car occupant kilometres	Average motorcycle occupancy
Car kilometres per car	Per capita m-cycle occupant kilometres
Car kilometres per km of road	Motorcycle kilometres per motorcycle
	Motorcycle kilometres per km of road
PASSENGER CAR PARAMETERS (including taxis, excluding motorcycles)	TAXI-LIKE MODE PARAMETERS
Per capita car kilometres	Taxis/1000 people
Average car occupancy	Per capita taxi kilometres
Per capita car occupant kilometres	Per capita taxi occupant kilometres
Car kilometres per car	Taxi kilometres per taxi
Car kilometres per km of road	

In 1995, staff at the World Bank requested ISTP to conduct a further extension of the study in the form of the collection of 10 specific items of data. Some of these were already included in the wider CAAD study, or were derivable from data already

included in that study, but some, related mainly to economic and environmental dimensions, required the collection of additional primary data items.

The items of data required for the study for the World Bank and the extra primary data items necessary to calculate them were:

1) Mode split for the journey-to-work:

part of original study, no extra raw data.

2) Energy efficiency by mode of transport:

part of original study, no extra raw data.

3) Journey-to-work trip length:

part of original study, no extra raw data.

4) Journey-to-work trip time:

this was a new primary item in itself and needed to be directly sought from local sources in each city.

5) Transport deaths (per capita and as a percentage of total deaths):

primary data from local sources on traffic deaths and total deaths.

6) Transport air pollutant emissions (per capita):

air pollutant emissions inventories (nitrogen oxides, sulfur dioxide, carbon monoxide, volatile hydrocarbons, suspended particles). For CO₂, fuel use was the basis of the calculation. Information was also needed on the fuels used to generate electricity in the specific city, as well as standard emissions rates of CO₂ for each fuel.

7) Road expenditure (per capita):

primary data from local sources on road expenditure over 3 years.

8) Percentage of income spent on the journey-to-work:

many extra primary data items including: Gross Regional Product per capita, typical car (and motorcycle) capital costs per km, typical car (and motorcycle) variable costs per km, average car (and motorcycle) work trip length, car occupancy for journey-to-work, average public transport fare per passenger km, travel time cost per hour, capital cost of a typical bicycle, percentage of commuters using bicycles, number of working days per year.

9) Public transport operating cost recovery:

financial data on revenues and costs of operations from public transport company reports or from consultants' studies of public transport.

10) Condition of the road infrastructure:

data from various road authorities or from consultants' reports (this variable was ultimately dropped from consideration because of unusable data or no data in nearly every city).

4.6 Boundary Definitions and Related Issues

A major dilemma for the collector of data on urban areas is the choice of appropriate geographical areas. For this study, all data items were required for each full metropolitan area, and a smaller number of items were required for the central business district (CBD), the inner area and the outer area. Each of these areas had a standardised definition to guide the choice of appropriate boundaries in each city. Nevertheless, there is often more than one possible choice for such boundaries. It was not always possible

to use the geographical areas that would have been most ideal, and administrative and data realities in each city sometimes required that compromises be made. The actual boundaries that were used in the Asian cities are discussed below. Standardised maps of the boundaries that were used in each Asian city are provided in Appendix 4.

4.6.1 Asian metropolitan area definitions

The metropolitan area was defined to be as close as possible to the full functional metropolitan area of the city or full urban agglomeration. Many national statistical departments have a definition of metropolitan areas that is compatible with the needs of this study. However, collecting data on the ideal full metropolitan area is not always possible, and in a number of cities, the metropolitan area that had to be used was somewhat smaller or larger than the actual full metropolitan area³¹. It is thought that this causes relatively small effects on most of the variables considered in this study. Where there is any doubt about this, an assessment is made below of the extent of the problem.

Below, the metropolitan definitions that have actually been used for the Asian cities for 1990 are listed and discussed. These definitions follow the definitions listed in joint publications by this study team, such as Kenworthy and Laube et al. (1999, forthcoming). These were compiled by Felix Laube, based on previous work by Newman and Kenworthy (1989), and in close consultation with the main data collectors for each city, including this author (as listed in Table 4.2). In some cases, data for earlier years (1960, 1970 or 1980) apply to more restricted metropolitan areas, as appropriate, but most comments below apply to the 1990 data set.

In most of the Asian cities in the sample, the metropolitan area for which data have been gathered in this study matched quite well, or slightly exceeded, the full extent of the functional metropolitan area. The exceptions are Jakarta, Manila, and Surabaya and only in Jakarta was the metropolitan area for this study substantially smaller than that which should ideally have been used. However, the problems created by this were felt

³¹ A further question over metropolitan boundaries arises as a result of the “Desakota” hypothesis (or the idea of Extended Metropolitan Regions). McGee (1991) and Ginsburg (1990) have argued that a distinctive pattern of urban expansion is occurring around many Asian cities, including several that are included in this study (notably Bangkok, Jakarta, and Manila). In addition to urban cores, peri-urban (suburban) regions, and truly rural areas, McGee identifies regions that he labels desakota regions. These are “regions of an intense mixture of agricultural and non-agricultural activities that often stretch along corridors between large city cores (McGee, 1991: 7). Such research challenges traditional notions about the boundaries between a metropolitan area and its rural hinterland (always a somewhat problematic issue statistically speaking, but particularly difficult in these Asian “mega-urban regions”). For the purpose of this international comparison of urban data, it has been impossible to take account of such mega-urban regions, since little reliable information is available for these areas. There may be transport implications of this phenomenon, since it has been argued that the availability of cheap motorcycles, light trucks and footloose jitney and bus services has contributed to the development of these “desakota” regions (McGee, 1991: 17).

to be much less serious than the impossibility of collecting most items of data for a more generously defined metropolitan definition.

It should be pointed out that the metropolitan definitions used for Kuala Lumpur, Seoul, Tokyo and Bangkok in this study represent an important improvement over figures that are commonly presented for these cities in international comparisons and in case studies presented at conferences or in the literature. Data on Kuala Lumpur in such publications most frequently refer to only the Federal Territory of Kuala Lumpur at the core of the Klang Valley metropolitan region, which included in 1990 only just over a third of the Klang Valley population. Similarly, most data on Seoul in international publications is for the City of Seoul only, representing about 65 percent of the metropolitan population. Tokyo data in such publications is often for the Tokyo Prefecture (Tokyo-to) alone, which represented only about 37 percent of the full metropolitan region in 1990. International information on Bangkok often refers to the Bangkok Metropolitan Administration area, which by 1990 excluded important parts of the metropolitan area, especially to the north, but included substantial rural areas to the east and west. For the other Asian cities, Manila, Surabaya, Jakarta, Singapore, and Hong Kong, the metropolitan definitions used in this study are the same as those that are generally seen in international publications.

4.6.1.1 Surabaya

The *Kotamadya* Surabaya covers a good part of the Surabaya functional region and was thus used as a metropolitan area definition.

Surabaya's actual metropolitan area in 1990 extended only slightly beyond Kotamadya Surabaya and only along one corridor (to the south). Any error or distortion introduced by this under-representation is small. The same metropolitan definition was also used for all earlier data (1970 and 1980).

4.6.1.2 Jakarta

The Indonesian National Capital District of Jakarta (*Daerah Khusus Ibukota Jakarta*) serves as a fair representation of the Jakarta metropolitan area. It is a little constrained as the city has somewhat outgrown this area. The definition is however acceptable as it enables data collection of reasonable quality.

Initially, it had been hoped to use a larger definition of the Jakarta metropolitan area. The use of DKI Jakarta was very appropriate as the metropolitan definition for 1970 and even 1980 but by 1990 the Jakarta region (known by the acronym Jabotabek) had a

substantial amount of urbanised land beyond the boundary of DKI Jakarta. The Jabotabek Metropolitan Development Plan Review explains:

In 1980 the urban area was concentrated within boundaries of DKI Jakarta with a major sub-centre around the city of Bogor and minor centres in Bekasi, Tangerang, Depok/Cimanggis, and Cibinong/Citeureup. By 1990 Depok, Bekasi and Tangerang had become incorporated in a continuous urban belt, including not only DKI Jakarta but also substantial areas on the immediate urban fringe. Bogor is linked to Jakarta by continuous urban development along the Old Bogor Road and Jagorawi Toll Road (Culpin Planning, PT Lenggogeni, Huzar Bramah and Associate, and Lembaga Penelitian Perencanaan Wilayah dan Kota (LPP) ITB, 1993: 5).

In 1990 it was estimated that of 13.1 million urban residents of Jabotabek, 4.9 million were beyond the boundary of DKI Jakarta. This compares with the 1980 situation when only 1.3 million of Jabotabek's 7.4 million urban dwellers were outside DKI Jakarta (Firman and Dharmapatni, 1994). Moriconi-Ebrard (1993) suggests a slightly lower figure of 12.5 million for metropolitan Jakarta. It has been estimated that in 1990 there were about 1.85 million trips between Jakarta and its surrounding areas compared with 7.85 million trips within DKI Jakarta (Dreesbach and Wessels, 1992). Despite such evidence, the use of the restricted definition in this study was unavoidable, since very few of the required data items were available for either the whole of Jabotabek or for any metropolitan definition lying somewhere between DKI Jakarta and Jabotabek.

Nevertheless, the use of the restricted, DKI Jakarta, definition does not invalidate the findings of the study on Jakarta. Checks using the few items of data that could be found for a wider definition suggest that the use of DKI Jakarta is not seriously misleading. This is because the contrasts in transport and urban development patterns between DKI Jakarta and the main contiguous urban areas just beyond its boundary appear to be relatively small. Incomes outside the DKI Jakarta boundary are, on average, slightly lower than inside DKI Jakarta and the use of public transport for the trips across the boundary is a slightly higher percentage than for trips within DKI Jakarta.

4.6.1.3 *Manila*

For Manila, the co-operative body of Metro Manila has reasonably good data for what covers most of the conurbation. Metro Manila includes the four cities of Caloocan, Manila, Pasay and Quezon, as well as the municipalities of Las Piñas, Makati, Malabon, Mandulayong, Marikina, Muntinlupa, Navotas, Parañaque, Pasig, Pateros, San Juan, Taguig and Valenzuela.

The definition of Manila used here is the only feasible one for which a reasonably reliable set of data could conceivably have been collected. There has been some spill-over of urban land use beyond Metro Manila but the evidence is mixed over how

significant this is. In previous years Metro Manila was a good representation of the metropolitan area but Moriconi-Ebrard's (1993) estimate of Manila's full metropolitan area population suggests that there is substantial urban population beyond the borders of Metro Manila (by about the same proportion as in Jakarta). However, the impression gained by this author from maps and a visit to the south-western boundary areas and from Benedicto Guia, Jnr (a Manila resident and the principal gatherer of data in the city for this project), is that urban spill-over into adjacent provinces was not yet very significant in 1990. A map from the recent Metro Manila Urban Transportation Integration Study (MMUTIS) that depicts the extent of the urbanised area by 1996 confirms this (JICA, 1997). By 1996 the MMUTIS study, which included some of the neighbouring areas in its study area, found that these outer areas accounted for 7.1 million motorised trips per day out of a total of 24.6 million motorised trips. However, it was estimated that the daytime population of Metro Manila was 9.196 million compared with the night-time population of 8.832 million; a relatively small difference (Esguerra, 1997). Furthermore, the contrast of transport characteristics across the boundary does not seem to be great. For example, in 1996 car ownership in the neighbouring areas beyond Metro Manila was only very slightly higher than within Metro Manila (20.0 percent of households outside owning a car compared to 17.7 percent inside) (Esguerra, 1997). So, on balance, using Metro Manila as the definition of the metropolitan area is only a slight underestimation of the true functional area in 1990.

4.6.1.4 *Bangkok*

Bangkok features two definitions, the most commonly used one being the JICA study area (JICA, 1990) whose boundary is defined according to the alignment of a planned outer ring road around the Thai capital which encompasses most of the region and thus gives a very valid definition, covering most of Bangkok's urbanised area. As this definition doesn't follow administrative boundaries, it was necessary to use data for the somewhat larger Greater Bangkok area, containing the provinces of Bangkok Metropolitan Area, Nonthaburi, Pathum Thani and Samut Prakan for some data items.

4.6.1.5 *Kuala Lumpur*

The Kuala Lumpur metropolitan area is most commonly defined as the Klang Valley, which includes the Federal Territory of Kuala Lumpur as well as four districts (Klang, Petaling, Ulu Langat and Gombak) in the State of Selangor which surrounds it. This is a very appropriate definition and was used for all but few data, where they were only available for the entire State of Selangor and the Federal Territory of Kuala Lumpur.

In Kuala Lumpur, the metropolitan definitions that were most commonly used in 1990 had the opposite problem from Jakarta's or Surabaya's. They were, if anything, overgenerous and included substantial rural areas. However, this does not introduce any significant distortion into most standardised variables because most of the rural areas included have rather sparsely settled land under tree crops or forest. Thus less than 6 percent of the Klang Valley's population was classified as rural in the 1991 census, while only 16.5 percent of the population of Kuala Lumpur and Selangor taken together was classified as rural (Department of Statistics Malaysia, 1992). In 1990, all standardised data items refer to the Klang Valley except for the vehicle ownership and private transport energy parameters, which refer to Kuala Lumpur plus the whole of Selangor.

Earlier dates caused greater problems in defining the metropolitan area of Kuala Lumpur. For many variables in the 1980 and 1970 data, it was often not possible to use the Klang Valley as the metropolitan definition. At those times, the Klang Valley was an overly generous definition of the metropolitan area and not many sources yet used it. Consultants' reports that were the sources of a number of items for those years provided their own definitions of the extent of the "Kuala Lumpur Conurbation" at each date. This is an example of a case where time series of standardised data items in this study do not always refer to the same area. Nevertheless, comparisons of variables over time do still have value, since they characterise the state of the best approximation of the full metropolitan area at each time. It must be remembered that all standardised data items are always carefully standardised according to the appropriate metropolitan definition.

4.6.1.6 Seoul

Seoul presented some problems in that a lot of data were only available for the National Capital Region which includes the independent cities of Seoul and Inch'on (*Seoul-t'ukpyolsi* and *Inch'on-jikhalsi*) and Kyonggi-do, the surrounding Province. Wherever possible, data were collected only for Seoul and its satellite cities, a discontinuous, however genuinely urban area. This definition includes the independent cities of Seoul and Inch'on, as well as the municipalities of Ansan, Anyang, Hanam, Koyang, Kung'o, Kuri, Kwachon, Kwangmyong, Migum, Osan, Puch'on, P'yongt'aek, Shihung, Songt'an, Songnam, Suwon, Tongduch'on, Uijongbu and Uiwang.

In Seoul, data items were usually most easily obtained for the City of Seoul only but this definition could not be used as the metropolitan area for 1990 since it excluded substantial parts of the functional metropolitan area, even in 1980. The City of Seoul was accepted only for a few items of data for earlier years and for the air pollution

emissions inventory for 1990. The best definition of the 1990 metropolitan area, called Seoul Metropolitan Area (SMA), consists of the City of Seoul plus its recognised satellite cities, including Inch'on. Unfortunately this definition was able to yield good data for relatively few items in 1990 and almost none for earlier years. However, most items could be obtained for the definition that included Seoul plus the City of Inch'on and the whole province of Kyonggi-do. This was because these boundaries are at the provincial level for which many data items are compiled and published. In 1990 this area had a population of 18.6 million compared with 16.7 million in the SMA and 10.9 million in the City of Seoul. The use of this definition for most of the 1990 data items was therefore reasonable, since the percentage of rural dwellers included is apparently less than 10 percent.

4.6.1.7 *Singapore*

In Singapore, national boundaries provide a good definition, although there is some external urban interaction, mainly with Johor Bahru in adjacent Malaysia. The Republic of Singapore has been used for all data. Good information is available through national agencies.

4.6.1.8 *Hong Kong*

Hong Kong is very well represented by the area included in the British Crown Territory of Hong Kong (as it was in 1990), and good, well-published data are available throughout. This definition covers Kowloon, Hong Kong Island and The New Territories.

4.6.1.9 *Tokyo*

Tokyo is generally defined as Tokyo-to or Tokyo Metropolis. However, the functional region extends well beyond this narrow definition which only contains about one third of the area's 32 million inhabitants. The Tokyo Metropolitan Region that was used in most cases in this study also includes the prefectures of Chiba-ken, Kanagawa-ken and Saitama-ken.

Most of the standardised data for Tokyo in this study refer to the metropolitan region also known as the Tokyo Metropolitan Transportation Area (TMTA). This represents the entire commuter catchment for the central area of Tokyo. Unfortunately, in a small number of cases data for the TMTA could not be obtained and Tokyo-to data had to be accepted. The main examples were vehicle ownership figures and metropolitan job density figures. Vehicle ownership beyond the Tokyo-to boundary is generally expected to be substantially higher.

4.6.2 Inner and outer area definitions

The inner area was defined in the international study to be the area of the city, including the central business district, that was developed by the time of the Second World War. The outer area is then simply the rest of the metropolitan area beyond the inner area.

In the cases of American or Australian cities, this definition captures reasonably well the boundary of the areas that were developed in the era when cars were few and when tramways and suburban railways were the dominant influences on the patterns of accessibility and hence on development patterns. The main motivation for defining inner and outer areas in this way was the desire to study the contrast between pre-car inner areas and the outer areas developed in the automobile era.

However, in other cities the inner area boundary may not always match so well with the boundary of pre-car development. This is because the rise of mass car ownership occurred at different times in different regions. In many American cities it happened before the Second World War. In Australia, it was in the 1950s that mass car ownership became a reality. In many European cities it did not occur until the 1960s. In most Asian cities, the influx of large numbers of cars and motorcycles is very recent. In some, such as Hong Kong or Seoul there has been little or no car-oriented development, even now³². Therefore, much of what is labelled as the “outer” area in this study’s data on the Asian cities has been built in an era of low private vehicle ownership, just like the inner area. There may be some car-oriented development in some of the Asian cities but the outer area data here does not necessarily reveal it. Despite the above comments, post-1945 development in the Asian cities may contrast with older development for other reasons. For example, the post-war period often coincided with the rise of affordable bus-based transport in Asia (as will be discussed in the next chapter).

For most cities there are certain problems with finding an inner area delineation that matches the ideal definition closely and can also provide the data required. The task of identifying suitable boundaries was made easier because the number of items that are required for the inner area is small (only population, jobs, and urbanised area). The inner area definitions for the Asian cities in the sample are shown in Table 4.7.

³² For example, consider the date that each city passed a certain level of car (plus motorcycle) ownership, say 150 vehicles per 1000 people, at which point it might be expected that development would be beginning to be significantly shaped by private transport modes. Data presented later in this thesis show that Tokyo passed this threshold level in about 1976, Kuala Lumpur in 1980, Bangkok in 1982, Surabaya in 1985, Jakarta in 1987, Singapore in 1993, and Seoul in approximately 1994. Finally, Hong Kong and Manila have not yet reached the threshold level. Los Angeles, the first major automobile oriented city, reached 150 cars per 1000 persons sometime in the 1920s - it had about 110 per 1000 persons in 1919 according to Brindle (1995). Most Australian cities reached this level during the 1950s (Moriarty, 1996). London and many other European cities reached 150 cars per 1000 during the 1960s (based on data from this international study).

Table 4.7 Inner area definitions for Asian cities in an international sample of cities, 1990

City	Administrative unit	Names
Bangkok	District	Chatuchak, Bang Kho Laem, Bang Phlad, Bang Rak, Bang Sue, Bangkok Noi, Bangkok Yai, Dusit, Huasi Khwang, Khlong San, Khlong Toei, Pathum Wan, Phaya Thai, Pom Prap Sutton Phai, Pra Nakhon, Ratchatavee, Samphanthawong, Sathon, Thon Buri, Yan Nawa
Hong Kong	Tertiary Planning Unit	1.1.1-1.1.6, 1.2.1-1.2.4, 1.3.1-1.3.3, 1.4.4, 1.4.6, 1.5.1, 1.5.7, 1.6.1, 2.1.1, 2.1.2, 2.1.4, 2.2.1-2.2.5, 2.4.1-2.4.3, 2.5.5, 2.6.1, 2.6.4-2.6.7, 2.7.1, 2.8.4, 2.8.5 corresponding approximately to the districts of Central & Western Hong Kong, Wan Chai, Eastern Hong Kong, Yau Ma Tei, Mong Kok, Kowloon City, Sham Shui Po and Wong Tai Sin
Jakarta	Kecamatan	Cempaka Putih, Gambir, Grogol Petamburan, Jatinegara, Johar Baru, Kebayoran Baru, Kemayoran, Mampang Prapatan, Matraman, Menteng, Palmerah, Pancoran, Sawah Besar, Seene, Setia Budi, Taman Sari, Tambora, Tanah Abang, Tebet
Kuala Lumpur	Local Government	Wilayah Pesekutuan Kuala Lumpur (Federal Territory of Kuala Lumpur)
Manila		Area inside Epifanio de los Santos Avenue
Seoul	Gu	Chongno, Chung, Map'o, Sodaemun, Songbuk, Songdong, Tongdaemun, Yongdunp'o, Yongsan
Singapore	1980 Census Division	Alexandra, Brickworks, Bukit Ho Swee, Bukit Merah, Buona Vista, Cairnhill, Delta, Farrer Park, Geylang East, Geylang Serai, Geylang West, Havelock, Henderson, Jalan Besar, Kallang, Kampong Glam, Katong, Kim Seng, Kolam Ayer, Kreta Ayer, Leng Kee, Macpherson, Moulmein, Mountbatten, Queenstown, Radin Mas, River Valley, Rochore, Tanjong Pagar, Tiong Bahru, Whampoa
Surabaya	Kecamatan	Krembangan, Papean Cantikan, Simokerto, Bubutan, Genteng, Tegalsari, Wonokromo, Sawahan
Tokyo	Ku (23 ward area)	Adachi, Arakawa, Bunkyo, Chiyoda, Chuoh, Edogawa, Itabashi, Katsushika, Kita, Koto, Meguro, Minato, Nakano, Nerima, Ota, Setagaya, Shibuya, Shinagawa, Shinjuku, Sugiyama, Sumida, Taitoh, Toshima

In three of the four cases for which this author had primary responsibility (Seoul, Jakarta, and Surabaya), it was possible to delineate the inner area in terms of appropriately sized administrative units that could be compared with a variety of historical maps that showed the progress of the expansion of the urban area at particular points in time. Wherever a compromise had to be made about the inner area definition, it was decided to err on the side of choosing a more generous definition rather than a smaller one. This is because of the argument above that the “pre-car” area in Asian cities extends well into the post-war era. As it turned out, each of these three cities’ inner areas correspond reasonably well to the areas that were developed by a date within about ten years after 1945.

Kuala Lumpur’s inner area turned out to be more problematic. The area used in this study was unavoidably very generous. It was not difficult to identify from historical maps the extent of the urban area for dates close to the time of the Second World War. The problem was that no reliable data at all could be obtained for boundaries that bore

any resemblance to this area. The authorities in neither the City Hall nor the Department of Statistics could provide disaggregated data on population, employment or land uses for the areas concerned. Therefore, the whole of the Federal Territory of Kuala Lumpur had to be used, despite the fact that this area is considerably larger than the 1945 urbanised area. This means that the data presented in this dissertation on Kuala Lumpur's inner area job density and population density are lower than they should be and the percentage of jobs and population in the inner area are exaggerated. In fact, the area that was used for Kuala Lumpur's 1990 central business district definition actually came slightly closer to approximating the 1945 extent of development, but this would then have been an underestimate and would have tended to exaggerate job densities and perhaps also population densities. In the final analysis, the problem with defining Kuala Lumpur's inner area is a minor one which has not seriously affected the research or the conclusions drawn.

4.6.3 CBD definitions

The Central Business District (CBD) is defined as the single most significant concentration of employment in the city. Its identity is usually clear cut, although occasionally there may be rival centres that threaten to claim the title of CBD (Manila is an example of this). Defining the precise boundaries of the CBD is often less clear cut.

The CBD usually coincides with, or is close to, the older (pre-1900) parts of the city. It may not necessarily be the geographic centre of the urban area but employment and services tend to concentrate over time at the places where transport routes (road, rail, water) converge in or close to the old part of a city. Through most of this century, in Western cities at least, the most pressing transport problems have been those of getting large numbers of workers to and from the central business district within a short period of time at the beginning and end of the working day. In large cities, such as New York, London, Paris and Tokyo, this can amount to well in excess of a million people, every working day. Thus, peak hour congestion of radial roads and high peak hour demands on radial public transport during peak hours have been major preoccupations. This means that the nature of the CBD is a natural focus of attention for this and other transport studies (as for example Thomson's study discussed in Chapter 2).

Ideally for a comparative study, it would be best to use a strict criterion for the boundary of the CBD such as, those census tracts (or other small divisions) within which there was greater than a certain jobs-to-residents ratio. However, for many reasons this is rarely, if ever, possible. Instead, local definitions of what constitutes the

CBD have been used wherever possible and these generally reflect boundaries where “central city” type mixed land uses end and a more uniformly residential character takes over. The data collected for the CBD were the population, number of jobs, the urbanised area and car parking numbers. From the previous experience of the earlier CAAD study, the use of the locally-defined CBD delineation was the only way to ensure that most of these items of information could be collected for the same area and dates. In this regard, the availability of parking inventory data often determined the boundaries for practical reasons, though this was usually a reasonable definition.

The styles of the central business districts in most of the Asian cities, particularly the Southeast Asian ones, tended to cause some unique difficulties in delineating an appropriate CBD definition for the purposes of this study. In particular, the characteristic ribbons of office and commercial development in cities such as Jakarta, Bangkok and Surabaya, presented certain difficulties or dilemmas. Since the CBD is usually small, the choice between different definitions for the district could potentially have a significant impact on the values of some standardised data items. For example, an overly generous definition could result in a much lower CBD job density when compared with a very tight definition. The interpretation of the data on Asian CBDs in Chapter 6 will take account of qualitative information about the shapes and characteristics of these cities’ central areas to ensure that no erroneous conclusions are reached.

Now some brief comments are provided on the specific CBD definitions used in some of the Asian cities (as shown in Table 4.8). In Seoul and Kuala Lumpur in 1990, all of the required data were available for consistent areas that conformed reasonably well to any objective definition of the CBD. Kuala Lumpur’s 1980 CBD definition was unavoidably more restrictive than the 1990 definition. This reflects different sources of data, especially the parking data, but also reflects the fact that the city’s central business district has in fact expanded greatly since 1980.

In Surabaya and Jakarta it was more difficult to choose a suitable CBD definition. In neither case was sufficiently reliable parking data available for an area for which the other data items could also be specified. The small administrative units (*kecamatan*) that were included in these cities’ CBDs were chosen on the basis of their high concentrations of employment according to transport studies conducted soon after 1990 (and also containing significant commercial and administrative land-uses according to land use maps). However, substantial areas that are predominantly residential (or

intensely mixed use) were unavoidably included, since such areas tend to be interspersed with strips of commercial development in Indonesian cities.

Manila is interesting in that Makati (a sub-centre first developed in the 1950s about 6 kilometres to the south-east of the old CBD) is considered by some to now be the main CBD rather than the older central area. However, even in 1996, the old CBD does remain the largest concentration of jobs in the metropolis, despite its lower-rise profile (JICA, 1997). So the old CBD was retained as the CBD definition, even though Makati, with its high-rise profile, has the appearance of a western-style CBD and may have a higher job density within its boundaries than the old CBD.

Hong Kong's CBD uses a highly restrictive definition. In fact, the whole of the inner area in Hong Kong has such a high density of jobs that some would call the whole area one huge CBD. However, the local definition has been followed, which clearly defines the CBD as only the most intense office concentration on Hong Kong Island.

Table 4.8 Central business district definitions for Asian cities in an international sample of cities, 1990

City	Administrative unit	Names
Bangkok	District	Bang Rak, Pathum Wan, Pom Prap Sutton Phai, Pra Nakhon, Samphanthawong
Hong Kong	Tertiary Planning Unit	1.2.1-1.2.4, bounded by Victoria Harbour in the north, and on the south by a line starting at the Macau Ferry Terminal and following Connaught Rd Central, Jubilee St, Queen's Rd Central, Graham St, Staunton St, Aberdeen St, Gaine Rd, Upper Albert Rd, Garden Rd and Murray St.
Jakarta	Kecamatan	Gambir, Menteng, Sawah Besar, Seene, Setia Budi, Taman Sari, Tambora
Kuala Lumpur	Local government planning unit	Kawasan Perancangan Pusat/Central Planning Area, bounded by the "Middle Ring Road I", made up in the east and north by Jalan Tun Razak, in the west by Jalan Mahameru and Jalan Damansara, in the south by Jalan Istana (and the alignment of its (then) incomplete extension to the Kuala Lumpur-Seremban Highway), and in the south-east by Jalan Sungai Besi and Jalan Loke Yew.
Manila	City	Manila
Seoul	Gu	Chongno, Chung
Singapore	Planning area	Central Area, bounded by Lavender St, Serangoon Rd, Singapore River, Outram Rd, Cantonment Rd and including the Orchard Rd corridor
Surabaya	1991 Study Traffic Zone	23, 24, 27, 28, bounded in the south by Jalan Pandegiling, in the west by Jalan Raya Arjuno, Jalan Semarang and by the railway line, in the north by Jalan Jakarta, Jalan Sarwajala and the railway line, and in the east by the railway line (north of Gubeng Station) and by the river (south of Gubeng Station)
Tokyo	Ku	Chiyoda, Chuo, Minato

4.7 Reference Years for Data

The years for which all data were intended to be collected were 1960, 1970, 1980 and 1990³³. Occasionally data were not available or were very difficult to obtain or verify for the chosen reference years. In some such cases, an attempt could sometimes be made to estimate the level for the reference year (where sufficient time series data were available and where a regular trend was observable). However, for certain items of data it was necessary to accept data for a year other than the reference year. This was often the case with complex items obtained from infrequent modelling exercises, such as vehicle kilometres travelled (VKT). Such figures were generally accepted only if they were within one or two years of the reference year. However, when absolutely necessary, and only for certain items of data that tend to change relatively slowly, it was occasionally acceptable to use data from a year up to 5 years before or after the reference year.

Of course, in all cases the items used to calculate standardised data items must all refer to the same year. For example, if the VKT figure in a certain city is for 1991 rather than 1990 then the road length figure that is used to calculate vehicle kilometres per kilometre of road must also be for 1991. This may occasionally mean that in the data sheets in Appendix 1, a standardised item may be the result of using numbers slightly different from the reference year figures that appear in the primary data sheet. When this has occurred it is very clear in the spreadsheet cells used to develop the data, because the standardised item cell will contain a modified formula. However, this may cause some confusion if only the hard copy of the data is available to the reader.

4.8 Data Issues and Solutions in the Asian City Sample

The discussion now turns to the details of how the data in this study were systematically defined, collected, confirmed and corrected. It is not possible to discuss every single item of data and every problem that needed to be solved. However, enough detail is presented to illustrate the extent to which the data in this study are not just a compilation of easily available information. The main sources of the data for the Asian cities are listed in Appendix 3.

Although substantial difficulties have been encountered with many items of data, the procedures that have been used nevertheless ensure that the results are as accurate as

³³ In a number of cities in the CAAD data set, the reference years for data were 1961, 1971, 1981 and 1991. This was often the case where the national census cycle followed this schedule. Among the Asian cities, only the Hong Kong data are for 1961, 1971, 1981 and 1991.

possible. The purpose of this section is to demonstrate that the data are generally valid and as free from error and inaccuracy as can realistically be expected for such a study.

This section also highlights the special problems that were faced in collecting data and how such problems were solved in the middle-income cities for which this author was responsible. Many items of data that tend to be more readily available in high-income cities have often required a substantial effort to bring together in the middle-income Asian cities. In fact, in many cases items that at first sight appeared to be readily available and published regularly, required significant adaptation to be certain that they fitted the standard definitions of this study and that they were truly comparable. Many items had to be reconstructed from, or estimated on the basis of, other disaggregated or related data. While occasionally such methods were also required for certain data items in high-income cities in the sample, such estimation methods were much more commonly needed in the lower-income cities of the Asian sample.

Despite the extra difficulty and time required in these cities, in the end, surprisingly few items of 1990 data have been impossible to get. However, it was often impossible to collect many data items for the earlier years, 1960, 1970 and 1980. The earlier the year, the less likely data were to be available. This is partly because of the generally less well-developed systems of data keeping in these cities in earlier years, the relatively “less studied” nature of the problems, and also because of the (understandable) lack of interest of most current officials with reports and data from many years ago.

Data on the lower-income Asian cities were less likely to be directly available from officials than was the case in high-income cities. However, it should be pointed out that the study team always requested background documentation on all items in order to verify them and to allow valid adjustments if they did not conform to the standard definitions. When approached, local officials in middle-income cities mostly referred the data collectors to various consultants’ reports. This allowed better quality control than would have been possible if numbers had been supplied as final figures without the necessary context or full explanation by the relevant official. Most of the reports were transport studies carried out by large consulting firms and most used variations on the relatively standardised, city-wide “Urban Transport Planning (UTP)” process as developed since the 1950s (Dimitriou, 1992). Despite various criticisms of this approach to urban transport planning and even of some of the data that such studies generate, they are a rich source of reliable data on transport in the cities where they have been conducted. This remains true even though in the last two decades the emphasis on large scale modelling exercises has reduced to some extent (Dimitriou,

1992). The major criticisms of conventional UTP-based studies are not so much directed at the baseline set of data that they generate, but on the future projections and policy responses they tend to offer. In addition to UTP studies, air pollution studies, sought by this team for their emissions inventories, often also yielded important transport data.

4.8.1 Population

The population of the metropolitan area is a parameter that is used in the denominator of numerous items of standardised data. It is therefore important that this item be accurate. In almost all cases, census figures have been used for metropolitan population figures. Where populations were required for years other than census years, official estimates of the inter-census populations have been used where possible.

The main exceptions to the use of census data were the few cases where metropolitan area definitions were based on areas used in consultants' studies that did not match major administrative boundaries (such as many items of data for Bangkok in 1990 and Kuala Lumpur in 1980). In those cases, the consultants' population estimates had to be used. Occasionally the definitions of inner areas and CBDs also precluded the use of census population figures. Examples included Kuala Lumpur's CBD, which relied on City Hall information sources, and Surabaya's CBD definition, which relied on data on traffic zones in a consultants' study.

4.8.2 Urbanised area and urban density

Urban density is an item of data that receives significant attention in this dissertation. Urban density, as defined in this international study, is calculated by dividing the population of the metropolitan area by its urbanised area, where the urbanised area is the sum of the areas taken up by urban land-uses as shown in Table 4.9. In this thesis, the term "urban density" is used only in this specific sense.

The availability of reliable land-use data was the main difficulty in getting accurate urban density figures. Great care was required in interpreting such data. Fortunately, in most cities a number of different sources of land-use information were found. These included officially published statistics; estimates or measurements made by planning or transportation consultants; official figures based on zoning (which usually grossly overestimated the actual urbanised area); and, very occasionally, estimates based on satellite imagery. The urbanised area figures that emerged from the various sources often disagreed drastically and therefore had to be carefully compared and assessed. Time series of urbanised areas and resulting density figures were assessed for

plausibility. Urbanised area figures were compared against total areas (for the relevant administrative units) and maps were consulted to assess the plausibility of figures. Occasionally planimeter measurements from maps had to be made to check which set of figures came closest to agreeing with maps (and of course in such cases the reliability of the relevant map also had to be assessed).

Table 4.9 Urban (u) and non-urban (nu) land-use categories

Land use category	Type	Comment
Agricultural	nu	
Meadows, pastures	nu	
Gardens, parks	u	These areas are not generally built up, but in their size they are generally too small and in their human recreational use are too intense to qualify as genuine non-urban land
Regional scale parks	n/u	These are large, contiguous areas set aside within metropolitan areas for non-intensive or restricted recreational uses, water catchment functions, green belts etc.
Forest, urban forest	nu	Urban forests are larger than parks and are often significant wildlife and forestry areas
Wasteland (natural)	nu	This includes flood plains, rocks and the like
Wasteland (urban)	u	This includes derelict land, culverts
Transport	u	Road area, railway land etc.
Recreational	u, nu	Depending on the intensity of use, this group can belong partly in either category. Golf courses are urban, as their use is intense, while skiing areas (for example) are less intense in use and generally large and therefore non-urban. Mostly, however, recreational land is considered urban.
Residential	u	
Industrial	u	
Offices	u	
Commercial	u	
Public Utilities	u	
Hospitals	u	
Schools, Cultural	u	
Sports grounds	u	
Water surfaces	nu	

Source: adapted from Kenworthy and Laube et al. (1999, forthcoming).

Another common problem was that the land uses listed in the sources did not always match the categories in Table 4.9 that are required in the standard definition. For example, a source of land-use information might list a category (such as one called “other”) that might include some of both urban and non-urban land. This problem was usually resolvable with the help of local officials, by comparison with additional sources or time-series, or by making reasonable assumptions.

4.8.2.1 Common confusions over density

A problem in the literature on cities is a tendency for non-comparable density data to be quoted. It is important to emphasise again that urban densities quoted in this study are the relevant population divided by the **urbanised** area only. They are not **gross** densities, which are calculated using the whole area of the administrative unit, including

non-urban land, such as agricultural land, forest, and others. Gross densities are of no practical use for the purpose of comparisons among many cities, since administrative areas can include an arbitrary amount of non-urban land, depending on how far out the boundaries are set.

Nor do the densities quoted here refer to other possible density measures such as “net residential density” or “gross residential density”. Net residential density is defined as the population divided by the area of residential blocks only. Gross residential density is the population divided by the whole of the areas defined as “residential” but including streets and small non-residential uses within areas that are predominantly residential. Net residential density and gross residential density are clearly more useful than gross density, but are nevertheless problematic for international urban comparisons. This is especially so in low or middle-income cities where land uses tend to be more intensely mixed than in high income cities. This means that determining the boundaries of residential areas in such cities is extremely difficult and may tend to become somewhat arbitrary.

Another approach to the discussion of urban population density is to express it as a function of distance from the city centre, by giving the gross densities of concentric rings at various distances. This is more useful than quoting overall gross densities and provides significant additional information. However, it can still be misleading, since non-urban land is not excluded. Thus in outer areas especially, where urban and non-urban land uses are interspersed, the density will be underestimated. Comparisons between cities may also become complex and confusing and if an overall density is derived from these data and quoted it is usually the gross density and hence useless for reliable inter-urban comparisons.

Another cause of confusion over density in the literature is a tendency to make judgements on density based on subjective impressions. Even seasoned urban experts have been known to have mistaken impressions about the densities of urban areas. For example, even Peter Hall (1995) mistakenly described Jakarta and Manila as low density, presumably based on the low-rise character of most of their residential development. However, data presented in this study clearly show them to have rather high urban densities.

A further cause of confusion may be boundary issues. For example, when talking about New York one author could be referring only to New York City itself and may comment on its high density, whereas another writer may use “New York” to mean the

entire metropolitan area which extends into three states and which has a very low density overall. Finally, confusion can be caused because the words “high” and “low” are relative and their use is a matter of subjective opinion. Authors’ impressions of what is low or high density will depend on their previous urban experiences and which other cities they are comparing with a particular urban area.

Table 4.10 illustrates problems with much of the previous literature on urban densities using examples of density figures quoted for Asian cities in this sample. The most common problem is that gross densities are quoted, often without specifying clearly enough what kind of density figure is being used. In the most extreme example, figures for the density of Bangkok that have been quoted in the literature range from 12 to 160 persons per hectare.

To be fair, density and urban form were minor concerns of many of the studies cited above and most figures were provided for reference only, so it is perhaps not surprising if there are inaccuracies or deficiencies. Some of these cases acknowledge that gross densities are being used and that these are an inadequate measure. However, many are not so clear. In one or two cases, an attempt was made to relate entirely erroneous density figures (gross densities or a mix of gross and urban density figures) to transport variables, with confusing results (Birk and Zengras, 1993:36-37; Servant, 1995). In a case not shown in Table 4.10, a major collection of density data by the United Nations (Flood, 1997) appears to be problematic because it seems to have ended up with figures from different cities that use different, non-comparable density definitions. This is also the case with Ingram and Liu (1997) who use correct urban density data from Newman and Kenworthy (1989) for part of their data set but supplement this with erroneous density figures (apparently gross density figures) from a number of additional Asian cities (including Jakarta, Seoul, Bangkok and Manila).

The general lack of clarity on urban density is an important reason why the significance of urban form for transport has not been sufficiently explored in the literature on low and middle-income cities (as was mentioned in Chapter 2). Previous work on high-income cities using true urban densities by Newman and Kenworthy (1989), as well as evidence from the data presented in this study, demonstrate highly significant correlations between urban form (especially urban density) and transport patterns (Kenworthy and Laube et al., 1999, forthcoming; Laube, 1998).

Table 4.10 Density values from literature on Asian cities in the international sample

City	Density +Year	Sources	Type of density figures
Bangkok	12 (c.1990)	Birk and Zegras (1993)	Gross density of the Greater Bangkok Area?
	34 (c.1980)	Pendakur (1984: 9)	Gross density (of BMA area?).
	35 (c.1990)	Hayashi (1994)	Gross density of BMA area
	160 (c.1990)	Hayashi (1994)	Gross density of inner area of 2.3 million people.
	30 (1980)	Ishida (1997)	Gross densities for BMA area.
	45 (1990)		
	54 (1995)		
	128 (1983)	Cervero (1991b)	Apparently urban density estimates
	90 (1988)		
	167 (1971)	ESCAP (1982: 27)	Urban density.
	149 (1990)	this study team	Urban density
Jakarta	100 (c.1980)	Pendakur (1984)	Gross density.
	382 (c.1980)	Pendakur (1984)	Net residential or gross residential density estimate?
	100 (1980)	Cervero (1991b)	Gross densities.
	119 (1988)		
	92 (1980)	Ishida (1997)	Approximate gross densities.
	141 (1990)		
	173 (1995)		
	171 (1990)	this study	Urban density.
Kuala Lumpur	42 (c.1980)	Pendakur (1984: 9)	Probably gross density for Federal Territory only.
	51 (c.1990)	Ishida (1997)	Probably gross density for Federal Territory only.
	68 (late 80s)	Cervero (1991b)	Urban density for the conurbation apparently
	59 (1990)	this study	Urban density of Klang Valley.
Manila	94 (1980)	Ishida (1997)	Gross densities for Metro Manila.
	140 (1990)		
	168 (1995)		
	97 (1982)	Cervero (1991b)	Gross densities.
	120 (1988)		
	198 (1990)	this study team	Urban density.
Seoul	100 (c.1993)	Servant (1995)	Gross density of wider metro area (estimate)?.
	138 (1980)	Ishida (1997)	Apparently gross densities for City of Seoul only.
	183 (1990)		
	206 (1995)		
	245 (1990)	this study	Urban density
Singapore	39 (1980)	Ishida (1997)	Gross densities.
	44 (1990)		
	46 (1995)		
	34 (1972)	Cervero (1991b)	Gross densities.
	39 (1982)		
	42 (1988)		
	87 (1990)	this study team	Urban density.
Surabaya	75 (ca.1980)	Pendakur (1984)	Appears to be gross density.
	~94 (c.1990)	Birk (1993: 36)	Read from a graph. Appears to be gross density.
	78 (1976)	Cervero (1991b)	Gross densities.
	101 (1988)		
	177 (1990)	this study	Urban density.

4.8.3 Employment

Employment data (like population) were sought for metropolitan, inner and CBD areas. The relevant definition is of employment at the place of work rather than at the place of residence of the employees. In most of the Asian cities that were this author's responsibility, the population census provided no information on employment and other

sources had to be sought. Most such sources were transportation studies and occasionally other employment surveys by municipal or national governments.

The sources ostensibly included all employment (at the place of employment) including the self-employed and the informal sector. However, it is likely that the reliability of employment data will have been somewhat affected by the inherent difficulties of surveying informal sector businesses and their workers, many of whom have an incentive to avoid the attention of authority. However, it is hoped that any resultant error will have been small.

4.8.4 Vehicle ownership

The main standardised items that are derived from vehicle registration data are the number of cars, motorcycles, and total vehicles per thousand persons. In addition, a number of vehicle kilometres per vehicle items are derived from these data, along with the total vehicles per kilometre of road. It is the active vehicles in each city that are sought through this parameter.

The most common source is a vehicle registration department or such like. These figures may slightly overestimate or underestimate the numbers of vehicles actually available to residents. However, other more accurate sources (such as those from detailed household surveys carried out for large scale transport studies) cannot usually be used for this item of data because they are not available at regular intervals, for the particular years required, or for the correct metropolitan definitions. Registration figures usually allow good time series data to be compiled. However, in the case of Kuala Lumpur for 1970 and 1980, registration figures were unavailable or misleading because of boundary changes so figures from consultants' transportation study surveys had to be used³⁴.

One difficulty encountered in the Asian sample, but usually not elsewhere, was in defining what vehicles to classify as passenger cars. In some cities many pickups or mini-vans are registered as goods vehicles but used as private cars. Sometimes they are registered as cars but attract lower levels of taxation than sedans. Examples in this study where this was an issue are Bangkok, Manila, Hong Kong, Surabaya and Jakarta. In each case, an effort has been made to include in the car category all vehicles that are actually used as cars. This was successful, in all except Hong Kong, by using guidance

³⁴ The Federal Territory of Kuala Lumpur was created in 1974 from within the State of Selangor. Only newly registered vehicles appeared in the Kuala Lumpur figures at first. In addition, Spencer (1989) argued that earlier figures in Malaysia were overestimated, possibly because of a failure to remove defunct vehicles.

from previous studies that paid close attention to this issue and local knowledge of data collectors. In Hong Kong no “goods vehicles” could be included in the car category although some probably should have been (Hau, 1993) because no clear basis was found for estimating how many should be considered as cars. Fortunately, this is not a serious problem in this case because even if all goods vehicles were to be included in the car category in Hong Kong, its 1990 motorisation rate would still be the lowest in the sample.

Taxis are generally excluded from the private car figures unless they could not be separated. However, pirate taxis (cars illegally used as taxis) will appear in the private car figures, although their numbers were apparently small by 1990 in all the cities in this sample.

4.8.5 Private mobility parameters

Valid comparisons of private motorised mobility levels are a central feature of this study. Many compilations of data on urban transport are content to list motorisation data and to make assumptions about mobility based on this. However, this is inadequate. It is unrealistic to assume constant vehicle travel per vehicle, especially when comparing cities that vary widely in many of their other characteristics.

4.8.5.1 *Vehicle kilometres of travel (VKT)*

The primary data items that were collected on private mobility are the vehicle kilometres travelled (VKT) by various categories of vehicles, average vehicle occupancy figures, private vehicle occupant kilometres (passenger kilometres) and the average road network speed. A number of “per capita” and “per vehicle” standardised items are derived from the primary items.

In the Asian sample, it was clearly important to deal adequately with motorcycles and, to a lesser extent, taxi-like modes. Private mobility in cities with many motorcycles needed to be able to be compared in a valid way with cities that did not have many motorcycles. This demanded that they be integrated into the standardised format. Equally, the importance of motorcycles (and taxis) should not be submerged or hidden within the aggregate data. This required that some additional information be provided on these modes for those cities in which they are important (see Table 4.6). This refinement was a contribution of this author that was required in order to extend the approach in a valid way to a wider sample beyond rich cities.

So, in the middle-income Asian cities an extra effort was made to provide a breakdown of the private mobility figures into the various private modes (cars, motorcycles and taxis) in the standardised data sheets (Table 4.6 and Appendix 1). However, in the main sections of the standardised data sheets (which had to be uniform for the whole of the international sample of cities) the only breakdown is into total VKT per capita and car kilometres per capita (Table 4.5). In the case of the middle-income Asian cities, most of the mobility data items in the main standardised section that refer to “cars” actually mean cars, motorcycles and taxis³⁵. This was to ensure comparability of the main standardised data sheets among all of the cities in the international sample, whether or not motorcycles and taxis were significant.

Despite the importance of knowledge about vehicle kilometres of travel in urban areas, data on VKT are often difficult to find. None of the middle-income Asian cities had regular modelling of VKT but, in many cases, reliable VKT estimates were provided by major transport studies. Care was required to ensure that the VKT figures referred to the full 24 hours (not just the peak period or a 16-hour period) and to the whole road network (not just main roads or a limited “modelled network”). Adjustments were often necessary to estimate daily figures from figures from limited hours or limited networks. In addition, appropriate annualisation factors were required to estimate annual VKT from “typical weekday” daily figures. Reliable local information or informants were sought out where possible for such adjustment factors.

Air-pollution emissions studies also often provided estimates of VKT, as travel is always part of the basis of estimating emissions. However, these varied widely in their reliability. Some were almost as sophisticated as the major transport studies and included traffic counts to calibrate their results (or indeed some relied on the results of major transport studies). Others were somewhat less sophisticated and based their results simply on vehicle numbers along with educated estimates of travel rates for each vehicle type. Nevertheless, such an approach can yield reasonable results if carefully carried out and checked against reality in some reliable way.

Within the Asian sample, most VKT data from Tokyo, Kuala Lumpur, Hong Kong, Seoul and Bangkok are from relatively reliable sources (usually major transport studies)

³⁵ Figures for passenger cars per 1000 people do not include motorcycles or taxis (except where taxis could not be excluded). But all of the mobility figures in the main section of the standardised data in Table 4.5 and Appendix 1 did include taxis and motorcycles for the middle-income Asian cities (and only in these Asian cities, since in other cities motorcycles and taxi mobility were almost never expressed as separate categories). Thus, the per capita car kilometres, per capita car occupant kilometres and car kilometres per car included taxis and motorcycles in those Asian cities. Car kilometres per kilometre of road also included taxis, and motorcycles weighted by a ‘passenger car equivalent’ (pcu) figure of 0.33.

and have been confirmed by triangulation with other data items (such as energy use data, person trips data, trip distances, modal split data). In the case of Kuala Lumpur for 1990, information from an air pollution study and a feasibility study for HOV lanes both provided VKT data that broadly agreed, although they referred to different years.

It was helpful that in most studies of Asian cities, all vehicle types are considered, unlike some Western cities where good data are kept only on car travel and very little on other private vehicles. The exception to this in Asia was Singapore where there were reliable, modelled car kilometre data but VKT data for other categories of vehicles had to be estimated, assuming certain annual kilometres of travel for other vehicles (based on a host of other data from elsewhere).

Reliable modelled VKT data were not available in every case and VKT data for Manila, Jakarta and Surabaya are based on the results of calculations using many other items of urban transport data. Such data included modelled peak-hour VKT, vehicle occupancies, modelled passenger kilometre figures, passenger trip numbers and/or distances from surveys and/or vehicle numbers along with annual distances per vehicle. The resulting VKT estimates were checked against other data such as fuel use and found to be reasonably consistent. In Surabaya and Jakarta, estimates by other authors or studies (such as air-pollutant emissions studies) were available for comparison, although these were not suitable to be used directly. The reliability of the VKT estimates in these cities were highest for the passenger car component of the VKT total because there were generally many items of corroborating information on car travel on which to base a calculation or to confirm one. Slightly less information was usually available on motorcycle use and sometimes very little information on other categories, such as the taxi-like modes or goods traffic. Although the VKT figures for these three cities are possibly subject to a margin of error, it is believed that they are the best possible estimates of VKT (for these cities and these reference years) given the state of data availability. The figures are reliable enough to be confidently compared systematically with the data from the other international cities in the sample.

4.8.5.2 Average vehicle occupancy

Vehicle occupancy data presented a problem in many of the Asian cities. Unlike most of the other cities in the international sample, in the middle-income Asian cities the car-only occupancy does not provide an adequate approximation of the overall occupancy rate for private passenger transport. All day occupancy figures were therefore required for cars, motorcycles and taxi-modes. Such figures were not systematically collected on

a routine basis and were only ever available in major transport studies. The survey period that was used was often a 16-hour period over weekdays only rather than the sought 24 hour, 7-day figure. Frequently, occupancy data from years other than the reference years had to be accepted or were used to provide an estimate.

Private occupant kilometres data were generally calculated using VKT and occupancy data in most rich cities in the international sample. However, in the middle-income Asian cities it was more common to rely on person trips data combined with person trip lengths to generate occupant kilometre figures (both were from consultants' transport studies). This was because of the questions over vehicle occupancy data and the difficulties in obtaining VKT data in several Asian cities. In most cases, both methods were used and a comparison of the results provided a check. Care was required that trips lengths and person trip numbers both referred to the same definition of trip (for example, linked versus unlinked, since multiplying the number of unlinked trips by the trip length for linked trips would give erroneous results). Thus private occupant kilometre data for these Asian cities are probably more reliable than would be expected from the use of VKT and occupancy data alone.

4.8.5.3 Average road network speed

Another mobility indicator (or congestion factor) was the average road network speed. This was often available from air pollution studies (because of the use of speed in the modelling of emissions) and in major transport studies, which often produce vehicle-hours data for the respective VKT. However, the quality of the data varied quite widely. In each city, the source was used which came closest to providing a 24-hour, seven days a week, kerb-to-kerb average speed for a year as close as possible to the reference year.

4.8.6 Distinctive transport modes in Asia

Asian cities contain a number of distinctive vehicle types, kinds of public transport and types of taxi-like operation that are not found in the rest of the international sample (Plate 4.1). This section briefly introduces these modes and explains how they have been accommodated in the framework of this study. The section also considers how easily they fit and whether these modes cause any difficulties for the standard methodology.

Many of the distinctive modes have been described by the term, "paratransit" (Cervero, 1991b; Rimmer, 1986a). The term refers to a wide variety of modes distinguished by the fact that they are owned and operated by many small enterprises rather than corporate or government bodies. In this study a strong distinction is made between the

taxi-like modes and public transport. However, paratransit, as described in the literature, includes modes that are taxi-like in their operation and modes that operate fixed-route public transport services. Therefore, the term paratransit is generally avoided here. In this study, motorised taxi-like modes are grouped with private transport for most purposes and they are occasionally discussed in their own right, but are not grouped with public transport.

Non-motorised taxi-like modes, such as pedicabs, bicycle taxis (known as *ojek* in Indonesia), and horse-drawn cabs (which still exist in Manila's old CBD, known as *calesa*), are also often grouped with paratransit in the literature, but in this study they are included in the data on non-motorised transport. Nevertheless, they have much in common with motorised taxi modes and may sometimes complement or replace them to some extent. If non-motorised taxi modes had been more significant in any of the Asian cities in the sample, there might have been a need for some modification of the way that they were treated and the fact that there is usually a paucity of data on these modes would have been a greater problem.

4.8.6.1 Jitneys

Microbuses or minibuses operated on fixed routes are all classed with public transport in this study, although they are often termed as paratransit in the literature. Examples are Hong Kong's public light buses (PLBs), Kuala Lumpur's minibuses, Jakarta's *mikrolet*, Manila's jeepneys and Surabaya's *angkut*. The fact that some of the vehicles involved are rather small does not alter this fact (Surabaya's *angkut* have a capacity of about 10 passengers). The term paratransit refers primarily to their non-corporate style of organisation, rather than their mode of operation and their capacities, which are of greater interest in this study. These paratransit bus operations are often also referred to as "jitneys" which is a generic term used to connote small vehicles, operated by individual or small operators on fixed-route services, but often without fixed stopping places.

4.8.6.2 Taxi-like modes

Asian cities have a number of taxi-like modes in addition to the conventional four-wheeled sedan type. As mentioned above, motorised taxi-like modes were included with private transport in much of the data in this study. This is because in their physical characteristics (door-to-door service, high use of road space per passenger, and high energy use per passenger kilometre) they are more akin to private than public modes. Taxi-like modes are more significant in many Asian cities than they are in western

cities. For this reason, additional disaggregated data were sought on these for all of the middle-income Asian cities in the study. However, since it is common for a proportion of taxi-like modes to operate illegally, the data here are likely to represent a lower bound on the role of these modes in the Asian cities.

In Bangkok and Jakarta, motorcycle-taxis have become increasingly common in recent years. In Bangkok, Jakarta and Manila, motorised three-wheelers are ubiquitous providers of taxi-type services. In Jakarta they are known by the name of the Indian company which produces them, *bajaj*. In Bangkok they are known as *samlor* or *tuk-tuk*. In Manila they are simply called tricycles. Surabaya has a unique four-wheeled taxi-like mode, called *angguna*, which are modified mini-vans combining a passenger capacity of five with goods capacity of a cubic metre on an open tray-top at the back (Gunawan, 1992). In addition, each city in the sample has conventional four-wheeled taxis, although meters have only become commonly or universally used in the last decade or so. In the past, fares were negotiated.

4.8.6.3 Hybrids

In many cities in Asia there are modes that occupy a “grey area” between purely public transport and taxi characteristics. Such modes are known as “hybrids” and they operate somewhere on a spectrum of styles of operation, between fixed-route public transport at one extreme and a pure taxi-style at the other extreme.

One kind of hybrid offers services to the general public at any time but have routes that are neither fully fixed nor completely flexible. For example, minibuses or minibuses may vary their routes slightly according to passenger requests. Taxis (and sometimes minibuses) may operate in shared-taxi mode, whereby they will continue to pick up passengers who happen to be going in almost the same direction as the initial passenger (and may refuse to travel to locations where such sharing is not viable). These kinds of hybrid were not very significant in the cities of this sample in 1990. So it has not been necessary to define a separate mode category or to collect systematic data (which would, in any case, be very difficult). In the past, hybrids may have been somewhat more important than in 1990. For example, many more of the taxis in cities such as Seoul, Bangkok, Kuala Lumpur and others, formerly operated in shared mode (at least from time to time). Even now, Bangkok’s 6-seater *silor lek* are hybrids providing shared taxi and sometimes fixed route services from main roads into Bangkok’s back-streets or lanes (known as *soi*) (Poboon, 1997). Many of Manila’s tricycles operate in a similar way. Classing such small-capacity hybrids (below 8 passengers) in the taxi-like

category (and hence as private transport) as has been done in this study would appear to cause very little difference to the analysis here. This is because, as mentioned, the emphasis here is on the physical characteristics of the modes rather than the small details of their operations.

Plate 4.1 Some of the distinctive Asian modes of transport



Kuala Lumpur minibus (Photo: Zaitun Kasim)



Overloaded Manila jeepney (Photo: Zaitun Kasim)



Jakarta *bajaj* (3-wheeled taxis)



Bangkok tuk-tuk and motorcycle taxi



Jakarta bicycle taxi (*ojek*)



Jakarta motorcycle taxis (*ojek*)



Shared-taxi type hybrids with higher capacities (8 or more passengers) apparently tend to quickly develop a fixed-route style of operation and thus can usually then be classed as public transport. For example, in Manila in the mid-1990s, Toyota mini-vans, called “*Tamaraw FX*” (after the make of vehicle) began operations as shared taxis but increasingly tend to follow fixed routes. If they had been numerous in 1990, the *Tamaraw FX*s would have had to be grouped with public transport. Hong Kong’s public light buses, which are owned by many small enterprises in much the same way as many microbus and minibus operations throughout the region, also began in the 1960s as free-wheeling hybrids, with some operating in shared-taxi style and some as minibus service on more-or-less fixed routes. A gradual evolution has taken place with operations increasingly on fixed routes, with larger vehicles and increasing regulation, both by the industry itself and by government (Meakin, 1993). Thus, although a small number of Hong Kong’s PLBs may still be truly hybrid operations, most are now clearly within the collective transport category and are included in the public transport data in this study. In the rare instances that there was any doubt over whether to include a mode (such as the *silor-lek* or, hypothetically, the *Tamaraw FX*), then the vehicle capacity has been used to decide (based on the arguments above).

Another kind of hybrid includes modes of transport that have flexible routes (even if they are pre-arranged) and offer their service on a contractual basis to specific people or groups at specific times. “Factory” or worker buses and school buses are examples. These are significant in Kuala Lumpur, and somewhat significant in Singapore, Seoul and possibly other Asian cities. These present a little more of a dilemma for this methodology than the other type of hybrids (shared taxis). Since they use high-capacity vehicles (large buses or minibuses) they share an important characteristic of public transport. However, in not offering their service to the public and offering almost door-to-door service they are unlike other public transport and more like private transport. The decision was made to exclude these hybrids from public transport figures in this study (in line with the standard methodology, which excludes from public transport such modes as van-pools and school buses in all cities). However, some of the mode split figures for public transport may possibly still include trips on these modes if the sources included them and if there was no accurate basis for removing them.

Kuala Lumpur was the extreme case, with factory buses and school buses accounting for about 300 million trips per year compared with just under 700 million on the mainstream public transport. Therefore data on these “other” buses have been presented

in the primary public transport data on Kuala Lumpur with alternative figures shown for both the with and without-other-buses cases. The standardised data exclude “other” buses in order to be consistent with the standard methodology, but the data are provided on these buses so that they are not overlooked and can be incorporated if necessary by other researchers who might draw on this work (Appendix 1).

In summary, the distinctive modes of transport that are found in Asia required some careful thought and care to allow them to be consistently and validly accommodated in this study. However, they have generally successfully been dealt with and included, and their presence does not invalidate the approach that has been used or the results.

4.8.7 Public transport parameters

As mentioned above, public transport was defined in this study as collective modes of transport, offered on fixed routes to the general public. The definition here thus excludes all taxis and taxi-like modes but includes jitneys in their various manifestations. The public transport data required for each mode of public transport (grouped as rail, bus, tram and ferry) were vehicle kilometres of service, passenger trips or boardings, passenger kilometres or trip distance for each trip/boarding, average service speed, and energy consumption. These were, in general, much more difficult to gather in the middle-income Asian cities than in the richer cities of the sample.

Furthermore, the sources that needed to be used were often different. In most of the rich cities in the sample, public transport is operated, tightly regulated or co-ordinated by government agencies. Furthermore, almost all public transport operators are corporate bodies (whether private or government owned) which are capable of and/or required to report publicly on their operations. The situation is very different in most of the middle-income Asian cities in this sample, where a substantial proportion of the public transport is provided by small operators (paratransit or the “unincorporated” sector). In Manila and Surabaya most public transport is provided by such small operators.

Furthermore, in these cities, sometimes even the statistics provided by large, corporate public transport operators (private or public) left much to be desired. An exception was Seoul, where the operators provide relatively comprehensive and accurate information.

Therefore, most of the information on public transport in these cities came either from major transport studies or from consultants’ studies specifically on public transport in each city. Fortunately, such public transport studies were completed soon after 1990 in each of Jakarta (1990 and 1992), Kuala Lumpur (1989, 1991 and 1993), Seoul (1994) and Surabaya (1994). Consultants’ studies themselves generally could not rely on

reported statistics from operators, so some of them did their own on-board public transport surveys (along with their household surveys) to supplement or provide a check on such figures. However, in some cases the need to use major studies as sources meant that data on public transport were often for a year other than 1990, the reference year (for example, 1989 was used in Kuala Lumpur).

One issue that was common to many cities in the whole international sample of cities was the need for great care (and often calculations) to ensure consistency in the kind of trips referred to by the figures. Vehicle boardings (unlinked trips where each new boarding of a vehicle is counted as a trip) were required, not linked trips (a trip including transfers is counted as only one). Information on the transfer rate (or an estimate of it) was often required to convert figures from linked trips into the number of boardings. This was very common since household surveys usually yielded linked trip data, whereas data from operators and from some specific public transport surveys usually supplied boardings.

As was the case with private mobility parameters, the public transport passenger kilometres figures in Asian cities could often be estimated by two independent methods. The more accurate source was the product of passenger boardings and the unlinked trip length (or linked trips and linked trip lengths if necessary), and a rough check was often provided by using service vehicle kilometres and average occupancies (all day) which were often surveyed by major studies.

The average operating speed of public transport was sought for each city. This was the average of each mode's operating speed, weighted by passenger kilometres. The figure included stopping time, but ideally excluded time at terminals and dead-heading. Specialised public transport studies, and sometimes major transport studies usually supplied such data or estimates of it, even for the non-corporate minibuses or microbuses. Large operators could sometimes supply such data directly. Often contradictory figures were found in different sources or even the same source, necessitating detective work to decide which was closer to conforming to the requirements of the study. Generally, it can be said that this parameter could not be as precisely determined in the middle-income Asian cities as elsewhere, but that sources usually supplied broadly accurate estimates that could be used in the international comparisons.

A problematic public transport item in the middle-income Asian cities was the energy usage. In most rich cities, this item was available directly from operators. In the middle-

income Asian cities, this was almost never the case. As a result, most energy usage figures for road-based public transport in these cities had to be based on vehicle kilometre data combined with information or estimates of the fuel use per kilometre for each vehicle type in the public transport fleet.

Despite these various difficulties, which mean that the public transport data on middle-income Asian cities are somewhat less precise than in the richer cities, the data are still broadly representative of the true picture. This has been ensured by the various quality control procedures that have been described. The collections of public transport data in the middle-income Asian cities that are presented in this study are as high or higher in quality than any other comprehensive collections for these cities yet published, often improving on the individual sources to arrive at verifiable, cross-checked figures. They can therefore confidently be used in the international comparisons.

The Kuala Lumpur 1990 public transport passenger trip numbers provide an example of one of the most problematic cases. This example is described here to help validate the above claim. Many of the figures provided on public transport trips in Kuala Lumpur by four relevant studies were, at first sight, entirely contradictory and seemed to imply implausible trends in bus ridership. The studies were the 1986 JICA study, a 1989 study of minibuses, a 1991 study of buses in the Klang Valley and a 1993 study on bus rerouting in Kuala Lumpur and its Conurbation (Ecoville Consultancy Group, 1989; JICA, 1986; Perunding Atur Sdn. Bhd., 1991; Sir William Halcrow and Partners (Malaysia) Ltd., Halcrow Fox, and Perunding Atur Sdn. Bhd., 1993). A great deal of laborious detective work and calculations were required before it could be shown that most of the problems were explicable. Reasons for the apparently inconsistent figures included: under-reporting of passengers by bus companies; one table listed only a subset of the bus companies; some figures were linked trips while others were unlinked; and some included factory and school bus trips and others did not.

The figures that were finally used were based on the 1985 unlinked trip figures from the JICA study for each category of bus, which were updated using the growth in passenger numbers for each category of bus from 1985 to 1989 reported in the 1991 study (and extrapolated one year to 1990). The figures for the growth in passenger numbers were primarily from bus company sources and provided an internally consistent time series from 1982 to 1989. However, they could not be reconciled with the JICA 1985 totals or with the 1989 totals, so they could not be used in themselves. The results of updating the 1985 figures in this way were confirmed by other data in the later studies. Converting the 1990 unlinked trips figure obtained from the above procedure into

linked trips by using transfer-rate information from the 1991 study gave about 790 million linked trips per year, a result that matched reasonably well with the bus origin-destination matrix total from the 1991 study (of about 835 million trips per year). The 1993 study gave a 1993 figure for linked trips of approximately 896 million per year, a plausible trend. The chosen figures were also consistent with everything else that was known about bus numbers, vehicle kilometres, average occupancies, and about the modal split.

Although the number of studies that could be referred to seemed at first to be the problem (they apparently contradicted each other), in fact it was only the variety of sources that allowed the problems to be cleared up and for a valid estimate of passenger numbers to be made. Otherwise it is possible that an erroneous figure might have been accepted in the absence of evidence to clarify it. It can be concluded that although the data on Kuala Lumpur's passenger numbers cannot necessarily be said to be very precise, there is sufficient evidence to be confident that the figures are broadly accurate and that one can be confident that they provide a valid picture for comparative purposes.

4.8.8 Modal split data

The mode split data that were required by the CAAD study were for the journey-to-work trip. In many rich cities a question on this is included in the national census. Such data are therefore usually available in a highly reliable form and for the correct reference year.

In the middle-income Asian cities, only South Korea had a census question on the mode of the trip to work. In the others, the only reliable sources of modal split data were major transport studies. These studies usually assessed modal split in detail, generally providing mode split figures for each trip purpose and for all trips, which proved to be useful (for example as an extra check on various other items). However, the use of such infrequent studies meant that mode split data were often not available for the reference year. For example, in Kuala Lumpur for 1990 there was no choice but to accept 1985 data on mode split. In Surabaya, a small survey from 1987/88 was the basis for an estimate of the journey-to-work modal split. In Jakarta, consultants' findings for 1985 and 1993 were the basis for an interpolated estimate for the 1990 modal split. Very recently, a new round of studies has been completed for years such as 1995 in Surabaya, 1996 in Manila and 1997 in Kuala Lumpur. Mode split and other data in these studies

has provided a useful last minute check on the plausibility of 1990 data and estimates in this study.

There was often little possibility of checking the accuracy of modal split data. However, at least the plausibility of the public versus private part of the modal split was always checked against other information, such as the balance between private and public passenger kilometres and the number of public transport trips per capita (where this was from an independent source). Where source documents included taxi-like modes in the public transport category, adjustments had to be made to mode split data to bring them into line with the standard procedure of this study, which is to include taxi trips with private transport.

Data on non-motorised travel have always been somewhat sketchy and even by 1990 there were still problems, despite the inclusion of non-motorised trips in most (but not all) major studies in the region since the early 1980s. The main problem is that many studies use a restrictive definition of trips. For example, sometimes only trips of more than 500 metres, of more than 5 minutes, or only interzonal trips are included in data. In some cases this restriction is specified, for example in the Singapore data, where only walk trips of greater than 5 minutes were included, or the Kuala Lumpur data where only interzonal trips were included. Others do not specify any restriction on the trip definitions, but low figures for walking trips lead one to suspect that not all walk trips have been accounted for. Consequently, some caution is required in the interpretation of these data. The best that can be hoped for is that the same or very similar restrictions applied in most cities (which is not unrealistic, given the degree of standardisation that often occurs in UTP-based studies and the fact that many of the same firms are involved). These restrictions on the inclusion of short trips tend to affect non-motorised trips data more than motorised trips. However, work trips are longer, on average, than other trip types. Hence, the underestimation of non-motorised trips is a less serious problem for the work-trip mode split than for the mode split of all trips.

The standardised data format does not break down the non-motorised modes into walking, cycling and other non-motorised vehicles because it has been found that such data are rarely easily available. Whenever such a breakdown was supplied it was collected and is presented within the body of the thesis.

4.8.9 Average trip lengths

Most of the source studies that included a household survey included details of trips lengths for various purposes and modes. As with mode split information, it was

sometimes unavoidable to use data from years other than the reference year or to use an interpolated estimate for this item. But in general, this item was not much more problematic in the middle-income Asian cities than elsewhere.

4.8.10 Road network

The collection of data on the road networks generally caused no special difficulties in the Asian sample. The only problem was some concern that the definition of what constitutes a road may vary slightly from city to city. Thus, it is suspected that the road length figures for Tokyo and Seoul may include many small lanes that may not be considered roads elsewhere. Although these alleys may be theoretically passable by four-wheeled vehicles, they are just barely so and carry minute levels of traffic, even compared with small suburban streets in western cities.

4.8.11 Parking

The numbers of car parking places were required for the Central Business District in order to calculate the standardised item, car parking spaces per 1000 CBD jobs. In Seoul, such data were available in a readily useable form but parking data were more problematic in other middle-income cities. No useable parking data were found in Jakarta or Surabaya. Two reports in Jakarta presented estimates of parking in the central area, but each used a slightly different central area definition for which reliable employment data could not be collected.

In Kuala Lumpur, the City Hall provided CBD car-parking data but it was felt that motorcycle parking also needed to be taken into account. These were estimated based on the car park numbers along with traffic composition data for vehicles entering the CBD. Motorcycles were then assigned a weighting according to their peak-hour occupancies compared to car peak-hour occupancies. This weighting means that the figure should be comparable to other cities' car parking space numbers because it should be proportional to the number of commuters served by these parking places. Bangkok's parking data also seem to include motorcycles, since the source of the data listed "car equivalent" places (Chamlong Poboon, pers. comm., Jan. 1997).

4.8.12 Private transport energy parameters

The total amount of fuel used in private transport was sought for the correct metropolitan definition. The breakdown into gasoline, LPG (where applicable) and diesel was sought, as was a breakdown into fuel used for private passenger transport and fuel used for goods transport. Ideally, the sources of the private vehicle energy data were independent of the other transport data, so that fuel use and VKT data could be

checked against each other for accuracy and consistency. Fuel sales (or use) figures could be obtained in Kuala Lumpur, Jakarta and Seoul. Sales figures for Kuala Lumpur and the whole state of Selangor had to be used as no data were available for the Klang Valley. In Surabaya a recent study investigated transport energy use in the city in some detail, based on some sales figures, but also on calculations and assumptions. Its data were used here (Gunawan, 1992).

While gasoline sales generally reflected transport fuel use and could be used almost without modification, some of the diesel figures apparently included significant amounts of diesel used for industrial purposes. In Seoul it proved impossible to discover how much of the diesel figure was for transport. Therefore, diesel for transport in Seoul unfortunately had to be estimated using VKT by the relevant vehicle types along with estimated fuel efficiencies for each vehicle type. In Kuala Lumpur a 1992 air pollution study provided a reliable estimate of the proportion of diesel sales that were used by transport (71 percent). In Jakarta, the city's Statistics Department published details of total diesel use and diesel use by large and medium manufacturing establishments. The remaining diesel was assumed to be in the transport sector, but this may still be a slight overestimate.

4.8.13 Air pollutant emissions from transport

Annual emissions of CO, SO₂, NO_x, particulates and volatile hydrocarbons (VHC) were sought for 1990, but only for the 37 cities included in the study for the World Bank (which included all of the Asian cities). These were generally available from inventories in studies of air pollution in each city. These are always based on models of the traffic system (travel and speeds) using various assumptions and information about the state of the vehicle fleet and its emissions rates as they vary with vehicle speed. Seoul had regular published emissions figures. These were for the City of Seoul only but had to be used nevertheless. All of the other Asian cities' emissions data were found in major air-pollution studies for years close to 1990. Only Singapore did not have a recently updated air-pollution emissions inventory that could be used.

In addition, CO₂ emissions from transport were required. These were derived directly from total energy figures (both private transport and public transport) using conversion factors for the CO₂ equivalent of each fuel type, and a different conversion for each country's electricity depending on the mix of fuels used for generation.

4.8.14 Transport deaths

Total annual deaths in each city along with transport-related deaths were also collected only for the study for the World Bank. Total deaths were usually relatively easily found in published statistical documents or from health authorities. Transport deaths were problematic in the middle-income Asian cities, since not all of them published deaths statistics in the World Health Organisation's standard International Classification of Diseases (ICD) format, at least not for the administrative areas that were required. The figures required were deaths in the ICD categories E810 to E825. These data record deaths within 30 days of the crash. Police data generally record only deaths on the scene or within a short period after the crash. Unfortunately the deaths figures from Kuala Lumpur, Jakarta and Surabaya are figures based on police statistics. Such figures tend to be an underestimate (by as much as a factor of two). Despite this, Kuala Lumpur's figure for transport deaths per 100,000 people was among the highest in the sample.

4.8.15 Economic indicators

All of the economic indicators collected were converted to 1990 United States dollars with the aid of the conversions for Standard Drawing Rights published by the International Monetary Fund. Most economic indicators were collected only for the 37 cities in the study for the World Bank. A fundamental economic indicator that was collected was the Gross Regional Product (GRP) per capita for each city. Total GRP was generally available from government statistical compilations. Care was required that in cases of alternate metropolitan definitions, it was the larger one that should be used for the GRP figure. This is because a high level of cross border commuting can skew the value of the GRP (Laube, 1997). Appropriate populations were used in each case to derive per capita GRP. Three other economic indicators were collected for the World Bank sample, namely road expenditure, the percentage of GRP spent on commuting, and the public transport operating cost recovery rate.

The road expenditure data were extremely problematic. In each city, it was always a very difficult task to identify all of the agencies that were spending on roads (of all kinds), to avoid double counting, and to be sure that all construction and maintenance expenditures were included. Three years of figures were required to give an average that should help flatten brief peaks or troughs in expenditure. The author encountered some reluctance to release information on this issue in certain cities. In addition to these difficulties, it was not obvious how to assess the plausibility of the results. Although every effort was made to ensure accuracy, this is one of the few items of data in this study where it must be acknowledged that there may be doubts about some of the final

figures. These doubts are strongest for Kuala Lumpur. The low final figure does not seem to tally well with the relatively high road length per capita of this city or with the obvious surge of road building (mostly privatised) that has been occurring during the 1990s. On the other hand, another study in 1990 did state that road spending in Kuala Lumpur and in Malaysia in general had dropped during the late 1980s (Padeco Co. Ltd and Perunding Atur Sdn. Bhd., 1990). Therefore, it is possible that this study simply captured a period of time when road spending was unusually low in Kuala Lumpur. Despite the concerns over the Kuala Lumpur figures, these data represent a valuable contribution, being the only comparative data that are so far available to compare road spending among cities in this region.

The percentage of GRP spent on the journey-to-work was an extremely complicated item, since it was derived from a large number of primary data items, as was explained in Section 4.5. Some of the component data for this item were useful in their own right and will be mentioned later in the thesis. The most important and potentially difficult components were the car and motorcycle costs per kilometre (both fixed and variable). Fortunately, very detailed information on these issues was to be found in road-project feasibility studies, major transport studies, and specific cost studies in each country with middle-income cities in this Asian sample. These data could usually be used to derive reliable figures. In all cases car (and motorcycle) cost data had to apply to a representative vehicle. The source studies usually made this choice. In some cases, a weighted average between two very popular kinds of car was the best solution. In the Asian cities where motorcycles are numerous, motorcycle costs also had to be collected to include in the calculation with the appropriate weighting according to their mode split. In Seoul, where taxis are very important, the taxi fare per passenger kilometre was also sought and used in the calculation.

Public transport finances were generally straightforward in the cases of large, corporate public transport operators, such as rail companies and large bus operators. The operating costs and the operating revenues were the specific items required, excluding capital costs or interest payments on capital debt. In Seoul, bus financial statistics were available through the bus operators association. However, in most of the other middle-income Asian cities the financial positions of small and non-corporate operators were never available directly. In the cases of Jakarta and Surabaya this meant that the figure cited in this study applies only to the large operators and excludes all of the minibuses and microbuses (*mikrolet* or *angkut*) in those cities. Since these services operate without any government support whatsoever and since their number generally increased through

the 1980s, it must be assumed that most, if not all, are profitable. Thus, the public transport operating cost recovery figures quoted for these cities represent a lower bound on the actual level of cost recovery. In Kuala Lumpur, a public transport study provided data on operating costs and revenues of all buses, including minibuses. These data were clearly not the result of detailed financial reporting by all operators, but were the best data available and were therefore used.

4.9 Chapter Conclusion

This chapter has assessed the methodology used to collect and analyse the set of data that is at the core of this thesis. The discussion has made clear that such comparative data are not easy to compile. Nevertheless, it has been the experience of this study that the effort is worthwhile and that the results provide valid and sufficiently accurate insights on urban transport and urban form for the international sample of cities. The “experiment” of attempting to extend the basic methodology of Newman and Kenworthy (1989) to middle-income cities in Asia can be said to have been generally a success. The extra problems faced and time taken in the middle-income group of Asian cities have not prevented their inclusion in the international comparisons in a valid and valuable way. The remainder of this thesis therefore uses these comparative data (among other sources of information) to systematically answer the questions put forward in Chapter 1 of the thesis. It was argued in Chapter 2 that the literature lacks any significant body of comparable data on urban transport and land use systems in low or middle-income cities in Asia. No data set that is comparable in its scope or degree of cross-checking has ever before been compiled on these issues for this group of Asian cities. Therefore it is hoped that this collection will be, in itself, a major step forward in the understanding of Asian cities’ transport and urban land use processes and in the capacity to assess them in a wide international perspective.

CHAPTER FIVE

ASIAN URBAN TRANSPORT IN PERSPECTIVE

5.1 Introduction

Having now examined the evolution of the transport and land use systems in the nine Asian cities in the international sample up to the 1960s, this chapter turns to transport patterns in recent decades, with a focus on the situation in 1990. The chapter uses the data set that was described in Chapter 4, to put transport patterns in the nine Asian cities into an international comparative perspective. There tend to be regular patterns of variation in many of the major urban transport variables between the regions, Asia, Europe, Canada, Australia and the United States. The United States' cities, on average, are at one extreme, having the greatest orientation to private automobiles within their urban transport systems. The Australian cities usually come next, then the Canadian cities, then the European and finally the Asian cities.

There are also important variations to be found within the Asian group of cities. Transport patterns in cities in the Asian sample have diverged widely since the situation in the 1960s that was discussed in Chapter 3. Groupings within the Asian sample of cities in 1990 are identified using the data presented in this chapter. These groupings do not simply reflect variations in income and nor are they just the result of the continuation of past trends. The groupings, it is argued in this thesis, represent distinct and contrasting models or paths of urban transport development within the region. The major choices and events that have led to these contrasts are explored later in the thesis, in Chapter 8.

This chapter begins by examining in turn each of the major aspects of urban transport for which data have been collected for this study. It begins with private vehicle ownership patterns, followed by private vehicle use, public transport use and provision, then private transport infrastructure and non-motorised transport. Then a number of indicators of the negative impacts of transport are considered. Finally, after providing and analysing comparative data on all of these issues, conclusions are drawn about contrasting paths of transport development that can be identified within the Asian sample of cities.

5.2 Private Vehicle Ownership

The availability of private vehicles is an important factor in the travel choices that are available to urban residents. As discussed in Chapter 3 all of the Asian cities in this sample had very low motorisation levels in 1960 and even by 1970, all except Tokyo remained well below 100 cars per 1000 persons. However, since then, and especially since 1980, there have been very large increases in the number of vehicles per capita in many of the Asian cities.

5.2.1 Motorisation in 1990

Data on motorisation in 1990 for the whole global sample are shown in Figure 5.1. The cities have been arranged in order of decreasing private car ownership. The very wide range of vehicle ownership rates across the international sample is striking. Great variations are remarkable even among high-income cities. For example, low motorisation rates in high-income Asian cities, Hong Kong and Singapore in 1990, were in stark contrast with the American cities. Even among Western cities there was a wide range of car ownership rates, from less than 300 cars per 1000 persons in Copenhagen to almost 800 in several American cities.

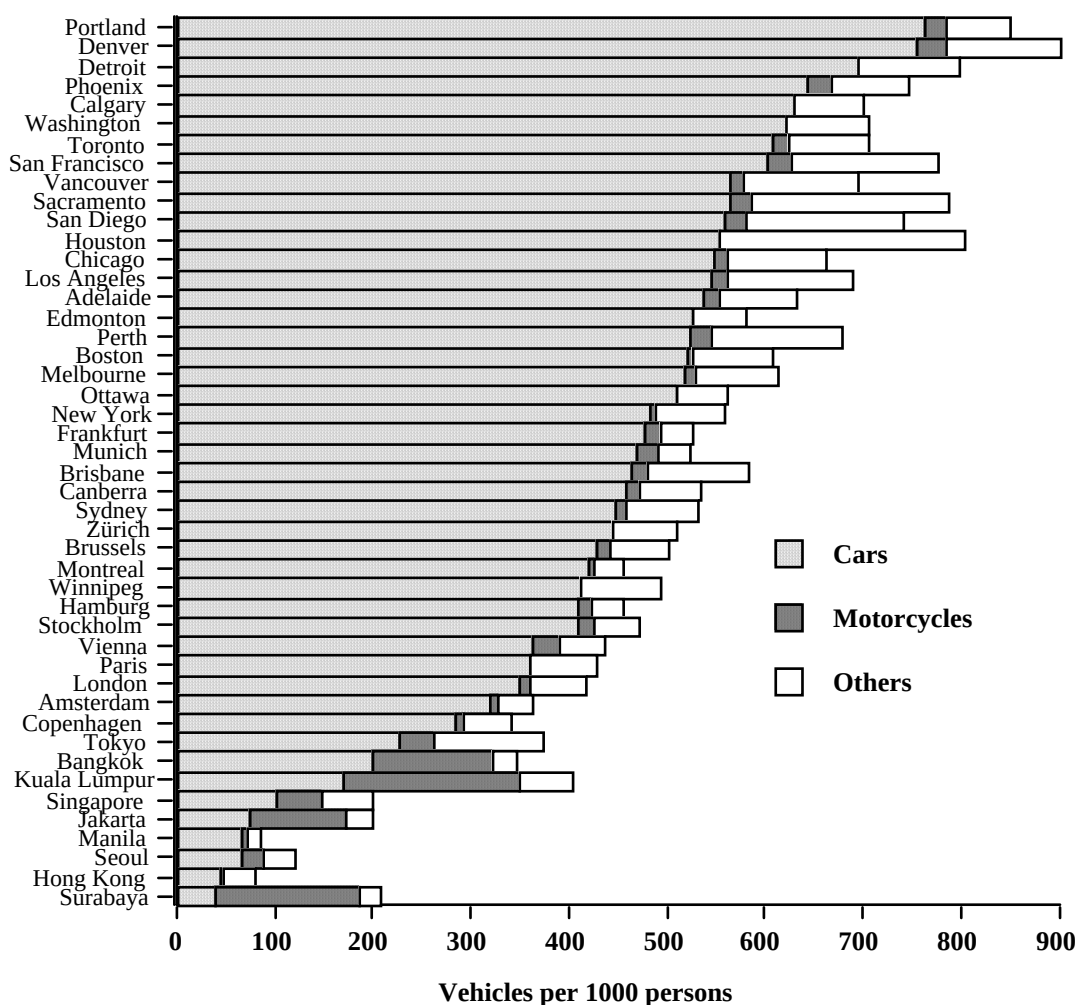
Regional variations can immediately be seen in Figure 5.1. All of the European cities have higher car ownership than any of the Asian ones, but lower car ownership than any of the United States cities. However, there is also some significant overlap between some regions. For example, Canadian and Australian cities appear within both the European and United States ranges of 1990 car ownership.

Focusing on the Asian cities, a first observation is that the 1990 Asian rates of car ownership were still all at the low end of the spectrum within this international sample. The Asian cities had lower 1990 car ownership than the lowest of the European cities (although total vehicle ownership rates of some of the Asian cities slightly exceeded those of some European cities, due mostly to a large number of motorcycles in some cities).

Secondly, by 1990 wide variations had emerged in the rates of vehicle ownership within the Asian sample. This is a change from the 1960 and 1970 situation presented in Chapter 3. Tokyo, Kuala Lumpur and Bangkok stood out as having significantly higher 1990 motorisation rates than the rest of the Asian sample. At the other extreme Hong Kong, Manila and Seoul stood out with much lower motorisation than the other cities.

A third striking feature of the 1990 motorisation situation is that motorcycles now featured very prominently in several of the Asian cities but nowhere else in the international sample. Motorcycles were owned in very large numbers in Bangkok, Kuala Lumpur, Jakarta and Surabaya, and in moderate numbers in Seoul, Tokyo and Singapore.

Figure 5.1 Vehicle ownership rates in an international sample of cities, 1990



Note: In a number of cities motorcycle figures could not be obtained separately. In these cases motorcycles are included in the “others” figures.

Table 5.1 Motorisation parameters in Asian cities and regional averages from an international sample of cities, 1990

	Cars per 1000 persons	Motor-cycles per 1000 persons	Total Vehicles per 1000 persons
Tokyo*	225	36	374
Bangkok	199	124	348
Kuala Lumpur	170	180	403
Singapore	101	45	200
Jakarta	75	98	201
Seoul	66	22	119
Manila	66	6	86
Hong Kong	43	4	78
Surabaya	40	147	209
American	608	18	749
Australian	491	15	595
Canadian	524	12	598
European	392	15	452
Asian	109	74	224

Note: * Tokyo's vehicle ownership data above are for the Tokyo Metropolis (Tokyo-to) only. Bernick and Cervero (1996: 312) quote the 1990 car ownership rate for the whole Tokyo region as somewhat higher at 275 per 1000 person.

5.2.2 Motorisation since 1960

This section examines the evolution of Asian cities' motorisation levels over the last three decades. Table 5.2 and Table 5.3 provide the time series data on car and motorcycle ownership in the Asian cities, compared with averages for each of the other regions. The average annual change in ownership for each decade are also shown, with figures of above 10 vehicles per 1000 persons per year shown in bold in order to highlight the decades that had particularly rapid motorisation. Figure 5.2 provides an illustration of these motorisation trends.

Car ownership was still rather low in 1970 throughout the Asian sample. Then, during the 1970s car ownership actually rose rather slowly in most of the Asian cities (except Tokyo). This was in contrast with continued high rates of increase in the Western sample. The dramatic surges in car ownership in the Asian sample have mostly been since 1980. Two of the most striking rises in vehicle ownership have been in Kuala Lumpur and Bangkok since 1980.

Table 5.2 Car ownership in Asian cities and regional averages from an international sample of cities, 1960 - 1993

	Car Ownership (cars per 1000 persons)					Average Annual Change ^a (cars per 1000 per year)			
	1960	1970 ^b	1980	1990	1993	1960-70	1970-80	1980-90	1990-93
Hong Kong	11	27	42	43	46	1.6	1.6	0.1	1.4
Surabaya	?	14	20	40	47	-	0.7	2.0	2.3
Manila	?	38	55	66	79	-	1.7	1.1	4.3
Jakarta	?	22	38	75	92	-	2.0	3.7	5.9
Singapore	39	69	64	101	110	3.0	-0.5	3.7	3.5
Seoul City ^c	?	6	16	83	123	-	1.0	6.8	13.3
Kuala Lumpur	46 ^d	72	86	170	206	2.6	1.4	8.4	12.0
Bangkok	14	54	71	199	220	4.0	1.7	12.7	7.3
Tokyo ^f	16	105	156	225	236	8.9	5.1	6.9	3.8
European	122	243	332	392	?	12.1	8.9	6.0	-
Canadian	274	348	447	524	?	7.4	9.9	7.7	-
Australian ^e	223	321	443	491	?	9.8	12.2	4.8	-
United States	376	460	547	608	?	8.4	8.7	6.1	-

Table 5.3 Motorcycle ownership in Asian cities, 1970 to 1993

	Motorcycle Ownership (motorcycles per 1000 persons)					Average Annual Change ^a (motorcycles per 1000 per year)			
	1960	1970 ^b	1980	1990	1993	1960-70	1970-80	1980-90	1990-93
Hong Kong	1	4	6	4	4	0.3	0.2	-0.1	0.0
Manila	?	6	4	6	8	?	-0.2	0.2	0.6
Seoul City ^c	?	?	6	18	?	?	?	1.2	?
Tokyo ^f	16	9	14	36	?	-0.7	0.5	2.2	?
Singapore	12	51	49	45	42	3.9	-0.2	-0.4	-1.2
Jakarta	?	32	66	98	113	?	4.2	3.2	5.0
Surabaya	?	35	91	147	175	?	6.2	11.5	7.0
Bangkok	6	20	35	124	179	1.4	1.5	8.9	18.2
Kuala Lumpur	?	50	65	180	201	?	2.1	11.3	6.0

Notes for Table 5.2 and Table 5.3:

a. The figures above for annual change in vehicle ownership are the average annual increments in ownership per 1000 persons. They are not percentage increases.

b. KL's 1970 figures are for 1972, Surabaya's 1970s figures are for 1971 and Jakarta's are for 1972.

c. The data in this table for Seoul are for Seoul City only.

d. Kuala Lumpur's 1960 car ownership data is for 1963.

e. In 1947 the Australian cities averaged 76 cars per thousand people, so the annual increase between 1947 and 1960 averaged 11.1 cars per thousand people.

f. Tokyo's figures are for Tokyo-to only.

In the 1970s motorcycle ownership rose quickly in the Indonesian cities, especially in Surabaya, so that by 1980 Surabaya had the highest motorcycle ownership in the sample. It was in the 1980s that motorcycle ownership rose most dramatically in Bangkok and Kuala Lumpur and by 1993 they had both overtaken Surabaya's motorcycle ownership of 175 per 1000 persons. These experiences of exploding motorcycle ownership were not shared by Singapore, where ownership has declined

slightly since 1970, or by the other Asian cities where motorcycle ownership has never risen above 40 motorcycles per 1000 persons.

Plate 5.1 Motorcycles are numerous in many Asian cities



Motorcycles in Kuala Lumpur, 1996

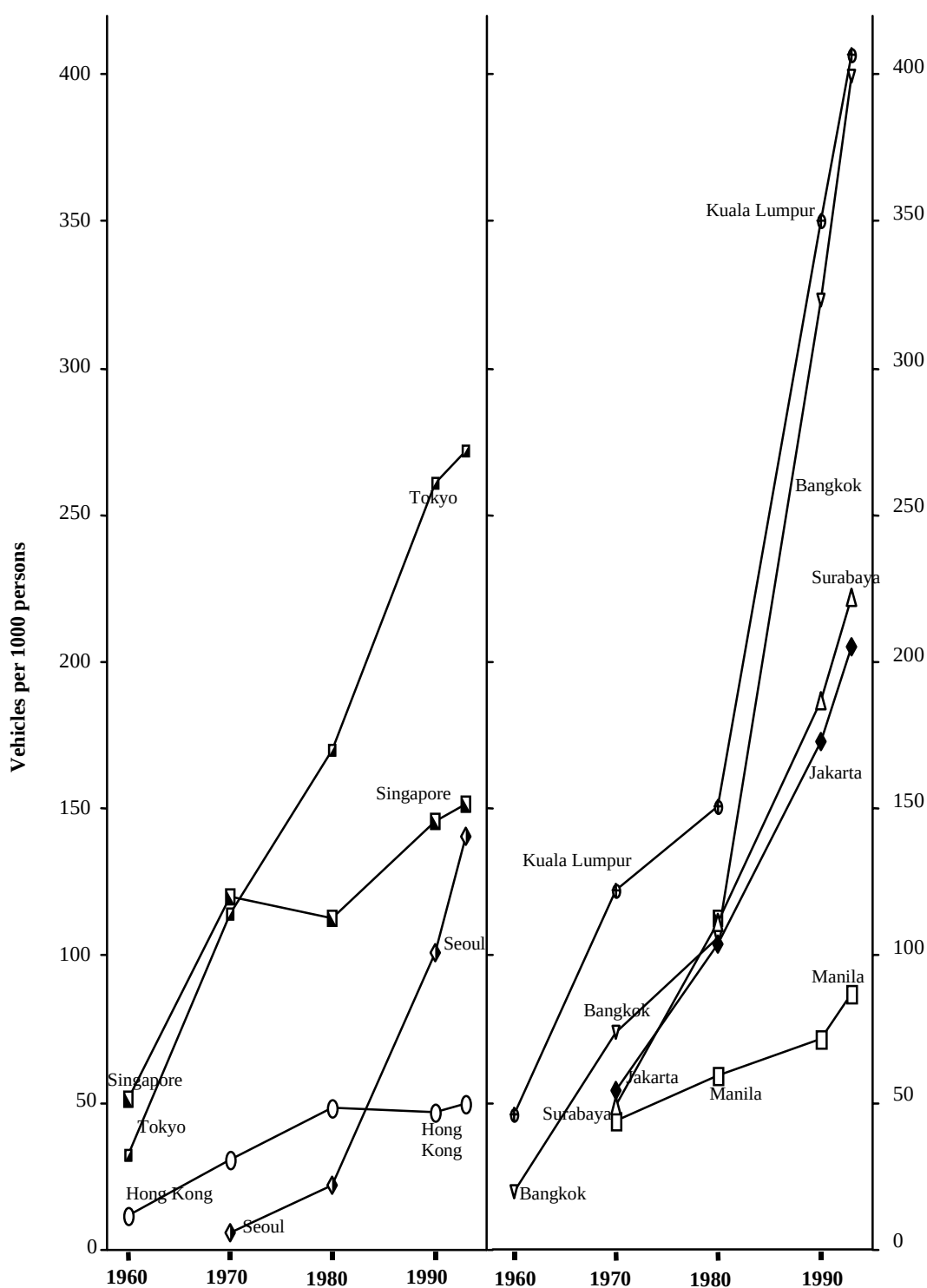


Parked motor scooters near Taipei City Government office, 1999

The surges in motorisation in Bangkok and Kuala Lumpur since 1980 have been so rapid that they raise the question of whether these rates of increase were unprecedented. If cars alone are considered, then the rates of increase in Bangkok and Kuala Lumpur are similar to rates of growth in other regions at earlier dates, such as in European cities during the 1960s (Table 5.2). However, Bangkok and Kuala Lumpur's increases in their "car plus motorcycle" ownership rates, of more than 20 vehicles per thousand people per year in the 1980s and early 1990s, were extremely high. These cities may indeed be undergoing among the most rapid transformations from low to high motorisation in history.

Since 1970, Tokyo has experienced a continued steady increase in car ownership but at a lower rate than its rapid rise of the 1960s and slower than one might have predicted given Japan's tremendous economic success throughout this period (until the early 1990s). Singapore and Hong Kong have had remarkably low rates of vehicle ownership growth by comparison with the middle income Asian cities and especially given their recent economic successes. This slow growth in vehicle numbers has been a matter of strong policy action by government (see Chapter 8). Figure 5.2 shows that between 1960 and 1970 the rising trend of private passenger vehicle ownership in Singapore had paralleled Kuala Lumpur's or Bangkok's but changed course drastically after 1970 and actually had declining passenger vehicle ownership between 1970 and 1980. Singapore's car ownership did rise during the 1980s but growth has been contained again in the 1990s.

Figure 5.2 Ownership of cars plus motorcycles in Asian cities, 1960-93



Note: The 1993 Tokyo and Seoul motorcycle data were unavailable so in those cases the 1990 motorcycle ownership rates were assumed to have remained unchanged for 1993.

Seoul's recent experience is especially noteworthy with a dramatic surge in car ownership, starting from a very low level in 1980. Table 5.2 shows that car ownership in Seoul prior to 1980 was the lowest in the whole sample at only 16 cars per 1000 persons. The 1980s saw a rapid increase in car ownership and within the decade, Seoul

overtook the rates in Hong Kong, Surabaya, Jakarta and Manila. Between 1990 and 1993 Seoul saw a further explosive rate of increase in car ownership. By 1993, Seoul had overtaken Singapore's car ownership rate. However, it was still well behind the ownership rates in Kuala Lumpur and Bangkok. Furthermore, motorcycles do not feature prominently in Seoul.

The rates of growth of car ownership in the three lower-middle-income cities of the sample have remained moderate, but it should be noted that car ownership growth in Manila and Jakarta has had a spurt since 1990 and motorcycle ownership has risen quickly in Surabaya. Surabaya and Jakarta's high rates of motorcycle ownership mean that their total private passenger vehicle ownership rates have soared well above Singapore's since 1980 (Figure 5.2). Manila's car ownership in 1990 was just below Jakarta's but, having very few motorcycles, Manila is far below the Indonesian cities' rates of private vehicle ownership.

Very recent data on motorisation have not been compiled but between 1993 and 1997 most cities probably continued rates of increase similar to their 1990 to 1993 trends. Newspaper reports about sales of motor vehicles in Malaysia and Thailand suggest that very high rates of increase continued in the period 1993 to 1996. Apparently Bangkok and Kuala Lumpur have continued to gradually gain on European car ownership rates. However, Seoul's rate of increase of car ownership dropped in the mid-1990s, even before the economic crisis (Lim, 1998). Possible reasons for this trend will also be examined in Chapter 8. Of course, since mid-1997, slower growth in vehicle numbers, and even some drops in certain cities, can be expected to be occurring in much of Asia as a result of economic contraction in most countries.

Table 5.4 emphasises the magnitude of the changes in vehicle numbers between 1980 and 1990 by presenting the increases in terms of absolute numbers (rather than per capita) and as percentage increases over the decade. Seoul stands out with an astounding 574% increase in the number of cars between 1980 and 1990. In Bangkok cars more than tripled in number during the decade and almost tripled in number in Kuala Lumpur. Cars more than doubled in number in both of the Indonesian cities. Motorcycles quadrupled in number in Kuala Lumpur, Bangkok and Seoul. The 1980-90 percentage increases for all vehicles taken together come to 450 percent in Seoul, 252 percent in Bangkok, 235 percent in Kuala Lumpur, 111 percent in Jakarta, 104 percent in Surabaya, 54 in Manila, 46 in Singapore, 43 in Tokyo, and 32 percent in Hong Kong. These dramatic figures, especially in the upper-middle-income cities, are partly due to the relatively low base figures in 1980 and are compounded by population growth.

Nevertheless, such enormous increases in total vehicle numbers have massive implications for the cities, especially given the limited road space available to move them. There are inherent spatial reasons for the limited road space in Asian cities that will be elaborated in detail in Chapter 6.

Table 5.4 Increases in absolute vehicle numbers in Asian cities, 1980 to 1990 (thousands)

	Cars			Motorcycles			Other Vehicles ^b		
	1980	1990	%	1980	1990	%	1980	1990	%
Seoul City	131	883	574%	45	194	331%	76	310	308%
Bangkok	355	1,168	229%	172	729	324%	84	149	77%
K. Lumpur ^a	173	515	198%	131	544	316%	43	160	271%
Jakarta	246	614	150%	428	804	88%	106	231	118%
Surabaya	41	99	141%	184	363	97%	28	54	93%
Singapore	155	275	77%	118	123	4%	98	145	48%
Manila	324	521	61%	27	50	85%	95	114	20%
Tokyo	1,811	2,667	47%	167	427	156%	1,113	1,335	20%
Hong Kong	212	237	12%	27	23	-15%	91	174	91%

Note: a. Because of boundary and other discrepancies between the 1980 and 1990 Kuala Lumpur data, that city's figures are estimates for the Klang Valley, calculated by multiplying motorisation rates by the appropriate populations.

b. Other vehicles include primarily goods vehicles, but also public transport vehicles, taxis and taxi-like vehicles.

A framework for describing different levels of motorisation has been suggested by Gilbert (1997). In the “first phase” with below 60 cars per 1000 persons they are a “luxury possession”. In the second phase between 60 and 300 cars per 1000, they are a “household possession”³⁶. Between 300 and 600 cars per 1000 they are an “individual possession”. Beyond that level, they are “one of several such specialised items owned by individuals”. If this framework is applied to the Asian cities in 1990, it can be said that cars remained a luxury possession in only Surabaya and Hong Kong. Manila, Seoul and Jakarta had just crossed into the household possession phase of car ownership and Bangkok and Kuala Lumpur were well into that phase. Singapore had entered the household possession phase by 1970 but has since then remained in the lower part of that range. Tokyo was the only city moving close to the individual possession stage. However, if motorcycles are counted along with cars, then Bangkok and Kuala Lumpur could be considered to have ownership of private vehicles in the individual possession category.

³⁶ The low end of the ‘household possession’ category may seem low but with a large household size of about 5 persons per household, an ownership level of 60 cars per 1000 persons does indeed imply that a significant proportion of households own a car. In 1980 in Kuala Lumpur for example, car ownership was 86 per 1000 persons and this equated to 36.6 percent of households owning at least one car (Wilbur Smith and Associates and Jurutera Konsultant (S.E.A.) Sdn. Bhd., 1981: 5.7).

5.2.3 Motorisation and incomes

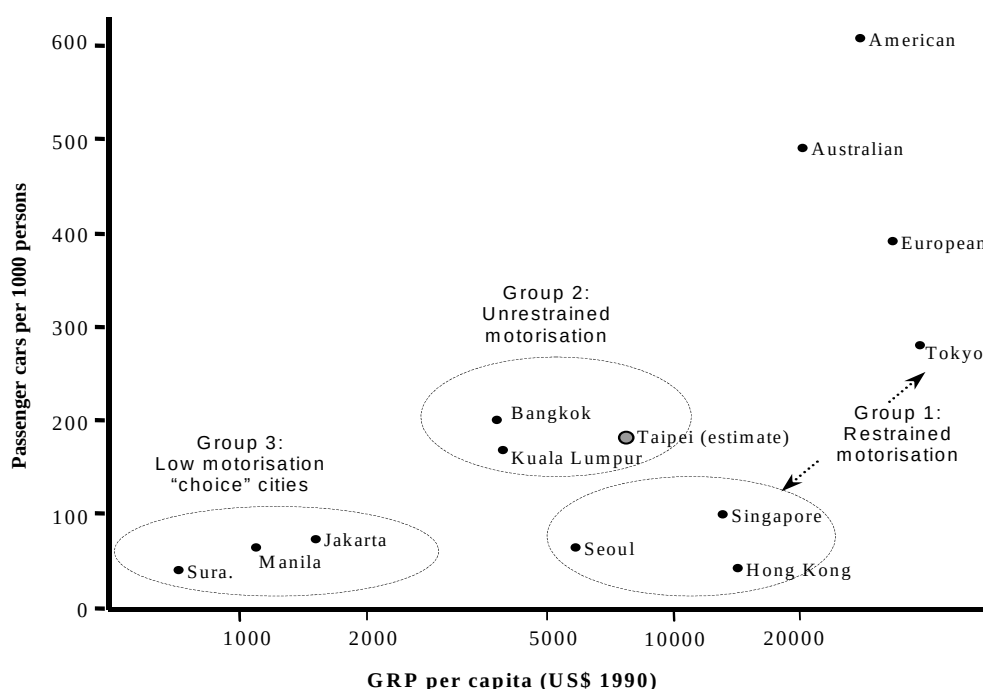
It was mentioned in Chapter 2 that many observers emphasise income as the primary determinant of motorisation levels, especially when national data are considered (Lave, 1992). Figure 5.3 shows car ownership in 1990 plotted against Gross Regional Product (GRP) per capita for the Asian cities along with the averages for the other regional groupings of cities. This Asian sample of cities clearly does not have a regular rise in car ownership with rising incomes.

The graph allows three groups of Asian cities to be identified. Hong Kong, Singapore and Seoul clearly had lower rates of car ownership in 1990 than would be expected given their comparatively high levels of wealth. Very rich Tokyo is in something of a class of its own, but it also had low car ownership when compared to its slightly less wealthy counterparts in Europe, America and Australia. Tokyo, Hong Kong, Singapore and Seoul have in common that they have restrained or delayed increases in car ownership relative to their increasing wealth through a variety of measures. These are discussed in detail in Chapter 8. Seoul's 1990 level of car ownership is seen to be still rather low relative to its income, despite the extremely rapid increases in car numbers during the 1980s that were discussed above.

The second group consists of Kuala Lumpur and Bangkok which show up in Figure 5.3 as having high car ownership considering their modest levels of GRP per capita. These cities in fact had much higher car ownership in 1990 than Seoul, Singapore, or Hong Kong, despite having considerably lower income levels (in terms of GRP per capita). They could be said to have unrestrained motorisation in contrast to the restrained or delayed motorisation of the first group of cities. These contrasting motorisation experiences have far reaching implications. They suggest that Bangkok and Kuala Lumpur are taking different urban transport paths from those of Seoul, Singapore, Hong Kong or Tokyo and that the differences are not simply a result of differences in income levels. When motorcycles are taken into account the distinction between the two paths is even more apparent.

The three lower income cities, Surabaya, Manila and Jakarta, form a third group of Asian cities, where both incomes and car ownership remained relatively low in 1990. The 1990 data for these cities apparently do not rule out the possibility of their following either the unrestrained motorisation path of Bangkok and Kuala Lumpur or the restrained motorisation path, although it has to be said that the former appears more likely at this stage.

Figure 5.3 Passenger car ownership per 1000 persons versus GRP per capita³⁷ in a global sample of cities, 1990



- Notes: a. The x-axis is on a logarithmic scale.
b. This graph shows passenger cars only and does not include motorcycles and other vehicle types.
c. Tokyo figures in this graph are for the whole Tokyo Metropolitan Transportation Area.
d. The American and Australian averages in this graph refer to the restricted sample of cities used for data items requested in the study for the World Bank (see Chapter 4). GRP data were not collected for Canberra, Portland, San Diego or Sacramento, hence their exclusion.
e. The figures for Taipei are estimates for the whole Taipei Metropolitan Area, made on the basis of Taiwan's GNP per capita of US\$7,761 (O'Connor, 1994) and Taipei City's car ownership of 157 per 1000 in 1990. The metropolitan GRP per capita can be assumed to be somewhat higher than the whole Taiwan GNP per capita figure and the metropolitan car ownership to be somewhat higher than the City's figure. Taipei City had about 2.5 million out of the metropolitan area's population of about 5 million in 1990.

An important comparison to present at this point is with Taipei in Asia's other "Tiger" economy, Taiwan. Taipei is highly relevant even though it could not be included in detail for this study. Motorisation data for Taipei suggest that its experience has been similar to Bangkok and Kuala Lumpur's, rather than like Hong Kong, Singapore or Seoul's. Taipei has had rapidly rising car and motorcycle ownership in the last two decades. In 1980 car ownership in Taipei City was 59 cars per 1000 people but by 1990 this had reached 157 and by 1993 it was 190. This trend is much like Kuala Lumpur's

³⁷ International comparisons of income levels must always be used with some caution. Differences in prices from country to country and misleading results due to currency conversions have led to a trend towards adjusting income data to give "purchasing power parity" (PPP) figures. These have not been used here for two main reasons. First, such numbers are difficult to find or derive for urban areas. Secondly, transport-related prices are a significant component of the basket of goods and services that are used to make the adjustments to derive PPP figures. Deliberate policies of keeping vehicles and their usage expensive may be among the underlying reasons for contrasts in Figure 5.5. High land prices may also be a factor. So comparing transport variables with PPP income figures might cause more confusion or be misleading in this case. Therefore, unadjusted GRP figures for the metropolitan regions are used here despite their drawbacks.

and Bangkok's and occurred during the same time period and motorcycle ownership in Taipei was even higher than in these two Southeast Asian cities. Motorcycle ownership in Taipei rose from 158 per 1000 people in 1980 to about 220 in 1990, and 256 motorcycles per 1000 people in 1993. By 1997, motorcycle ownership in Taipei was 335 per 1000 (Taipei City Government, 1998).

Taiwan has had a substantially higher income than Thailand or Malaysia during the 1980s and 1990s, so Taipei's surge of motorisation has, in fact, occurred slightly later in its economic development process than Kuala Lumpur or Bangkok's. Although exact figures for Taipei's metropolitan area could not be obtained, the approximate position of that city is shown on Figure 5.3. Taipei appears a little to the right of Bangkok and Kuala Lumpur (above and slightly to the right of Seoul). From this perspective, Taipei's 1990 motorisation appears to be relatively unrestrained, in common with Bangkok and Kuala Lumpur, and in contrast with the restrained or delayed motorisation of the Hong Kong, Singapore, Seoul and Tokyo. Certainly, Taipei's motorisation contrasts strongly with Seoul's, despite similar incomes.

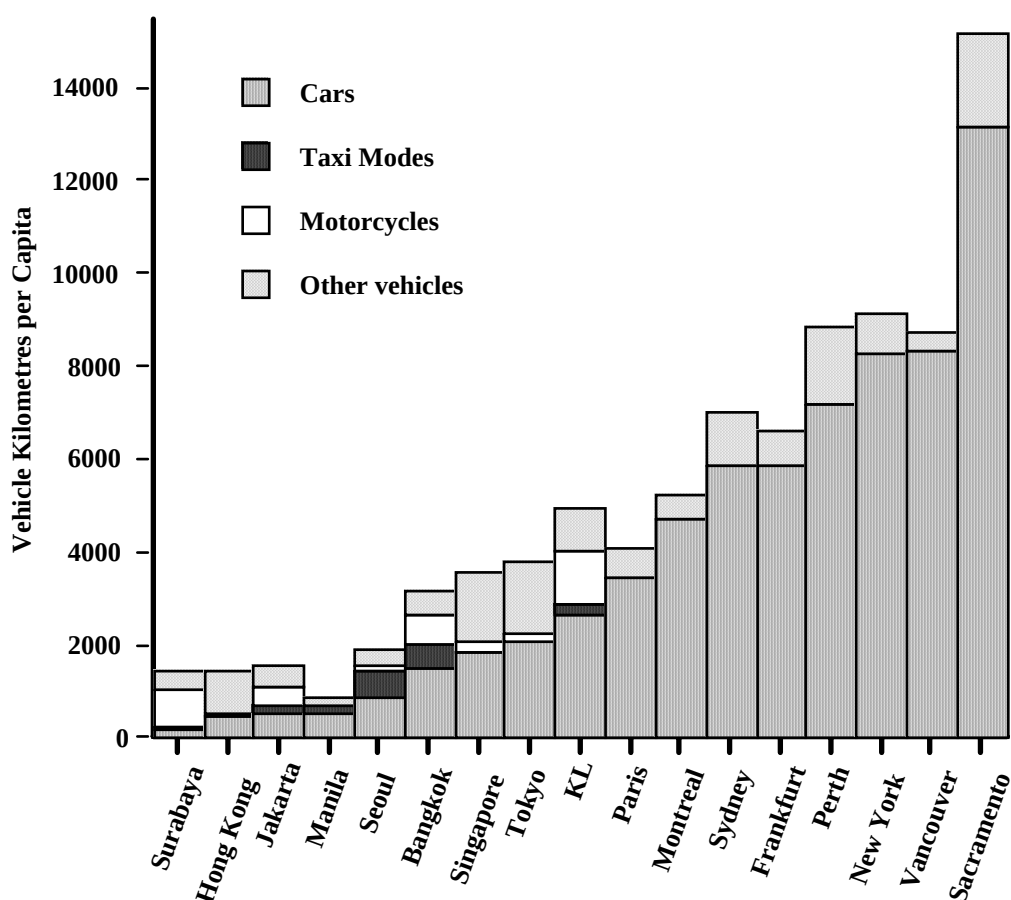
5.3 Private Vehicle Use

In the 1960s private vehicle use per person was very low in all of the Asian cities in this sample but by 1990 there were wider variations. Motorisation had created the potential for higher levels of private motorised mobility. However, variations in private vehicle use do not necessarily follow the variations in vehicle ownership exactly. Therefore, it is important to examine vehicle use in its own right. Many of the most pressing of the urban transport problems, including congestion and pollution, are a function of vehicle use, not mere ownership.

5.3.1 Vehicle use per capita

Private vehicle use in 1990 in most Asian cities, as measured by total private vehicle kilometres of travel (VKT) per capita, remained relatively low compared to the levels in Europe, Canada and Australia and very low compared with levels in the USA (Figure 5.4). In 1990 Kuala Lumpur, Tokyo, Bangkok and Singapore had between 3,000 and 5,000 vehicle kilometres per person. These levels fell a little below typical European levels of vehicle use (which ranged from just over 4,000 to almost 7,000 vehicle kilometres per person). Kuala Lumpur's private vehicle use per person had already reached a level that was within the lower end of the European range. The other five Asian cities, Seoul, Jakarta, Surabaya, Hong Kong and Manila, all had annual vehicle travel per person of less than 2,000 kilometres.

Figure 5.4 Private vehicle use per capita³⁸ for Asian cities and the extreme cases from each other region in an international sample of cities, 1990



Note: The other vehicles are primarily goods vehicles. However, in cases where motorcycle VKT is not specified separately, then it is included in the other vehicles' VKT figure. In cases where taxi VKT is not specified separately it is generally included under car VKT.

By 1990, several of the Asian cities, including Bangkok, Manila, Jakarta and Seoul, were already facing severe and well-known congestion and traffic-related air pollution problems. Therefore, it is sobering to note that in most of these cases the problems were actually the results of rather low levels of vehicle use per person by international standards. Reasons for this phenomenon are analysed in later sections and chapters. Figure 5.4 again shows the importance of motorcycles in Bangkok, Kuala Lumpur, Jakarta and Surabaya. It also reveals the relative importance of goods traffic in many of the Asian cities. This is especially striking in the wealthy Asian cities such as Tokyo, Singapore and Hong Kong, and may suggest that goods movement benefits from the restraint of private passenger traffic in those cities³⁹.

³⁸ Private vehicles include cars, motorcycles, taxis, other taxi-like modes and goods vehicles. The vehicle usage data in this section do not include public transport vehicles.

³⁹ However, some of these 'goods vehicles' may be carrying passengers, especially in cases such as Hong Kong, where it has been much cheaper to register a small goods vehicle than a car.

5.3.2 Private vehicle use and income

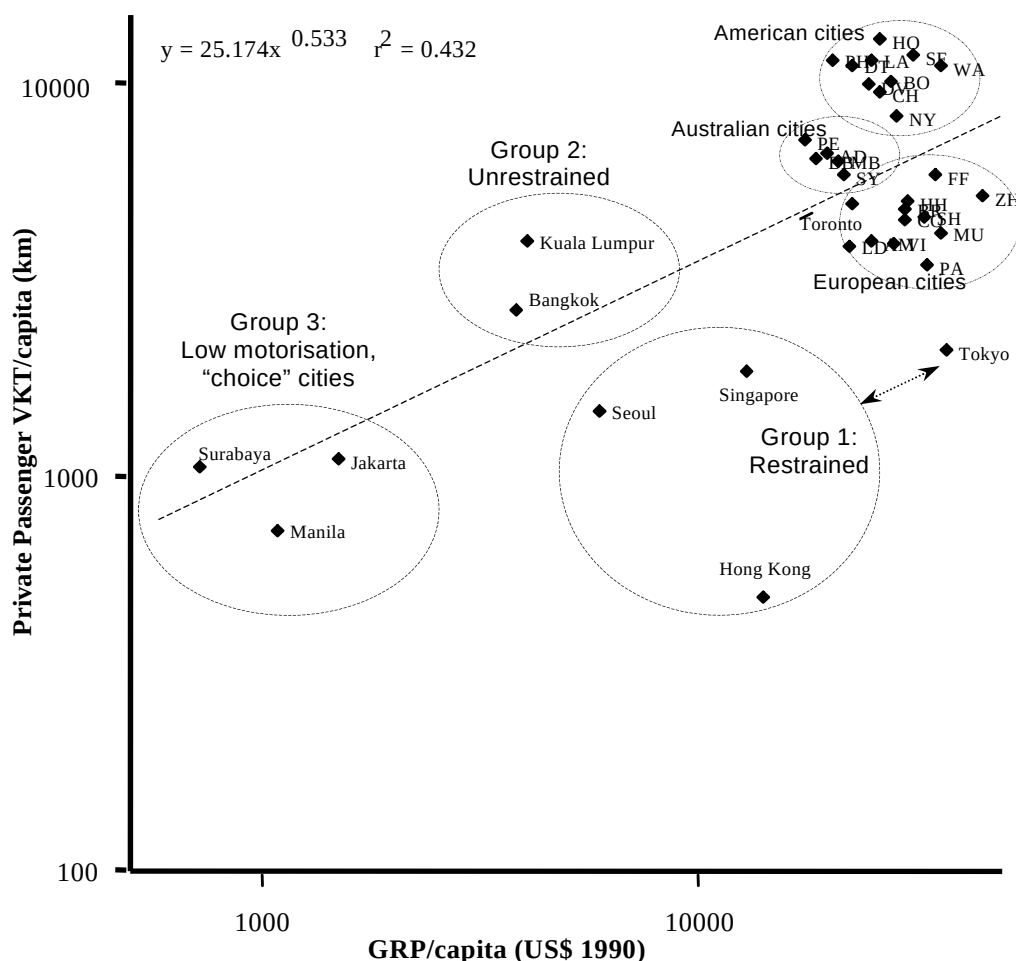
A graph of vehicle use versus income (Figure 5.5) provides similar insights as were revealed by Figure 5.3. This graph again clearly shows up the contrast between Kuala Lumpur and Bangkok on the one hand and Tokyo, Seoul, Hong Kong and Singapore on the other.

This graph can also be used to group cities according to whether they fall above or below the curve of best fit. Cities above the line of best fit had traffic that was relatively less restrained. Those below the curve had vehicle use that was apparently restrained by other factors besides income alone. Such other factors, some of which are examined in detail in Chapters 6 and 7, include: fiscal measures that make vehicle ownership or usage expensive; the influence of urban form parameters; lack of road infrastructure; levels of public transport service; and various other policies under the broad category of transport demand management (Newman and Kenworthy, 1995).

As was the case with car ownership, Kuala Lumpur and, to a slightly lesser extent, Bangkok, had vehicle usage levels that were surprisingly high given their relatively modest incomes in 1990. On the other hand, Tokyo, Singapore, Seoul and especially Hong Kong had lower levels of vehicle use than might be expected given their incomes. Jakarta, Surabaya and Manila all had low private vehicle use, which is understandable given their lower-middle income levels. However, Surabaya and Jakarta seem to have somewhat less “restrained” private vehicle use than Manila.

Looking at other regions, the European cities tended to have lower private vehicle usage than would be expected according to their incomes and the American and Australian cities had higher private vehicle use than their incomes would lead one to predict. Toronto fell between the Australian and European groups. Such differences point to the influence on vehicle use of factors other than income. Such factors, as suggested above, are also evident to a great extent in the Asian cities of the sample.

Figure 5.5 Private passenger vehicle use per capita versus GRP per capita in an international sample of cities, 1990



Note: Both axes are on logarithmic scales. Goods traffic is not included here.

5.3.3 Vehicle use per vehicle

There are substantial variations in how much individual vehicles are used in the different cities of the sample. Table 5.5 provides details on vehicle use per vehicle. These variations in usage per vehicle highlight the fact that caution must be used in making conclusions about mobility from motorisation data alone. The highest regional average values for vehicle use per vehicle and car kilometres per car were found in the United States, with each vehicle travelling an average of almost 17,000 kilometres per year (or about 47 kilometres per day). All of the other regions had lower (and similar) average values for vehicle kilometres per vehicle of between 11,600 per year (32 kilometres per day) in European cities and 13,600 kilometres per year (37 kilometres per day) in Australian cities. Within the Asian sample, Singapore and Hong Kong had particularly high values for the vehicle kilometres per vehicle, in fact higher than US

levels. At the other extreme, Jakarta and Surabaya apparently had much lower vehicle kilometres per vehicle and car kilometres per car figures than are typical world-wide.

Table 5.5 Annual vehicle use per vehicle parameters in Asian cities and other regional averages for an international sample of cities, 1990

	Vehicle km per vehicle (all vehicle types)	Car km per car	Car km per car (excluding taxi modes)	Motorcycle km per motorcycle
Hong Kong	19,100	11,500	?	?
Singapore	18,200	18,400	?	?
Seoul	13,600	18,500	11,500	?
Tokyo	12,100	10,900	?	?
Manila	11,000	10,200	8,300	?
Bangkok	10,700	13,000	9,900	4,900
Kuala Lumpur	10,800	14,900	13,800	5,700
Jakarta	8,000	9,100	7,000	4,100
Surabaya	7,100	6,600	5,100	5,500
Australian	13,600	13,400	?	?
American	16,700	18,600	?	?
Canadian	12,400	12,600	?	?
European	11,600	11,800	?	?
Asian	12,300	10,800	?	5,000

Taxis (and other taxi-like modes) are important in a number of Asian cities. Since taxis usually travel further per day than private cars, their inclusion boosts the car kilometres per car figures in these cities. Table 5.5 shows this for a number of the Asian cities where a split could be calculated. In Seoul in particular, the car kilometres per car figure drops from a high value of 18,500 km to 11,500 km when taxis are excluded. Taxis and other taxi-like modes are discussed in more detail in the next section. Motorcycles apparently tend to be used less intensively than cars. For the four cities with high levels of motorcycle use, motorcycle kilometres per motorcycle were within the range of 4,000 to 5,700 km per year.

5.3.4 Taxis and taxi-like modes

The variety of motorised taxi-like modes⁴⁰ in Asia was discussed briefly in Chapter 4. Taxi-like modes are more significant in many Asian cities than in Western cities. The reasons for considering taxis with private vehicles in the main data set were also outlined in Chapter 4. However, their importance in Asia means that they warrant a brief separate discussion.

⁴⁰ Non-motorised taxi-like modes, such as pedicabs and bicycle taxis, are discussed along with other non-motorised transport.

Table 5.6 gives a range of data on taxi-like modes in the Asian cities and in the very few other cities for which this study has any taxi data. The data suggest that taxi modes are at least as important, or more so, in most Asian cities as they are in some of the most “taxi-rich” of Western cities, such as London.

Table 5.6 Taxi-like modes⁴¹ in Asian and selected other cities, 1990

City	Taxis per 1000 persons	Taxis as % of all vehicles	Taxi % of all trips	Taxi VKT per person (estimated)	2 or 3-wheel taxis per 1000 persons
Hong Kong	3.2	4.0%	~10 (of motorised)	?	0
Manila	3.3	3.8%	?	160	2.1
Seoul	4.2	3.5%	12.8 (of motorised)	610	0
Singapore	4.5	2.3%	1.9	?	0
Jakarta	>3.7	>1.8%	3.0*	>190	>1.8 [†]
Bangkok	6.3	~1.8%	?	>520	~4.0 [†]
Tokyo	~4.1	~1%	~3.0	?	0
Kuala Lumpur	3.7	0.9%	1.8*	260	0
Surabaya	0.8	0.4%	?	60	0
London	<~3.3	0.8%	?	?	-
New York	3.2	0.6%	?	?	-
Phoenix	<0.8	0.1%	?	?	-

Notes: * Jakarta and Kuala Lumpur mode split figures are from 1985.

[†] Jakarta motorcycle taxi numbers are unknown but significant. Bangkok had an estimated 16,000 motorcycle taxis in 1988 (Poboon, 1997: 66). This is assumed as the 1990 figure for this table, amounting to 2.7 vehicles per 1000 people. Unfortunately, the taxi VKT estimate for Bangkok excludes these.

In Seoul and Hong Kong in 1990, taxi modes apparently carried a significant proportion of motorised trips⁴², more than in most of the other Asian cities. Taxi modes accounted for a significant amount of the vehicle kilometres in Seoul and in Hong Kong too (Hau, 1995). In Hong Kong, taxi numbers are reported to have quadrupled in the 15 years up to the early 1990s (Meakin, 1993). The figures for taxis as a percentage of all vehicles also suggest that taxi-like modes play a strong role in Manila.

5.4 Public Transport Use and Provision

Chapter 3 discussed the general picture for public transport in the 1960s when buses were the main public transport of all of the Asian cities in the sample, except Tokyo. In Tokyo, rail was already the main public mode in the 1960s. Here the 1990 situation and trends since the 1960s are presented.

⁴¹ It is common for a proportion of taxi-like modes to operate illegally, so data presented here are likely to represent a lower bound on the role of these modes in most middle-income Asian cities.

⁴² The estimate of the mode share for taxis in Hong Kong is based on data in Lo (Lo, 1992) which shows taxis as 12.6 percent of trips on public transport (where taxis were included in his public transport total).

5.4.1 Public transport in 1990

Very high levels of public transport use were achieved in some of the Asian cities in the sample in 1990 but certainly not in all (Table 5.7). In addition to the Asian cities and the other regional averages, data are also given for two cities in each other region, namely the cities in each region with the greatest and lowest roles for public transport. Perhaps the best measure of the relative importance of public transport in a city is the percentage of total motorised passenger kilometres that are by public transport. By this measure, public transport remained reasonably important in all of these Asian cities in 1990. However, the passenger kilometres per capita and the trips per capita figures show that some of the developing Asian cities have rather low levels of public transport use per person.

Hong Kong, Tokyo, Seoul, Singapore, Manila, and Jakarta each had a high or very high role for public transport compared with private motorised modes. All of these six cities had a much higher share of motorised passenger kilometres on collective modes than any of the cities in the West. Indeed, in 1990 Tokyo, Hong Kong, Seoul, Singapore and Manila all had higher public transport passenger kilometres per capita than any of the Western cities in the international sample. Hong Kong, Seoul, Singapore and Tokyo have particularly high percentages of work trips on public transport, a large proportion of which are concentrated in the peak hours when pressure on road capacity is most acute.

Surabaya, Kuala Lumpur and Bangkok had the smallest role for public transport out of the Asian cities in the sample with between 20 and 33 percent of motorised travel in 1990. This is surprisingly low for such dense and relatively low-income cities and such levels were similar to those typical in much wealthier European cities. Nevertheless, these Asian cities still had much higher roles for public transport than Australian or American cities.

Although Jakarta had a significant role for public transport when expressed as a percentage of motorised travel, its absolute level of public transport use in 1990 was actually rather low. Thus even though Jakarta's percentage of all passenger kilometres by public modes was higher at 46 percent than either Bangkok's or Kuala Lumpur's, its public transport use per capita was substantially lower. Surabaya had the lowest level of public transport passenger kilometres per person of the Asian cities, with a level similar to many American or Australian cities, though as percentage of total motorised travel Surabaya's public transport was still more important than in most Western cities.

Manila's high use of public transport was in contrast with Jakarta and Surabaya. This is perhaps surprising given that many other characteristics, such as income levels, density, urban fabric and car ownership levels are similar between Manila and the Indonesian cities. However, it will be remembered that the other major contrast between Manila and the Indonesian cities was in motorcycle ownership, with Manila being extremely low in this factor. Interactions between public transport use and motorcycle ownership are discussed further later in the thesis.

Table 5.7 Public transport use in an international sample of cities, 1990

	Percent of motorised pass. km on public transport	Annual passenger km per capita on public transport	Percentage of motorised work trips on public transport	Annual public transport passenger trips per capita
Hong Kong	82	3,784	89	570
Tokyo	63	5,501	62	461
Manila	62	2,568	66	481
Seoul	54	2,890	74	460
Singapore	47	2,775	72	457
Jakarta	46	1,323	47	238
Bangkok	33	2,313	33	423
Surabaya	26	555	27	174
Kuala Lumpur	20	1,577	31	227
Other Regions' Extremes (based on percent of motorised passenger kilometres on public transport)				
New York (US maximum)	11	1334	29	155
Phoenix (US minimum)	1	124	2	15
Sydney (Australian max.)	16	1,769	27	160
Perth (Australian min.)	4	544	10	54
Toronto (Canada max.)	24	2,173	21	350
Vancouver (Canada min.)	6	871	13	117
Vienna (European max.)	32	2,430	50	422
Frankfurt (European min.)	12	1,149	46	217
Regional Averages				
Asian	49	2,587	56	388
European	23	1,895	47	318
Canadian	10	998	21	161
Australian	8	882	15	92
American	3	474	9	63

5.4.2 Public transport trends 1970-90

As discussed in Chapter 3, in 1970 public transport was predominant in the motorised transport of most of the Asian cities of this sample, except Kuala Lumpur, where motorcycles, taxi-modes and cars had already captured a slight majority of motorised trips. In most of the Asian cities, the share of motorised trips by public modes has been slowly decreasing over the 1970 to 1990 period (Table 5.8). This has generally been a result of rising private vehicle transport rather than because of drops in the absolute level of public transport usage. In fact, public transport passenger kilometres per person

have been rising in all of the Asian cities, except Manila which experienced a small decline in this measure of public transport use between 1980 and 1990 (Table 5.8). The increase in public passenger kilometres has been most dramatic in the cases of Hong Kong and Singapore. In Jakarta, Surabaya and Manila, public transport has apparently been maintaining its share of motorised trips in the early 1990s, despite rapid motorisation in this period.

Table 5.8 Trends in public transport use in an international sample of cities, 1970 to the mid 1990s

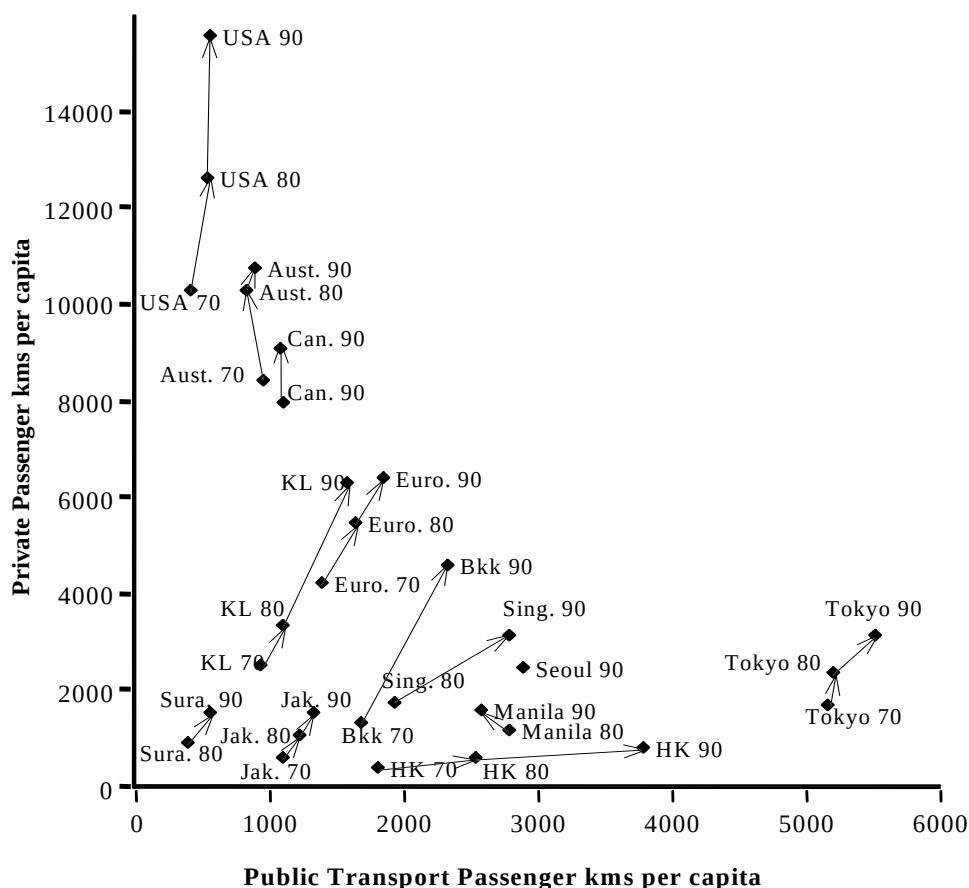
	Percent of all motorised trips by public transport				Public transport passenger km per person		
	1970	1980	1990	1993-96	1970	1980	1990
Tokyo	65	51	48	?	5,161	5,191	5,501
Hong Kong	?	?	?	?	1,806	2,531	3,784
Seoul	81	74	63	?	?	?	2,890
Singapore	42	?	?	51	?	1,928	2,775
Manila	?	70	67	70	?	2,772	2,568
Bangkok	53	?	39	?	1,683	?	2,313
Kuala Lumpur	37	33	32	24	936	1,101	1,577
Jakarta	61	58	52	53	1,084	1,221	1,323
Surabaya	?	36	27	35	?	390	555
European average	-	-	-	-	1,430	1,660	1,895
Canadian average	-	-	-	-	667	1,009	998
Australian average	-	-	-	-	949	815	882
USA average	-	-	-	-	332	452	474

Notes: Kuala Lumpur's public transport mode split figures may include trips on school and factory buses that are excluded from other data on public transport. The 1995 Surabaya mode split figure includes taxis. The Seoul mode split figures are for the City of Seoul only.

Sources for mode split figures for all trips (this is not a standard CAAD data item): Jakarta - Mogridge (1992) citing earlier studies and Pacific Consultants International (1995: 7.31) (this is a modelled estimate including DKI-DKI and DKI-BOTABEK trips); Surabaya - (Dorsch Consult et al., 1996b; Gunawan, 1992; JICA, 1983); Kuala Lumpur - (JICA, 1987b; Perunding Atur Sdn. Bhd., 1991; Wilbur Smith and Associates, 1974; Wilbur Smith and Associates and Jurutera Konsultant (S.E.A.) Sdn. Bhd., 1981; Yasukawa, 1998); Singapore - (Land Transport Authority, 1996; Rimmer, 1979); Seoul - (Korea Transport Institute, 1993; Lim, 1993); Bangkok - (Poboon, 1997); Tokyo - (City Bureau and Building Research Institute, 1990); Manila - (JICA, 1984; JICA, 1997).

Another picture of motorised mobility trends is offered by Figure 5.6 below. It graphically shows not only the relative roles of public and private transport in each city at each date, but also the levels of mobility in each city. This allows additional insights that cannot be seen in simple modal split figures. The graph shows that overall motorised mobility has been rising almost everywhere in the sample but that different regions and different cities vary widely in how much of this greater mobility is on public or private modes.

Figure 5.6 Trends in motorised mobility (private versus public) in Asian cities and regional averages from an international sample of cities, 1970 to 1990



Note: Complete time series were not available for all cities, so the American averages in this graph exclude Houston, Portland and Sacramento, and the European averages exclude Frankfurt, Zurich and Vienna.

Strong contrasts can be seen among the Asian cities in the time trends in Figure 5.6. Over recent decades, Kuala Lumpur, Bangkok, Surabaya and Jakarta have seen greater rises in private travel than in public transport travel. In contrast, Singapore's public transport use came closer to keeping pace with increased private transport. In Hong Kong, almost all of the increased mobility since 1970 was in public transport. Manila's and Tokyo's private transport use have risen more than public transport, but these cities already had high levels of public transport use by 1980. The Indonesian cities can be seen to have unusually low absolute levels of motorised travel compared with most other cities. However, the trends in the graph suggest that, as their levels of mobility rise, Jakarta and Surabaya may follow paths similar to Kuala Lumpur and Bangkok.

The United States, Australian and Canadian cities already had high private and low public mobility in 1970. On average, this pattern has increased further, with private transport mobility increasing much faster than public transport mobility in these regions.

The European cities average has had a similar trend line to Kuala Lumpur or Bangkok, but with a slower overall rate of change.

In addition, Figure 5.6 casts further light on the character of the Asian bus cities in 1970. It suggests that rather low levels of both public and private mobility are characteristic of these bus cities. Furthermore, Surabaya's trajectory on the graph, which only goes back to 1980, suggests that in the 1960s, Surabaya must have had very low levels of motorised mobility indeed, even by public transport. It was thus almost certainly still predominantly a non-motorised city at that time.

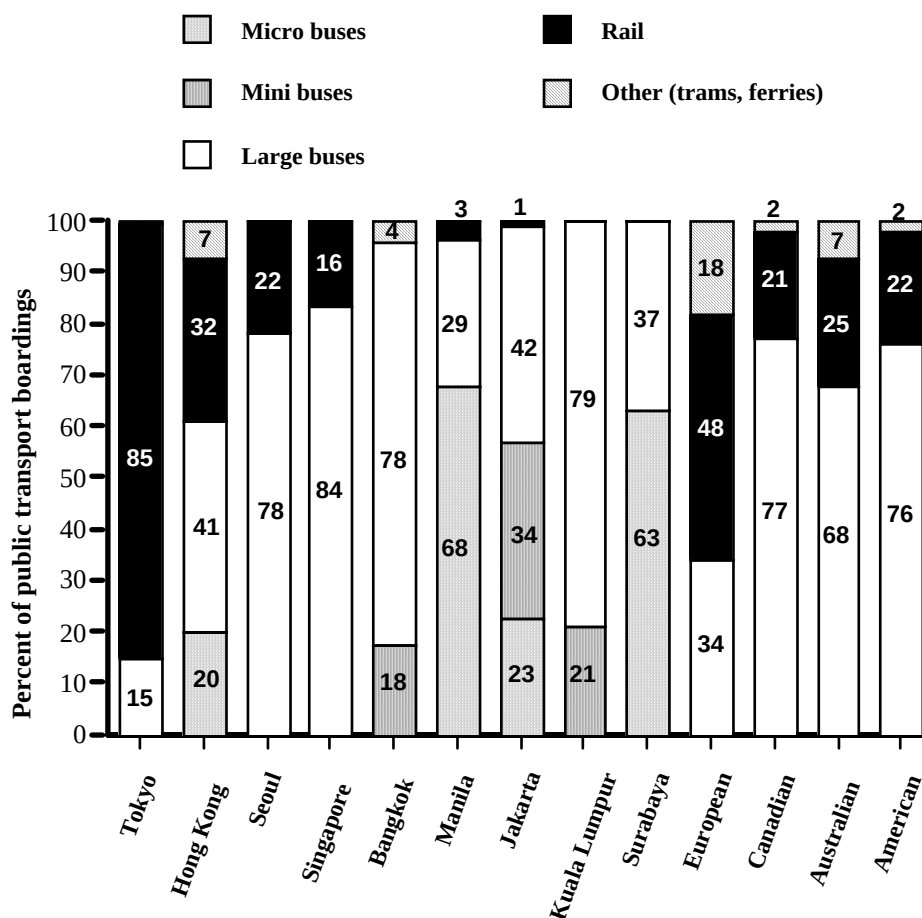
5.4.3 Relative importance of different public modes

The cities in the international sample have widely varying mixes of public transport modes and widely varying shares of passenger boardings by each. There are also wide variations within the Asian sample. Figure 5.7 presents data on the relative significance in 1990 of the different kinds of public transport in the Asian cities. The regional averages for the international sample are also shown along with data on a number of other specific cities, for comparison.

The first noteworthy feature of Figure 5.7 is the relative importance of the different sizes of buses in the Asian cities' public transport systems. Small buses are important only within the Asian sample. Manila and Surabaya had the greatest proportions of minibuses. Jakarta and Hong Kong also had significant numbers of passengers travelling in minibuses. Minibuses with capacities between about 25 and 45 persons were significant in Jakarta and Kuala Lumpur. Bangkok also had significant numbers of private minibuses which also had a capacity of 30.

The second noteworthy feature is the relative importance of urban rail in the public transport of each city. The 1990 data reveal striking variations within the Asian sample. A major change is seen to have taken place since 1970 in Singapore, Hong Kong and Seoul. In 1970, like the other developing Asian cities, these cities had negligible rail service. However by 1990, each of these three cities had significant use of rail (more than 15 percent of public transport boardings ranging up to 32 percent). The dominance of Tokyo's public transport system by rail continued to be exceptionally high, as it had already been by 1960 and 1970. Tokyo's public transport system, and indeed its overall passenger transport system, was more rail-oriented than any other city in the international sample. In the remaining five Asian cities, rail remained insignificant in their transport systems in 1990. In none did rail account for more than 3 percent of public transport boardings.

Figure 5.7 Percentages of passenger boardings by each public transport mode⁴³ in Asian cities in an international sample of cities, 1990



Rail was significant in most of the European cities, carrying on average half of public transport's passengers. In North America and Australia the role of rail within the public transport systems varied widely, from no role at all to the dominant role. However, it must be remembered that in these cities public transport overall had a relatively small role in the total transport systems.

These figures reveal that in most Asian cities in 1990, not only did road-based public transport account for most public transport passenger trips (Figure 5.7), but it also carried a large proportion of total motorised travel (Figure 5.8). Manila is the extreme case in this respect, with buses and jeepneys accounting for 58 percent of all motorised passenger kilometres in that city and virtually all of the public transport task. In European cities this situation is reversed with rail as the dominant public transport

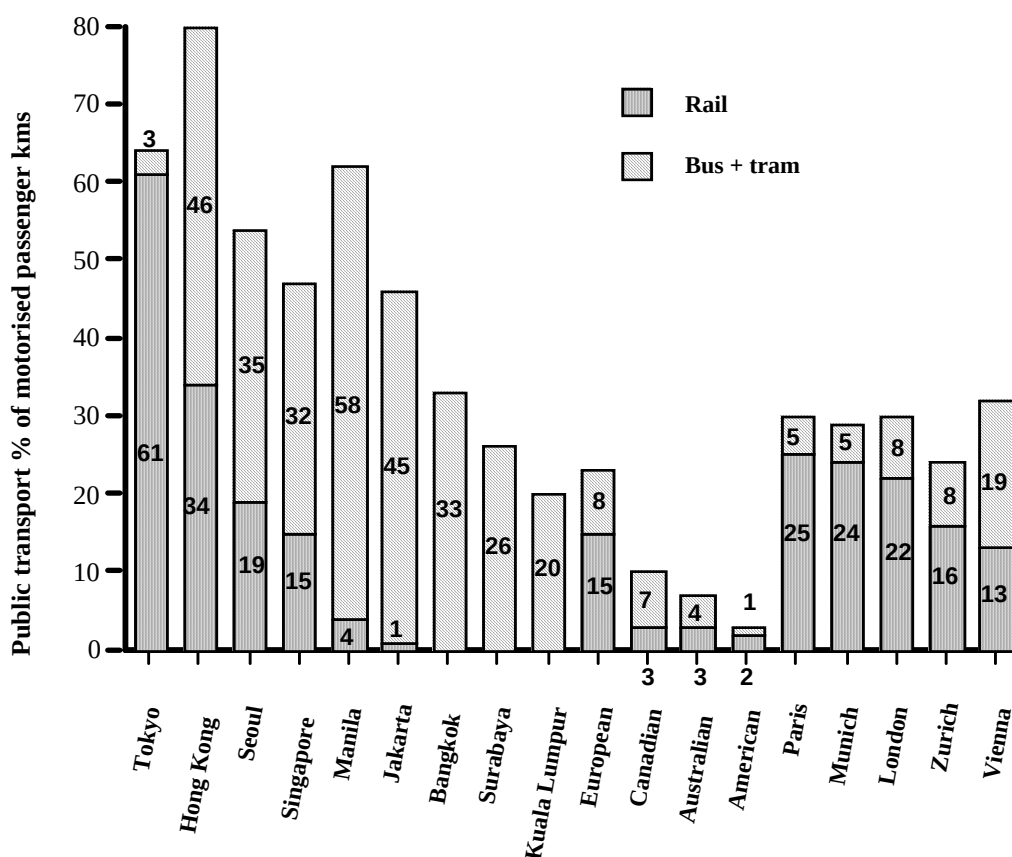
⁴³ The public modes are here grouped into the following categories: minibuses (of 8 to 20 passenger capacity), minibuses (of 21 to 50), large buses (of greater than 51 passenger capacity), rail (which includes modern light rail, suburban rail and metro systems), and others (which includes ordinary trams and water transport).

carrier in most European cities and rail carrying a significant proportion of all motorised passenger kilometres (an average of 15%).

Within the international sample, this vital importance of road-based public transport is almost unique to the Asian group of cities. Buses accounted for between 20 and 58 percent of total motorised passenger travel in each of the Asian cities, except for rail-oriented Tokyo. Among the Western sample, very few cities retain a significant role for buses or trams in their overall transport task. Vienna was the only city with almost as significant a role for the road-based public transport modes, its buses and trams accounting for 19 percent of its total motorised passenger kilometres (compared to 13 percent by rail). Many cities in North America and Australia do have bus-based public transport systems, but these are cities in which public transport as a whole plays a minor role in the overall transport system.

Figure 5.8 clarifies the situation further by showing the importance of rail and road-based public modes compared to the overall transport task in each Asian city. Regional averages and a number of the most public transport-oriented European cities are also shown for comparison.

Figure 5.8 Rail versus buses/trams as percentages of total motorised travel in Asian (and selected European) cities in an international sample of cities, 1990



The high level of dependence on road-based public transport in Asia highlights the vulnerability of public transport in these cities, and therefore their whole transport systems, to the impact of traffic congestion. This also highlights the vital importance of measures to provide on-road priority to buses in Asian cities and/or to develop fully segregated public transport systems, such as rail or high-quality busways. The importance of rail in Seoul, Hong Kong and Singapore is relatively recent. Singapore's mass transit rail system was only opened in 1987. Seoul's first subway line opened in 1974 and most suburban rail development has also been since that time. Hong Kong's mass transit rail system opened in 1979. Hong Kong had suburban rail prior to that, but in 1970 rail carried less than three percent of public transport passenger kilometres. Although buses remain very important in these cities, the development of segregated rail systems has now given their public transport systems a strong measure of immunity from the impacts of traffic congestion, unlike the situation in most of the middle-income Asian cities.

5.4.4 Public transport service levels

This section compares the public transport supply within the various cities in both per capita terms and in per hectare terms. Two main measures of supply per capita are presented in Table 5.9. The first is the vehicle kilometres of public transport service per capita. This is the standard measure which has been collected for all cities in the sample and provides a simple measure of public transport supply. The second measure, capacity kilometres per capita has been compiled for the Asian sample (and estimated for a few other cities) and is useful to consider in conjunction with service kilometres because of the very wide variations in the size of public transport vehicles used in the cities of the sample. Capacity kilometres per capita provides a measure of the ultimate potential of the system to carry passenger kilometres, although of course in practice, public transport in most of the Asian cities actually carries somewhat less than this amount. Even with overcrowded buses in long peak periods, there are always periods of the day with lighter passenger loadings.

Table 5.9 Public transport supply and effectiveness measures in an international sample of cities, 1990

City	Service km per capita	Capacity km per capita (‘000s)	Service density (‘000 km per ha)	Average public transport speed	Public transport speed % of traffic speed
Tokyo	89	22.8	6.3	39	158%
Hong Kong	140	12.2	42.1	28	108%
Seoul	114	11.8	27.9	26	107%
Singapore	114	11.6	9.9	26	79%
Bangkok	110	6.6	16.5	9	70%
Manila	258	6.6	51.1	17	67%
Kuala Lumpur	50	2.7	2.9	16	55%
Jakarta	55	2.0	9.3	15	64%
Surabaya	62	1.1	11.0	18	65%
Asian average	110	-	19.7	21	86%
European average	92	?	4.5	37	114%
Canadian average	53	?	1.4	24	61%
Australian average	60	?	0.8	31	68%
American average	28	?	0.4	28	57%
Zurich	148	~32.0	7.0	45	124%
Frankfurt	48	~9.2	2.2	46	153%
Phoenix	10	~1.0	0.1	25	48%

Note: The capacity kilometre figures are estimates based on service kilometres and capacity figures (including both seating and standing space) for each vehicle type. In the Asian cities the capacity figures were based on officially stated numbers (often the legal maximum capacity). In the European cities the capacities were estimates for each vehicle type.

In addition to these per capita measures, a per hectare measure of public transport service is also provided. This measure, public transport service kilometres per hectare, provides an indication of the “density of service” which relates to the accessibility of public transport services. A high figure implies high frequency services and/or a tightly knit network of routes. Personal impressions on the ubiquity of public transport in cities should also tend to match this figure reasonably well. Finally, the average speed of public transport in each city and the relative speeds of public transport and general traffic, provide simple measures of the quality of public transport service and of its potential competitiveness relative to private transport. The speed of public transport service relative to private transport speed, is a key factor influencing how people opt to travel, particularly as incomes rise and a greater proportion of people can afford a number of travel choices.

Among the Western cities in the sample, a number of European cities are renowned for their high levels of high-quality public transport service and supply, with Zurich having the highest level of service of the European cities in this international sample (Laube, 1998). So it may be useful to use the Zurich and European average figures as a

benchmark against which to measure the Asian cities' public transport supply parameters.

In 1990 most of the Asian cities (except Kuala Lumpur, Jakarta and Surabaya) had service kilometres per capita in the high end of the European range. Manila actually had a much higher value than Zurich. However, high service kilometres do not necessarily translate to high capacity kilometres per capita in cities, such as Manila, where most public transport vehicles are small. Only the four richer Asian cities (Tokyo, Hong Kong, Singapore and Seoul) had capacity kilometre figures in the estimated European range (with greater than about 9,000 capacity kilometres per person). Surabaya, Jakarta and Kuala Lumpur, had low public transport capacity kilometres per capita, with Manila's and Bangkok's being a little higher, but still nowhere near Zurich's estimated figure.

Turning to service kilometres per hectare (or public transport service density), it is noticeable that a number of the Asian cities had extremely high values, especially Manila, Hong Kong and Seoul. Singapore and Tokyo also had public transport service densities above or within the high end of the European range⁴⁴. Even Surabaya and Jakarta had higher service density figures than European cities, despite their low service kilometres per capita and capacity kilometres per capita figures. Thus in 1990, public transport in Jakarta and Surabaya was plentiful on a spatial basis, but offered low capacity relative to the number of people in the service catchments. In other words, public transport supply appears to be insufficient, despite the fact that public transport vehicles are plentiful in the streets. For example, in Surabaya buses or minibuses pass very frequently on most routes, but passengers are often unable to board because of overloading (Colin Buchanan and Partners, P.T. Pamintori Cipta, and P.T. Insan Mandiri Konsultan, January 1994). Kuala Lumpur had the lowest service density of the Asian cities, with a value within the lower end of the European range. This matches the casual observer's impression of a lack of public transport in the city⁴⁵ and the data that showed relatively low usage of public transport in Kuala Lumpur. Nevertheless, its service density was still much higher than that of most North American or Australian cities.

⁴⁴ The figures are still high even allowing for the fact that service kilometres per hectare figures for Seoul and Hong Kong will be exaggerated to an extent. This is because some proportion of the public transport services must run through a certain amount of non-urbanised land on their way to satellite cities.

⁴⁵ The author has been resident in Kuala Lumpur for much of the period, 1994 until 1998.

The public transport speed data in Table 5.9 show that in 1990 the four higher income Asian cities achieved average speeds of more than 25 kilometres per hour for public transport, and in Tokyo, Hong Kong and Seoul, public transport speeds were greater than the average speed of traffic⁴⁶. On the other hand, public transport speeds in Bangkok, Kuala Lumpur, Manila, Jakarta, and Surabaya, were less than 20 km/h and significantly slower than general traffic speeds. Bangkok's public transport speed of only 9 km/h is particularly alarming and the slowest in the global sample. These low public transport speeds reflect the dominance within public transport of buses in mixed traffic in most middle-income Asian cities. Other than in the rich Asian cities it is only in European cities that public transport was competitive in speed with private modes.

5.5 Private Transport Infrastructure

This section returns to private transport, to discuss the provision of the infrastructure used primarily (although not exclusively) by the various private transport modes. First, a brief comparison of road provision is made, then car parking in central business districts (CBDs) is compared and discussed.

5.5.1 Road provision

In comparing road provision it is hoped to contrast the relative levels of commitment to infrastructure for moving traffic. The road provision variable which has been collected for all of the cities in the sample, is the simple centre-line length of all classes of roads (Figure 5.9).

A problem with this simple measure is that most of the road length in each city is accounted for by the local roads, the majority of which play only a minor traffic role. Figure 5.10 provides some data on main road provision in the Asian cities and in the few cities of the global sample for which such information was collected⁴⁷. There are enough data however from a number of cities in the sample to make some assessment of this issue.

Both the total roads data and the main roads figures suggest that road provision per capita in the Asian cities tends to be much lower than in the other regions for which data were gathered. However, the Asian cities that are most endowed with roads, Singapore and Kuala Lumpur, have levels that are similar to or only slightly lower than the European cities with the least road provision.

⁴⁶ These are in-vehicle speeds.

⁴⁷ More sophisticated measures of provision for arterial traffic flows would be provided by lane length measures, but these were not easily available in many cities and have not been systematically collected.

Figure 5.9 Road length per capita in an international sample of cities, 1990

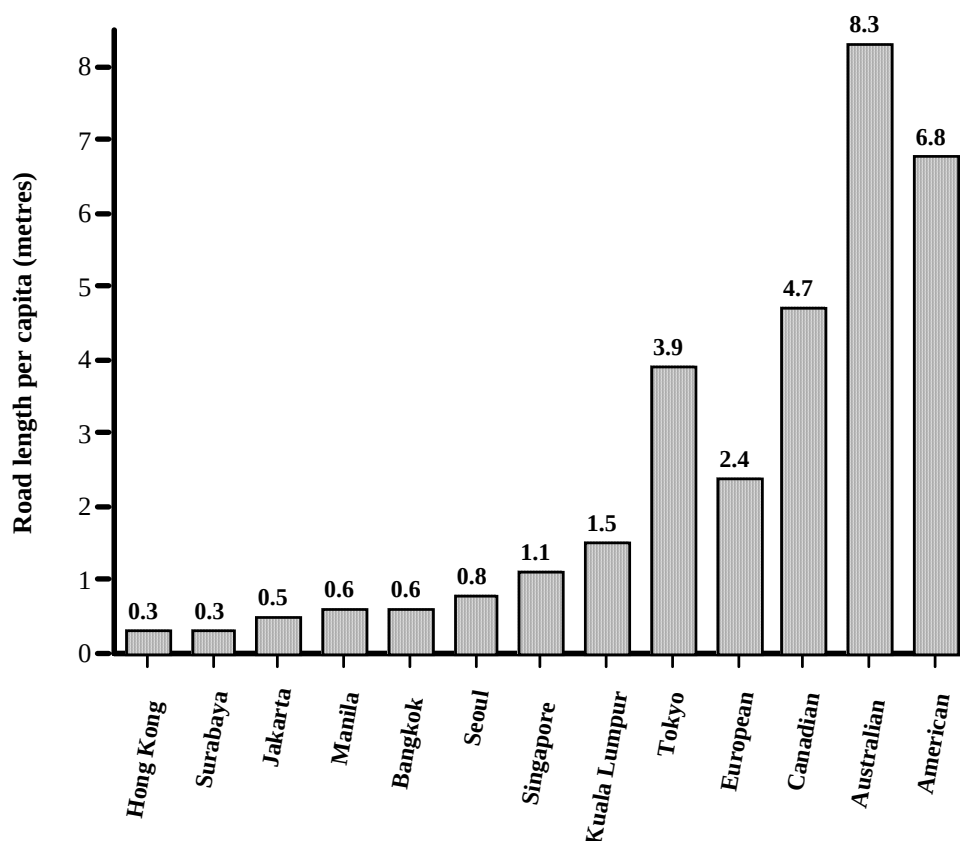
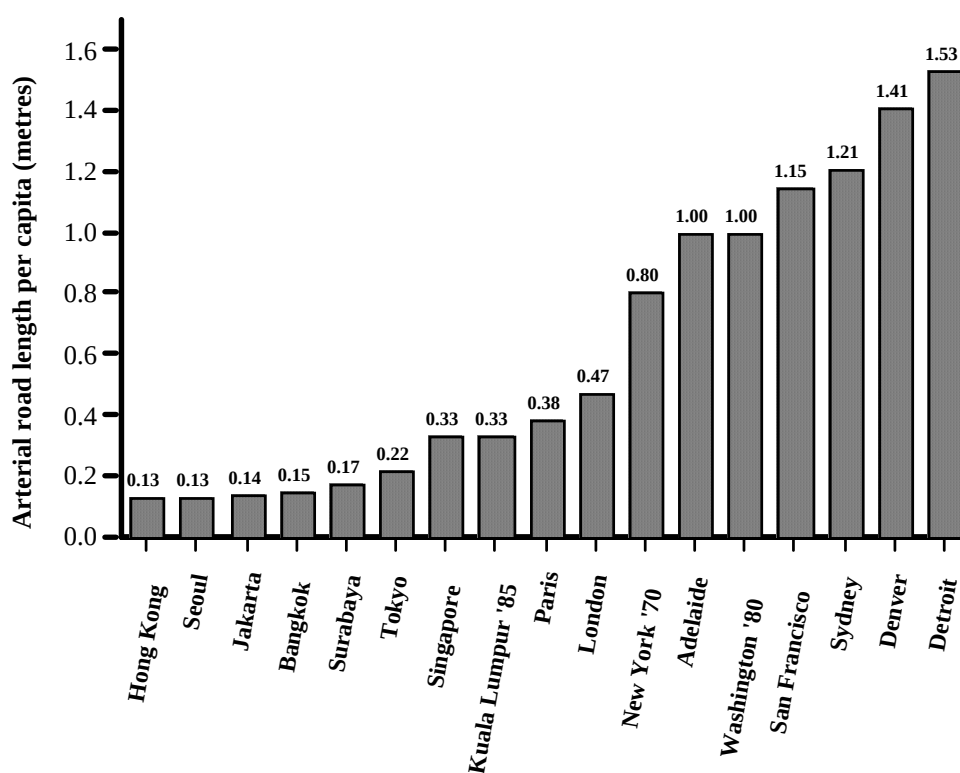


Figure 5.10 Provision of main roads in an international sample of cities, 1990



Note: a. It is difficult to consistently draw the line between “main” and “local” roads. The street types that have been included in the definition of main roads in each case are:
 Hong Kong (all major roads as defined in traffic census);

Seoul (includes avenues >~40m width, streets 25~35 m, roads 12~20 m, excludes "paths" <~10 m);
 Jakarta ("arterials" included, "local" roads excluded);
 Bangkok ("expressways" and "main roads", excludes "local" streets);
 Surabaya (all "arterials" and "collectors");
 Tokyo (all categories except local "shi" and "gun" roads);
 Singapore (includes "expressways", "major arterials", and "collectors", excludes "local" streets);
 Kuala Lumpur ("expressways, primary distributors, district distributors, local distributors");
 London ("classified roads");
 Paris (all roads except ordinary departmental roads);
 Sydney (includes "main roads", excludes "local" streets);
 Adelaide (includes "arterial roads", excludes "local" streets);
 New York (includes "freeways and arterial", excludes "local");
 Washington (excludes only "collectors and local streets");
 San Francisco (excludes "city streets");
 Detroit (excludes "local roads");
 Denver (includes "freeways, expressways" and "arterials").
 b. Tokyo's arterial road data are for Tokyo-to, not the larger Tokyo Metropolitan Transportation Area (TMTA).

All of the Asian cities in this international sample have also built at least some length of expressway or completely controlled-access highway. The amount of expressway varies very widely from city to city. In the 1960s, apart from in Tokyo, there was little or no length of expressways in the Asian cities of this sample, as mentioned in Chapter 3. By the 1990s, Jakarta, Tokyo, Seoul, Kuala Lumpur and Singapore all had significant networks of expressways, with over 150 kilometres each according to the latest information (Table 5.10). Seoul has the largest network in absolute terms, but on the basis of length per capita it is Kuala Lumpur that stands out as having, by far, the most "expressway per person" in the Asian group of cities.

On many of the transport parameters presented so far in this chapter, Kuala Lumpur and Bangkok have had distinct similarities. However, in the case of the measures of road provision per capita presented in this section, Kuala Lumpur contrasts strongly with Bangkok, having much higher levels of road length, main road length and expressway length per capita than Bangkok. There is further discussion on indicators of road provision in Chapter 6, where it will be shown that a spatial perspective provides a deeper understanding of the underlying reasons for the road provision patterns presented here.

Table 5.10 Lengths of expressway in Asian cities and selected other cities in an international sample of cities, 1970s to 1990s

City	Year	Expressway length (km)	Expressway length per capita (km per million persons)
Manila	1980	26	4.4
	1990	~40	~5.0
Bangkok (BMA)	1980	0	0
	1990	27	4.6
	1993	48	8.5
Surabaya	1980	0	0
	1990	18	7.3
	1995	30	9.4
Hong Kong	1990	82	14.8
Jakarta (Jabotabek)	<1978	0	0
	1980	50	6.8
	1990	203	15.5
Seoul(+Inchon+Kyonggi-do)	1982	160	12.7
	1990	222	13.3
	1995	311	~16.3
Tokyo (Tokyo-to)	1974	97	8.4
	1993	225	18.9
Singapore	1970	4	1.9
	1980	39	16.1
	1990	104	38.4
Kuala Lumpur	1973	25	27.4
	1985	150	59.5
	1997	~257	~69.5
London	1990	57	8.5
Hamburg	1990	81	49.0
Paris	1990	646	60.6
New York	1980	2,506	142.5
Los Angeles	1990	1,443	162.8
Denver	1990	367	209.1

Sources: Jakarta 1970-1990: Pacific Consultants International (1995: 3-22);

Surabaya, 1996: Dorsch Consult et al. (1996b);

Tokyo 1974: Hall (1977: 231); Tokyo 1993: Sakamaki (1993);

Bangkok 1993: Townsend (1995);

Hong Kong: No expressway length data were found so the figure above was measured from maps.

Kuala Lumpur 1997: estimate based on the opening since 1985 of the North Klang Valley Expressway (27.4 km), the Shah Alam Expressway (27 km), the Central Link of the North South Highway (48 km), and the extension to the east of the Federal Highway (~5 km) and an estimated 1997 Klang Valley population of 3.7 million.

The rest of the data were among those collected for the CAAD study (Kenworthy and Laube et al., 1999, forthcoming).

Notes: a. Jakarta data are for the whole Jabotabek area. The population used for the per capita figure was the urban population of Jabotabek at each date, according to Firman and Dharmapatni (1994), namely 7.374 million in 1980 and 13.091 million in 1990.

b. Seoul data are for Seoul, Inch'on and Kyonggi province. However, to calculate the per capita figure the population of the Metropolitan area (Seoul, Inch'on and the satellite cities) was used (11.59 million in 1980, 16.73 million in 1990 and estimated as 19.0 million in 1995).

5.5.2 Parking provision

The supply of parking spaces is also a significant transport variable, especially parking supply in concentrated centres of activity, such as the central business district (CBD).

Parking is expensive and difficult to provide in large quantities in dense and busy areas.

This means that space demands for parking are often a critical constraint on private car access to an area. The number of parking places in the CBD relative to the number of central city jobs is the parking parameter that has been systematically collected for this international sample.

Again with this indicator, the regional averages vary in a regular way. However, there are some wide variations within each region, therefore extreme cases from each region are also presented. On average, American, Canadian and Australian cities had relatively plentiful CBD parking, while European and Asian cities provided much less.

Cities with high levels of public transport use, such as Tokyo, Hong Kong, and Seoul, provided very little parking space in their CBDs in 1990 (the three cities averaged only 42 spaces per 1000 jobs). However, relatively low CBD parking is also true of some Western cities that have lower levels of public transport use overall, such as New York and Toronto. However, these cases have very high levels of public transport use for travel to their CBDs (Kenworthy, 1991; Thomson, 1977: 201). Many Australian and American cities that have low usage of public transport, whether for CBD trips or for travel overall, tend to provide large numbers of parking spaces in their central areas (usually more than 400 spaces per 1000 workers). Most European cities fell between the extremes, with 150 to 350 spaces per 1000 CBD workers. Singapore had moderate CBD parking, near the lower end of the European range and similar to Toronto.

Again, Kuala Lumpur and Bangkok stand out from the four higher-income Asian cities in the sample with surprisingly high numbers of parking spaces in their city centres (300 to 400 spaces per 1000 jobs), well above the European average of 209 spaces per 1000 jobs. It must be concluded that a rather large proportion of vehicle-owning CBD workers in Kuala Lumpur and Bangkok have parking available and have little parking-related incentive not to use cars or motorcycles.

Table 5.11 Parking supply in central business districts relative to employment in Asian cities (and selected others) in an international sample of cities, 1990

Asian Cities	Parking spaces per 1000 CBD workers	Other Cities (extremes in each region)	Parking spaces per 1000 CBD workers	Regional Averages	Parking spaces per 1000 CBD workers
		American			
Manila	27	New York	60	American	468
Hong Kong	33	Phoenix	906	Australian	489
Tokyo	43	Australian		Canadian	408
Seoul	49	Sydney	222	European	209
Surabaya	?	Canberra	842	Asian	144
Jakarta	?	Canadian			
Singapore	164	Toronto	176		
Kuala Lumpur	297	Edmonton	593		
Bangkok	397	European			
		Zurich	137		
		Amsterdam	354		

5.6 Non-Motorised Transport

Asia is renowned for high rates of non-motorised vehicle (NMV) use in both low-income countries, such as China and India, and high-income Japan. The high urban densities and mixed land use that are characteristic of most Asian cities, provide the opportunity for walking and NMVs to play a significant transport role. Chapter 3 showed that NMVs were indeed important in the 1950s in most of the Asian cities in this international sample. However, since then the use of NMVs has declined to very low levels in all of them except Tokyo and Surabaya. Walking usually still retains a significant role, but it appears that NMV use can be extremely vulnerable to the hostile conditions created by rapid motorisation.

Notwithstanding some concern over whether very short trips have always been counted (see Chapter 4), the data show that walking remained important in 1990 in most of these Asian cities, with the walking share of all trips ranging from a low of 15 percent in Bangkok to a high of 40 percent in Jakarta (Table 5.12). This range is similar to levels in the few European cities for which similar data are presented. Walking was also clearly important for work trips in most of the Asian cities. Surmising from the data in Table 5.12, walking probably accounted for well over 10 percent of work trips in most of the Asian cities in the sample, which is apparently similar to levels of walking in European cities.

However, the use of bicycles or other non-motorised vehicles (NMVs) was very low within this sample of Asian cities, except in Tokyo and in the Indonesian cities. This suggests that the level of NMV use is a fragile thing since, as discussed in Chapter 3,

most of the Asian cities in the sample had high levels of bicycle and/or pedicab use in the 1950s. Only Tokyo's trends stand out in contrast. Over the last two decades, bicycles have actually risen dramatically in popularity in Tokyo and other Japanese cities (Yamakawa, 1994). In 1968, bicycles⁴⁸ accounted for almost 8.1 percent of all Tokyo Metropolitan Transportation Area trips, in 1978 it was 15.1 and by 1988 it had risen to 17.6 percent (City Bureau and Building Research Institute, 1990: 17).

Table 5.12 Non-motorised transport mode shares in Asian cities and selected other cities in an international sample of cities, 1990

	NMT % work trips	NMT % all trips	Breakdown (% of all trips)		
			Walk	Bicycle	Pedicab
Tokyo	22	42	27	15	0
Hong Kong	17	?	?	tiny	0
Singapore	22	25	25	<1	tiny
Seoul	20	?	?	<2	0
Kuala Lumpur	18 [†]	28 [†]	~26 [†]	~2 [†]	0 [†]
Bangkok	10	15	~15	tiny	tiny
Jakarta	22	47 [†]	40 [†]	2.4 [†]	4.6 [†]
Manila	19*	30*	?	tiny	~1-2?
Surabaya	31*	(35 in 1995)	(20 in 1996) 20 (19.6 in 1995)	5 (10.5 in 1995)	10 (4.8 in 1995)
Amsterdam	35	~47	~23	~24	0
Copenhagen	32	?	?	?	0
Zurich	24	~29	~25	~4	0
Munich	16	~37	~24	~13	0
Stockholm	14	~30	~24	~6	0
London	14	~36	~34	~2	0
European average	18	-	-	-	-
Canadian average	6	-	-	-	-
Australian average	5	-	-	-	-
USA average	5	-	-	-	-

Sources: The shares for all trip types for Amsterdam, Zurich, Munich, Stockholm and London are from Pharoah and Apel (1995: 254). The sources for the Asian cities' all trips mode split data are from among the sources listed in the notes to Table 5.8.

Notes: * denotes 1980 data, † denotes 1985 data. Since 1985, pedicabs have been banned in Jakarta and are now restricted to the far outskirts beyond the city boundary.

Non-motorised taxi modes (mainly pedicabs) are insignificant except in Surabaya and perhaps also in Manila (of the cities in this sample). A number of the Southeast Asian cities phased them out in the 1960s, as mentioned in Chapter 3. After many years of gradually tightened restrictions, Jakarta banned pedicabs (*becak*) in 1989 (the Jakarta pedicab data is from 1985), but small numbers are said to still operate in peripheral

⁴⁸ These Tokyo figures also include motorcycles but bicycles account for almost all of these trips.

areas within DKI Jakarta and many certainly operate in the urbanised areas just beyond the DKI Jakarta boundaries. Two-wheeled bicycle taxis, known as *ojek*, also still exist in small numbers in Jakarta, especially in older central areas. A paying passenger sits behind the *ojek* driver on a padded seat. In Manila, pedicabs have seen a resurgence since the mid-1980s and are now an important feeder mode in certain areas of the city (Williams, 1994). Unfortunately, no reliable data are available on the extent of their use. Nowhere in this sample do pedicabs dominate the transport system, as they do in Dhaka, Bangladesh (Gallagher, 1992).

Of the other regions, it is in the European cities that levels of non-motorised transport are highest. In the European sample the 1990 non-motorised share of work trips ranged from 8.5 percent in Frankfurt and 12 to 14 percent in several other European cities, to such high figures as 35 percent in Amsterdam and 32 percent in Copenhagen. Bicycle trips were a significant proportion of these non-motorised trips in the latter two cities. Zurich and Brussels, with lower bicycle use, nevertheless achieved non-motorised work trip shares of 24 percent and 19 percent respectively. Thus, the European range is similar to the Asian range and in both regions, some cities had significant NMV use and some did not. Within the more car-oriented regions, Canada, the USA and Australia, non-motorised transport rates tend to be very low, although they are highest in Canada.

By 1990, levels of income seem to have little to do with the levels of non-motorised transport, especially non-motorised vehicle use in this sample of cities. There are middle-income cities with surprisingly low non-motorised transport use and very high-income cities with very high non-motorised transport use. This factor seems to depend much more critically on whether or not the conditions for the safe use of these modes are protected and enhanced, such as through improved footpaths (sidewalks), pedestrianisation, lowered speed limits, traffic calming, bike lanes, bike parking, etc. Land use patterns with high densities and mixed use are also critically important, though as the Asian cities data demonstrate, this alone is not sufficient if the other conditions for non-motorised transport use are too hostile or dangerous.

5.7 Challenges and Impacts of Transport

This chapter has so far provided a picture of how the key transport characteristics of the Asian cities compare with each other and with many other cities internationally. Ideally, at this point it would be desirable to examine possible measures of success for each city's transport system. However, specifying indicators of success is a surprisingly difficult task. An attempt to do so has been made, but the resulting indicator probably

requires further development and testing to ensure rigour and completeness. Therefore, since it is not central to the main arguments of the study, the discussion of indicators of success in urban transport has been relegated to Appendix 5, so as not to distract from the main points of this chapter. This section now turns to a number of the major negative impacts of transport (on residents and on the local, regional and global environment). The key issues involved and the regional contrasts are highlighted using a small number of impacts that illustrate the issues.

5.7.1 Global impacts

Urban transport contributes significantly to a number of the important human impacts on the global environment. Prominent among these is the build-up of greenhouse gases, in particular carbon dioxide (CO₂), in the atmosphere. This is a by-product of the burning of fossil fuels, primarily oil in the case of transport. The fossil fuel industry also has other significant environmental impacts associated with the mining, processing and transport of the products. Furthermore, other transport-related global environmental issues include those related to consumption of material resources of many kinds.

In this sub-section, only energy use for transport and CO₂ emissions are presented to illustrate the patterns of variation for global impacts of urban transport among the cities of this international sample. Energy use in passenger transport was a central concern of the earlier study by Newman and Kenworthy (1989). They found that the regional variations of energy consumption for urban passenger transport followed much the same pattern as the variations in vehicle kilometres of travel (VKT) per capita. In fact, the American cities' fuel use per person were higher than other regions by an even greater margin than with VKT, due to the larger, less fuel-efficient vehicles in North America. In this international study, the same general picture still holds for the 1990 data (Table 5.13, Figure 5.11). As with so many other transport variables that have been presented here, there were extremely high levels of energy use and CO₂ emissions in the US, lower levels in Australian cities, then Canadian, then European, then Asian cities.

On the basis of the data in Table 5.13, most Asian cities contributed relatively little (per person) to the global impacts of urban transport compared with cities in the other regions. The Asian city average per capita CO₂ emissions from urban transport in 1990 were half of the European average and just over a fifth of the American cities average. This is to be expected of low-income cities but even Hong Kong and Seoul had CO₂ emissions per capita lower than the Asian average. However, the highest emitting Asian city in 1990, Kuala Lumpur, had CO₂ emissions per capita that were only slightly lower

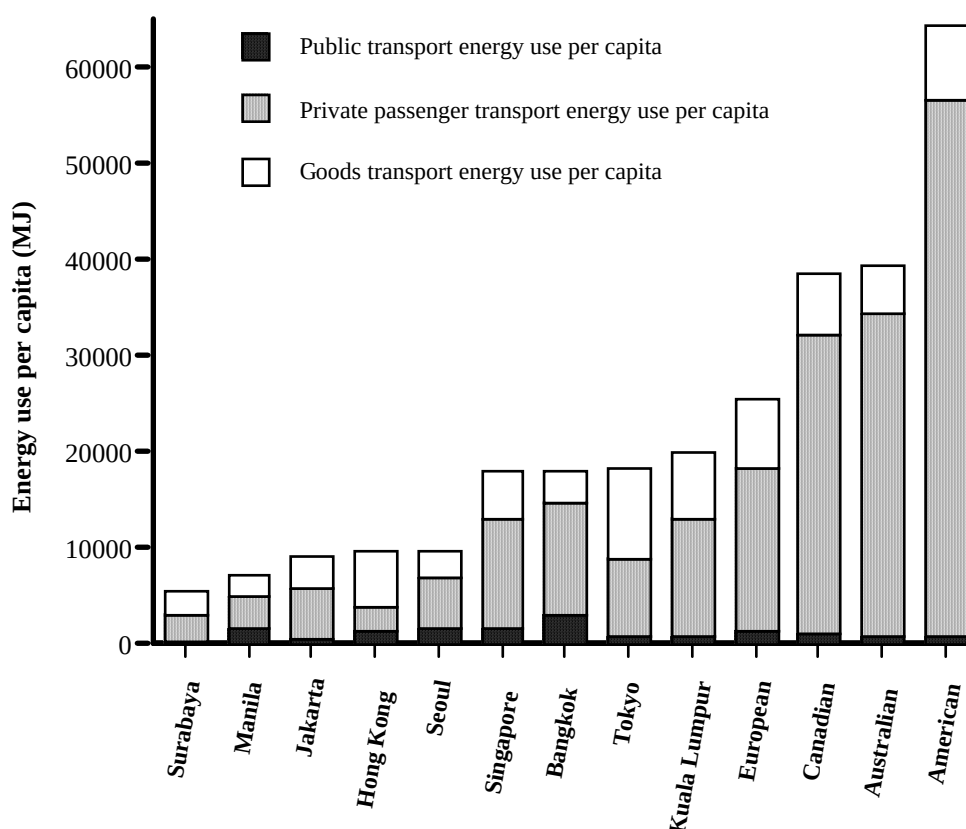
than the lowest emitting European city. Tokyo, Singapore and Bangkok were just below Kuala Lumpur in transport CO₂ emissions per capita. In the cases of Kuala Lumpur and Bangkok it is sobering that, despite only middle-incomes, they already had “global impacts” from transport that were almost within the high-income European range. It was found in a previous section that vehicle travel has been rising rapidly in these two Southeast Asian cities in the early 1990s, so it is expected that by 1997 energy use and CO₂ emissions from transport in Kuala Lumpur and Bangkok may have been as high or higher than those of some European cities.

Table 5.13 Energy use and carbon dioxide emissions per capita from urban transport in an international sample of cities, 1990

	Passenger transport energy use per capita (MJ)	Total transport energy use per capita (MJ)	Total transport CO₂ emissions per capita (kg)
Kuala Lumpur	12,339	20,017	1,424
Tokyo	8,015	18,243	1,397
Singapore	11,383	18,079	1,317
Bangkok	11,764	18,176	1,304
Hong Kong	2,406	9,612	760
Seoul	5,293	9,615	705
Jakarta	5,536	9,072	653
Manila	3,347	7,335	529
Surabaya	2,633	5,611	404
Averages			
American average	55,807	64,351	4,541
Australian average	33,562	39,456	2,789
Canadian average	30,893	39,173	2,434
European average	17,218	25,692	1,888
Asian average	6,968	14,170	944
Selected other cities			
Amsterdam	13,915	19,843	1,475
Munich	14,224	18,197	1,441
London	12,884	23,374	1,704

Figure 5.11 shows the breakdown of transport energy use per capita into public transport, private passenger transport and goods transport. It is apparent that even in the cities where public transport accounts for most motorised passenger movements, the public modes make only a small contribution to the total transport energy use, and hence to CO₂ emissions. Private passenger transport, and often goods transport as well, account for most of the energy consumed by urban transport in most of the cities of the sample.

Figure 5.11 Energy use per capita in urban transport in Asian cities in an international sample of cities, 1990



The small contribution of public transport to energy consumption, even in cities where public transport is the dominant motorised mode of transport, is partly a result of its greater energy efficiency per passenger kilometre than that of private transport. Table 5.14 shows the energy consumption per passenger km of each major mode of transport in each Asian city and the averages for the other regions. Public transport is particularly energy efficient in most of the Asian cities, largely because high vehicle occupancies are commonly attained in these cities. Conversely, buses and trains are much less energy efficient in the American and Australian cities where many services run relatively empty. Private transport is also more energy efficient in a number of the Asian cities. This is explained partly by higher average occupancies for cars in most Asian cities, but also by the influence of the large number of small motorcycles in cities such as Surabaya, Jakarta and Kuala Lumpur. Nevertheless, even in cities such as Surabaya or Manila, where public transport is dominated by relatively low-capacity vehicles, these still achieve much better energy efficiency than private transport. The well-used rail systems of Tokyo, Hong Kong, Singapore, Seoul and Manila achieve extraordinarily low energy use figures of less than 0.2 MJ per passenger kilometre, which is much less than one-tenth of the typical private transport figure in the

international sample of cities. Of course, it was shown earlier that non-motorised transport is significant in several Asian and European cities, and these modes consume almost no fuel and make almost no contribution at all to CO₂ emissions.

Table 5.14 Energy consumption per passenger kilometre for private transport, buses and rail in Asian cities in an international sample of cities, 1990

	MJ per pass. km (private passenger modes)	MJ per pass. km (bus)	MJ per pass. km (rail + tram)
Surabaya	1.2	0.5	-
Jakarta	1.6	0.3	?
Kuala Lumpur	1.8	0.5	-
Seoul	2.2	0.8	0.18
Manila	2.3	0.7	0.06
Tokyo	2.5	1.0	0.13
Bangkok	2.5	1.6	0.47
Hong Kong	3.0	0.7	0.19
Singapore	3.6	0.8	0.15
Asian average	2.3	0.8	0.2
European average	2.6	1.3	0.5
Australian average	3.0	1.7	1.1
American average	3.5	2.5	0.9

Thus, on average, the Asian cities tend to have low energy use per capita because they have relatively low private vehicle use per capita compared to the other regions and also because they have energy efficient transport systems, with high patronage levels on relatively energy efficient public modes (and in some cases a significant role for non-motorised modes). Low energy use per capita translates almost directly into low rates of CO₂ emissions per capita in most Asian cities, compared with cities in the other regions, particularly the American cities. This suggests that the Asian cities' contributions per capita to most other negative global impacts of transport are also likely to be relatively low.

5.7.2 Local impacts

The major negative local impacts of urban transport include air pollution, noise pollution, water pollution, the severance of communities by roads or railways, transport accidents and congestion. The regional variations of a number of these local negative impacts are in stark contrast to the global impacts. This is because for many local impacts it may be more appropriate to compare their intensity on a spatial basis rather than their levels per capita. For example, local air pollution emissions per hectare may be more useful than emissions per capita because the spatial (per hectare) value better measures exposure. The same applies to noise from transport or to the nuisance effects

of traffic. It turns out that local impacts per hectare of urban transport are already very high in many Asian cities, despite low VKT per capita. This is in keeping with many people's simple observations and experience of walking in cities such as Bangkok, Jakarta or Manila. Many of these Asian cities can be described as "traffic-saturated" rather than "automobile-dependent". This distinction is developed further in Chapters 6 and 7.

Local air pollution is used as the main example with which to illustrate the regional variations. The issue of road safety is also presented briefly. Finally congestion, the local impact which generally receives the most attention, is examined.

5.7.2.1 Local air pollution

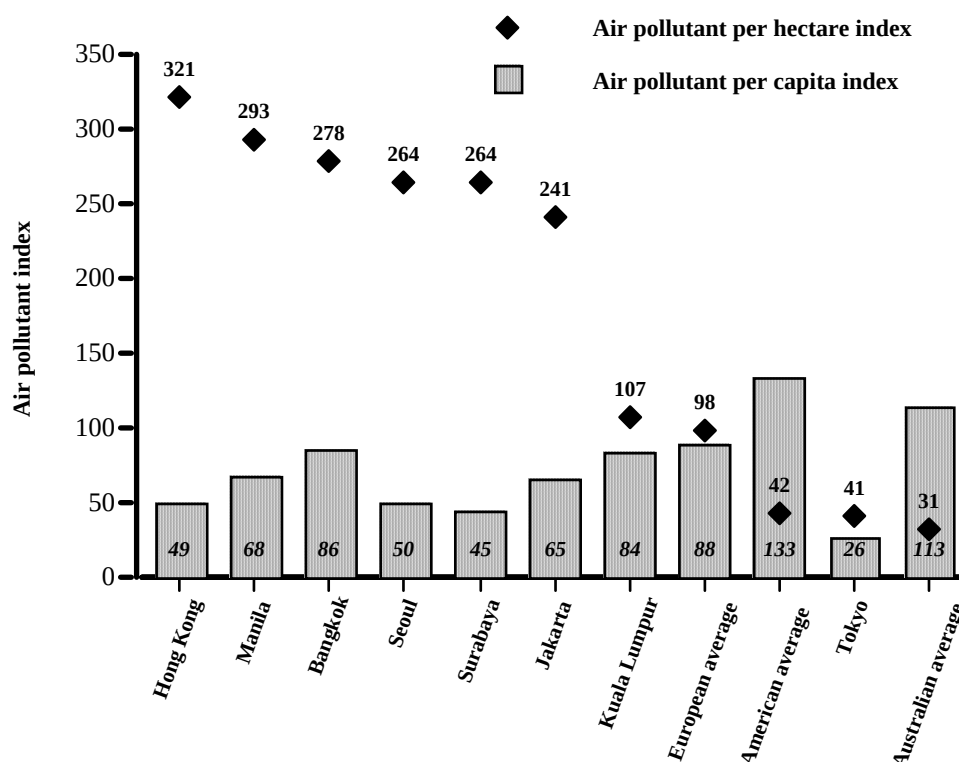
Data have been collected for this study on transport emissions of five major noxious pollutants that are of local air quality concern. These are nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), volatile hydrocarbons (VHC) and particulates (SPM).

To discuss every pollutant would be complicated and might obscure the central issues. Therefore data on four of the pollutants (CO, SO_2 , NO_x , and VHC) have been combined in a simple index of local pollutant emissions per capita and an index of emissions per hectare (Figure 5.12). Such an index provides a way to combine information on these four pollutants despite the fact that their average concentrations, or even their units of measurement, vary widely. Particulates were excluded from the index because for a number of cities the data were either missing or of questionable quality. The following procedure was used to calculate the emissions-per-person index. Each emissions per capita figure was multiplied by a coefficient such that the overall average became 25 for each of the four pollutants. The four figures that were produced in this way were added to produce the overall index. If a city had average emissions per capita (within this sample) for each of the four pollutants then it would have an index value of 100.

The emissions-per-hectare index is simply the per-capita index multiplied by the urban density of the city and again normalised so that the average city would again have a value of 100. This index will thus be proportional to pollution emissions divided by *urbanised land area*⁴⁹.

⁴⁹ It might be argued that pollution disperses, without discrimination, into the air over non-urbanised land as well as over urbanised land. However, no reasonable alternative is available to derive such an index. For example, using total land areas within administrative boundaries would introduce unpredictable amounts of non-urban land, much of which may lie well beyond the urban area, thus making many of the numbers meaningless. Using only urbanised land in the calculation is the only reasonable procedure without further detailed investigation involving finding the

Figure 5.12 Indices of transport air pollution emissions per capita and per hectare in Asian cities and other regional averages in an international sample of cities, 1990



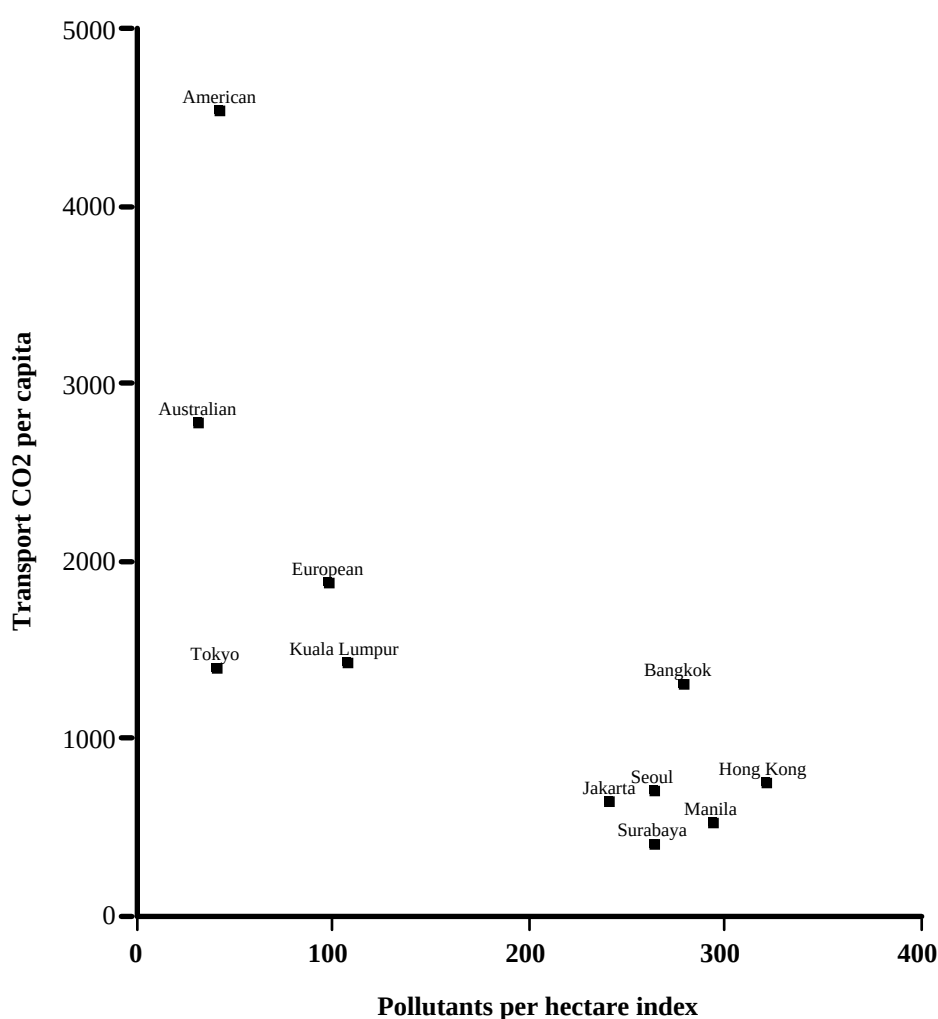
Note: a. The American and Australian averages here cover only the slightly restricted sample of cities for the study for the World Bank (see Chapter 4). The European average excludes Copenhagen and Amsterdam because data were incomplete for these cities.
b. For both of the indices, the overall average over all cities in the international sample is 100.
c. The pollutants covered are CO, SO₂, NO_x, and VHC.

The result of this exercise demonstrates that, although the Asian cities have below average levels of pollutant emissions per capita (due to lower vehicle use), most of them have much higher than average emissions per urban hectare (due mainly to their high densities - which will be discussed in more detail in Chapter 6). In most of the Asian cities, the per hectare emissions of air pollutants from transport were more than two and a half times European average levels and more than five times American or Australian levels. Kuala Lumpur and Tokyo were exceptions among the Asian cities. These two cities are the Asian cities with the lowest urban densities, as will be seen in the next chapter. Singapore was unable to provide any air pollutant emissions data but it might be expected that it falls into the same class as Kuala Lumpur and Tokyo due to its similar density.

whole area (whether urbanised or not) within an “envelope” around the whole main urbanised area. Nevertheless, it is acknowledged that the pollutant-per-hectare index may exaggerate the potential for pollution problems in certain kinds of city, such as those in which the urbanised area consists of a number of discontinuous patches. Seoul and Hong Kong are examples of this. In fact, most cities have irregular shapes and the extent of the exaggeration is unlikely to vary systematically among the different regions. Therefore the main conclusions drawn from these indices remain valid.

American and Australian cities may be “villains” when it comes to CO₂ emissions per person from transport and they clearly have the highest per capita emissions of local pollutants, but they have rather low levels of local pollutants emitted per hectare. At the opposite extreme, transport in Hong Kong, Seoul, Jakarta, Surabaya and Manila contributes only small amounts of CO₂ emissions and local air pollutant per capita, but each of these cities face the challenge of high levels of local traffic pollutants per hectare. These cities’ high densities are “unforgiving” in this respect. Figure 5.13 presents both global impacts per capita and local pollution per hectare on one graph to illustrate these points further. Bangkok contributes a moderate amount per person to the global problem of CO₂ (a little below the typical European city contribution per capita) and stands out with high levels of local pollution per hectare.

Figure 5.13 Global impacts versus local impacts of transport: CO₂ emissions per capita from transport versus local air pollutants from transport per hectare for Asian cities and regional averages in an international sample of cities, 1990



It must be acknowledged that high emissions per hectare do not always translate into a major air pollution problem, since this depends on other factors as well, such as climate, prevailing wind patterns, the layout of the city, topography, etc. Furthermore, many American cities face smog problems despite their relatively low levels of pollutant emissions per hectare (photochemical smog is, of course, a secondary derived pollutant, caused by the action of sunlight on hydrocarbons and nitrogen oxides and has a complex genesis). Nevertheless, these data do show that dense cities face an inherent danger of direct, severe local emissions impacts from traffic as a result of even relatively low levels of vehicular travel per person. These impacts are felt most acutely on the streets by pedestrians, cyclists and by people in open public transport vehicles and are another factor working to reduce the attractiveness of these modes.

This finding of high local emissions impacts in Asian cities relates to the fact that a number of these cities have high levels of traffic per hectare, despite their relatively low levels of vehicle travel per person. Low quality fuels and polluting vehicle fleets are certainly partly to blame for this poor result in the middle-income cities. But high levels of traffic per hectare is a more fundamental reason. This issue is at the centre of the spatial challenge for transport in dense Asian cities and is dealt with in more detail in Chapter 6.

5.7.2.2 Safety

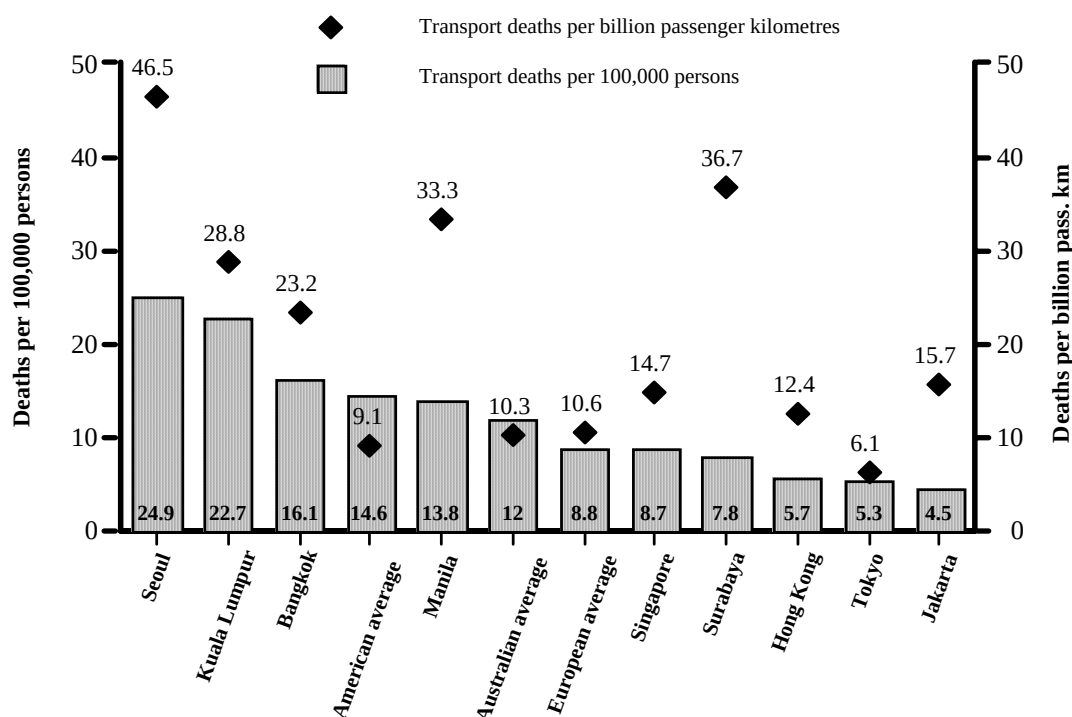
A lack of safety in urban transport is another important negative impact. Transport deaths data were collected in this international study as part of the study prepared for the World Bank. Referring to this data set, Kenworthy, et al. (1997) note that within the rich cities in the sample, transport deaths per capita tend to follow the level of private vehicle travel. Thus among the rich cities, transport death rates per capita are highest in the United States, lower in Australian and European cities and lowest in the three high-income Asian cities. Much of this variation is apparently due to differences in mobility, especially private mobility and is thus explained mainly by “exposure” to transport risks. This is despite the fact that the regional variation of the transport death rate per passenger kilometre (including public transport passenger kilometres) shows the opposite pattern, at least among the high-income cities (see Figure 5.14).

The low and middle-income cities in Figure 5.14 stand out as exceptions to the patterns observed among the rich cities. Most have very high transport death rates per unit of motorised mobility and hence much higher death rates per capita than would be expected given their relatively low levels of motorised vehicle use. In the cases of the

middle-income cities, Seoul and Kuala Lumpur, the death rates per 100,000 persons are the highest in the international sample. Dangerous traffic and moderate levels of mobility combine to produce very high death rates per capita. Surabaya is an example of a city with a high traffic risk per kilometre travelled, but a relatively low traffic death rate per capita, because of its low level of mobility. Tokyo stands out with very low transport death rates by both measurements.

Some of the factors that may explain the high transport death rates outside the rich group of cities include: lower safety consciousness, lax safety standards and enforcement of the rules that do exist, relatively poorly developed traffic systems, poor engineering standards, large numbers of motorcycles in some cities, high levels of exposure of vulnerable road users (i.e. high levels of non-motorised transport use in some cities), and large numbers of new and inexperienced drivers as a result of very rapid growth in the number of drivers.

Figure 5.14 Transport deaths per capita and per unit of mobility in an international sample of cities, 1990



Note: a. The American and Australian averages here include only the cities in the study for the World Bank (see Chapter 4).

b. Jakarta, Surabaya, and Kuala Lumpur's figures are likely to be somewhat underestimated since the source of the data in these cases were police records rather than health department records compiled in accordance with the WHO's International Classification of Diseases (ICD) procedure, as was the case in the other cities.

5.7.2.3 Congestion

An aspect of urban transport system quality that receives a very high level of attention is traffic congestion. For example, Bangkok's traffic nightmare is now legendary with speeds having reached extraordinarily low levels by the early 1990s (Poboon, 1997).

Some argue that the widespread attention to congestion is sometimes overblown and that other costs or problems associated with transport are often more significant (Litman, 1995; McNeill, ca. 1977). Others have argued that a focus on solving congestion can lead to wrong-headed solutions which may make other transport problems such as air pollution, lack of public transport, or high energy consumption even worse (Newman and Kenworthy, 1988). Nevertheless, traffic congestion is one of the most visible transport problems and it is understandable that it attracts attention. It has been shown already in this chapter that there have been dramatic increases in traffic in most Asian cities since the 1970s and there is no doubt that congestion has also been increasing. It has also been shown that many of the Asian cities are highly dependent on road-based public transport (primarily buses and jitneys). Without segregated rights-of-way, the efficient operation and the attractiveness of buses to patrons are extremely vulnerable to the impact of congestion.

Unfortunately, congestion is difficult to measure consistently across many cities and can be a subjective matter. Motorists and bus riders can be heard in almost any large city of the world complaining of "unbearable congestion". Table 5.15 presents two indicators which, when taken together, provide something of a picture of the potential for or degree of congestion in the cities of this international sample. Average speed of traffic is possibly the most revealing and meaningful.

The regional averages for traffic per kilometre of road shown in Table 5.15 suggest that, on average, the Australian cities had the least congested roads, followed by the North American cities, then the European, and finally the Asian cities with the most heavily used roads in 1990. Bangkok and Hong Kong had the highest VKT per kilometre of road figures. Almost all of the Asian cities in 1990 already had traffic per kilometre of road figures above the European average. The exceptions were Tokyo and Manila which have low figures⁵⁰. Across the whole global sample, there is an inverse linear correlation of traffic speed with VKT per kilometre of road ($r^2 = 0.332$) that is significant at the 5 percent confidence level.

⁵⁰ Previously it was mentioned that Tokyo's road figures apparently include many small lanes which carry little traffic and this may partly explain this surprising result.

In the absence of completely objective, independent indicators of the level of congestion, other sources of information have also been consulted. Bangkok's well known problems have been mentioned and its low traffic speed figures leave little doubt that congestion has reached extraordinary heights in that city. Turning to other cities, Manila's roads were already described as heavily congested by the mid-1980s. Despite the strong role performed by public transport, private vehicles dominate traffic flows even in Manila (Kirby et al., 1986: 264). Manila's congestion problem has become more serious since 1990. Public transport average speeds for 1996 were 12 km/h for buses and 9 km/h for jeepneys within Metro Manila (Joson, 1997). This is a substantial drop from 1990's overall bus/jeepney speed of 15.4 km/h (Appendix 1). In 1996, traffic congestion was described as "chronic everywhere in Metro Manila and at all times of the day" (JICA, 1997: 11).

Table 5.15 Simple indicators of congestion in an international sample of cities, 1990

	VKT per km of road (millions)	Average Traffic Speed (km/h) ⁵¹
Hong Kong	5.3	26
Bangkok	5.3	13
Jakarta	3.0	24
Singapore	3.4	33
Kuala Lumpur	3.3	29
Surabaya	4.4	27
Seoul	2.4	24
Manila	1.4	26
Tokyo	1.0	24
Other cities		
Paris	4.4	26
Los Angeles	3.4	45
San Francisco	2.9	44
London	2.3	30
Detroit	2.1	56
Denver	1.4	58
Adelaide	1.0	46
Sydney	1.1	37
Regional averages		
Asian	3.3	25
European	2.5	33
American	2.0	51
Canadian	1.7	40
Australian	1.0	46

In the mid-1980s the following description of Seoul was given.

⁵¹ Traffic speed data provide an indication of congestion to some extent. But speeds are also influenced by design factors such as the proportion of roads that are designed for high speed or as limited access highways or freeways.

Transport problems are less acute in Seoul than in many other of the world's mega-cities, mainly because of the still moderate levels of car ownership, the rapid pace of road and bridge construction, reasonably good traffic management, and an efficient bus and subway system. (United Nations, 1986b: 41-42).

An ESCAP mission to the city in June 1989 described the situation even then as "moderate congestion during peak periods" (ESCAP, 1990: 29). However, the average CBD peak hour traffic speed dropped from 22.2 km/h in early 1986 to 17.1 km/h in 1989 and to 13.1 km/h in 1992. Elsewhere in Seoul, peak hour speeds dropped from 23.9 to 14.6 km/h between 1989 and 1992 (Korea Transport Institute, 1993: 98). Overall daily average traffic speeds for the outer areas dropped from 37.2 to only 23.8 km/h between 1989 and 1993 (World Bank 1995: 17, citing KOTI statistics). These are all drastic falls in speed in the space of only a few years.

In Hong Kong congestion is always a danger despite the low level of motorisation. In 1988 peak hour speeds averaged 12 km/h (Kenworthy, Barter, Newman, and Poboon, 1994: 27). So it is clear that competition for road space is fierce. Even in rail-oriented Tokyo, the expressway network was extremely congested, with the average for the ten routes being 10.3 hours of congestion per day (with congestion defined as speeds having dropped below 10 km/h!) (Midgley, 1994: 16).

Jakarta's traffic conditions have also deteriorated over time, horrifying residents and decision-makers there. But 1993 measurements showed morning peak hour speeds on most of the main roads were still above 20 km/h (Pacific Consultants International and Yachiyo Engineering Co. Ltd., 1995: 6.15). Kuala Lumpur's congestion has also worsened steadily and is the subject of numerous newspaper articles. A speed survey in 1992 suggested that on certain inner radial roads in peak hours, traffic speeds in Kuala Lumpur could be as low as 10 km/h. However elsewhere in the metropolis and at other times, speeds were generally quite high (JICA, 1993: 5.34). Surabaya is, so far, remarkably uncongested with only 9 percent of vehicle hours being operated at below 20 km/h even by 1995 (Dorsch Consult, PT Pamintori Cipta, Colin Buchanan and Partners, SOFRETU, and IMK Consulting Engineers, 1996a: 2.11). Singapore also reports high traffic speeds even in peak hours and in the central area (Land Transport Authority, 1996).

In summary, by the early 1990s, severe traffic congestion problems were almost universal among the large Asian cities in this sample. Only Singapore and Surabaya lacked serious peak-period congestion.

5.8 Some Wider International Comparisons

This chapter has compared in detail the transport patterns of the Asian cities together with high-income Western cities in this international sample. However, a number of regions were not represented and it is useful to examine briefly some transport patterns of other cities around the world⁵². This is to further place these nine Asian cities into a clear comparative perspective and to examine whether the patterns that have been observed in the Asian cities have parallels elsewhere. In particular, middle-income cities from elsewhere in the world will be considered, since much of the focus of this dissertation is on middle-income Asian cities. In addition, a small number of low-income cities and some high-income Asian cities will be mentioned.

5.8.1 Motorisation in other relevant cities

How does motorisation in the Asian cities in this study compare with other Asian cities of various income levels and with other low and middle-income cities around the world? Table 5.16 provides data on a number of relevant cities which allow such an assessment for 1990 or dates close to 1990. The cities are arranged in order of 1990 national GNP per capita.

A few brief observations can be made from Table 5.16. Apparently, Tokyo's car ownership rate (at 275 cars per 1000 in the Tokyo Metropolitan Transportation Area) was slightly lower than the levels found in smaller Japanese cities, such as Nagoya and Sapporo. Other Korean cities shared Seoul's low motorisation levels, relative to income. In these smaller Korean cities, motorcycle ownership was low but was still substantial relative to the car ownership.

Middle-income Athens, Budapest, the Brazilian cities, Buenos Aires, Mexico City and Warsaw all had car ownership in the range of about 150 to just over 300 cars per 1000 persons and most seem to have low motorcycle ownership rates. These cities seem to have relatively unrestrained levels of car ownership relative to income (although it is difficult to be certain without data on actual metropolitan GRP per capita)⁵³. The most motorised of these cities were close to the rates in the least motorised high-income

⁵² Note that although some care has been taken to use only credible sources, any data on cities that are not in the main international sample of cities for this study have not undergone the extensive checking procedures to which the main data set for this study has been subjected (as described in Chapter 4).

⁵³ Motorisation in many middle-income countries is apparently often higher than expected based upon wealth alone. Gakenheimer (1995) makes the point that motorisation is better correlated with the average income of the richest 20 percent of the population than with the overall average income. Thus in middle-income cities with strongly skewed distributions of income, motorisation would be expected to be higher than it would on the basis of average income. Unfortunately, insufficient data has been gathered on income distribution within the sample of Asian cities to investigate this further here.

European cities in the main international sample. This is surprising considering the very large difference in average incomes. Santiago, however, appears to have had strongly restrained vehicle ownership relative to its income.

Kuala Lumpur, Bangkok and Taipei thus had similar or slightly lower car ownership rates to many middle-income Latin American or middle-income southern and eastern European cities. But these three Asian cities had significantly higher total private vehicle ownership if motorcycles were included.

Table 5.16 Motorisation in other relevant international cities, ca. 1990

City	Cars per 1000 persons	Motor- cycles per 1000 persons	Total vehicles per 1000 persons	Year of data	1990 National GNP per capita (US \$)
Cities in High-Income Countries					
Nagoya City (Japan)	341	?	537	1991	25,430
Sapporo (Japan)	309	?	446	1991	25,430
Taipei City (Taiwan)	157	219	403	1990	7,761*
Cities in Middle-Income Countries					
Athens (Greece)	~311	~38	~419	~1992	5,990
Taegu (Korea)	60	35	132	1990	5,400
Taejon (Korea)	52	32	117	1990	5,400
Pusan (Korea)	44	16	91	1990	5,400
Kwangju (Korea)	42	23	95	1990	5,400
Budapest (Hungary)	242	?	277	1991	2,780
Sao Paulo (Brazil)	?	?	367	1990	2,680
Brasilia (Brazil)	142	?	266	1990	2,680
Curitiba (Brazil)	254	?	344	1991	2,680
Mexico City (Mexico)	184	?	?	1988	2,490
Buenos Aires (Argentina)	333	?	398	1987	2,370
Penang (Malaysia)	165	367	566	1991	2,320
Santiago (Chile)	54	?	77	1991	1,940
Warsaw (Poland)	322	?	?	1992	1,690
Chiang Mai (Thailand)	<136	430	566	1992	1,420
Cities in Low-Income Countries					
Semarang (Indonesia)	42	147	215	1992	570
Medan (Indonesia)	38	134	?	1989	570
Delhi (India)	32	81	127	1993	350
Mumbai (<i>Bombay</i>) (India)	21	18	49	1990	350
Bangalore (India)	17	67	94	1986/87	350
Chennai (<i>Madras</i>) (India)	17	52	76	1990	350
Lucknow (India)	14	104	129	1990/91	350
Varanasi (India)	10	106	150	1991	350
Hanoi (Vietnam)	<44	116	161	1992	? ~250
Ho Chi Minh (Vietnam)	~24	~200	?	1991	? ~250
Dhaka (Bangladesh)	13	8	33	1992	210

Notes: 1990 National GNP per capita data are from the World Bank (1992) except for Taiwan's which is from O'Connor (1994).

Sources for motorisation data: **Athens**: Matsoukis (1997); **Osaka City, Nagoya City, Sapporo, Buenos Aires, Sao Paulo, Brasilia, Curitiba, Santiago**: Seoul Metropolitan Government (1994); **Pusan, Taegu, Kwangju, Taejon**: Korea Transport Institute (1993); **Penang**: Road Transport Dept., Malaysia; **Chiang Mai**: Padeco Co. Ltd. (1993); **Medan**: Nippon Koei Co. Ltd (1990); **Semarang**: China Engineering Consultants (1995a); **Ho Chi Minh City**: Luu Duc Hai (1995); **Hanoi**: Padeco Co. Ltd. (1993); **Mumbai, Delhi, Chennai, Bangalore, Lucknow**: UNCHS (1994); **Varanasi**: Elangovan (1992); **Dhaka**: PPK Consultants (1993); **Mexico City**: Bauer (1991); **Taipei City**: Taipei City Government (1998).

Table 5.16 confirms that high rates of motorcycle ownership are common in Asia, especially Southeast and South Asia. The four cities with high-motorcycle ownership in

the main international sample are thus not atypical in that respect. In fact, certain medium-sized, middle-income cities, such as Penang and Chiang Mai, have motorcycle ownership rates above 350 per 1000 persons. Motorcycles feature prominently in all of the Southeast Asian cities shown in Table 5.16. Motorcycles are also already significant in India and in Vietnam, despite the very low income levels of those countries.

5.8.2 Public transport in other relevant cities

Table 5.17 shows data from a number of sources on public transport in many relevant cities. In assessing the data in Table 5.17, let us first consider the role of public transport overall. Based on the cities shown in this table, most large developing country cities had greater than 50 percent of motorised trips by collective modes. However, in some cities the high percentage of motorised trips on public transport did not translate into a high percentage of all trips being by public transport. This indicates a high role for non-motorised transport with public transport as only the major transport provider within a relatively small motorised transport sector. Dhaka, Shanghai and Lucknow are in this category and similar comments could also have applied to Surabaya or Jakarta in the 1960s, as discussed in Chapter 3.

There is another group of cities in Asia where private motorised modes are already the most significant modes. Surprisingly this group includes cities at all levels of income. Rich Asian cities where public transport is relatively insignificant include small and medium sized Japanese cities (such as Nagoya and Sendai in Table 5.17) where cars and bicycles share dominance of the urban transport systems (City Bureau and Building Research Institute, 1990).

Public transport is also at surprisingly low levels in a number of low and middle-income cities in Asia. In Table 5.17, Semarang and Denpasar in Indonesia are the main examples, with both having high rates of motorcycle ownership (China Engineering Consultants, 1995a; China Engineering Consultants, 1995b). This group includes many small or intermediate Asian cities where motorcycles are important. In the main sample of Asian cities, Kuala Lumpur and Surabaya are in this situation. Motorcycle-dominated Taipei is in a similar situation. Other examples where public transport use is low include all of the cities which were identified above as having high motorcycle ownership, such as Penang, Chiang Mai, Medan, Hanoi and Ho Chi Minh city. In Penang, much less than 30 percent of motorised trips, even in peak-hour to the city centre, were by public transport in 1997 (Halcrow Consultants Sdn. Bhd. and Excelcet Sdn. Bhd., 1997). Many small and medium sized Indian cities, such as Varanasi and

Lucknow, are also moving in this direction with motorcycle ownership increasing very rapidly (Midgley, 1994).

Interesting parallels to these patterns exist in China where bicycles are extremely important in most cities. Public transport is only very significant in the largest of the Chinese cities, Shanghai and Beijing, where public transport ridership exceeded 400 trips per person per year. In most other cities, even the large cities of Tianjin, Shengyang and Guangzhou, there were fewer than 200 public transport trips per capita per year in 1990 (Hu and Kenworthy, 1997).

Table 5.17 Public transport in other relevant international cities, ca. 1980 to 1990

	Public transport % of all trips	Public transport % of Motorised Trips	Rail % of public transport trips
Cities with a strong role for public transport			
Chennai (<i>Madras</i>) (India) 1984	55	91	17
Mexico City (Mexico) 1983	66	80	36
Ankara (Turkey) ca.1990	?	78	2
Bangalore (India) 1988	?	73	1
Caracas (Venezuela) 1982	?	72	?
Delhi (India) ~1988	36	71	4
Buenos Aires (Argentina) ~1992	?	70	16
Santiago (Chile) ~1995	?	70	14
Mumbai (<i>Bombay</i>) (India) 1986	?	67	50
Cairo (Egypt) 1985	?	65	negligible
Sao Paulo (Brazil) 1987	37	57	25
Taegu (Korea) 1990	?	55	0
Pusan (Korea) 1990	?	54	15
Cities with a low or moderate role for public transport overall but a strong role relative to motorised modes			
Shanghai (China) 1990	33	89	?
Dhaka (Bangladesh) 1992	13	69	negligible
Lucknow (India) 1990	16	54	0
Keihanshin* (Japan) 1980	23	53	80
Cities with a relatively low role for public transport - both overall and relative to motorised modes			
Semarang (Indonesia) ca.1990	?	39	0
Sendai (Japan) 1982	15	29	32
Nagoya (Japan) 1981	13	27	76
Denpasar (Indonesia) ca.1990	?	16	0

Notes: a. Keihanshin is the name of the metropolitan region that includes Osaka, Kyoto and Kobe.

b. Cairo bus figure includes all formal public transport (e.g. trams as well). The small bus figure is all "informal" public transport, mainly collective taxis.

c. Lucknow "tempos" have been classed as minibuses.

Sources: **Keihanshin** 1980: City Bureau and Building Research Institute(City Bureau and Building Research Institute, 1990; Nagasawa, 1992); **Nagoya** 1981, **Sendai** 1982: (City Bureau and Building Research Institute, 1990); **Pusan** 1990, **Taegu** 1990: (Korea Transport Institute, 1993: 99); **Shanghai** 1990: Chen, S. H. (Shanghai City Comprehensive Transport Planning Institute) "Some Information on Shanghai Transportation"; **Semarang**: (China Engineering Consultants, 1995a); **Denpasar**: (China Engineering Consultants, 1995b); **Delhi**: (Gupta, Singh, and Jain, 1996) citing Patankar, 1989; **Mumbai** 1986: (UNCHS, 1994); **Delhi**, **Chennai** 1984, **Bangalore**

1988, **Lucknow** 1990: (UNCHS, 1994); **Dhaka** 1992: (PPK Consultants, 1993); **Mexico City** 1983: (Ward, 1990); **Cairo** 1985: (Lashine, Hawary, and Eastman, 1987); **Sao Paulo** 1987, **Caracas** 1982: (Poole et al., 1994: 13); **Curitiba**: (Cervero, 1995); **Buenos Aires** ~1992: (Arcusin, Brennan, Rivasplata, and Ternavasio, 1996); **Santiago** ~1995: (Rivasplata, 1996: I-174); **Ankara** c.1990: (UNCHS, 1993: 108).

A significant role for rail was found in the large Japanese cities. But in low-income and middle-income cities in Table 5.17 rail was usually not significant and in most cases buses of various kinds were the dominant mode. Bombay was the primary exception. Rail was also quite significant in Mexico City, Sao Paulo and Madras. Even in these cities however, road-based public transport apparently carries a large percentage of the total motorised travel in the cities. It can be concluded that in most of the low-income or middle-income cities around the world where motorised public transport is important, buses play a very great role. Thus, like the middle-income Asian cities in the main sample of this study, many similar cities around the world are vulnerable to the impacts of congestion on their public transport systems.

5.8.3 Non-motorised transport in other relevant cities

Table 5.18 gives data on walking and non-motorised vehicles in several additional cities for which such data were available in the literature. Table 5.18 emphasises the great importance of walking in many low-income cities, such as Dhaka. Motorised transport accounts for a small minority of trips in such a city.

Table 5.18 Non-motorised transport in other relevant cities

	Percent of all trips				Sources
	Walk	Bicycle	Pedicab	NMT Total	
Tianjin (China) 1990	11	75	?	86	Liu, Shen and Ren (1993: 2)
Guangzhou (China) 1984	46	37	?	83	Liu, et al.
Dhaka (Bangladesh) 1992	60	1	19	80	PPK Consultants (1993)
Lucknow (India) 1990	25	29	15	69	UNCHS (1994)
Beijing (China) 1986	14	54	?	68	Liu, et al. (1993: 2)
Delhi (India) ~1987	49	9	?	58	Gupta, et al. (1996: 67)
Madras (India) 1984	28	11	1	40	UNCHS (1994)
Sao Paulo (Brazil)	<~36	tiny	~0	36	Poole, et al. (1994: 57)
Mexico City (Mexico) 1983	21	0.3	0	21	Ward (1990: 96)

Note: Mexico City figures are for trips over 500 m or 5 minutes duration.

The highly significant role of bicycles in Chinese cities and in some Indian cities is well known. Although no specific mode split data were available, Vietnamese cities also have had a very high role for bicycles in the 1970s and 1980s (Luu Duc Hai, 1995). At this point it is interesting to note that Taipei, which is now motorcycle-dominated, had a high level of bicycle use in the 1960s (McNeill, ca. 1977). A similar trend of rising

motorcycle use threatening the role of bicycles has recently commenced in a number of Indian and Vietnamese cities (Barter, 1996b; Luu Duc Hai, 1995; Replogle, 1992). Southern Chinese cities are also grappling with how to handle motorcycles in the 1990s. Kuala Lumpur, Jakarta, Surabaya, and Bangkok have also seen drastic drops in the use of NMVs since their height in the post-war decades, as mentioned in Chapter 3 and in Section 5.6 of this chapter. These experiences are thus clearly relevant to the recent and current experiences of many low-income Asian cities.

5.8.4 Conclusions from comparisons with additional relevant cities

The data on extra cities in Asia and other developing regions have verified that a number of the key characteristics of the Asian cities in this study do have a wider relevance. A number of other middle-income cities around the world have levels of motorisation that appear to be “unrestrained” relative to their income levels. High motorcycle ownership rates are common in many Asian cities. A high degree of dependence on buses and jitneys is common in developing cities all over the world, as within the main sample of Asian cities. A number of other developing Asian cities have surprisingly low levels of public transport use despite low incomes and this is usually associated with a high rate of ownership of two-wheelers (both motorised and non-motorised). Bicycles are rapidly being displaced in a number of other Asian cities in recent times, especially by motor cycles. This process is similar to that which occurred earlier in some of the cities within the main sample of this study.

5.9 Distinct Transport Development Paths Among Asian Cities

Having presented a large amount of data on transport development in the Asian cities over recent decades, it is now appropriate to summarise and identify important themes. A number of the data items or graphs have already strongly suggested that distinct, contrasting paths of transport system development are being followed by some of the Asian cities. In Chapter 3 it was found that in the 1960s, all of the Asian cities, except Tokyo, could be described as bus cities with low levels of motorised mobility, but since then divergent paths can be identified.

A number of the graphs presented in this chapter can be used to categorise the cities, as shown in Table 5.19 below. Criteria are chosen that relate to central concerns of this thesis. In particular, the groupings relate to long or middle-term scenarios for transport systems in the Asian cities. Criteria that reveal fundamentally distinct paths for urban transport system development need to be distinguished from variations that only show

cities' transport systems at different stages in the course of following in each other's footsteps.

Table 5.19 Grouping the cities in the Asian sample and the other regions according to chosen transport criteria

Criterion	Suggested Groups of Cities	Comments
1. Car ownership and private vehicle use relative to GRP per capita (Figure 5.3 and Figure 5.5)	Manila, Jakarta and Surabaya	Low motorisation with open options. Of the three, Surabaya has the least restrained private transport and Manila has the most.
	Seoul, Hong Kong, Singapore and Tokyo	Strongly delayed or restrained motorisation.
	European cities	Moderately restrained motorisation and private vehicle use.
	Kuala Lumpur and Bangkok	Unrestrained motorisation and private vehicle use. Figure 5.3 suggested that Taipei also probably falls in this grouping.
	American, Canadian and Australian cities	Unrestrained motorisation that has reached high levels over many decades.
2. Private versus public transport mobility trends (Figure 5.6)	Surabaya and Jakarta	Low motorised mobility per person (but private mobility has been rising faster than public transport).
	Singapore, Seoul, Manila, Hong Kong and Tokyo	High public transport mobility (almost as high or higher than private). But only in Hong Kong has public transport mobility been rising much faster than private.
	Kuala Lumpur, Bangkok (and the European cities on average).	Private mobility higher than public. Both public and private transport increasing but private has increased faster.
	American, Australian (and Canadian) cities.	Overwhelming private transport dominance that has generally increased over the decades. The American cities are distinctly ahead of the Canadian and Australian cities and rising faster.
3. Motorcycle ownership (Figure 5.1)	Kuala Lumpur, Bangkok, Surabaya, Jakarta	High motorcycle ownership. In Kuala Lumpur and Bangkok, motorcycle ownership have continued to rise quickly despite rising incomes and car ownership passing 150 cars per 1000 persons.
	Singapore, Tokyo, Seoul, Hong Kong, Manila and most cities in the other regions	Motorcycle ownership below 50 per 1000 people, and in some cases actually falling.

The clearest examples of criteria that reveal groups of cities to be following contrasting paths are the graphs that compared car ownership or private vehicle use with levels of wealth. These graphs, Figure 5.3 and Figure 5.5, clearly show Bangkok and Kuala Lumpur with high private transport levels relative to their incomes, and strongly

contrasting with Tokyo, Hong Kong, Singapore and Seoul which have low levels of private transport relative to their income levels. The three lower-income Asian cities form a third group, with both low incomes and low private transport usage. This group appears to have something of a choice ahead; to follow the Bangkok/Kuala Lumpur “model” or the Tokyo/Seoul/Hong Kong/Singapore “model”, as discussed below.

Almost the same groupings also show up in Figure 5.6 which showed trends in the modes and amounts of motorised mobility over recent decades. Again, Kuala Lumpur and Bangkok stand out with much more private transport oriented systems than the four higher-income Asian cities in the sample, and with their trends showing private transport mobility to be rising much faster than public transport mobility over recent decades. In contrast, since the 1970s Singapore, Hong Kong and, to a lesser extent, Seoul and Tokyo, have had much greater success in maintaining or increasing the role of public transport.

The graphs make it clear that the first two groups of cities (Bangkok and Kuala Lumpur versus Hong Kong, Singapore, Seoul and Tokyo) represent fundamentally distinct responses to the new transport possibilities opened up as wealth levels rise into the middle-income range and beyond. Bangkok and Kuala Lumpur are not simply at earlier stages of the paths taken by richer cities. Since the 1970s, these cities’ transport systems have responded to rising wealth in ways that were very different from Tokyo, Hong Kong, Singapore or Seoul.

By 1990, none of the three lower-middle-income Asian cities, Jakarta, Manila and Surabaya, had yet embarked decisively on either of these two contrasting paths. The three cities shared relatively low levels of overall motorised mobility in 1990. However, it seems clear from recent trends that Jakarta and Surabaya are more likely to follow the Bangkok and Kuala Lumpur model. On the other hand, Manila, which is more public transport-oriented and differs from the Indonesian cities in having very low motorcycle ownership, may yet avoid Bangkok’s path.

Chapters 7 and 8 will investigate in some detail the circumstances and choices that have led to these different paths. There will also be some consideration of how these paths may relate to other developing cities around the world.

5.9.1 Kuala Lumpur and Singapore contrasted

A comparison of trends in Singapore and Kuala Lumpur provides a particularly interesting illustration of the two different paths. This is because in the late 1960s, transport in Kuala Lumpur and Singapore had much in common. This is not surprising

considering their proximity, common cultural heritages and common legacy of British colonial rule over the century prior to 1957. Singapore even joined the Malaysian Federation for a brief period in the early 1960s and it was primarily ethnic politics, rather than any great disparity in wealth, that was the main reason for Singapore and Malaysia parting ways again.

Kuala Lumpur was a much smaller city than Singapore in 1970, with just under one million people compared with Singapore's population of just over 2 million. Both had a similar ethnic make-up at that time, with a majority of ethnic Chinese and with Malay and Indian minorities. However, Kuala Lumpur's Malay community was a larger proportion and was growing faster than Singapore's. Singapore had already become considerably richer than Kuala Lumpur, but the difference was much smaller in the late 1960s than in 1990. Zahavi (1977: 12) gives Singapore's 1970 income per person as US\$1,100 compared with Kuala Lumpur's \$660.

Some of the key similarities between Kuala Lumpur and Singapore in about 1970 can be summarised as follows. In 1970 Kuala Lumpur and Singapore had similar levels of private vehicle ownership. In 1972 Kuala Lumpur had 72 cars and 50 motorcycles per 1000 persons, while in 1970 Singapore had 69 cars and 51 motorcycles per 1000 persons (Table 5.2 and Table 5.3). Both cities had rapidly rising vehicle ownership during the late 1960s and early 1970s (Arthur D. Little and Associates, 1972; Wilbur Smith and Associates, 1974). As discussed in Chapter 3, both cities at that time had a poor and sparse bus-based public transport service which carried under 50 percent of motorised trips. Kuala Lumpur was a little more sparsely populated than Singapore, but the difference was not dramatic (about 79 persons per hectare in Kuala Lumpur and about 93 in Singapore).

However, from the early 1970s onwards the transport situations of the two cities diverged. Most obviously, growth of car ownership and motorcycle ownership were drastically slowed in Singapore but not in Kuala Lumpur. This was clear in the graph of private vehicle ownership in the various Asian cities since 1960 (Figure 5.1). By 1980, Singapore had significantly lower private vehicle ownership than Kuala Lumpur (64 versus 86 cars per 1000 and 49 versus 65 motorcycles per 1000). Singapore's vehicle ownership had apparently actually decreased since 1970, as a result of vigorously pursued policies of restraint (which are described in detail in Chapter 8). Singapore also had achieved a much larger role for public transport than Kuala Lumpur. In Singapore the 1980 public transport share of motorised work trips was 71 percent compared with 36 percent in Kuala Lumpur and in Singapore public transport carried about 52 percent

of total motorised passenger kilometres, compared with about 25 percent in Kuala Lumpur. Nevertheless, and quite significantly, all public transport in Singapore was still on buses, as it was in Kuala Lumpur.

By 1990 the contrast was even wider in almost every respect, as has been made clear throughout this chapter. Singapore's 102 cars per 1000 persons contrasted with Kuala Lumpur's 170. Motorcycles in Kuala Lumpur reached 180 per 1000 persons while in Singapore they had dropped to 45 per 1000. Singapore's public transport carried 47 percent of all motorised passenger kilometres, while Kuala Lumpur's carried only 20 percent by 1990. Public transport speeds, which did not differ greatly between the two cities in previous years, jumped upwards in Singapore from about 19 km/h in 1980 to almost 26 km/h in 1990. In Kuala Lumpur public transport speeds were about 16 km/h in 1990. Singapore's new mass rapid transit system was the main factor behind its increased public transport speed by 1990.

So the 1990 transport situations of the two cities are in stark contrast, although both were metropolitan areas of around 3 million people (with the Klang Valley actually a little larger than Singapore's population). Singapore, despite greater economic success than Kuala Lumpur between 1970 and 1990, had become more public transport-oriented rather than more car-dependent, while Kuala Lumpur's transport system had become dramatically more private vehicle-oriented. The choices and events that led to such diverging trends are examined in Chapter 8.

5.10 Chapter Conclusion: Transport Patterns in the Asian Sample

This chapter has provided an international comparative overview of transport patterns in the nine Asian cities of the international sample for the period since 1970. This was done using the data set that was described in detail in Chapter 4. The author collected and compiled a substantial proportion of the data on the Asian cities that has been used in this chapter and synthesised other transport data from a range of additional cities from a large collection of literature on the subject. The comparative perspective of this chapter has provided an answer to the transport part of Research Question 1, which asked, "How do the urban transport and urban form characteristics and development trends of selected Southeast and East Asian cities compare with each other and with a large sample of international cities?"

The chapter has provided data on how the Asian cities, on average, compared in 1990 with the averages for European, Canadian, Australian and American cities on many of the key transport variables. These comparisons can be briefly summarised as follows:

- Asian cities had the lowest levels of motorisation, followed by European, Australian, Canadian and American cities. There was some overlap in the ranges of motorisation between regions. Only in Asian cities were there significant levels of motorcycle ownership.
- Private vehicle use per capita was lowest in the Asian cities, followed by European, Canadian, and Australian cities and again, American cities had, by far, the highest average private VKT per capita figure. Again there was some slight overlap between the ranges of VKT per capita of each region.
- The Asian cities had, on average, by far the highest share of their motorised travel on public transport (49 percent), followed by the other regions in the same familiar order as above: European (23 percent), Canadian (10 percent), Australian (8 percent), then American (3 percent). However, in terms of the modal split for motorised work trips, the European city average was only slightly lower than the Asian city average (47 percent compared with 56 percent). Road-based public transport had a particularly high role in the Asian cities, typically much higher than in any of the other regions. A related fact is that the Asian cities had the lowest average public transport speed, while the European cities had the fastest.
- The Asian cities had the lowest rate of provision of roads per capita, as measured by length of all classes of roads per capita or length of main roads per capita. Australian cities had the highest average figure for roads per capita, followed by the American cities, the Canadian cities and the European cities. Asian cities also had the lowest average levels of CBD car parking spaces relative to CBD employment. European cities had a slightly higher average, then Canadian, then American, then Australian. However, there was considerable overlap between the regions and each region had a wide range of figures for this parameter, with low CBD parking being strongly associated with the existence of high-capacity, traffic-segregated public transport systems able to bring large numbers of workers to the CBD.
- The Asian cities had the highest rates for the use of walking and NMVs for the trip to work. The European average was only slightly lower but the other three regions fell very far behind on this parameter.

- The Asian city average was the lowest in the use of energy per capita in transport and the related parameter of CO₂ emissions per capita from transport. These parameters provide some indication of global impacts of urban transport per person. As usual, the European average came next, then the Canadian, then the Australian, then the American cities with by far the highest energy use and emissions per capita of these five regions.
- However, when local noxious pollutant emissions are examined on a spatial or per hectare basis, the Asian cities are shown to have typical emissions per hectare that are much higher than the other regions' averages. The European cities had the next highest local pollutant emissions per hectare. This parameter highlighted the relevance of the high urban densities found in many of the Asian cities, which will be examined further in Chapter 6.
- In terms of both VKT per km of road and average traffic speeds, the Asian cities were judged to be the most congested on average. Again, the European average came next in the regional rankings. Australian cities were "least congested" in terms of VKT per km of road but the American cities had the fastest traffic on average. The congested nature of most of the Asian cities was confirmed using independent data on congestion from other studies.

Despite the above characterisation, which might suggest that there is such a thing as a "typical" Asian city transport pattern, it was also clear from the data presented in the chapter that there is a great deal of diversity in the transport characteristics of the Asian cities in this sample. On most parameters, the Asian cities did tend to fall as a group, towards one end of the range of values that were found in the international sample. Nevertheless, this still leaves room for noteworthy variation among the Asian cities. In addition, on a number of these parameters there was some overlap between values found in the European group and values in the Asian group.

Contrasts within the Asian group of cities in the international sample were highlighted throughout the chapter. Particularly noteworthy contrasts were summarised in Table 5.19 and used to suggest groups within the Asian sample according to several different criteria. Chapter 3 showed that by the 1960s, all of the developing Asian cities (all except Tokyo at that time) could be described as having much in common in their transport patterns and as conforming to the bus city type (Figure 3.2). However, in this chapter it was found that since 1970, Kuala Lumpur and Bangkok have been following a fundamentally different path in their transport development from Seoul, Singapore,

Hong Kong and Tokyo. Kuala Lumpur and Bangkok in 1990 were not simply at earlier stages of a similar path to that taken by the four higher-income cities, but were developing in distinctly more private transport-oriented ways. Bangkok and Kuala Lumpur had high motorisation (both cars and motorcycles) relative to their incomes per capita, while the four higher-income Asian cities had low motorisation relative to their income levels and were emphasising public transport to a much greater extent than the first group of cities. Manila, Jakarta and Surabaya could not as yet be clearly said to be following either of these paths by 1990.

The contrasts between the Asian sample and the other regions and the contrasts within the Asian group, both provide important steps towards an answer to Research Question 2, on whether distinctive Asian models of urban transport and land use can be identified. At least two different Asian models seem to be emerging. The next chapter examines land-patterns in some detail and will provide further evidence on this question, as well as providing the urban form part of the international comparative perspective that is called for by Research Question 1. Spatial insights provided by the next chapter will highlight some long-term implications and ramifications of the choice between these two distinctive paths, especially for cities with particularly high densities.

CHAPTER SIX

LAND-USE PATTERNS AND THEIR IMPLICATIONS FOR ASIAN URBAN TRANSPORT

6.1 Introduction

This chapter investigates the 1990 urban form characteristics of the nine Asian cities in the international sample and some important ways that these urban form characteristics affect urban transport in these cities. The discussion is in two main parts. The first part presents data to provide an international comparative perspective on the key urban form characteristics of the Asian cities relative to the rest of the international sample of cities. This complements the comparative perspective on urban transport patterns provided by the previous chapter and continues the story that began in Chapter 3, which presented the historical evolution of transport and urban form in the Asian cities. This presentation of comparable data also answers the urban form part of the first research question, namely: How do the main urban form characteristics of the selected Pacific Asian cities compare with each other and with a large sample of international cities?

The second section of this chapter examines some major interconnections between the transport and land-use characteristics of the Asian cities in the international sample. Some of these have been mentioned in the theoretical discussion of Chapter 2 and in the historical background of Chapter 3. A number of comments in Chapter 5 also strongly suggested that relationships between land-use patterns and transport choices must be investigated in more detail in the Asian cities in this study. The existing land-use patterns of the Asian cities present both opportunities and challenges to transport planning and these are investigated and clarified in this chapter and also in Chapter 7. Furthermore, recent transport trends have implications for the emerging land-use patterns in these cities. These new trends also present dangers and opportunities which are discussed in this chapter and which provide essential background to the understanding of choices that is developed in Chapters 7 and 8.

6.2 Asian Urban Form in International Perspective

The focus for this section is to present comparative information on a number of aspects of urban form that are of most relevance to urban transport patterns. The overall urban

population density is considered first, followed by discussion of the distribution of population, employment and activities within urban areas.

6.2.1 Urban density

Urban density was defined in Chapter 4 and the importance of comparing true urban densities rather than gross densities was emphasised. As discussed in Chapter 3, the following sections provide data that have been carefully validated and which avoid the problems and confusions that afflict many discussions of the issue of density in the literature. It is only by using density data that are truly comparable across the international sample, that valid insights on the implications of land-use patterns for transport become possible or meaningful. As mentioned previously, most of the Asian cities are relatively densely settled, which tends to set them apart from most other cities in the international sample. Only Kuala Lumpur has an urban density which is more akin to an average European city (Europe being the next densest regional grouping of cities in the sample). The new insights on transport and land-use in dense cities that are presented later in this chapter have only been made possible by the quality of the data set that underpins them.

6.2.1.1 Density comparisons

In 1990 the Asian cities in the sample were on average more than three times as dense as the average European city in the sample and more than eleven times the density of the Australian and American averages. The terms “high density” and “low density” can sometimes be used carelessly. In order to be clear when describing density levels in this thesis, it is useful to establish a vocabulary by defining a number of density categories. Therefore, for the purposes of this research, the following ranges are defined:

very low	15 persons per hectare (pph) or less,
low	16 to 25 pph,
lower-middle	26 to 50 pph
upper-middle	51 to 100 pph
high	101 to 200 pph
very high	greater than 200 pph ⁵⁴ .

⁵⁴ Another way of expressing densities is the inverse of density, namely the total amount of urbanised land area per person. This may be helpful for conceptualising in practical terms what these densities mean. In these terms the ‘very low’ category implies greater than 667 square metres of urbanised land per person, ‘low’ is between 400 and 667, ‘lower-middle’ from 200 to 400, ‘upper-middle’ from 100 to 200, ‘high’ 50 to 100, and ‘very high’ less than 50 square metres per person. To illustrate this further, at 10 persons per hectare there is a patch of urban land for each person which is about 32 metres by 32 metres in size. At 100 pph they have 10 metres by 10 metres, and at 300 pph each person has a patch under 6 m by 6 m. These areas refer to all urban land uses, not just residential land.

Figure 6.1 shows the densities of the Asian cities and the other regional averages and highlights the large range of densities found in the Asian sample.

Table 6.1 shows the above terminology applied to the densities of all of the cities in the international sample. Of the nine Asian cities in this study, three have upper-middle density, four are high density and two are of very high density. Plate 6.1 provides a pictorial perspective to give a better idea of the kinds of urban fabric that have such contrasting densities.

Figure 6.1 Urban densities in Asian cities and for other regional groupings of cities from an international sample of cities, 1990

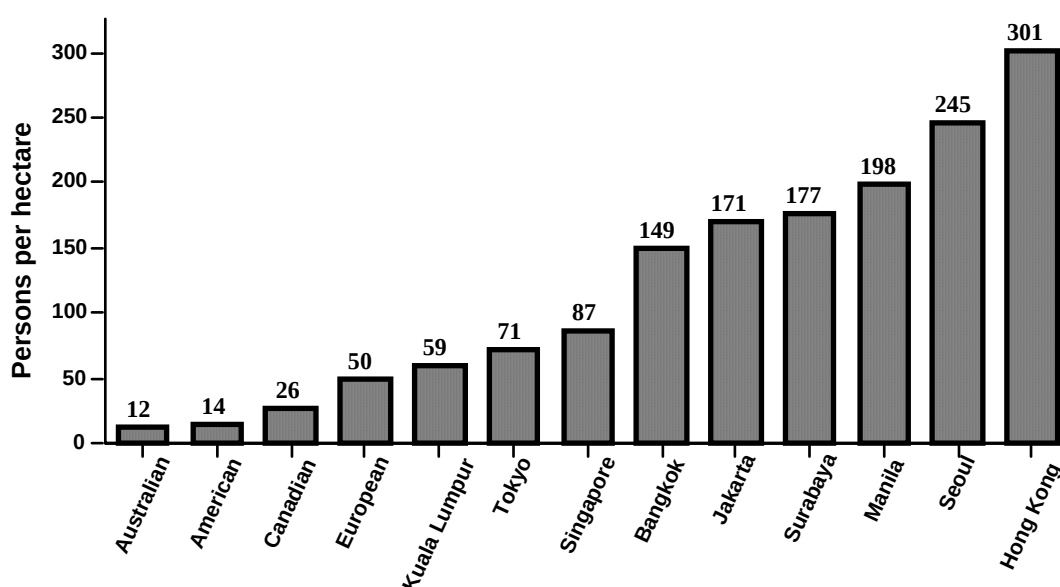


Table 6.1 Urban density categories in an international sample of cities, 1990

Very Low Density		Low Density		Lower- Middle Density	
Canberra	10	San Francisco	16	Toronto	26
Houston	10	Chicago	17	Copenhagen	29
Brisbane	10	Sydney	17	Edmonton	30
Phoenix	11	New York	19	Ottawa	31
Perth	11	Vancouver	21	Montreal	34
Portland	12	Calgary	21	Hamburg	40
Adelaide	12	Winnipeg	21	London	42
Boston	12	Los Angeles	24	Paris	46
Sacramento	13			Frankfurt	47
Detroit	13			Zurich	47
Denver	13			Amsterdam	49
San Diego	13				
Washington	14				
Melbourne	15				

Upper-Middle Density		High Density		Very High Density	
Stockholm	53	Bangkok	149	Seoul	245
Munich	54	Jakarta	171	Hong Kong	301
Kuala Lumpur	59	Surabaya	177		
Vienna	68	Manila	198		
Tokyo	71				
Brussels	75				
Singapore	87				

Note: All density figures are in persons per urban hectare.

Plate 6.1 Examples of the built form in various cities in the international sample of cities



Perth, Australia outer suburban housing



Amsterdam inner residential area (Photo: Zaitun Kasim)



Zurich outer area (Photo: Jeff Kenworthy)



Kuala Lumpur new suburban middle-class housing



Jakarta inner urban *kampung* (low-income settlement)



Singapore new town



Seoul's Kangnam area developed in 1970s and 80s. Tightly-packed family housing, apartments with commercial areas along main streets

Tokyo inner area housing and mixed land uses (Photo: Jeff Kenworthy)

6.2.1.2 Density trends

Urban densities in the Asian cities in the 1960s were briefly discussed in Chapter 3. Table 6.2 shows the trends in urban density in Asian cities and in the other regions over recent decades. With few exceptions, the Asian cities in this sample have followed the international trend for urban densities to gradually decrease over time. However, decreases in density have generally not been as steep as in the Western regions. Most Asian cities had much higher densities than Western cities in 1970 and this was still very much the case in 1990.

For the European group of cities, the average density figure dropped between 1970 and 1990 by a greater percentage (23 percent) than the Australian and American cases (with about 14 and 12 percent respectively), but nevertheless, European cities remained very much higher in density than Australian or American cities in 1990. Canadian cities maintained an average density between the European and United States values, and showed only about a 10 percent decrease between 1970 and 1990.

Most of the Asian cities' densities declined moderately, with drops of about 10 percent or less, or in the cases of Surabaya and Manila apparently increasing slightly. However, Kuala Lumpur declined by a percentage similar to the European average, with a drop of 25 percent between 1970 and 1990.

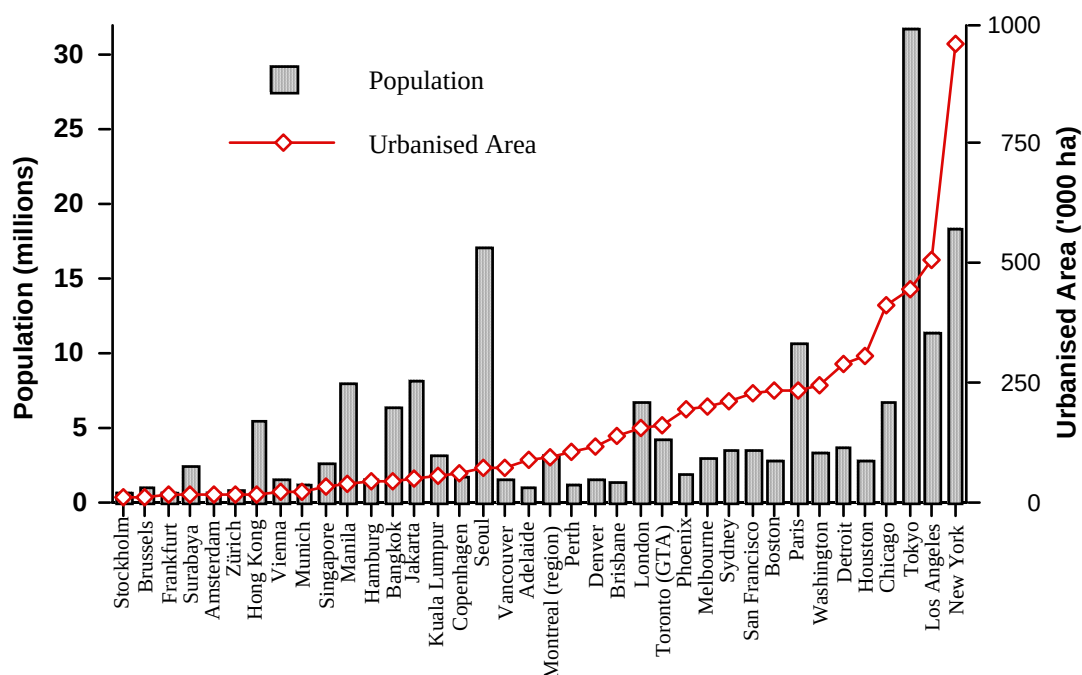
Table 6.2 Urban density trends in a sample of Asian cities, 1960-1990

	1960	1970	1980	1990	Change: 1970 - 1990
Kuala Lumpur	?	79	60	59	-25.3%
Bangkok	168	167	?	149	-10.8%
Hong Kong	?	333	293	300	-9.9%
Singapore	104	93	83	87	-6.5%
Tokyo	86	75	72	71	-5.3%
Jakarta	?	178	185	171	-3.9%
Surabaya	?	178	202	177	+0.6%
Manila	?	184	167	198	+7.6%
Seoul	?	?	?	245	?
Australian average	17	14	13	12	-14.2%
American average	17	16	14	14	-12.5%
Canadian average	?	31	28	28	-9.7%
European average	73	65	54	50	-23.1%

With high urban densities, Asian cities are, of course, compact relative to their population sizes. Figure 6.2 emphasises this by showing the 1990 urbanised areas and populations of the cities in the sample. It is striking that, of the nine Asian cities, only Tokyo occupied a greater area than the Australian cities of Adelaide and Perth, which had only about one million residents each. Seoul's 17 million residents occupied less area than Adelaide's one million. Tokyo is certainly a giant in terms of area as well as

in terms of population, but its 32 million people occupied markedly less area than Los Angeles' 11.4 million and less than half the space of New York's 18.4 million residents. Kuala Lumpur's middle density means its 3 million or so residents occupy a greater area than is taken up by high-density Bangkok, Jakarta or Manila, whose populations are much larger.

Figure 6.2 Populations and urbanised areas in an international sample of cities, 1990



Although within this international sample high densities may appear to be exceptional, it is clear that such densities are common in large cities in developing countries. Table 6.3 shows sixteen additional cities in Asia or other developing regions for which sufficiently detailed data were available to calculate or quote urban density figures that are compatible with the definition used in this study. Of these sixteen cities, fourteen had high or very high urban densities.

The point that high density cities are commonplace is further emphasised by Table 6.4 that shows gross densities for a number of cities where even the gross density is above 60 pph. The gross density of a city will always be lower than its true urban density (see Section 4.8.2). Thus these figures put a lower bound on the urban densities of the cities in question. Of the fourteen cities shown, eight had gross densities above 100 pph with some exceeding 200 pph and thus they certainly all had high or very high urban densities.

Table 6.3 Urban density in some other developing cities, ca. 1990

	Urban Density	Population (millions)	Year of Data	Source of Data
Cairo (Egypt)	400	~10	ca. 1988	United Nations (1990)
Hanoi (Vietnam)	256	1.1	ca. 1992	Padeco Co. Ltd. (1993: 1.4)
Shanghai (China)	251	6.2	1990	Hu and Kenworthy (1997)
Pusan (Korea)	245	3.8	1990/91	Seoul Metropolitan Government (1992)
Taipei City (R.O.C.)	227	2.7	1990	Seoul Metropolitan Government (1992)
Taegu (Korea)	190	2.2	1990/91	Seoul Metropolitan Government (1992)
Medan (Indonesia)	164	1.8	1988	Nippon Koei Co. Ltd (1990)
Guangzhou (China)	157	2.9	1990	Hu and Kenworthy (1997)
Mexico City (Mexico)	150	17	1988	Bauer (1991: 52)
Beijing (China)	141	5.6	1990	Hu Gang and Kenworthy (1997)
Kwangju (Korea)	133	1.1	1990/91	Seoul Metropolitan Government (1992)
Santiago (Chile)	100	5	ca. 1990	Rivasplata (1996)
Taejon (Korea)	91	1.0	1990/91	Seoul Metropolitan Government (1992)
Ipoh (Malaysia)	38	0.4	1985	Majlis Perbandaran Ipoh (1986)

Notes: a. Taipei's metropolitan area had a 1990 population of about 4.9 million and its density would be expected to be somewhat lower than that of the inner part, Taipei City, with 2.7 million.

b. The Chinese city populations and densities refer to the "built-up" areas only.

Table 6.4 Gross population densities in a sample of developing cities

City	Gross Density	Population (millions)	Year of Data	Source of Data
Bangalore, India	227	3.4	1990	Seoul Metropolitan Government (1994)
Bombay, India	226	9.9	1991	"
Madras, India	221	3.9	1992	"
Hyderabad, India	170	3.0	1992	"
Lahore, Pakistan	116	3.8	1989	"
Tehran, Iran	114	6.5	1991	"
Karachi, Pakistan	113	6.7	1989	"
Rangoon, Myanmar	111	2.5	1983	Leonard (1985)
Guadalajara, Mexico	88	1.7	1992	Seoul Metropolitan Government (1994)
Delhi, India	66	9.8	1992	"
Rio de Janeiro, Brazil	66	6.0	1990	"
Sao Paulo, Brazil	65	9.8	1992	"
Recife, Brazil	62	1.3	1990	"
Belo Horizonte, Brazil	60	2.0	1991	"

These data confirm that high urban population densities are not uncommon among low and middle-income cities, especially large ones. So it is clear that the Asian cities in this sample, which range in density from 59 to 300 pph, are not atypical of the range of densities to be found in low to middle-income countries world-wide. Apparently, some of the highest urban densities are to be found in Asia, especially in Korea, Vietnam, China and South Asia. Remembering the discussions in Chapter 2 that reviewed some connections between urban transport and urban form, it is not surprising that high densities are common among cities that have long had low incomes and hence low levels of motorised mobility (especially low levels of private vehicle use). The fact that high urban densities are common in many countries is important in confirming that the

findings of the present research may relate to a wider range of cities. Such wider implications of the research are discussed in the conclusion, Chapter 9.

6.2.2 Population, employment and activity distribution

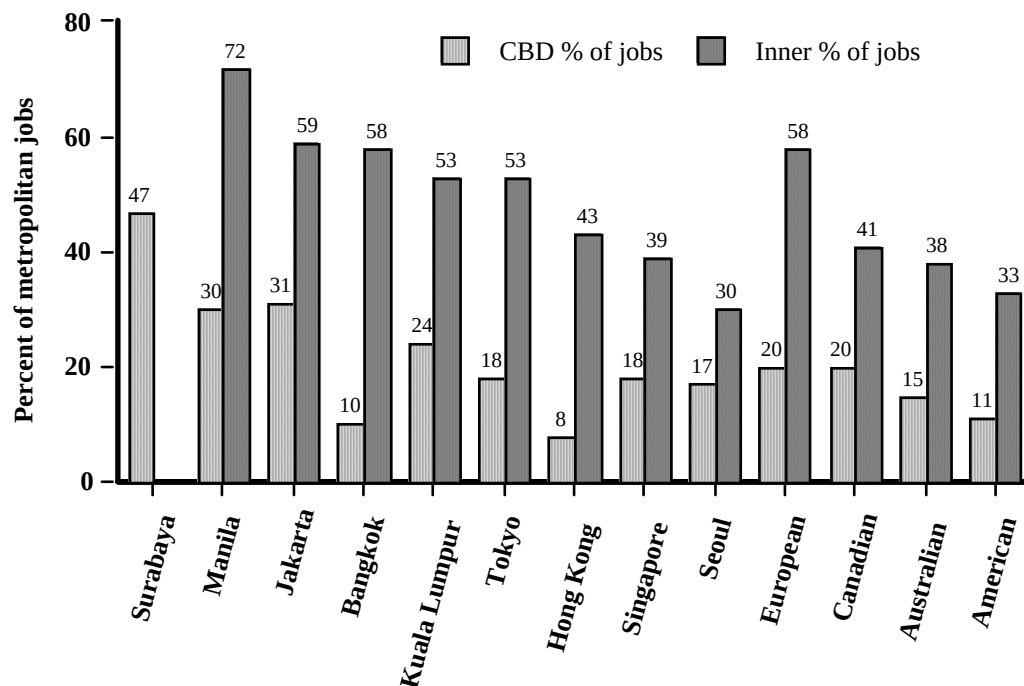
Urban density alone is clearly insufficient description of the urban form of a city. The patterns of locations and density of people, jobs and activities also vary widely from city to city in the international sample. The following sub-sections review a few of the most important and relevant of these patterns using data from the main sample. Like urban density, each of these other features of urban form have their own implications for transport choices and trends. They also relate closely to typologies of transport and urban form, such as those that were presented in Chapter 2, and the bus city type that was introduced in Chapter 3. Further insights on these typologies are developed in Chapter 7.

6.2.2.1 Centralisation of employment

In Chapters 2 and 3, a generally centralised pattern of employment was identified as one of the characteristics of both Thomson's low-cost strategy and of bus cities. By 1990, with the exception of Seoul, employment remained more centralised in the middle-income Asian cities than is typical of cities in other regions in this sample or in the richer Asian cities. Hong Kong and Singapore no longer had highly centralised employment. The picture is clearest if both central business district (CBD) and inner area data are considered together, as in Figure 6.3.

The data in Figure 6.3 reveal that in 1990, employment in the four higher-income Asian cities tended to be less centralised than in the five poorer Asian cities or even than the European average. Employment in Manila and Surabaya was very centralised in 1990. Jakarta, Bangkok, Kuala Lumpur and Tokyo also had relatively high centralisation, with percentages of jobs in both inner and central areas generally similar to the European average (with the exception of Bangkok's CBD). Hong Kong, Singapore and Seoul showed lower levels of centralisation of jobs, at levels similar to the Canadian, Australian or American cities.

Figure 6.3 Percent of metropolitan employment in inner and central areas of Asian cities, together with other regional averages in an international sample of cities, 1990.



Note: a. Reliable data on jobs in the full metropolitan area of Tokyo could not be obtained and was estimated by assuming a similar proportion of jobs to total population as found in other wealthy cities (about 0.4 jobs per person).
b. Inner area includes the CBD

It will become clear (as further urban form characteristics are presented) that these variations are consistent with a description of Surabaya, Jakarta, and Manila as still essentially bus cities in 1990. Furthermore, Bangkok and Kuala Lumpur also retain many bus city characteristics. A number of features will point to the increasing similarities of Hong Kong, Singapore and Seoul to the transit city model, albeit with some variations upon the original idealised model which was based on Western cities earlier in the 20th Century. One such variation, which is highlighted by Figure 6.3, is that these modern Asian transit cities are not quite as highly centralised in their employment locations as the classic transit cities apparently were, although mass transit is indeed playing a part in allowing high concentrations of employment to emerge within these cities, both in CBDs and elsewhere.

6.2.2.2 Density of central area (CBD) employment

There are also marked differences in the density of employment in the central areas of the Asian sample of cities. Central Business District (CBD) job densities for 1990 in the Asian cities studied here, ranged from among the lowest in the global sample (less than 200 jobs per hectare in Kuala Lumpur and Bangkok) to among the highest (more than 500 jobs per hectare in Tokyo, Seoul and Hong Kong). Again there is a systematic

pattern to the variations with Hong Kong, Tokyo, Seoul and Singapore having much higher CBD job densities than Kuala Lumpur, Bangkok, Jakarta, Surabaya and Manila. This is consistent with Hong Kong, Singapore and Seoul changing to join Tokyo in the transit city category, while the remaining Asian cities retained the bus city characteristic of relatively dispersed employment within the central area.

Hong Kong's CBD had by far the highest job densities of any city in the global sample, with 1,713 jobs per hectare⁵⁵. Only a handful of cities in the international sample had more than 540 jobs per hectare in their CBDs. They were Hong Kong and New York, along with Chicago, San Francisco, Toronto, Washington DC, Seoul and Tokyo. Urban rail seems to be a decisive factor in allowing such high CBD job concentrations. All of these cities had significant rail systems by 1990 to move workers into and within their central areas, even if some of them (such as the American cities) have transport systems that are generally private-transport oriented overall.

CBD job densities in the richer Asian cities have apparently been rising substantially over the last few decades (from 315 in Tokyo in 1960 to 547 jobs per hectare in 1990, from 281 in Singapore in 1970 to 386 in 1990, and from 1,256 in Hong Kong in 1980 to 1,713 in 1990). These patterns are consistent with gradual improvements in the capacity and reliability of the radial public transport services over recent decades. More details on such improvements are provided in Chapter 8. Hong Kong seems to have had very highly concentrated employment in its CBD, even before rail systems became a major mode of transport. This is related to the very high urban density overall. It is also probably due to the significant role that ferries played in providing high-capacity and congestion-immune transport to the CBD, especially in the 1960s and early 1970s, before the opening of the mass transit railway and the Cross Harbour Tunnel (Appendix 1 and Thomson (1977)). High density residential areas close to (and within) the CBD also allowed a strong role for walking in the trip to work, thus helping to minimise accessibility problems for such a high concentration of employment as in Hong Kong's core.

In contrast, the middle-income Southeast Asian cities had among the lowest 1990 CBD job densities in the global sample. Jakarta, Kuala Lumpur, Manila and Bangkok had CBD job densities between 132 and 227 jobs per hectare (Table 6.5). Outside Asia, such low figures were only found in very-low-density, dispersed cities such as Phoenix,

⁵⁵ In fact, even if Hong Kong's whole inner area had been defined as its CBD, the job density would still have been in the upper range of cities in the sample.

Perth and Denver (these also had less than 250 jobs per hectare in their CBDs). Surabaya's figure of 310 jobs per hectare was only a little higher than the other middle-income cities. In each of these Asian cities in 1990, access to the central area was overwhelmingly provided by buses in mixed traffic and increasingly also by private cars and/or motorcycles (as discussed in Chapter 5). These are modes that, because of their low capacities and high road-space and parking-space consumption, do not promote, and cannot cope well with, highly concentrated activity centres. Dense employment centres can be serviced effectively only by higher-capacity modes, of which urban rail is the main, proven technology. Of course, private vehicles, especially cars, are the least efficient modes in terms of their space requirements, so it is probably no accident that Kuala Lumpur and Bangkok, the two Asian cities with the greatest orientation to private modes, also had the least concentrated CBDs. As bus cities in the 1960s, Bangkok and Kuala Lumpur probably had relatively low CBD job densities at that time, but the growth of car use has apparently been associated with further dispersal of CBD employment. This has also been argued by Kidokoro and Hanh (1993) for the case of Bangkok.

Interestingly, in 1990 most of the European cities had moderate CBD job densities, in the range of 250 to 500 per hectare, despite the significance of urban rail in most of these cities. This reflects the retention of a great deal of historical architecture in most urban core areas in western Europe. A small number of European cities in the sample, such as Frankfurt and Brussels, do have skyscraper districts and these have CBD job densities of almost 500 per hectare, the highest of the European sample.

Table 6.5 Employment density in central, inner and outer areas in Asian cities in an international sample of cities, 1990

	CBD job density (per ha)	Inner job density (per ha)	Outer job density (per ha)
Hong Kong	1713	775	87
Seoul	580	210	84
Tokyo	547	108	31
Singapore	386	133	35
Surabaya	310	?	?
Manila	227	141	29
Jakarta	203	135	33
Kuala Lumpur	178	36	16
Bangkok	132	120	38
Asian average	480	207	44
European average	370	89	17
Canadian average	355	45	9
Australian average	368	30	6
American average	423	29	4

The need to bring large numbers of people into and out of a small area in a short period of time gives the CBD special transport requirements compared to the rest of any city. The transport difficulties of bringing most of Tokyo's 2.3 million CBD workers into the area each morning are legendary, but this was not reflected by Tokyo's relatively low figure for the percentage of total workers in the CBD (Figure 6.3). Tokyo's huge size means that even this relatively small percentage of jobs in its CBD amounts to a very large number of jobs in this concentrated area. This case highlights the need to also compare the absolute numbers of jobs in CBDs in the international sample (Table 6.6).

Table 6.6 CBD sizes (number of jobs) in Asian cities and selected other large cities in an international sample of cities, 1990

	No. of jobs in the CBD	Metropolitan population (millions)
Tokyo	2,301,000	31.8
Seoul	1,227,000	16.7
Jakarta	877,000	8.2
Manila	815,000	7.9
Surabaya	496,000	2.5
Kuala Lumpur	290,000	3.0
Singapore	280,000	2.7
Bangkok	272,000	7.6
Hong Kong	194,000	5.5
New York	2,306,000	18.4
London	1,143,000	7.4
Paris	862,000	10.7
Chicago	317,000	6.8
Montreal	273,000	3.1
Los Angeles	206,000	11.4
Sydney	175,000	3.5
Toronto	174,000	4.2
Detroit	93,000	3.7

Tokyo and New York had by far the largest CBDs in the sample with about 2.3 million jobs each in 1990. Then came Seoul with 1.2 million, London with 1.1, Jakarta and Paris with about 0.9, and Manila with 0.8 million jobs. Hong Kong's inner area should also perhaps be mentioned in the context of this discussion of CBDs, since in 1990 it had 1.1 million jobs at job densities in the upper range for CBDs in this international sample. The official Hong Kong CBD is very tightly defined, hence the small number of jobs. The Asian sample thus has many examples of very significant central business districts. Four out of the eight largest central business districts in the 1990 sample were in the Asian group.

The number of CBD jobs was an important element in Thomson's typology of cities that was introduced in Chapter 2. Thomson argued that once a CBD exceeds a certain size it is no longer feasible to have cars as the primary means of access. Detroit and Los

Angeles are examples of large cities with relatively small CBDs, since in both cities cars are the dominant mode of access, even for travel to the CBD. With buses and trams as the main modes, a CBD can have many more jobs than a car-oriented city. However, only with heavy rail systems as the main access mode can CBDs reach the enormous sizes seen in cities such as Tokyo, New York or London.

The comments above suggest that the large CBDs in Seoul, Jakarta and Manila and Hong Kong's inner area face formidable transport challenges, perhaps on a scale comparable to London's or Paris's. However, it will be shown below that a number of these central areas also have very large numbers of residents, often as many residents as jobs. This would tend to reduce the transport task involved to a considerable extent.

6.2.2.3 Other features of the central business districts of Asian cities

It has been shown that the five lower-income Asian cities tend to have centralised employment patterns in terms of the proportion of jobs located in the central areas. However, this central employment is not highly concentrated into a compact centre. A number of other features of CBDs vary widely among the cities of the sample and have transport implications. These include the number of residents in the CBD and some of the qualitative features of the shape of the city centre. Most of the lower income Asian cities were unusual in the international sample in having very high ratios of residents to jobs in their CBDs (Table 6.7). Thus Bangkok, Manila, Jakarta and Surabaya all had more CBD residents than jobs and Kuala Lumpur had 69 CBD residents for every 100 CBD jobs. To some extent, the presence of large numbers of residents in CBDs can mitigate the transport problem of bringing in the workforce of these central areas because many will simply walk to work. Nowlan and Stewart (1992) have shown this for the case of Toronto whose CBD has been undergoing rapid residential development since the 1970s.

The highest CBD population densities in the international sample were found in the large middle-income cities of the Asian group. Seoul, Bangkok, Manila, Jakarta and Surabaya all had CBD population densities above 200 pph. Kuala Lumpur, Hong Kong, Singapore and Tokyo had moderate CBD population densities ranging from 63 to 123 pph, as did most European cities where CBD densities of between about 50 and 100 pph were typical. Time series data are somewhat lacking for most of the developing Asian cities but in the three high-income Asian cities, the CBD population densities have been falling rapidly since 1960 as CBD job densities have increased. Each of Tokyo, Hong

Kong and Singapore had 1960 CBD population densities more than double their 1990 values. The centres of these cities have become more strongly commercial in character.

Outside Asia, New York stands out with a high population density in its CBD (227 pph). Paris is the only other non-Asian city which came close to this level with 180 pph in its CBD. Most American cities (except New York, San Francisco and Boston) and all of the Australian cities, had low CBD population densities, mostly well below 30 pph.

Table 6.7 Residents in central business districts of an international sample of cities, 1990

	CBD residents per 100 CBD jobs	CBD population density (pph)
Bangkok	245	325
Manila	196	445
Jakarta	116	235
Surabaya	101	360
Kuala Lumpur	69	123
Seoul	35	204
Singapore	21	83
Tokyo	12	63
Hong Kong	7	114
Asian average	89	217
European average	22	77
Canadian average	14	38
American average	11	50
Australian average	4	14

The data already presented suggest that the CBDs of the middle-income Southeast Asian cities are quite distinctive compared with the rest of the sample. Turning to qualitative features, the CBDs of Jakarta, Surabaya and Bangkok consist largely of a series of ribbons of offices and commercial land-use that have spread along major roads throughout and beyond the old, intensely mixed-use city cores (Kidokoro and Hanh, 1993; Sivaramakrishnan and Green, 1986). In Bangkok, such development now extends well beyond the usual definition of the CBD. Residential and other mixed land uses are interspersed with these commercial strips, especially within the large blocks between the main roads. More intense concentrations of employment and commerce can usually be found near major road intersections (Electrowatt Engineering Services and Pak-Poy & Kneebone, 1985; Soenyoto and Rogers, 1988). Kuala Lumpur's CBD has also spread since the 1970s into several areas along major roads beyond the old centre. The main new CBD area straddles several such roads, to the east of the old CBD area. Other nodes of office development lie near three expressway junctions beyond the old core of the city.

Plate 6.2 Central business districts in middle-income Southeast Asian cities tend to be relatively dispersed



The North-eastern part of Kuala Lumpur's CBD



Part of Bangkok's CBD extending along major streets

6.2.2.4 Other centres of activity

The promotion of multi-centred cities is a widespread planning goal. In addition, the nature of sub-centres, especially their characteristics that relate to transport, has become an important focus of urban research in recent years (Bernick and Cervero, 1997; Cervero, 1986). This is part of the broader agenda of examining which patterns of urban development are most compatible with high levels of public transport (Cervero, 1998). A systematic comparison of sub-centre characteristics would be a major undertaking and was beyond the scope of this study. However, this section will provide a brief and necessarily simplified treatment of the issue to highlight some of the most important comparisons of the character of typical urban sub-centres in the Asian cities. Particular emphasis is on features that relate to the modes of transport that best suit the sub-centres.

Transit-oriented, and especially rail-oriented, sub-centres are common in Tokyo, Seoul, Hong Kong and Singapore (Bernick and Cervero, 1997; Kenworthy et al., 1994; Korean Research Institute for Human Settlements (KRIHS), 1991; Urban Redevelopment Authority of Singapore (URA), 1991). Sub-centres focused along streets with heavy bus traffic or near bus termini are common in most of the other Asian cities (and also in Seoul). However, some car-oriented sub-centre features are now appearing too, especially in Kuala Lumpur and Bangkok, and even to some extent in up-market locations in Jakarta and Manila.

There are several main types of sub-centres with contrasting transport orientations. At one extreme, suburban sub-centres of employment and services in many of the car-oriented cities (such as in the United States) are designed for, and have developed in conjunction with, easy access almost exclusively by private car. Whatever the scale,

such centres provide generous, mostly free car parking, that frequently occupies most of the exterior spaces of the centre. Car-oriented centres are, so far, rare in Asia. However, they are beginning to appear around some cities, such as Kuala Lumpur, and Bangkok, although they do not have the extremes of low density and high parking provision seen in American examples, and in fact they are often developed quite densely. Nevertheless, there are examples that are geared primarily to access by private vehicles in their design details. For example, in the outer areas of Kuala Lumpur's metropolitan region, the author has observed in the 1990s the appearance of an increasing number of "big box" shopping centres and business parks in locations with very poor public transport access. The One Utama shopping centre in the Damansara Utama area, the Kelana Jaya business centre, and the expanding node of office development in and around Bandar Utama Damansara are all examples in the prosperous western parts of Petaling Jaya to the west of central Kuala Lumpur. All are located close to major expressways (or to expressways under construction), but are divorced from the region's expanding urban rail network.

At the opposite extreme in transport terms are the explicitly transit-oriented sub-centres that are common in Europe (for example around Stockholm) or in Tokyo and Singapore (Cervero, 1998). Such centres tend to be focused on a mass transit station or interchange, with most employment in the centre and much of the housing lying within walking distance of the station. They are therefore compact with high job densities. Internal access is primarily by foot or other non-motorised means and car-parking will usually be in high-rise, underground and often, peripheral garages, and is frequently charged for. Rail-oriented land-use patterns are at their most strongly developed when a sub-centre has been planned from the start as a transit-based centre. However, rail-oriented centres can also develop gradually after a mass transit system is built through an existing urban area. If other conditions are right, then developers may seek to increase the intensity of commercial land uses in the vicinity of well-used stations. Examples of this can be seen at a number of stations on Seoul's subway, especially those in the middle suburbs south of the Han River but still within the City of Seoul (stations further out are more likely to have been explicitly planned as new transit-oriented centres). Locations of high commercial land values in the City of Seoul, almost all coincide with stations on the four longest established subway lines (Seoul Development Institute, ca. 1995: 55, 86).

A third kind of sub-centre is the traditional main street which is a linear centre, oriented to access by tram or high-frequency bus service. These usually emerged at intervals

along important tram routes earlier this century. Such strips can still be seen in the inner areas of European, American and Australian cities. Similar linear strips of commercial development also occur in all developing cities in Asia. Commercial strips that target lower-income groups continue to adopt patterns with many “main street” features in a number of the Asian cities, such as Jakarta, Manila and Surabaya. Bus or tram-oriented main streets are distinguished in a number of ways from car-oriented strips of commercial development, epitomised by the “strip mall” of the USA. Main streets generally have shops and establishments with continuous, narrow frontages close to the street, in contrast to strip malls and their detached establishments with wide frontage, often with a set back for car parking in front. Although the two kinds of strip development are distinct, main streets are vulnerable to being turned slowly into strip malls as private vehicle ownership rises in a city. In this process, walkable street frontages tend to become gradually broken up by parking lots, set backs, gasoline stations, and other features that accommodate the private car, unless strong planning controls prevent such changes. Furthermore, strip malls tend to spread out further into other sections of existing or new main roads, creating an almost continuous mix of private-vehicle oriented establishments along such roads throughout the metropolitan area. Visual impressions by the author in the outer areas of Bangkok, Jakarta, Manila and Kuala Lumpur suggest that by the mid-1990s, the creation of numerous car-oriented strip malls is well under way along many major roads.

Hybrids of bus-oriented strips and car-oriented strips can also be seen in “high-end” commercial strips in the inner areas of cities such as Bangkok or Jakarta, where developers of shopping centres, offices and hotels increasingly provide highly car-oriented access features in their buildings. Linear sub-centres are the dominant pattern of activity centres throughout Bangkok, Jakarta and Surabaya (Cohen, 1985; Jakarta Government, 1991; Poboon, 1997), although they vary in the extent to which the details of their streetscapes welcome bus access or car access.

Manila is an interesting case. The CBD, as defined for this study, is the old centre. However, many of the CBD functions at the high end of the market have moved into other major sub-centres, such as Cubao and Makati (Electrowatt Engineering Services and Pak-Poy & Kneebone, 1985; United Nations, 1986a). Most of Manila’s sub-centres are located about 7 kilometres from the old CBD, near the large middle ring road (EDSA) and major radial streets. The most important is Makati, which was first developed in the 1950s and 1960s. In many ways Makati now rivals the old CBD for the title of Manila’s CBD. Buses and jeepneys continue to carry most workers to these sub-

centres. Makati and Cubao are planned, private developments but most of the other sub-centres are simply the intensification of strip developments close to the major intersections between the circumferential road and radial roads. A similar pattern can also be seen in a slightly less obvious way in Jakarta (Jakarta Government, 1991; Sivaramakrishnan and Green, 1986).

A fourth type of suburban sub-centre is an established town centre that then becomes part of the metropolitan area. Examples are particularly common in the case of Kuala Lumpur. For example, planning in the Klang Valley around Kuala Lumpur has long emphasised the development of new townships (such as Petaling Jaya, Bandar Tun Razak, Wangsa Maju, Shah Alam, Bangi New Town and most recently Putra Jaya) and the expansion of existing towns (such as Klang, Kajang and Rawang). These townships were always planned to be connected with the rest of the region by major roads rather than rail (Jamilah Mohamed, 1992), although in most cases rail connections are being put into place in the 1990s. This type of centre is faced with many of the same problems as the main CBD but on a smaller scale. Their reactions are also similar in transport terms. If private access increases and public transport is restricted to buses in mixed traffic then such sub-centres tend to have to spread out under the pressure of needing to provide car parking and to avoid congestion pressure on the compact core. However, if public transport access to the centre is improved through bus priority and/or rail service then the intensity of activities may actually increase in the old sub-centre core with strong pressure to redevelop at higher densities.

The features of sub-centres are clearly intimately related to transport trends. This discussion of sub-centres has provided further evidence that the five middle-income Southeast Asian cities, Surabaya, Jakarta, Manila, Bangkok and Kuala Lumpur retain many bus city features and that the four higher-income Asian cities are developing many transit city features. In addition, some sub-centres are beginning to show the influence of private transport in certain cities, most notably Kuala Lumpur and Bangkok.

6.2.2.5 *Mixed land-use patterns*

Mixed land-use is another important aspect of the distribution of employment and population, although it is one that is difficult to quantify. The mixing together of different land-uses in close proximity can provide opportunities for high levels of walking and cycling and even for many motorised trips to be short. Greater land-use

mixing has been widely advocated in the West as a measure to help reduce car dependence in cities.

Chapter 3 mentioned that most of the older parts of Asian cities tend to have intensely mixed land-use patterns. In recent decades there has been some tendency for mixed land-use patterns to give way to more segregated land use patterns. Formal, post-war real estate developments have tended to be more segregated in their land uses than earlier development or post-war unplanned development. The most segregated urban developments in the Asian context are probably new Malaysian formal housing developments. Nevertheless, even these are generally well-served by local shops, by Western suburban standards. The new towns of Seoul, Singapore and Hong Kong are also somewhat less intensely mixed than earlier ad-hoc development but nevertheless have highly mixed land use by Western standards. In Hong Kong, mixed-use occurs even within many single buildings, where “many compatible uses are piled on top of each other...” (Pun, 1980: 53-56).

Since unplanned development accounts for a large proportion of the urban environment in Manila, Bangkok, Jakarta, and Surabaya, these cities retain a very high level of mixing of land uses. For example, Cohen (1985) gives an account of the development of a typical mixed use neighbourhood in Bangkok as it evolved over recent decades in what was, at first, a fringe area. He describes the great extent to which residences and various kinds of enterprises are interspersed at a very fine scale. Even in areas where the built form itself has been constructed in a segregated style in the middle-income Asian cities, the presence of street stalls and roving hawkers helps to ensure an element of mixed use.

6.2.2.6 *Population distribution*

Most of the large Asian cities in the international sample not only have high population densities in their CBDs, they also have very high population densities in their inner areas overall. Table 6.8 presents data on the density and distribution of population in the inner and outer areas of the Asian cities of the sample and the averages for the other regions. The highest 1990 inner density by far in the international sample was Hong Kong's, which was extreme even by Asian standards, with 1.1 million people living at a density of 804 persons per hectare. The middle-income Asian cities (except Kuala Lumpur) had very high inner population densities, ranging from Surabaya's 265 pph to Manila's 391 pph. Furthermore, the inner areas of Manila, Bangkok, Jakarta and Surabaya contained substantial proportions (40 percent or more) of the total

metropolitan populations. Kuala Lumpur, Singapore, and Tokyo had much lower inner area densities, in the European range⁵⁶. However, for the six remaining Asian cities, their very dense, large and populous inner areas represent a significant portion of the built environment that is highly unsuited to space hungry modes of transport, especially cars. These significant inner areas cannot easily be ignored, swept away or “decongested” as urban decision-makers sometimes wish to do. Spatial constraints imposed by high urban densities are explored further later in this chapter.

Table 6.8 Population density and distribution in inner and outer areas in Asian cities in an international sample of cities, 1990

	Inner density (pph)	Outer density (pph)	% of total population in inner area
Hong Kong	804	258	21%
Seoul	299	236	18%
Manila	391	96	68%
Surabaya	265	145	40%
Jakarta	267	138	40%
Bangkok	289	89	58%
Singapore	124	81	21%
Tokyo	132	61	26%
Kuala Lumpur*	69	54	39%
Asian average	291	133	35%
European average	87	40	58%
Canadian average	44	24	25%
American average	37	12	33%
Australian average	24	12	38%

Note: * As mentioned in Chapter 4, Kuala Lumpur’s inner area definition is much larger than would have been ideal.

6.2.3 Outer urban expansion patterns

All of the Asian cities in the international sample continued to expand outwards between 1970 and the early 1990s. As always, transport patterns were a key factor in the nature of such expansion. This is true even in the cities, such as Singapore and Hong Kong, where land use planning by this time had tight control over new development, since in these cases transport considerations were usually an integral part of the plans that were adopted.

Hong Kong, Singapore, and Seoul all expanded primarily into highly-planned new towns in this era since the 1960s or 1970s. These new towns tend to have high quality transport links (roads, express bus and increasingly rail). However, there have been complaints that residents of some of Hong Kong’s new towns have faced transport

⁵⁶ The highest-density European inner area was Vienna’s with 129 pph in 1990.

disadvantages for a long time (a number of the new towns are not yet linked to the city's rail systems) (Lau, 1997). Increasingly such new towns are being retro-fitted with rail services. In most cases, the new towns in all three cities were planned in an explicitly rail-oriented form from the beginning. Some of Singapore's new towns, most of them served by both expressways and electric rail by 1990, were in locations up to 20 kilometres from the CBD (longer corridors are not possible on the small island). By the early 1990s, 50 per cent of the Singapore population already lived within 1 kilometre of a mass transit line, even though the system only opened in 1987 (Kenworthy et al., 1994). Hong Kong's most distant new towns in the New Territories were 25 kilometres from Kowloon (in the inner area). Again this is almost to the limits of Hong Kong's small territory. Most of the distant Hong Kong new towns had expressways reaching them but only some of them were served by electric rail by 1990 (see maps in Appendix 4). Nevertheless, by 1993, 50 per cent of the entire Hong Kong population lived within 500 metres of a Mass Transit Railway station (Kenworthy et al., 1994).

Seoul's satellite cities were almost all served by electric rail by 1990 and some also had expressways reaching them. The most distant was located about 48 kilometres from central Seoul but most satellite cities were within a radius of 30 kilometres. Being very high density, much of Seoul is intrinsically transit-oriented. This has been reinforced as urban rail has gradually become the backbone of the transport system in the last two decades. Rail became a significant influence on private location decisions by the 1980s, especially in the rapidly developing new areas south of the Han River. The Korea Land Development Corporation and the Seoul Development Corporation have played leading roles in developing the new areas, in financing rail infrastructure, and in ensuring integration of development with the rail systems (World Bank, 1995:126). Planning for satellite cities is explicitly transit-oriented (Korean Research Institute for Human Settlements (KRIHS), 1991).

In Tokyo, the rail system continued to be the primary influence over the patterns of suburban development. Tokyo's metropolitan area is considered to extend along suburban rail lines for about 60 kilometres from the centre in some directions (Cybriwsky, 1991: 22).

In the Southeast Asian middle-income cities, the primary pattern of expansion has been in corridors defined by major roads. The details of the land-use patterns of these corridors vary. There is generally a mix of unplanned developments of various kinds and formal real-estate industry developments (Kidokoro, 1992). These are often interspersed with pre-existing villages, industry (small or large-scale) and undeveloped

land. In Kuala Lumpur and Bangkok formal real estate development accounted for most new development. In Malaysia such developments tend to be large, with hundreds of housing units developed at one time. In other countries smaller developments are more typical and planning control over development is weaker. In Indonesian cities and Manila a large proportion of new development is still unauthorised and unplanned (Angel and Mayo, 1992; Kidokoro, 1992).

By 1990, the large middle-income Southeast Asian cities in the sample had expanded along corridors to considerable distances (see maps in Appendix 4). Expansion up to about 25 kilometres seems to have been possible along arterial road corridors, and contiguous expansion to 40 kilometres had occurred in some corridors served by expressways. Kuala Lumpur had expanded along major road corridors, with the longest being the 35 kilometre corridor of almost contiguous development along the Federal Highway (an expressway) between the city centre and Port Klang to the south-west. Another long corridor extended about 22 kilometres to the south-east to Kajang. Most of Bangkok's developed land was within 20 kilometres of the central area, but several narrow corridors were developed for up to about 40 kilometres, in particular to the north, served by expressway (or semi-expressway) for most of the distance (Poboorn, 1997: 51). Manila's contiguous development extended just over 25 kilometres in several directions by the early 1990s (JICA, 1997). Jakarta also extended about 24 kilometres along corridors to east and west and about 36 kilometres towards Bogor to the south (a corridor served by both the Jagorawi Toll Road and electric suburban rail) (Culpin Planning et al., 1993: 5, 6).

Beyond the more or less contiguously built-up urban areas of the large Southeast Asian cities (with the exception of Kuala Lumpur) is the so-called "*desakota*" zone with a mix of urban and non-urban land uses interspersed at a fine scale. This zone extends especially along major road corridors for a great distance beyond the recognised extent of the metropolitan area. These areas have complex patterns of movement and linkages, based on cheap, but footloose, modes of transport, such as small motorcycles and jitneys (McGee, 1991; McGee, 1992). Further research is needed to understand the transport and land-use interactions in these peri-urban regions, which are beyond the scope of this study.

6.2.4 Built form

Some brief comments need to be made about the specific built forms that underlie the data that have been presented in the previous sections. In the context of the principal

aims of the thesis, these comments are restricted to the mix of housing types in each city. This information provides some additional insight on how the various densities in the Asian cities come about and on how visual impressions of density can sometimes be misleading. The details of the built form may also provide some hints on the question of how easily the spatial demands of cars might be accommodated in these cities.

In the lowest-density of the Asian cities, Kuala Lumpur, terrace houses (link houses) are the most popular form of housing. In 1980 in the Federal Territory of Kuala Lumpur, terrace houses constituted 32 percent of dwellings. Detached houses accounted for 28 percent but a majority of these would have been squatter and traditional village houses. Semi-detached houses accounted for 13 percent. Apartments accounted for 25 percent of dwellings. The remaining two percent of dwellings were single rooms (such as above shop-houses or attached to a factory or warehouse) (Department of Statistics Malaysia, 1984-85).

Tokyo is the next city in the Asian rankings of density within this sample. It has a traditional housing style of small, tightly-packed detached houses in intimate neighbourhoods, but middle-rise apartments and flats have been gaining in numbers gradually since the 1960s, especially, but not only, in the inner areas (Cybriwsky, 1991). By 1990, multi-family housing accounted for approximately 67 percent of housing units in Tokyo-to. The percentage would be lower however, if the whole metropolitan area was considered (Tokyo Metropolitan Housing Master Plan, 1991).

Despite their high urban densities, single houses tend to dominate the housing stocks of Surabaya, Jakarta, Bangkok and Manila. However, most of these houses are tightly packed together, especially in inner areas and in “unauthorised” settlements. Furthermore, the average number of people per household is high (generally over 4 in these cities). In 1990, 44 percent of Bangkok’s dwellings were detached houses and another 34 percent were row houses (National Statistical Office, 1990). In Jakarta approximately 70 percent of the population lived in *kampung*, which consist of small houses tightly packed together. The percentage of the population in unauthorised housing in Manila was 76 percent (Angel and Mayo, 1992). In Surabaya, the figure was similar (Silas, 1989). By contrast, Kuala Lumpur and Bangkok had well below 20 percent of their dwellings in unauthorised housing (Angel and Mayo, 1992).

By 1990, both Singapore and Hong Kong had most dwellings in high rise flats (Lo, 1992; Urban Redevelopment Authority of Singapore (URA), 1991). Unauthorised housing was by then a very small percentage of dwellings in these “city states”.

However, high-rise housing results in very different urban densities in the two cities (300 persons per hectare in Hong Kong versus 87 in Singapore). Singapore's much lower density is the result of lower building heights, generous devotion of land to non-residential uses, and to landscaping around apartment buildings. In Hong Kong buildings of all kinds tend to be arranged very close together.

Between 1970 and 1990 a rapid change took place in the housing of Seoul. In 1970, 88 percent of dwellings had been detached houses (generally in a very tightly packed arrangement, with alleyways providing access to many of the houses). Apartments accounted for only 4 percent of dwellings at that time. However from 1970 onwards, most new housing in Seoul was in the form of large-scale, high-rise apartment projects, so that by 1990, apartments constituted 46 percent of dwellings in the City of Seoul (Kim and Choe, 1997: 106-107). Most of these apartments are located in the newer parts of the city, so that the areas developed before 1970 (mostly north of the river) remain dominated by tightly-packed but detached houses.

This brief survey of housing types has highlighted that it is possible for similar densities to be achieved with rather different styles of urban fabric. This provides a reminder that first impressions on the urban density of a city can be misleading, as mentioned in Chapter 4. The different styles of urban fabric may have slightly different implications for transport. For instance, the more "orderly" and formal developments will usually include provision for road and parking space in conformity with some formal guidelines. So to some extent, such developments will tend to be inherently more welcoming of cars than informal settlements, although they may also better lend themselves to efficient service by formal-sector public transport. Conversely, governments may find it relatively easier to demolish unauthorised settlements to make way for transport infrastructure, such as roads, than to demolish formal sector housing.

Although the potential influence of variations in the style of the urban fabric is undoubtedly real, it is extremely difficult to study systematically and must be considered to be beyond the scope of this particular study. Therefore this chapter has focused primarily on the large-scale features of urban form. These major features present each city with its own particular set of transport-related challenges and opportunities that are the subject of the rest of this chapter. These challenges and opportunities vary in regular ways relative to the major land-use variables, especially urban density, that have been presented so far in this chapter.

6.3 Spatial Challenges and Opportunities

The high density, mixed use, and often centralised urban forms of the Asian cities in the sample present their transport decision-makers with challenges and opportunities that are, in many cases, different from those faced in America, Australia and Europe. This section examines some of the key implications for urban transport of existing Asian urban forms.

One example of the challenges that are faced has already been mentioned in Chapter 5. It was shown that several of the Asian cities already face a high potential for local pollution per hectare from traffic, despite relatively low vehicle use per person. Conversely, one of the transport-related opportunities presented by Asia's generally high-density urban forms was also seen in Chapter 5, where high levels of public transport usage were found in many of the Asian cities. It was also seen that almost all of the Asian cities achieve plentiful public transport service levels, at least on a per hectare basis.

It was pointed out in Chapter 2 that it is well recognised that urban form can be influenced by the main modes of transport and by transport infrastructure. Hence it might be thought that it is unimportant to worry about the challenges and opportunities of present urban form, since land use patterns will adapt to whatever transport changes occur. However, that would overlook the tendency for land use patterns to adapt to transport patterns rather slowly, generally over a time scale of decades. Asian cities tend to be densely settled today largely because they mostly had low mobility until recently and therefore needed to remain compact in order to maintain their accessibility and to remain amenable to non-motorised modes and public transport. The sudden emergence of relatively high mobility in some Asian cities, in the form of rapid increases in private vehicle ownership, is completely new to these cities and does indeed create strong pressures for changes in urban form, especially in the style of new development. However, large parts of these cities, housing many millions of people, are already built up and their existing high-density, non-automobile character has important implications for their ability to cope with transport changes. In any realistic assessment, it is simply not possible to have the wholesale demolition in such areas that would be required to adapt them to the space standards that mass ownership of automobiles would appear to dictate.

In many of the Asian cities, rapid changes in transport over the last decade or two have led to a traumatic imbalance between new levels of mobility, especially private

mobility, and many aspects of their existing urban fabric and transport infrastructure, even though their levels of private mobility are still relatively low in an international context.

Sub-sections below will consider not only the inherent challenges but also the significant opportunities that Asian land use patterns present for transport. These point to potential paths forward from the apparently intractable traffic-related problems that plague many Asian cities today. The key choices that are involved in facing up to these challenges and opportunities are the focus of Chapter 8, where the experiences of the Asian cities in this sample provide ample evidence for understanding the possibilities.

6.3.1 Transport challenges from high densities

It was seen in Chapter 5 that in upper-middle-income and high-income cities there is the potential for private car ownership levels to reach or exceed about 180 cars per 1000 people. However, insufficient income is not the only obstacle to high levels of car ownership and car use. This section examines the extent to which urban form characteristics are an obstacle.

The impacts of urban transport, discussed in Chapter 5, helped to focus attention on transport challenges for high density cities. In particular, it was shown that a number of the dense Asian cities faced high levels of transport pollutant emissions per hectare, despite relatively low levels of travel per person. Spatial constraints on urban transport are a major challenge in many cities around the world. It is shown here that these constraints are particularly severe in the denser Asian cities.

The influx of private cars into cities during this century has influenced urban forms by a number of mechanisms. One is that the speed of cars (in combination with generous road provision) allowed distant locations to become accessible. More importantly, these distant locations could be widely scattered, no longer linked to fixed-rail public transport systems and no longer very compact to facilitate non-motorised transport. Both of these factors can be considered as “pull factors” in the spread and dispersal of car-oriented cities. There is however also a “push factor” which is sometimes neglected in the discussion. This is the problem that cars require very large amounts of space if they are to be a main mode of access. This voracious demand for space by cars in cities has been understood for many years (Mumford, 1961). An influx of cars therefore creates great difficulties for established dense urban areas and generates substantial pressure for activities to spread out to make space for cars (both movement space and storage space). It is also well known that private cars make very inefficient use of

precious road space, especially in the context of dense, congested cities. For example, in many low or middle-income cities, such as Manila in the 1980s, public modes dominated trips but private transport dominated traffic (Kirby et al., 1986). The same point was made in Chapter 3 with reference to traffic in some Asian cities before the 1960s.

Recent research further clarifies the issue and focuses attention on the large amount of urban space taken by cars compared with public transport. By calculating the product of the space occupied by the time that it is occupied, this line of research focuses attention on the enormous differences (90 times) in “space multiplied by time” consumption between cars and public transport for a trip to work in a central business district (Bruun and Schiller, 1995). This approach emphasises the importance of the space consumed for car parking, especially car parking that is occupied continuously for the entire day in expensive central areas.

Even focusing only on the road space consumed, reveals that private vehicles are much less efficient in spatial terms than collective public transport. This remains true even where public transport is dominated by small jitneys. The rather extreme case of Manila illustrates this point. Data from this study (Appendix 1) shows that in 1990, buses and jeepneys carried about 60 percent of the road-based passenger kilometres, but accounted for only 26 percent of the vehicle kilometres by passenger vehicles. Even if it is conceded that jeepneys and buses may cause greater traffic friction than cars, it is still clear that private vehicles are contributing most to any congestion while carrying a small proportion of passenger travel. Cuthbert (1983) calculated that Jakarta’s jitneys (*mikrolet* and *opelet*) had a passenger car unit (pcu) value of between 1.2 and 1.7 (depending on the frequency of stopping on different types of road). He found a pcu value of 2.0 to 2.4 for large buses operating on large roads (in Manila buses operate only on major roads). If therefore a pcu figure of 1.7 is applied to all road-based public transport in the Manila data, then public transport still accounts for only 37 percent of pcu-kilometres by passenger vehicles, while accounting for 60 percent of the road passenger transport task.

Unfortunately, the recognition of the inefficiencies of private transport from a space perspective has often not penetrated to a policy level. For example, Bangkok’s main approach to its traffic crisis is still the building of more roads (Poboorn, 1997).

6.3.1.1 Road provision

The problem that many Asian cities are facing with traffic is often specified primarily in terms of a lack of road capacity (Bodell, 1995; Midgley, 1994: 21; Tanaboriboon, 1993; World Bank, 1996: 4). This definition of the problem seems to drive transport policy in many cities, as it has for many years in Bangkok (Poboon, 1997). This section examines the issue of road provision in Asian cities compared to other cities, first using the road length data developed in this study, and second by gathering together some data from other sources on road area in selected cities. Both sets of data provide valuable insights when examined with the extra awareness of spatial factors and urban density that is the focus of this chapter.

6.3.1.1.1 Road length comparison

It was seen in Chapter 5 that many of the Asian cities do indeed have low levels of road length per person relative to cities in the other regions in the international sample. However, it is too simplistic to blame traffic problems on a lack of road space. The problem is in fact more fundamentally a spatial one, related to the high densities of development of most of the Asian cities. Rapid motorisation has meant that both the road network and the land use patterns of most of these cities, remain highly unsuited to mass use of private cars. In fact, high-density urban form is the central underlying reason for the low road provision per person of the dense Asian cities. Road space is inherently a scarce commodity in dense cities. In fact, logically any measure of road capacity *per person* will necessarily be low in dense cities unless road capacity *per hectare* can be made unusually high. Figure 6.4 illustrates these points using data from the international sample.

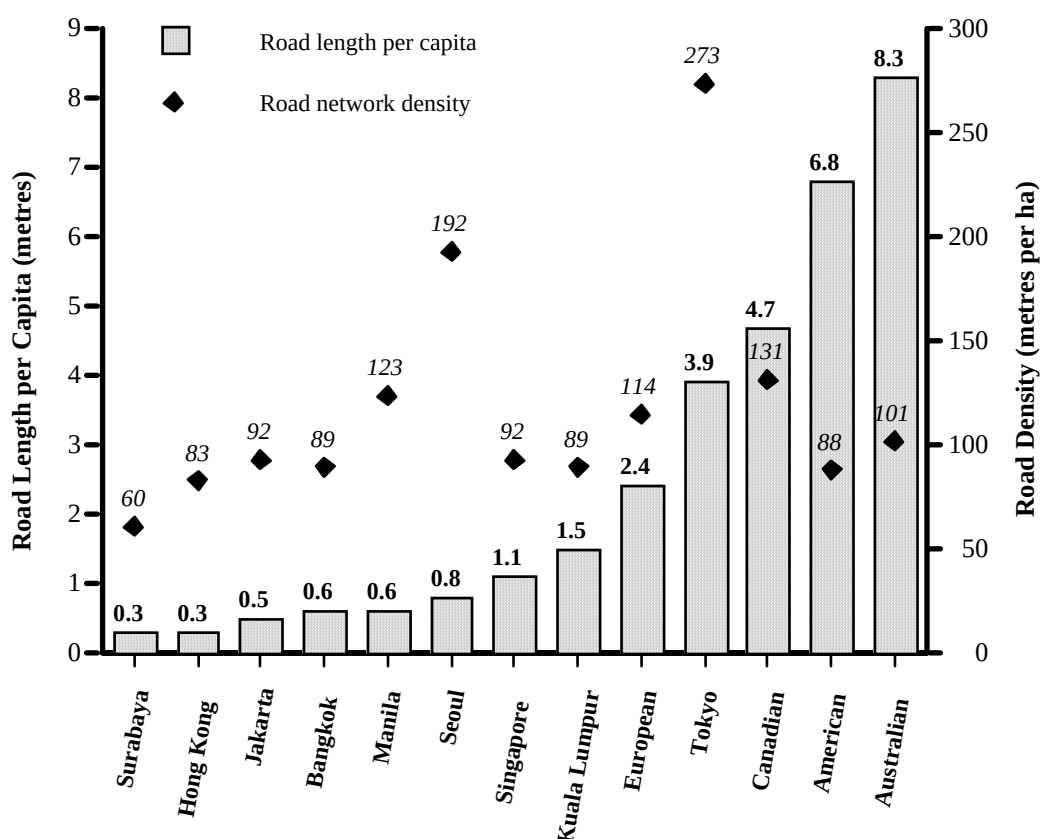
The Asian cities had a low average road length per person despite having an average road density that was close to the average for the whole international sample⁵⁷. Even Tokyo, which had an upper-middle urban density and a very high figure for its road density, still had a level of road length per person that was well below the Canadian, Australian or American figures. Seoul also had an unusually high figure for road density, but with a very high urban density in Seoul, this equated to a very low figure for road length per person⁵⁸. There is no obvious systematic variation in road density

⁵⁷ Road density figures (road length per urban hectare) presented here are calculated as the product of the road length per capita figures and the urban density of the relevant area. In effect, this is the total length of roads divided by the urbanised area. It will inevitably be a slight overestimate of the road density within the actual urbanised land, since some of the roads that are counted pass through non-urban land uses. However, this error is unlikely to vary systematically across the international sample. Therefore the variations noted in Figure 6.4 and Figure 6.5 are valid.

⁵⁸ It is suspected that the high road density figures in Tokyo and Seoul are, to some extent, the result of the inclusion

between the regions, with density, nor with income. Only Tokyo's exceptional road density level exceeds Ingram and Liu's (1997) figure for a statistical threshold level for urban road density of 230 metres per hectare (which was mentioned in Table 2.1).

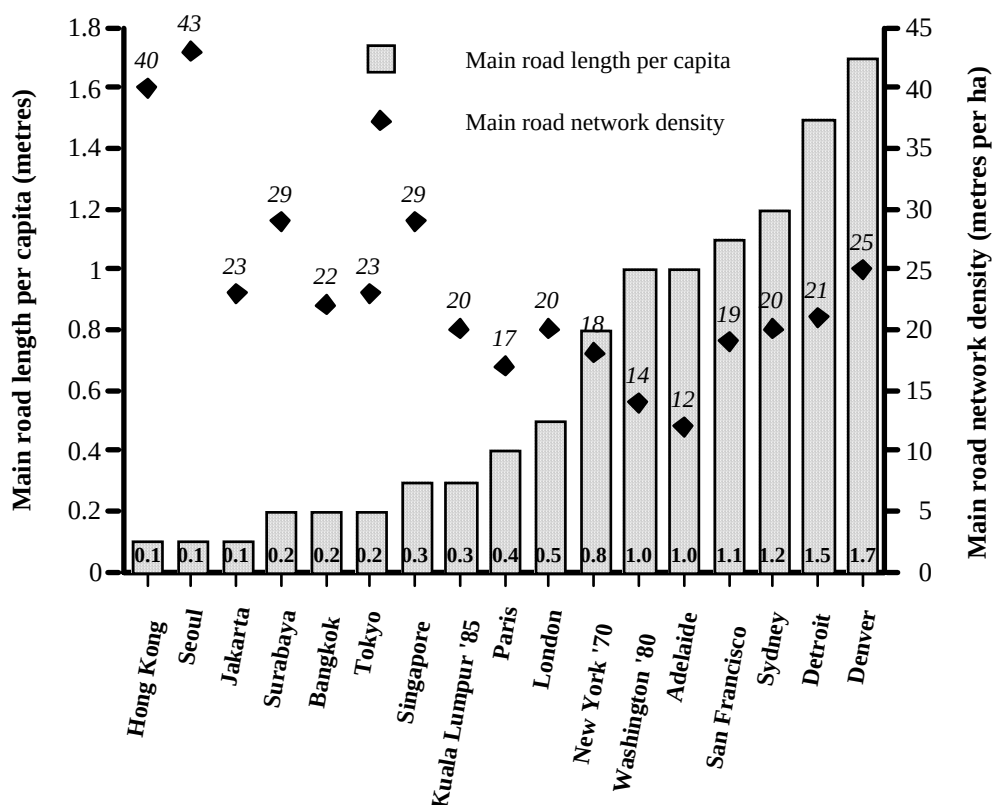
Figure 6.4 Road network density (metres of road per urban hectare) compared with road length per person in Asian cities and regional averages of an international sample of cities, 1990



Data on main road provision show similar patterns (Figure 6.5). Main road density also varies relatively little across many cities in the sample. If anything, some of the higher density Asian cities tended to have slightly higher arterial road densities than others (the Asian cities' average was 29 metres per hectare, while for the non-Asian cities in Figure 6.5, the average was 18 metres per hectare). Yet, the Asian cities, especially the highest density ones, had very low figures for main road length per person. This in itself at least partly suggests the difficulties to be encountered by aggressive road building programs in Asian cities. For one thing, they would imply covering the Asian urban environments with much more bitumen per urban hectare than they now have, which is already at least equal to, or more than, other cities in the sample.

of many small alleys in the road length figures. Many such alleys in Seoul and Tokyo are passable to cars, but only just barely, and carry almost no four-wheeled traffic. These alleys are essentially for non-motorised traffic.

Figure 6.5 Main roads network density compared to main length per person in Asian cities and a number of other cities in an international sample, ca. 1990



Notes: a. Tokyo's arterial road data are for Tokyo-to, not the larger Tokyo Metropolitan Transportation Area (TMTA).

b. The definitions of the categories of road that were included as "main" roads were specified in the notes to Figure 5.10.

Nevertheless, the question needs to be asked, could arterial road density be raised to high enough levels in dense cities to bring their arterial road lengths per person up to levels comparable with European or even American cities and hence allow vehicle use per person also to rise to similar levels? The answer, at least for the high density Asian cities, must almost certainly be in the negative, unless urban densities decrease tremendously. The two very-high density cities in the sample, Hong Kong and Seoul, already had unusually high figures for main road network density. Furthermore, it is easy to imagine that it would be difficult to increase arterial road network density in any city beyond a certain point (Zahavi, 1976: 26). Very high arterial road network densities would result in large numbers of intersections and would leave little space for urban development between the arterials. Such an approach threatens the very existence of a dense city.

Expressways do however provide one way to increase the network density and capacity, but spatial (and financial) constraints must inevitably limit this network density as well.

For example, some Asian cities in this sample may already be close to having quite dense expressway networks even by international standards. Using data presented in Table 5.10, along with urban density figures for the closest relevant year that is available, shows that Hong Kong in 1990 had 4.4 metres of expressway per hectare of urbanised land. Kuala Lumpur had an expressway density of 3.6 metres per hectare (m/ha) in 1985 and by 1997 it had approximately 4.1 m/ha. Seoul's 1995 figure was about 3.1 m/ha and Singapore's 1990 figure was 3.3 m/ha. These figures can be compared with Los Angeles (County) with 3.9 metres of expressway per urban hectare in 1990, Paris with 2.8 m/ha in 1990, and New York with 2.7 m/ha in 1980. Even if a proportion of the expressways in the Asian cities actually lie beyond the urbanised areas, these figures nevertheless suggest that some of the upper-middle-income and high-income Asian cities are not lacking expressways on a per hectare basis.

6.3.1.1.2 Road area comparisons

The conclusions so far have applied to the centre-line lengths of roads. Greater variations between cities in road capacity per hectare could be achieved through wider roads, bigger intersections, more multi-lane expressways, etc. It is possible that main roads in Asian cities may be systematically narrower than elsewhere. However, even if this were to be remedied, high density cities will tend inevitably to have low road capacity per person unless these efforts (at providing more lanes, etc.) could produce levels of road capacity per hectare that are higher than that seen in cities anywhere in the world to date. Furthermore, in established high-density urban areas, the opportunities to increase road capacity are probably even more limited than they are in more sprawling cities, due to the greater expense of reclaiming space occupied by residences and commercial activities. Potential displacement of residents and jobs is very high in such environments.

A related perspective on the amount of roads a city has is therefore provided by considering the percentage of urbanised area that is devoted to roads (which is sometimes called the roads ratio)⁵⁹. This measures, in effect, the actual road space per hectare. Although such data are difficult to assemble in a consistent way for many

⁵⁹Unfortunately, it is difficult to be sure that these figures are comparable because some sources may include road reserves as well as road pavement and yet others may refer to the space devoted to all transportation including rail lines, marshalling yards and bus terminals, etc. Nevertheless, data are presented on this variable with the caveat that their absolute accuracy may be in question, though not the significant patterns of regional variation.

international cities, it has been possible to gather a few figures that seem to be reasonably reliable and comparable (Table 6.9)⁶⁰.

In the literature on Asian urban transport, a low roads ratio is often stated as a major problem, with the comment typically being made that the percentage of urban land devoted to roads is far below the levels of western cities (Chae, Kim, and Hong, 1994; Soegijoko, 1997; Tanaboriboon, 1993; World Bank, 1996: 4). This is certainly true to some extent, particularly in the large lower-middle income cities (Table 6.9). However, it should be pointed out that Seoul, Singapore and Kuala Lumpur do not have particularly low roads ratios. Conversely, a number of European cities (including Paris with 11 percent and Munich with 13 percent) seem to have relatively low roads ratios that are similar to those in Tokyo, Hong Kong and Bangkok (Kenworthy et al., 1995). Nevertheless, this indicator apparently does tend to be somewhat higher in the car-oriented cities of the US and Australia and lower elsewhere. Poole, Pacheco and de Melo (1994: 22) suggest about 35 percent or higher as the percentage of land devoted to all roads in American cities.

Table 6.9 Road area as a percentage of urbanised land area and road area per person in Asian cities, 1990

	Road area as % of urbanised area	Road area per person (m ²)
Singapore	21	25
Seoul	19	6
Kuala Lumpur	15	19
Tokyo	13	12
Hong Kong	12	4
Bangkok	11	7
Manila	?	?
Jakarta	7	4
Surabaya	8	5

Notes: Tokyo's road area figure is for Tokyo-to only.

Kuala Lumpur's road area figure is for the Federal Territory in 1983.

The laments about low percentages of land devoted to road space in Asian cities sometimes imply that they should strive for some ideal percentage for roads, which is usually put at 20 percent or 25 percent of the urbanised area, and which is said to be a general yardstick in the West (Tanaboriboon, 1993). However it must be pointed out again that for dense cities, even if they are able to attain such a target, this will still

⁶⁰ In particular, the data in this study avoid the main problem with many such figures cited in the literature, which is that the figures commonly available provide the percentage of the total area of a city that is devoted to roads. Like the problems with using gross density data, such figures will have random variations depending on how much of the metropolitan area is not urbanised. Even though some of the road area that is counted in the figures in Table 6.9 may pass through non-urbanised land, this error is likely to cause much less random variation than would the use of total land areas.

equate to a low level of road space per person. Seoul provides a useful example to illustrate this point. By 1990 Seoul had achieved a level of almost 20 percent of its urban land devoted to roads and unusually high figures for its road network density and its arterial road network density. However, because of Seoul's very high urban population density, these apparently high levels of road infrastructure still equated to low figures for road length per person, arterial road length per person and road area per person (among the lowest in the international sample of cities) (Table 6.9, Figure 6.4 and Figure 6.5).

It will be very difficult indeed, if not impossible, for dense cities to remain dense **and** to significantly increase their road provision per capita, except perhaps by using extraordinary means such as extremely high-capacity, perhaps multi-decked or underground roads, all of which are extremely expensive. Such a strategy would also have to confront the experience in other cities that traffic tends to expand to fill the space available (Goodwin, 1996). These comments may seem quite obvious at this point, but they have not previously been emphasised in the literature on urban transport, and indeed the opposite view has frequently been put that substantially increasing road supply in Asian cities is a viable and desirable policy direction. A reason for the lack of careful attention to this issue in the literature may be because of the more narrow range of urban densities found in the West, which is the subject of much of the English language literature on urban issues. However, these spatial considerations are obviously of great relevance in a region such as Pacific Asia, with cities ranging in density from about 50 pph to 300 pph and which are also rapidly motorising.

Plate 6.3 Expressway amid dense urban fabric in Bangkok's inner area



Obviously, such comments apply in less strong terms to the middle-density Asian cities, such as Kuala Lumpur, Singapore and Tokyo. In such cities, a given level of road length per hectare equates to a level of road provision per person that lies between the extremes of the low-density cities of Australia and the very high-density cities, such as Seoul and Hong Kong. However, the densely built-up inner areas of almost all Asian cities face significant spatial constraints to the expansion of roads.

To be realistic, it would seem from this analysis that the only feasible way that road capacity per person might be significantly increased in very dense cities is as a result of the expansion of urban areas outwards at much lower densities than is currently the case. In such a process, the inner area may lose a proportion of its population, thus directly creating a higher road provision per capita in that area. At the same time, newer areas that are built with much more generous road standards and with lower population densities, inevitably have a much higher rate of road capacity per person than the existing urban area. As lower-density areas increase as a proportion of the total urbanised area, the road capacity per person figures would rise. Whether or not this is a desirable strategy is another question, and just how much of an increase could be achieved is also questionable. The example shown in the footnote below suggests that the ability to increase road availability per person is inherently limited in dense urban environments⁶¹. Such a process occurred within the last fifty or sixty years in such Western cities as New York, London and others. However, these cities have also had to maintain extensive rail systems to continue to provide transport into and within the pre-car areas that remain rather densely built up and densely populated.

6.3.1.2 *Traffic intensity*

Another spatial perspective on the challenge of traffic for dense Asian cities is provided by examining the parameter called “traffic intensity” (or vehicle kilometres per year per hectare) for each city. In the discussion here, traffic intensity is used as a city-wide parameter, rather than referring to specific parts of a city. This idea of traffic intensity is

⁶¹ Some rough figures may help to illustrate the possibilities. Suppose a city of 5 million people that currently has a density of 150 pph and 100 metres of road per hectare (note that this is similar to Bangkok in the mid-1980s and could be considered reasonably typical of large lower-middle-income cities in Asia). This implies a figure of 0.67 metres of road per person, again fairly typical. Suppose after 30 years this existing area gets no new roads but its population drops to 4 million. In addition, a further 6 million are added in outer areas at densities of 50 pph (still a European-type density, but lower than the density of the existing outer area of cities such as Bangkok). Suppose that roads are provided in the newer areas at the same rate of road length per hectare as the inner area (i.e. the same road density is created in inner and outer areas, even though in practice in most cities, the outer area often has slightly lower road density than the inner area). After 30 years the whole metro area would have 10 million people at an overall urban density of 65 pph and a road length per person of 1.5 metres. Even with such a significant drop in density, such a city would therefore still probably have a relatively low level of road length per person (still 38 percent lower than the average European city in 1990).

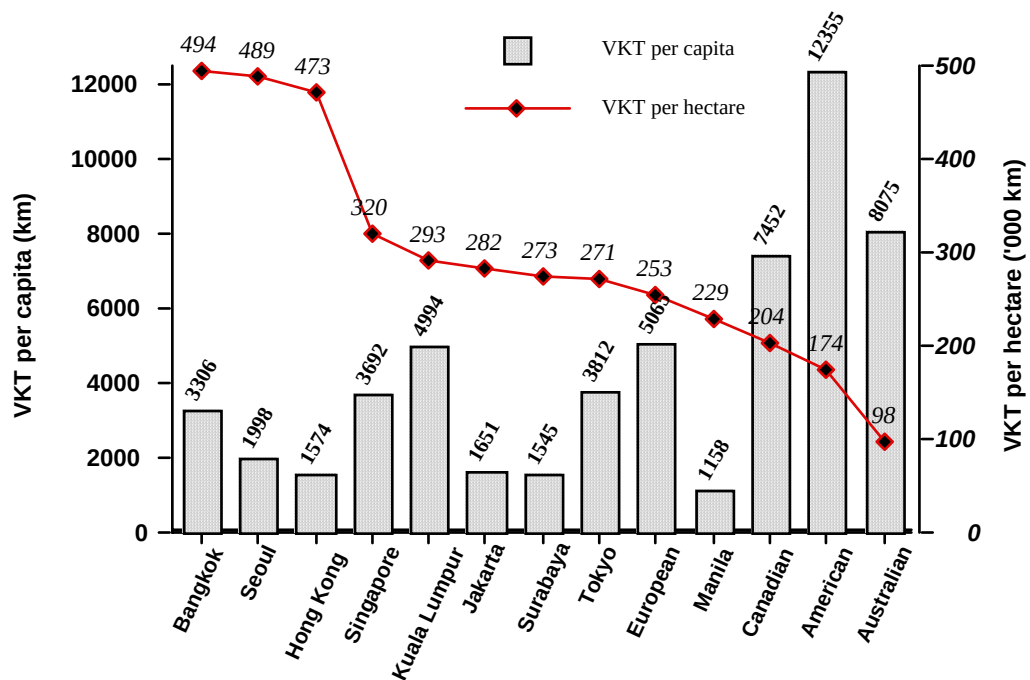
to provide an indication of the spatial intensity of vehicle travel in the urbanised area. It is an aspect of urban transport that has received very little attention in the literature. In principle, traffic intensity figures should provide an indicator of the level of “impact” of traffic (all else being equal)⁶². It can be expected that cities with high traffic intensity will be those that are likely to have the most severe local air pollution, noise and general traffic nuisance problems (notwithstanding variations from city to city in vehicle fleets, vehicle emissions rates, detailed traffic patterns, city shape and meteorological patterns).

The index of local pollution emissions per urban hectare was high in a number of the Asian cities (as shown in Chapter 5), particularly Hong Kong, Manila, Bangkok, Seoul, Surabaya and Jakarta. Fuel quality and high vehicle emissions rates are partly to blame for this result in many cases. But the high pollution per hectare figures are more fundamentally a consequence of high VKT per hectare in those cities.

In fact, in 1990 most of the Asian cities already had higher vehicle use per hectare than cities in any of the other regions (Figure 6.6). The Australian cities had the lowest traffic intensity, followed by the American, the Canadian, the European and then the Asian averages. This is a striking result, given the low vehicle use per person in most Asian cities. By 1990, every one of the Asian cities in this sample, except Manila, already had a traffic intensity higher than the European average.

⁶² A certain proportion of the vehicle kilometres that are included in the calculation of traffic intensity actually pass through non-urban land. Urban areas that are very ‘discontiguous’ (e.g. with islands of urbanised land) would also have the most exaggerated traffic intensity since some of the VKT would take place on roads between the patches of urbanised land. In the Asian sample, such a comment would apply mainly to Hong Kong and again to Seoul. However, these errors are unlikely to amount more than about 20 percent and should not negate the comments in this section.

Figure 6.6 Traffic per hectare compared with traffic per person in an international sample of cities, 1990



Note: These vehicle kilometres of travel (VKT) data include on-road public transport vehicle kilometres.

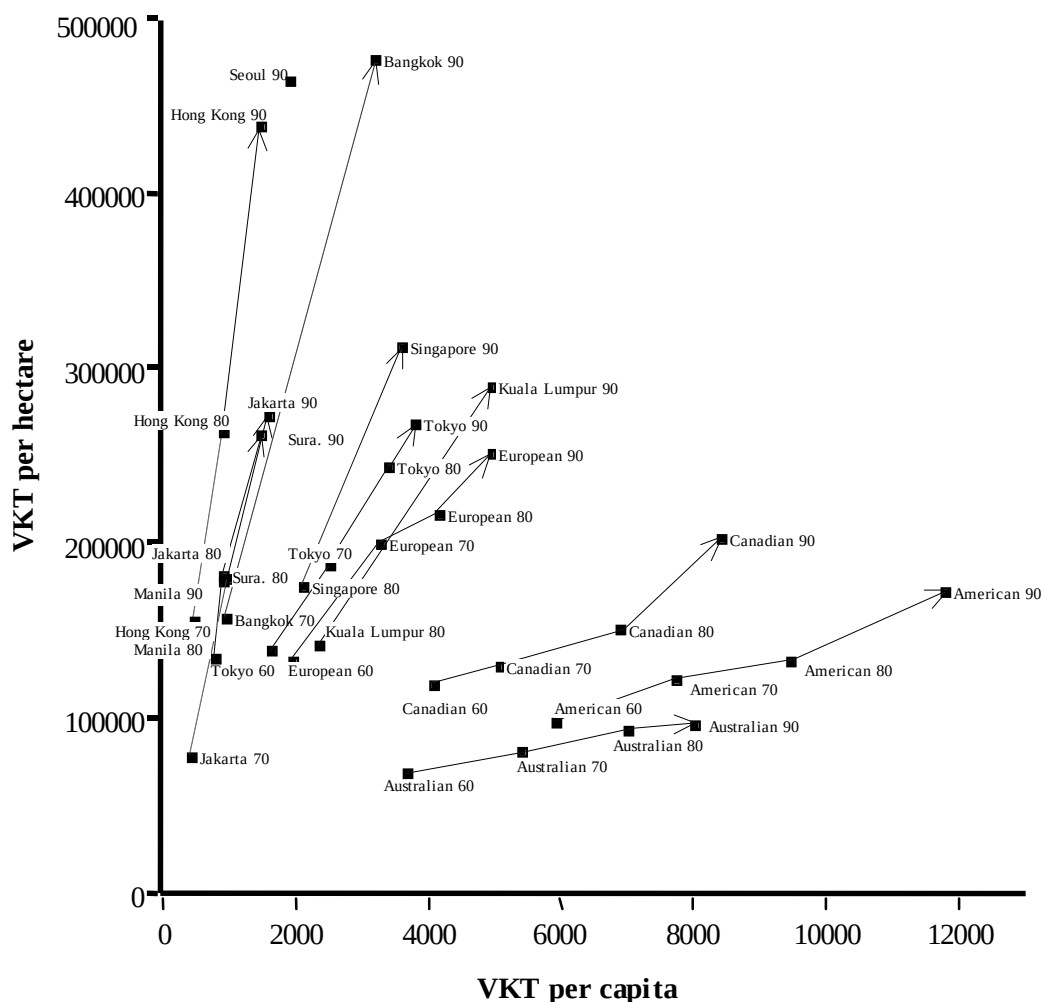
It is noteworthy that the two highest density cities in the international sample, Hong Kong and Seoul, had high traffic intensities, despite their low levels of vehicle use per capita. With almost the lowest vehicle kilometres per capita in the whole sample of cities, these cities had almost the highest vehicle kilometres per hectare. This underlines the strong spatial imperative in Hong Kong and Seoul to restrain private vehicles and to promote the lowest impact modes. Bangkok also had high traffic levels per hectare, a consequence of moderate vehicle use per person combined with high urban density. The American cities had relatively low vehicle use per hectare, despite their very high rates of vehicle use per person. This is related to their low urban densities, which also explains the fact that the Australian cities have the lowest traffic intensities of all of the cities in the sample, since their densities are similar to US cities, but their VKT per capita figures are lower.

Plotting travel per hectare against travel per person on different axes and showing the trends over time (Figure 6.7) provides another useful perspective. It offers another way of visualising why, in dense cities, small increases in VKT per person amount to huge increases in traffic intensity (always assuming most traffic is within the urbanised area). An interesting feature of this graph, which aids in its understanding, is that the slope of the line between the origin and each city point is equal to the urban density of the relevant city at that time. This is simply because the estimates for VKT per hectare are

equivalent to urban density multiplied by VKT per capita. Thus, over time for each city, if its VKT per capita rises and density remains the same, it will trace a trajectory along this line from the origin. If density changes over time the trajectory will curve slightly.

Small increases in VKT per person unavoidably translate into large rises in traffic intensity in dense cities. This is not something which can be avoided. For dense cities to both remain dense and to have as much vehicular travel as, for example, American cities would clearly entail almost unimaginably high (and probably impossible) levels of traffic per hectare. This graph provides a visually striking statement of the extent of the challenge which motorisation and increasing vehicle use present to dense cities.

Figure 6.7 Trends of annual vehicle kilometres of travel (VKT) per hectare versus VKT per capita in an international sample of cities, 1960 to 1990



Note: These figures include only private vehicles travel. Road-based public transport makes only a small difference. It could not be included here because of the lack of full time series for a number of cities.

There is little way of knowing how high traffic intensity can potentially go in cities. There are apparently no precedents in the industrialised world. Much may depend on

other factors that vary from city to city. In Chapter 5 it was seen that motorisation has been rising rapidly in the early to mid-1990s. Everywhere in Asia efforts to expand road capacity within the existing urban areas have been continuing (although inevitably more slowly than motorisation in most cities). It must be acknowledged that urban densities are also dropping, as mentioned earlier in the chapter. So although this might tend to compensate for the other trends, the process is very slow, too slow to cause a drop in traffic intensity in the near future.

Even though congestion and pollution problems are already extreme in several cities, it may still be possible that traffic intensity could rise a good deal higher. Despite gridlock throughout inner areas for several hours per day, vehicle travel can probably continue to increase in outer areas further and further from the centre and through the spreading of peak travel periods throughout longer and longer periods of the day. Any road capacity increases within the built up area add even more to this potential for increased traffic intensity. So it is conceivable that the levels of traffic intensity found in Hong Kong, Bangkok and Seoul are not yet at the limits of what is possible. Traffic per hectare could (in theory) continue to increase until traffic impacts are felt intensely throughout the urban area for the major part of the day and night. Of course, this is not a desirable scenario for an efficient and liveable city, and it is to be hoped that before such a nightmare scenario ever came to pass, action would be taken to avert it.

Rallis (1988: 49) gives figures for traffic intensity for different parts of London and Copenhagen from between 1960 and 1970. Assuming an annualisation factor of 340 on his data gives a figure of 408,000 kilometres per hectare per year in inner London at that time and 143,000 in the suburbs. Copenhagen had 347,000 km/ha/yr in the inner area and 133,000 in the suburbs. The inner London figure may provide a relevant comparison since inner London is considered to have been saturated with traffic for many decades (Mogridge, 1990). These European data suggest that the current Asian figures approaching 500,000 annual vehicle kilometres per hectare for the whole metropolitan areas in Bangkok, Seoul and Hong Kong, are indeed extraordinarily high. The figures for Copenhagen and London suggest also that most modern cities probably already have high traffic intensity in their major centres of activity (such as in an around the CBD) with the highest levels during peak periods. The high city-wide traffic intensity figures achieved in some of the Asian cities indicate that wide areas of these cities must be experiencing very high traffic intensities for long periods of the day.

The insight provided by traffic intensity and this spatial perspective suggest that it will be very difficult for large, dense Asian cities to control vehicle-related air pollution

problems without a much greater effort than any that has occurred in the West. Many American cities currently have air pollution problems despite their relatively clean vehicles and lower levels of traffic per hectare. Therefore, it must be expected that dense Asian cities would still face air pollution problems even if their vehicle fleets could be made as clean as the US fleet. High traffic intensities in the Asian cities underline the spatial imperative to restrain traffic in dense cities.

This section has highlighted the urban transport challenge presented by high urban densities in Asian cities. The arguments that have been presented here address in particular Research Question 2 which asked whether Asian cities face unusual or unique urban transport challenges or opportunities. The arguments also have a wider relevance beyond this international sample, since inherently low levels of road capacity per person, high traffic intensity, and high impacts of traffic per hectare, are also likely to be common features of all high-density cities that motorise quickly. Like the dense Asian cities in this sample, such cities will tend to develop levels of traffic well beyond that which can be comfortably accommodated in their dense urban fabrics; the higher the density, the lower the vehicle ownership level which is likely to generate a severe problem. However, high urban densities should not be thought of as simply a problem for urban transport and transport planners. Research Question 2 also asks about opportunities, and indeed, the high urban densities found in Asian cities do present opportunities for certain modes of transport and for certain strategies in urban transport planning.

6.3.2 Transport opportunities from high-densities

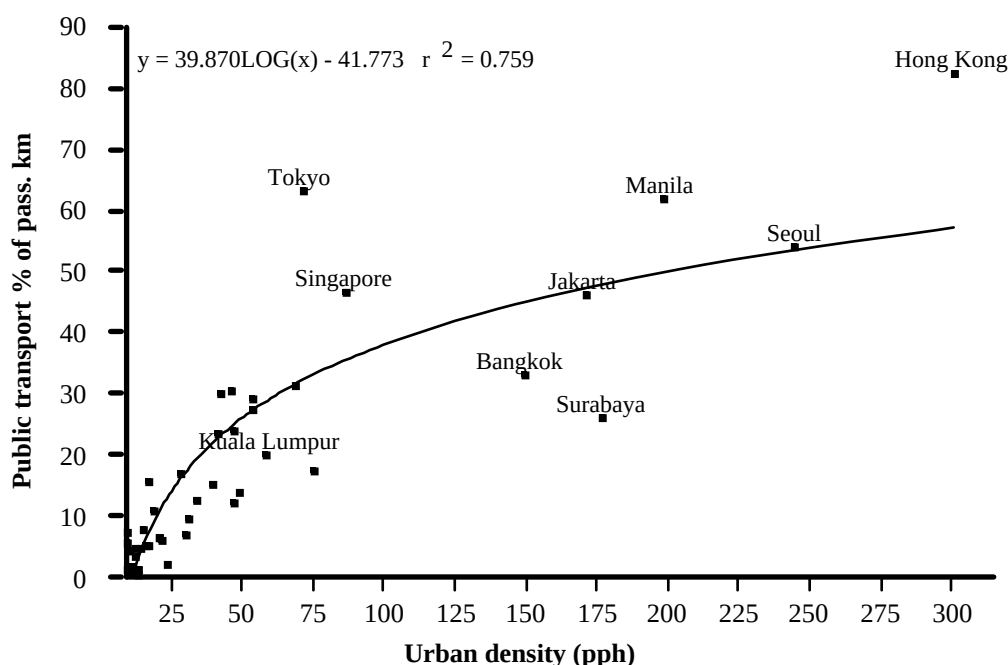
This section turns to some of the opportunities presented by urban form characteristics in Asian cities. It is well known that high urban densities (of population, jobs and services) provide an opportunity for high service levels of well-used and potentially profitable public transport and for a significant role for non-motorised modes of transport (Pushkarev and Zupan, 1977). The case of Hong Kong, with 82 percent of all motorised passenger kilometres by public transport and with 570 passenger boardings per person per year, best exemplifies the opportunity that high urban density presents to public transport.

A number of mechanisms explain the potential for high levels of public transport in dense cities. In high density environments there will be larger numbers of potential customers within the catchment of any particular public transport service than in a lower density city. Another mechanism is that private cars fit poorly into high density

environments but such areas can be effectively served by public modes that take much less space per passenger kilometre. Third, high density makes it easier to provide highly accessible public transport. For a given level of service kilometres per person, service kilometres per hectare (and hence ease of access to public transport) will be higher in a higher density city. The tendency for high density cities to also have mixed land use encourages demand for public transport to be well spread throughout the day, as many trip purposes will be served within a small area. Finally, high density, mixed land uses also mean that there is sufficient demand to justify high-frequency public transport service, which further strengthens the convenience of public transport.

Figure 6.8 makes clear that a very high role for public transport is possible in high density cities, even in those with high incomes. However, the examples of Bangkok and Surabaya suggest that high density does not necessarily guarantee that public transport will be the centre-piece of motorised urban transport (because of other factors such as service quality and the competitiveness of public transport speeds with private transport).

Figure 6.8 Public transport percent of total motorised passenger kilometres versus urban density in an international sample of cities, 1990



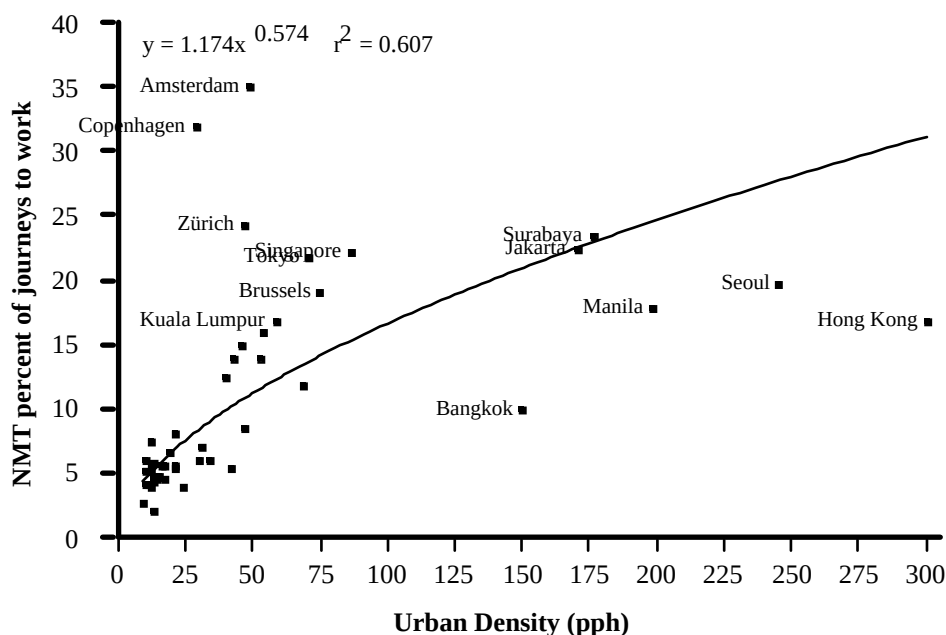
Another opportunity presented by the high urban densities found in many Asian cities is the possibility that many trips can be short and therefore easily made on foot or by non-motorised vehicles. Mixed land uses, that are often associated with high densities, also

encourage short trips and non-motorised transport by allowing a diversity of destinations to be available within a short distance.

Figure 6.9 demonstrates that a high role for non-motorised transport is possible even in middle density cities. The potential should be high, in theory, for non-motorised transport to play a very large role in dense Asian cities. Even in large Asian cities with rather high levels of motorisation, such as Bangkok and Kuala Lumpur, high proportions of trips are still within non-motorised range. In Kuala Lumpur in 1985, 41% of all trips were less than 5 kilometres (JICA, 1987b: 93). In Bangkok in 1989, according to a JICA study, about 30% of motorised trips were less than 4 kilometres in length and 51% were less than 6 kilometres. This implies that if non-motorised trips are included, then approximately 60 percent of all trips in Bangkok were less than 6 kilometres in length (Poboorn, C., August 1996, pers. comm.).

However, Figure 6.9 also highlights that although high density provides an opportunity for non-motorised transport to play an important role, it does not guarantee it. Bangkok seems to have remarkably little walking or cycling to work despite its high density. In fact, the graph shows that the levels of non-motorised transport for work trips in the high and very high-density Asian cities in this sample are no higher than levels found in most middle-density cities. Possible reasons for this result have already been mentioned briefly in Chapter 5, in terms of the hostility of the urban environments of many Asian cities for people on foot or on bicycles.

Figure 6.9 Non-motorised transport work-trip mode share versus urban density in an international sample of cities, 1990



It would appear from the brief survey of opportunities in this section that most of the Asian cities in this sample are not fully exploiting the potential that their high urban densities present to encourage flourishing public transport and non-motorised transport. This is particularly apparent with respect to non-motorised transport. Nevertheless, there is no doubt that the land-use characteristics of the Asian cities mean that they have a high inherent potential for these modes of transport to do well. Policy settings that work with this opportunity are likely to reap rapid and significant rewards for dense cities. This is so primarily because the local environmental impacts and the spatial demands of public transport and non-motorised transport are much lower (per kilometre travelled) than those of private cars or motorcycles (Bruun and Schiller, 1995; Kenworthy et al., 1997; Replogle, 1992; TEST, 1991). The greater energy efficiency of public and non-motorised modes, especially in Asian cities, was mentioned in Chapter 5.

6.3.3 Accessibility versus mobility: measuring success in urban passenger transport

The challenges and opportunities of different land-use patterns can be further clarified by introducing an indicator for accessibility, which takes account of urban density. Such an indicator also provides a measure of the relative “success” of different city’s urban transport and thus provides a balance to the discussion of negative impacts in Chapter 5. The indicator proposed here provides insights that support other findings of this study.

Since the 1970s, accessibility rather than mobility has increasingly been recognised as the goal of transport planning (Cervero, 1997; Whitelegg, 1993). Accessibility is a function of both the proximity of two places and the quality of the transport link between them, or the “intensity of possible interaction” (Hansen, 1959: 73). Mobility refers to the ability to move. Personal movement can be considered as a regrettable cost of gaining access to goods and services in society, rather than as an end in itself (Laube, 1998). In a very low-income city, where most residents cannot afford any vehicular mode of transport, any increase in the affordability of greater mobility would probably tend to increase the overall level of accessibility in the city. However higher and higher mobility, beyond a certain level, may not necessarily bring about further improved accessibility. Reasons for this include changes to urban form prompted by the ability to move quickly (Engwicht, 1992). The impacts of certain fast transport modes on the viability of other modes will also effect accessibility for those, particularly low-income people, who are less able to use rapid modes of transport, (Whitelegg, 1993).

A number of measures of movement have been presented in this chapter. They included passenger kilometres travelled by private or public motorised modes of transport. However, if transport is considered to be a regrettable cost of gaining access to a range of exchange opportunities in a city, then the appropriate measure of success for transport is how easily and affordably residents can achieve such access.

Accessibility, while simple in theory, is potentially complex to measure. Here a “broad-brush”, city-wide approach is taken to suggest a simple indicator that nevertheless provides a meaningful indication of this notion and allows comparisons between cities. Table 6.10 shows the patterns of variation of a city-wide indicator of accessibility applied to the international sample of cities. This indicator was calculated using a number of the items of data that were collected with the purpose of calculating the percentage of GRP per capita spent on commuting (see Chapter 4).

The accessibility indicator is defined as the square root of the average number of activities (in hundreds of activities) that are within an average “affordable distance”. “Activities” are represented, somewhat imperfectly, by jobs plus residents. This is theoretically proportional to the number of activities that would be encountered in moving such an affordable distance in a straight line. The affordable distance is defined as the distance that could theoretically be covered by a person spending 20 percent of the average daily GRP per capita on transport operating costs (including monetised time costs). The calculation assumes that the person uses the average mix of motorised modes of transport and experiences the average speeds of those modes that are typical for each city⁶³. The resulting accessibility indicator thus takes account of the affordability of travel, the actual modal split between private and public transport, the speed of movement by each mode, and the average density of activities (population plus jobs) in each city⁶⁴. The accessibility indicator used here is a variation on one of Laube’s (1998) accessibility indicators⁶⁵. Despite the simplifying assumptions and the city-wide nature of the indicator, it provides a useful comparative perspective.

The equation for the theoretical affordable daily distance⁶⁶ is:

⁶³ It is necessarily assumed that the city is of uniform density, that the urbanised area was completely contiguous, and that it has no edges.

⁶⁴ The indicator does take account of motorcycles in the middle-income Asian cities. However, it does NOT currently take account of non-motorised modes of transport. The primary reason for this is a lack of complete data on the actual usage of these modes in most cities. In principle the indicator could be expanded to include these modes. The indicator also does not take account of the detailed spatial distribution of urban activities nor the specific geography of transport infrastructure networks in each city.

⁶⁵ Laube’s indicator was developed partly in collaboration with the author. The indicator used here is proportional to the square root of Laube’s indicator.

⁶⁶ The scaling for the theoretically affordable travel distance (with 20 percent of GRP being arbitrarily designated as

$$Distance = \frac{GRP / 365 * 20 / 100}{\left(\frac{D_C}{D_C + D_t} \left(C_C + V_C + \frac{C_{tt}}{S_C} \right) + \frac{D_t}{D_C + D_t} \left(C_t + \frac{C_{tt}}{S_t} \right) \right)}$$

Where:

GRP	= GRP per capita	D _C	= Car passenger kilometres per capita
C _t	= public transport fare per passenger kilometre	D _t	= public transport passenger kilometres per capita
C _{tt}	= travel time cost per hour	S _C	= Average road network speed
C _C	= car capital cost/km	S _t	= Average public transport speed
V _C	= car variable cost/km		

The equation for the accessibility indicator is then:

$$Access = \sqrt{Distance^2 \cdot \pi \cdot d_A} / 100$$

Where:

Distance	= Affordable daily distance
d _A	= Activity density (urban density + employment density).

Table 6.10 Accessibility, theoretically affordable travel, actual motorised travel and personal spending on motorised passenger travel in Asian cities in an international sample of cities, 1990.

	Accessibility indicator	Theoretical affordable distance per day (km)	Actual motorised travel per day (km)	Personal spending (including time cost) on motorised passenger travel (% of GRP)
Tokyo	95	44.7	23.8	3.2%
Hong Kong	89	23.9	12.6	4.7%
Seoul	53	16.2	14.7	8.3%
Singapore	40	19.5	16.3	7.3%
Bangkok	22	8.7	19.0	17.3%
Kuala Lumpur	19	11.8	21.6	19.0%
Jakarta	17	6.4	7.9	15.5%
Manila	12	4.3	11.4	24.2%
Surabaya	12	4.3	5.8	17.7%
European average	44	28.0	23.3	7.6%
American average	30	35.0	45.3	12.2%
Australian average	18	23.8	32.0	12.7%

The indicator suggests that the motorised transport systems of the European cities and of the four higher income Asian cities are more “successful”, in some sense, than

the limit of what is “affordable”) was chosen to give units that are roughly comparable (on average) with the actual daily motorised travel distances that are typical in cities in the sample (on both private and public modes of transport).

American, Australian and the rest of the middle-income Asian cities in providing affordable access to the opportunities in their cities.

These figures highlight the distinction between mobility and accessibility. It is striking that, by this measure, the American cities do not emerge as the most accessible, although they have by far the highest rates of mobility in the international sample and also have a higher figure for theoretically affordable daily travel distance than most other cities. Conversely, dense cities that are rich in public-transport, such as Hong Kong and Seoul, score highly in accessibility, despite rather low levels of motorised mobility.

It is also interesting to observe that in cities with low accessibility indicator figures, their actual daily motorised travel tends to be higher than the theoretically affordable distance. In the high-accessibility cities, the reverse is true and actual travel tends to be lower than theoretically affordable distances. An interpretation of this might be that a low level of accessibility forces residents of such cities to travel further than they would otherwise prefer, while high accessibility allows residents to travel less to achieve the same ends. Supporting evidence for this interpretation is provided by the fact that over the whole international sample of cities, personal spending (including time costs) on motorised passenger travel as a percentage of GRP per capita is negatively correlated with the accessibility indicator ($y = 1.3053 x^{-1.0292}$, $r^2 = 0.8022$). The lower the accessibility indicator figure, the higher the spending on passenger travel relative to income.

The high percentages of GRP being devoted to motorised travel that these calculations show for the lower-middle-income cities in the Asian sample are somewhat theoretical (since they include travel time, costed at a standard rate in each city). Nevertheless, others have also observed that the percentages of household incomes devoted to transport can be high in developing country cities (Dimitriou, 1995: 21; White, 1990: 94; World Bank, 1996: 26; Yasukawa, 1998). Bangkok and Kuala Lumpur are particularly noteworthy. Despite their incomes having risen into the upper-middle-income category in the 1980s, their residents are apparently paying a high price for a poor level of accessibility.

The chosen accessibility indicator inherently depends on income, transport costs, density, mode split and travel speeds. High-income cities tend to have higher accessibility index figures because vehicular transport of all kinds tends to be more affordable and hence the affordable travel distance is high. High-density cities tend to

have higher accessibility because more activities will be encountered within a short distance than in low-density cities. Cities with high levels of public transport use tend to have a high accessibility index because public transport fares are generally cheaper than total car costs per passenger kilometre so that the affordable distance will be high. High speeds for public transport can further extend the affordable distance, especially if a city also has high public transport usage.

The high-income Asian and European cities thus have the highest accessibility figures because of medium to high densities, significant roles and healthy speeds for public transport, and high affordability of travel due to high incomes. American cities' high incomes and cheap car travel only partly compensate for very low density and a very low role for public transport to give only moderate accessibility figures. Manila and Jakarta have low accessibility figures despite their high densities and high public transport shares. It seems that these factors cannot make up for low incomes and very slow public transport, which mean that these cities' affordable distances are short. Similar explanations apply in the other developing Asian cities.

This accessibility indicator is probably not yet perfect and may require further refinement to be sure that it fairly reflects the true variations in overall accessibility between cities. Nevertheless, it clearly provides the beginnings of a possible measure of success in urban transport that demonstrates further implications of urban density. It also highlights the fact that planning for increased mobility alone will not necessarily create a successful urban transport and land use system.

6.4 Contrasting Spatial Constraints on Transport

Table 6.11 provides a brief summary of how the cities in the Asian sample and those of the other regions in the international sample can be grouped according to urban density and also according to two important aspects of transport patterns that are strongly influenced by spatial factors. These comparisons, and the arguments already presented in this chapter, lead to the conclusion that the high and very high density Asian cities, Bangkok, Jakarta, Surabaya, Manila, Seoul and Hong Kong, can ill afford to allow, or continue to allow, vehicle numbers to grow quickly without restraint. Their existing dense urban forms impose tight spatial constraints that will inevitably make high rates of private vehicle use extremely problematic if not potentially disastrous for their urban environments and possibly also their urban economies in the long run.

Bangkok is perhaps the most extreme case of a phenomenon that is common to most of the Asian cities. The process of change in land use patterns is relatively slow (at least at

the scale of the whole city), and urban forms cannot possibly adapt as fast as transport conditions have been changing in many Asian cities in the 1970s, 80s and 90s. This has led to drastic imbalances between land-use patterns, which developed when non-motorised transport and buses were the dominant modes of transport, and new transport patterns, that involve large numbers of space-hungry cars. High traffic intensities are one indicator of such imbalances at the city-wide level. The results of a mismatch between land use patterns and high numbers of private vehicles are also repeated in every local centre of activity within the city, which find themselves overrun with traffic and parked vehicles.

Table 6.11 Categories of cities based on spatial constraint parameters, 1990

Criterion	Groupings of Cities	Comments
1. Urban Density (Table 6.1)	American and Australian	Very low or low density (<25 pph).
	Canadian and most European cities	Lower middle density (25 to 50 pph)
	Several European cities, Kuala Lumpur, Tokyo, Singapore	Upper middle density (50 to 87 pph).
	Bangkok, Jakarta, Surabaya, and Manila	High density (149 to 198 pph).
	Seoul and Hong Kong	Very high density (245 and 300 pph).
2. Road provision per person (Figure 6.4 and Figure 6.5)	American, Australian, most Canadian cities	High road length and arterial road length per capita.
	Tokyo, European cities, Kuala Lumpur, Singapore	Medium road length and arterial road length per capita.
	Seoul, Bangkok, Manila, Jakarta, Surabaya, Hong Kong	Low road length and arterial road length per capita.
3. Local impacts of transport per hectare compared with global impacts per capita (Figure 5.13)	American, Australian, Canadian cities	Relatively low local impacts (and VKT) per hectare but high global impacts per capita.
	European cities, Kuala Lumpur, Tokyo and Singapore.	Moderate local impacts per hectare and moderate global impacts per capita.
	Jakarta, Manila, Surabaya	Moderate local impacts (and VKT) per hectare but very low global impacts per capita.
	Bangkok	High local impacts per hectare and moderate global impacts per capita.
	Seoul and Hong Kong	High local impacts per hectare but very low global impacts per capita.

This phenomenon of spatial imbalance perhaps reached its most dramatic level to date in Bangkok in the early 1990s, so much so that it can be given the name, the “Bangkok Syndrome”. This can be used to describe the effects of rapid unrestrained motorisation in large, dense cities with little or no traffic-segregated public transport (rail or high-quality bus priority systems). Data presented in Chapter 5 and in this chapter suggest that the pre-conditions for such a predicament are widespread among large cities in the developing world. There are many large, dense, middle-income cities where buses and non-motorised transport are still predominant but where the potential for rapid motorisation is great, if incomes rise even slightly, and where policy settings that might restrain an explosion of motorisation are not in place.

The spatial considerations (along with road provision indicators) highlight a difference between Bangkok and Kuala Lumpur. Many of their transport trends have been very similar over the last 20 years or so and both cities were identified together in Chapter 5 as following a path of unrestrained private transport growth. However, Bangkok’s high-density urban form has been much less accommodating than Kuala Lumpur’s of the unrestrained vehicle growth that has been permitted to occur since 1980. With substantially higher urban density compared with Kuala Lumpur, Bangkok has suffered much higher local impacts of traffic per hectare and much lower road provision per person. The spatial perspective may thus largely explain Kuala Lumpur’s ability to cope with rising traffic somewhat more easily than Bangkok, at least so far.

Among the cities following vehicle restraint paths there are also spatial contrasts. Very high-density Hong Kong and Seoul differ strongly from upper-middle-density Singapore and Tokyo in having much higher local transport impacts but lower global impacts and lower road provision.

All three lower-middle income cities, Jakarta, Surabaya and Manila, have high density, low road provision and, despite quite low global impacts per person from their transport systems, they already face surprisingly high local impacts per hectare. This suggests that if these cities follow the unrestrained motorisation path of Bangkok and Kuala Lumpur, then they will also be vulnerable to facing Bangkok’s syndrome of extremely high local transport impacts per hectare and unmanageable traffic congestion.

6.5 Chapter Summary and Conclusions

The first half of this chapter used data from this study of Asian cities and from the wider study of an international sample of cities to place the land use patterns of the Asian cities into international comparative perspective. In particular, the comparisons

highlighted the high urban densities to be found in the Asian sample of cities. High densities were found only in the Asian cities of this international sample, but it was also shown that high density cities are common elsewhere in Asia and in the developing world in general.

The comparisons also demonstrated that urban development patterns among the Asian cities in the sample have diverged since the 1960s, just as their transport patterns have diverged, in two different directions. Evidence was presented that showed Hong Kong, Singapore and Seoul to have been transforming themselves from bus cities in the 1960s towards having many of the key features of the rail-oriented transit city type by the 1990s. In contrast, Surabaya, Jakarta, Manila, Bangkok and Kuala Lumpur have retained many of the land use features that were identified as bus city features in Chapter 3 (see Figure 3.2). In addition, Bangkok and Kuala Lumpur especially, show signs by the 1990s of developing some automobile-oriented land use patterns. Although these car-oriented patterns are not yet a major part of their overall urban fabric, they may eventually undermine any future efforts to restrain private transport or promote a transit-oriented strategy.

Thus, as required by Research Question 1, Chapters 5 and 6 have placed the transport and urban form characteristics of the Asian cities into a clear international comparative perspective. Furthermore, part of Research Question 2 asked about distinctive Asian models of urban transport and land use. Indeed, Chapters 3, 5 and 6 have identified diverging models within the Asian sample and shown how they are distinctive in an international context. These different models represent the outcomes of different key choices taken in each city. These models will be further clarified and integrated in Chapters 7 and 8.

The spatial issues and their transport implications, which have been highlighted in the second half of this chapter, are also central to an understanding of the context for the transport and land use choices that are open to Asian cities. High urban densities can be both positive and negative in their transport implications and which effect will dominate depends on policy settings and choices. It was shown that high densities mean that road capacity per person is inherently limited and that very high traffic intensities can emerge, with the implication of very high levels of traffic impacts. However, the chapter also provided reminders that high densities favour flourishing public transport service, convenient use of non-motorised transport and high accessibility. In fulfilment of Research Question 2, this chapter has identified unusual and unique transport

challenges and opportunities in Asian cities as well as some emerging models of Asian urban transport and land-use.

CHAPTER SEVEN

CONTRASTING PATHS IN ASIAN URBAN TRANSPORT: TOWARDS A FRAMEWORK FOR UNDERSTANDING TRANSPORT CHANGE IN DENSE ASIAN CITIES

7.1 Introduction

This chapter provides a synthesis of a number of the important themes that have emerged in the dissertation so far. It presents and discusses a framework or model of large-scale processes in the development of transport and land-use systems in the Asian cities of the sample. The framework aims to make clearer the choices available to Asian cities at various levels of income. A focus is on the situation in, and the choices for, middle-income cities, while their motorisation is at a relatively early stage, say between about 50 and 150 cars per 1000 persons, within the ranges identified in Chapter 5 with cars as a luxury possession and the lower levels of cars being a household possession.

At the end of Chapter 5, two distinct paths of transport development were identified as being followed by different cities in the Asian sample. These paths were defined primarily on the basis of a comparison of motorisation and income levels. Bangkok and Kuala Lumpur have allowed relatively unrestrained growth in private vehicle ownership and use as their incomes have risen. This contrasted with Singapore, Seoul, Hong Kong and even Tokyo, which have restrained private vehicles to a significant degree. Manila, Jakarta and Surabaya had apparently not embarked decisively on either of these paths by 1990. Chapter 6 placed the land-use patterns of the Asian cities into an international comparative perspective, highlighted how these characteristics reflect earlier transport patterns to some extent, and finally showed how pre-existing high-density urban forms in these cities place tight constraints on the rate of growth of private vehicle mobility.

It is now possible to combine the understanding of transport trends from Chapter 5 and the view of urban form from Chapter 6, with the theoretical background of Chapter 2, especially the various typologies of cities based on their urban transport and land use patterns. This synthesis yields a simple framework for understanding the trends in this sample of Asian cities at a city-wide scale. It provides a way of making greater sense of the range of choices that were available in the past and are now available to these Asian cities (and to other cities in similar circumstances). This leads into the topic of Chapter

8, which focuses on choices by examining in some detail major decisions and policies in each of these Asian cities along their different paths of transport and land-use evolution.

7.2 Preliminary Comments: Recap of Research Results So Far

By the 1960s, all of the cities in the Asian sample except Tokyo could be characterised as bus cities or as approximating Thomson's (1977: 224-227) low-cost strategy; an idealised transport and urban form system optimised for bus or tram transport⁶⁷. All had relatively centralised employment but no intense, compact central business district. All had inner areas with very high population densities and intense mixing of land uses. Commercial land uses had emerged in strips along most main roads that were well served by buses (Hamzah Sendut, 1969; Leinbach and Ulack, 1983; Lo, 1992:149-155; McGee, 1967; Poboan, 1997:49; Webster, 1992:7-8). Motorised mobility was relatively low in such cities. There were already variations among the Asian cities at that time: Surabaya had the lowest motorised mobility and a higher role for non-motorised transport than the others; Kuala Lumpur and Singapore had significant car and motorcycle numbers by the late 1960s; and Hong Kong had a high role for ferries and a very constrained site. Despite such variations and a wide range of urban density figures among these cities, there were enough features in common that it was proposed to label them all as bus cities.

It was also argued at the end of Chapter 3 that on the eve of mass motorisation, most of the Asian cities had rather different transport and land use characteristics compared with Western cities at roughly the same point in their motorisation histories. Western cities generally had densities well below 100 persons per hectare as they began their periods of rapid "mass" motorisation. Most of them also had significant urban rail systems, and generally did not depend primarily on road-based public transport that was vulnerable to the impacts of congestion from the influx of cars. In terms of the city typologies presented in Chapter 2, all of the large Western cities at that time could have been labelled as transit cities. In contrast, in the 1960s, Seoul, Hong Kong, Bangkok, Manila, Jakarta, and Surabaya all had high or very high urban densities and an almost total dependence on buses in mixed traffic, along with non-motorised transport. Singapore and Kuala Lumpur had only upper-middle densities but were also dependent on buses. In the Asian sample, only Tokyo had the Western combination of circumstances by the

⁶⁷It will be recalled that Thomson's archetype of the low-cost strategy 'consists of a high-density city with a major centre served by numerous bus (or tram) corridors in which non-residential activities are concentrated.... sub-centres are situated along the main radial roads' (pp.225-27). Manila was one of his main examples. The size and compactness of the city centre is limited by the absence of high-capacity mass transit.

1960s when motorisation began to surge in that city. At that time it already had a density below 100 persons per hectare (pph) and a rail-based public transport system.

High densities and bus-based public transport in most of the Asian cities in this sample tend to make them vulnerable to the negative impacts of a rapid increase in motorisation. This vulnerability is highlighted by the “Bangkok syndrome” identified in the last chapter. In fact, the vulnerability of these cities in the face of rapid motorisation is manifested in many of the negative transport impacts and examples of spatial constraints, including congestion, local air pollution, high VKT per hectare and low levels of road capacity per capita. The speed with which small increases in vehicle travel translate into high VKT per hectare in dense cities was highlighted by Figure 6.7.

The starting point for the descriptive framework then is this predicament that Hong Kong, Seoul, Singapore, Kuala Lumpur, Bangkok, Manila, Jakarta and Surabaya found themselves in by the early 1970s. They were bus cities (or low cost cities) on the brink of rapid motorisation. Such a situation is, even today, not uncommon throughout the developing world, as was shown in Chapter 6 by the high urban densities of many large low-income and middle-income cities and in Chapter 5 by the dominance of bus-based transport or non-motorised transport in many of the same cities.

Having started with similar situations in the early 1970s, the Asian cities’ transport paths then diverged, as was highlighted in Chapter 5. Some of them were able to maintain or enhance their roles for public transport, while some motorised quickly and their private transport increased faster than public transport. To some extent diverging transport development paths have also been reflected in diverging land-use patterns. Even more importantly, existing high-density land-use patterns have limited the options open to the Asian cities and influenced the results of their choices. One illustration of the different paths taken by the Asian cities in the sample was shown in Figure 5.6 on page 151, which gave the trends for private motorised passenger travel versus public transport motorised passenger travel over several decades. Figure 5.6, when viewed in terms of the theoretical groups of cities from Chapter 2, provides a basis for a new framework for understanding transport and land-use trends in these cities.

7.3 Mobility Trends and City Typologies

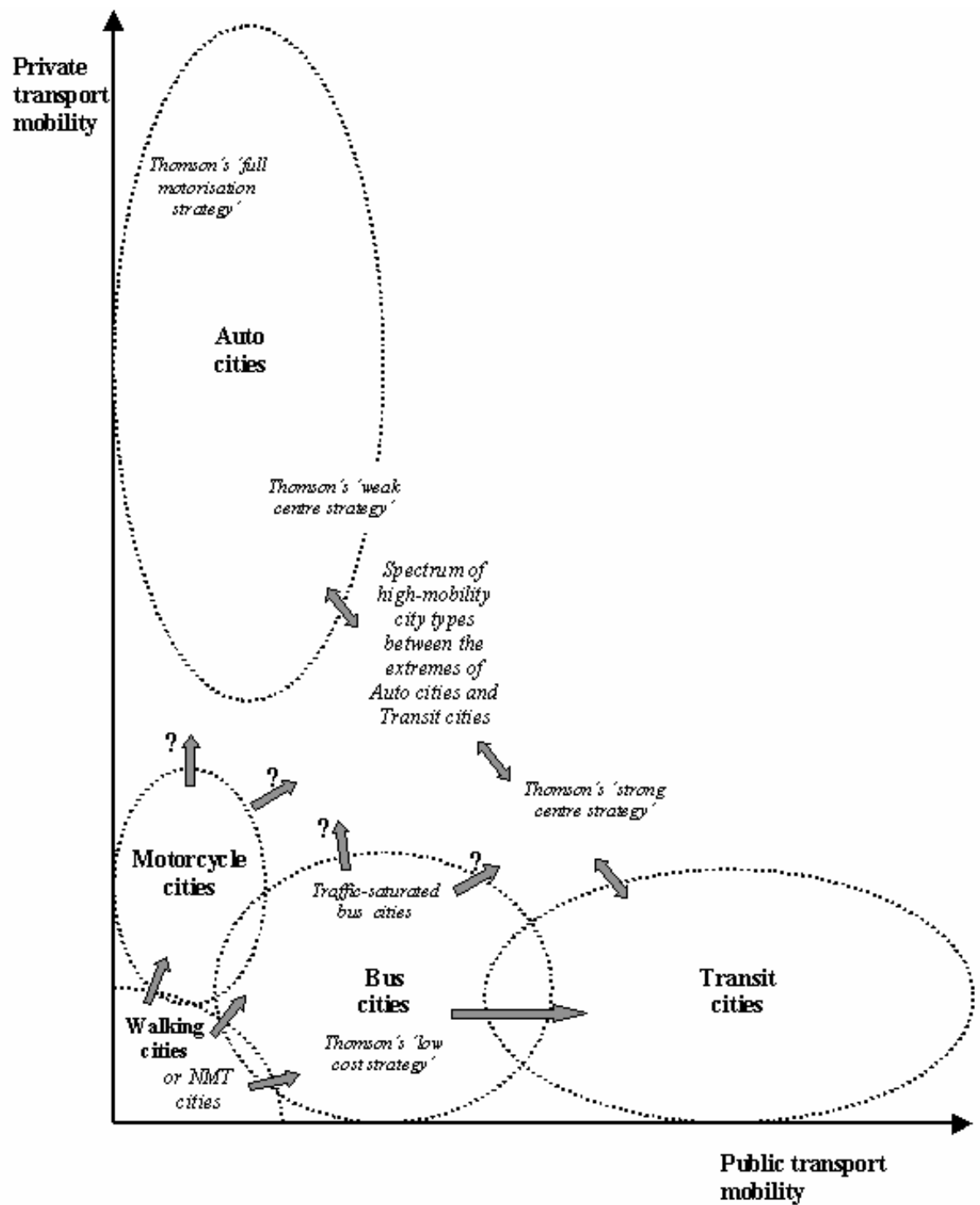
Figure 7.1 shows a schematic plot of how the various city types that were introduced earlier in the thesis can be interpreted in terms of a graph of the kind in Figure 5.6 (which has been superimposed over Figure 7.1 as a transparency). This provides a number of useful insights on possible transport and land-use development paths. Figure

7.1 shows city types from Newman and Hogan's scheme and from Thomson's scheme, as well as the bus-city type which was introduced in Section 3.4.6. The figure shows in a schematic way the levels of private and public mobility that are likely to be found in cities conforming to each type. These city types are not being defined by their position on this plot. Rather the plot represents this author's assessment of where the various city types would approximately lie on such a graph of private versus public travel.

Accordingly, no scale is shown on the transparency, since the positions of the city types are not intended to be precise, but rather to be indicative of the pattern that is expected.

In addition to the city types already mentioned, there is a further type proposed here, namely "motorcycle cities". Motorcycle cities seem to be a new phenomenon and thus were not observed by Thomson or by Newman and Hogan. Taipei is a large and prominent example that has been mentioned earlier. An increasing number of Asian cities that previously depended upon non-motorised transport, are apparently now moving directly to motorcycle-oriented transport, without any intervening period with a significant role for collective public transport. Examples include Denpasar in Bali, where 93% of households have one or more motorcycles, and Chiang Mai in Thailand, where motorcycles comprise 72% of all vehicles owned, including non-motorised vehicles (China Engineering Consultants, 1995b: 35-36; Padeco Co. Ltd., 1993: 4-1,4-3). In Ho Chi Minh City in Vietnam, motorcycle ownership had reached approximately 300 per 1000 persons by 1996 (MVA Consultancy, 1997). In India, motorcycle numbers are increasing rapidly and dominate the motorised vehicle fleets of most small and intermediate cities (Replogle, 1992: 56). In this sample, Surabaya could be considered to be a motorcycle city, or perhaps a hybrid of a motorcycle city and a bus city. The use of the label, motorcycle city, here is slightly speculative. It is not yet clear whether motorcycle domination will persist for long in any particular city. Furthermore, if it does persist, it is also not clear what land-use characteristics will emerge in such cities. For the moment, they can perhaps best be understood as being part of a more general low-cost city type that takes in both bus-oriented cities and motorcycle-oriented cities. Over time, a truly motorcycle-oriented city could probably have a more dispersed pattern of activities than a bus city. On the other hand, a motorcycle-oriented city can probably cope with much higher densities than are possible for a car-oriented city due to the more modest space demands of motorcycles (especially for parking space).

Figure 7.1 City types on a plot of private versus public motorised mobility



In the left corner of the graph are cities with very low levels of motorised mobility, whether public or private. These are walking cities in the Newman and Hogan framework. The arrows in Figure 7.1 represent possible trends in the use of motorised transport over time for cities in each group. The actual trends for the Asian cities and other regional groups of cities are shown in the transparency in Figure 7.1. The arrows radiating from the walking city type in the lower-left corner represent the fact that in the past, walking cities in Asia have tended to become bus cities or motorcycle cities, with many of the land-use characteristics that have previously been identified with the low-cost city type. The focus of attention in this study is on the choices available to cities in the bus city group or what has been happening to the transport and land-use of a number of low-income cities as economic development has progressed and they have risen through middle-income levels.

Figure 5.6 and data in Appendix 1 suggest that in 1990, the European cities in this international sample all fall along the central part of a spectrum, ranging from the transit cities at the bottom-right to the auto cities at top left. Cities along this spectrum have relatively high mobility with a varying balance of private versus public motorised travel. Canadian cities tend to lie a little further towards the auto city range from the European cities, followed by Australian cities, then with American cities tending to fall high in the auto city category. In Newman and Hogan's scheme the mostly European cities in the central part of the figure could be understood as having a mix of the land-use features of the "pure" transit city and the "pure" auto city. Thomson's strong-centre strategy and his weak-centre strategy can also both be understood as falling along this spectrum, with the weak centre city having more auto city characteristics and the strong centre city having more transit city characteristics.

Before discussing the interpretations of trends in the Asian cities in the sample in terms of the framework provided by Figure 7.1, it is first necessary to clarify the role of density and of spatial constraints in this framework.

7.4 Spatial Perspective on the Framework

Some of the challenges that high urban population densities present for transport were highlighted in Chapter 6. It was argued that many of the transport problems facing dense cities are fundamentally spatial in origin. For example, to a great extent, a lack of road space per person is an intrinsic feature of high density cities. Figure 6.7 provided an illustration of the implications of spatial constraints by showing that high density

cities will quickly reach high levels of vehicle use per hectare (traffic intensity) as their vehicle travel per capita rises.

Spatial constraints can be integrated with the framework in Figure 7.1. Let us assume that traffic movement per hectare (VKT per hectare) gives an indicator for expected negative local impacts of traffic, such as local air pollution, noise, traffic nuisance. Therefore, for any given level of urban density, in order for VKT per hectare to be kept within “tolerable” levels then the VKT per capita must also be kept below some limit. The higher the urban density, the lower will be the limit on VKT per capita⁶⁸.

The level of traffic intensity that should be considered to be the limit of what is “tolerable” is obviously a matter of debate. It might depend on how vulnerable that city is to some of the specific impacts of traffic, such as local air pollution. No such limit could be considered to be hard and fast but it might be expected that, as the nominal limit was approached and exceeded, there would be increasingly serious problems due to pollution, congestion and declining quality of life, which might also lead to an increase in the political pressure to do something about the situation. For argument’s sake, suppose that an annual VKT per hectare of about 270,000 km is considered to be the limit (compared with an average figure of 216,000 km per hectare in the whole international sample of cities). This would suggest that a city with a density of more than 200 pph could only “cope” with less than about 2,000 passenger kilometres per capita per year of private motorised travel (assuming a private vehicle occupancy of about 1.5 persons and neglecting public transport vehicles for simplicity’s sake). A city with a density of less than 50 pph could have up to about 8,000 passenger km and remain “tolerable”. For a city to reach a very high level of private motorised mobility, such as 16,000 passenger km per capita, would require the urban density to be below 25 pph in order to avoid “intolerable” traffic per hectare. Interestingly, cities that are approaching or exceeding these limits include several European cities and Los Angeles. Los Angeles County’s density of about 25 pph is high for such an automobile-oriented city.

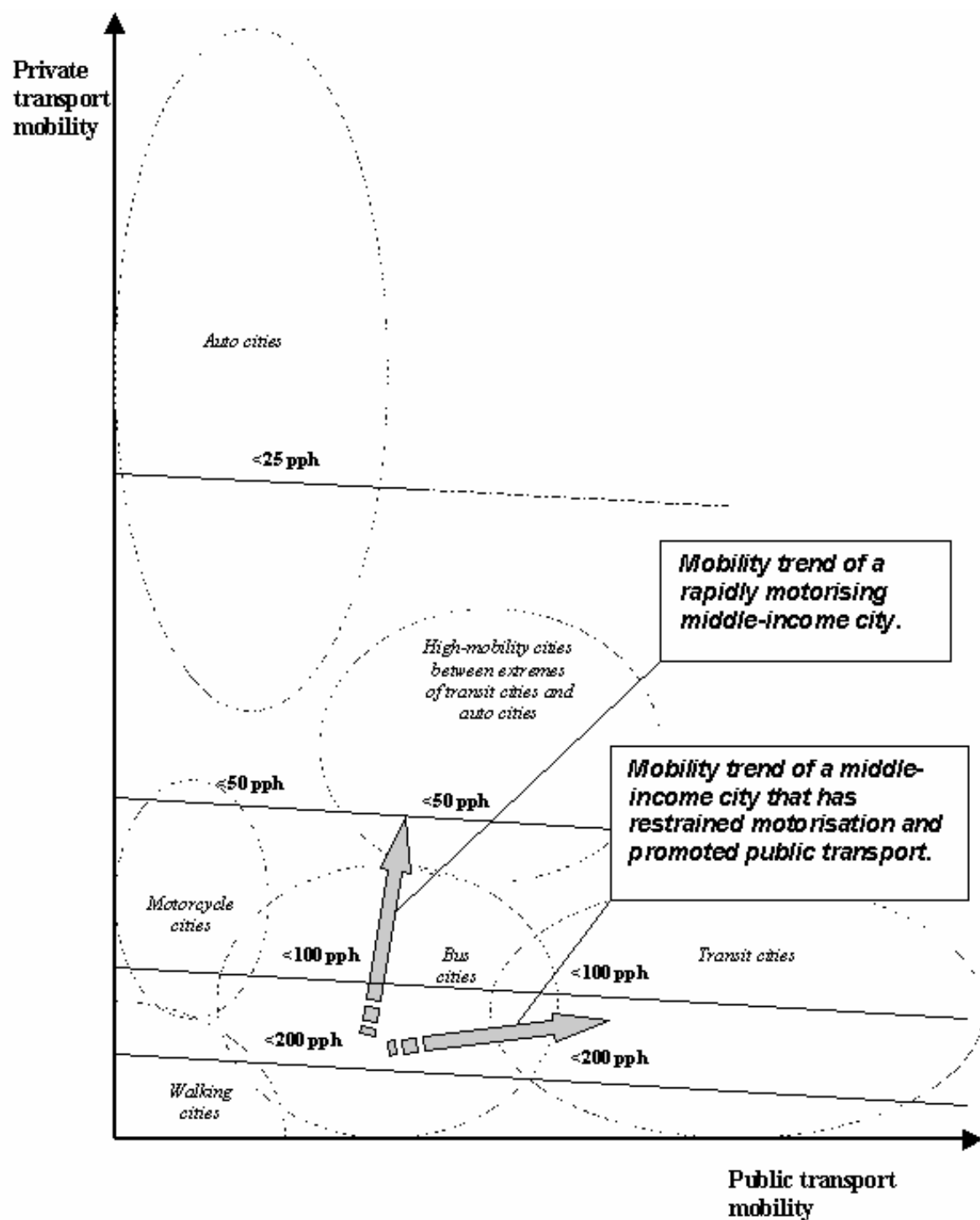
It should be emphasised that spatial constraints are not the only mechanism by which urban density interacts with vehicular mobility levels. For example, low density cities

⁶⁸ This may seem to paint high urban densities in overly negative terms. It must also be remembered, as was argued in Chapter 6, that dense cities also have advantages in enhancing the alternatives to private vehicular mobility. The fact that dense cities are inherently unwelcoming of private cars can also be seen as a positive, for example with their lower per capita contributions to global problems, such as CO₂ emissions. High density is thus not just a negative or a constraint in urban transport, it is also an opportunity. Nevertheless, the focus for the purpose of this argument is, for the moment, on the constraint side of the issue.

do not just “allow” high private vehicle use, they also *require* it to a great extent, for example through long trips distances, dispersed destinations and because of the non-viability of public transport, walking and cycling for most trips in such an urban environment. These low-density cities can be said to be “automobile dependent” (Newman and Kenworthy, 1989). High density cities do not just limit private vehicle use through spatial constraints but also encourage low car use through other mechanisms, such as short average trip distances and by allowing the alternatives to private vehicles to be convenient and competitive. Nevertheless, the phenomenon of spatial constraints on vehicle use appears to be an important mechanism in many cities, particularly in dense ones. Figure 7.2 shows a schematic view of how such density limits relate to the plot of city types and their mobility characteristics in Figure 7.1.

Figure 7.2 goes some way towards giving a visual illustration of what has been happening in a city such as Bangkok in comparison with trends in cities such as Hong Kong or Singapore. A transition from being a bus-city towards being a transit-city can be relatively smooth, in land-use terms, since the densities associated with the two city types are similar. In fact, a transit city with a very high density is eminently workable, as Hong Kong demonstrates. However, a rapid transition from bus city levels of private mobility towards even European city levels of private mobility will tend to be very difficult. In terms of Figure 7.1 and Figure 7.2, such a city moves quickly from the bus city part of the plot up into the “high-mobility-cities” part of the plot. The result in land-use terms is highly problematic, since a large bus city is likely to be a dense city, but much lower densities are required to cope comfortably with significant private vehicle mobility. In fact, similar spatial problems also occur if a dense transit city suddenly tries to increase its private mobility. Seoul since the late 1980s is an example of such a trend.

Figure 7.2 Indicative plot of approximate urban density ranges that are suited to each level of motorised mobility (private and public)



Note: The lines representing density limits in Figure 7.2 are sloped slightly downwards to indicate how the scheme might allow for the impact of road-based public transport.

Figure 7.3 provides an illustration of the ideas in Figure 7.2 using actual data from the international sample of cities used in this study. It is a graph showing the private and public transport passenger kilometres per capita of each of the cities in the international sample for each date (1960, 1970, 1980 and 1990) for which data are available. The density of each city at the appropriate date is shown on the graph. The purpose of the graph is to show those cities where VKT per hectare is within “tolerable” limits, what their densities are and where they fall on the plot of private transport versus public transport mobility. Inspection of Figure 7.3 reveals the expected patterns of densities of cities according to their levels of private and public mobility (and which were illustrated in an indicative way on Figure 7.2).

Cases with high VKT per hectare (greater than 300,000 km per ha per year) are highlighted on the graph by bold typeface with their respective names indicated. This provides further insight into the situation of those cities that may be close to some kind of limits in terms of local traffic impacts. Some of the cities with high VKT per hectare are among the cities that have actively restrained traffic, such as Seoul, Hong Kong and Singapore in Asia, along with Vienna in Europe. This apparently confirms that these cities do indeed need such traffic restraint policies in order to retain tolerable levels of traffic per hectare.

Most Western cities made a transition several decades ago from the transit city part of the plot towards much higher private vehicle use. However, as was argued in Chapter 3, most of them were not as vulnerable to the kind of spatial mismatch that faces Bangkok and other dense Asian cities. Historically, trams were predominant in most Western cities in the early years of the twentieth century and these cities would have fallen near the bottom of the part of the plot labelled “bus cities”. In Chapter 2, Hall was cited as labelling such tram-oriented cities as “early public transport cities”. Such cities had spatial characteristics that were very similar to bus cities, so much so that it is probably valid to ignore the distinction for the purposes here. Western cities then gradually increased their public transport mobility, with the large cities developing extensive electric rail systems. In the terms of a slightly modified version of Newman and Hogan’s scheme (as developed in Chapter 3 and which distinguished bus cities from the rail-oriented transit cities), these cities had become transit cities. In Hall’s terminology they had become “late public transport cities”. With relatively high mobility and speeds achieved by their public transport systems, Western cities could spread to relatively low densities during this time, even before the advent of mass motorisation.

Figure 7.3 Urban densities and private and public motorised mobility in an international sample of cities, 1960, 1970, 1980 and 1990

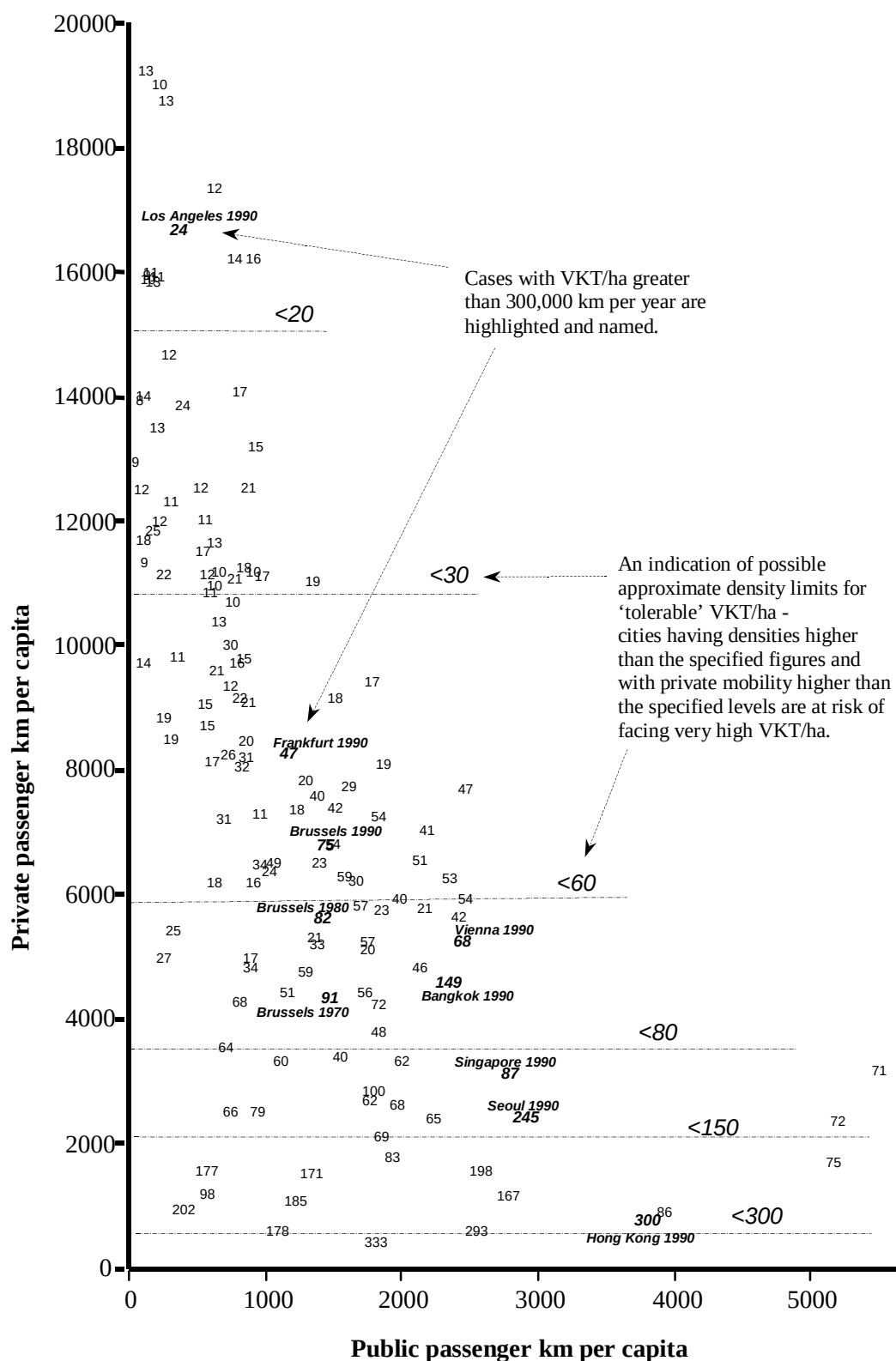


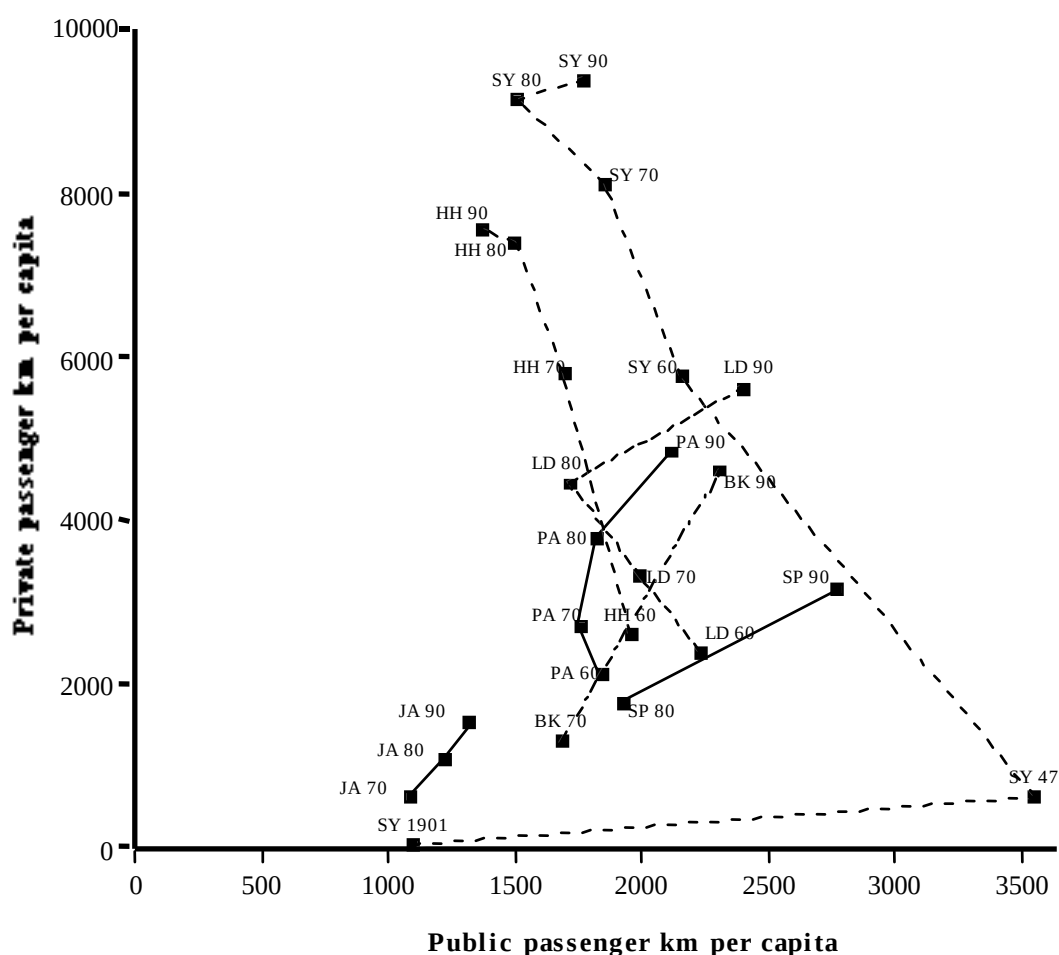
Figure 7.4 shows the mobility trends traced by several Western cities over time, along with Singapore, Bangkok and Jakarta for comparison. The longest time series is for Sydney with data for 1901, 1947, 1960, 1970, 1980 and 1990. As incomes rose and the city developed between 1901 and 1947, mobility in Sydney increased almost completely through increasing public transport passenger kilometres. In 1947 Sydney was a transit city with an urban density of only 30 pph. Judging from the 1950 data for Hamburg, Paris and London in Figure 7.4, European cities apparently had somewhat lower levels of public transport mobility than Sydney in the middle of the 20th century and had higher urban densities, although generally below 100 pph. Subsequently, as mass motorisation occurred, Western cities moved towards the middle part of the plot, with high motorised mobility and a mix of private and public transport. This is seen in the paths of Sydney, Hamburg, Paris and London on Figure 7.4. Between the 1950s and 1980, the European cities gradually increased their private transport usage, but at a much slower rate than in Sydney, and without such a clear and dramatic trend for public transport mobility to decline.

Many American cities have probably traced a similar trajectory to Sydney's but at an earlier date and moving further towards the upper left part of the plot with very high car use and low public transport use. To an extent, the different urban densities that prevailed in different Western cities just before they began to motorise rapidly may partly explain why some of them, namely the low-density Australian and American ones, were able to move so quickly towards an auto city mobility pattern, whereas private mobility in the denser European cities could not rise as quickly.

European cities did not face spatial constraints on private mobility that were quite as extreme as in most Asian cities but nevertheless, by the late 1960s, many European cities faced a growing political backlash against the rise of traffic and against road building proposals. Many of them have increasingly turned to restraint of private traffic and the promotion of public transport, especially rail, in an effort to meet mobility aspirations without unacceptable impacts for their cities (Newman and Kenworthy, 1995; Pharoah and Apel, 1995; Pucher and Lefevre, 1996). Examples of European cities with vigorous policies along these lines include Zurich, Copenhagen, London (in some respects), and Vienna. The case of Vienna is significant to the argument here since, in Chapter 3, it was pointed out that in the early post-war period Vienna had among the highest densities of the European cities and had public transport that was highly dependent on trams. It was thus in a similar predicament to that faced by the Asian bus cities (although Vienna's density was lower than most of the Asian cities' densities).

Vienna was particularly unwilling to compromise its beautiful and historic inner area for the needs of motor cars, the destructive potential of which quickly became apparent. Vienna's response to its predicament was to adopt a traffic limitation strategy (Thomson, 1977: 307) and to expand its urban rail system (from having no urban rail service in 1960 to 4.5 wagon kilometres of service per person in 1970 to 9.9 in 1980, then to 20.2 wagon kilometres of service per person in 1990) (Kenworthy and Laube et al., 1999, forthcoming). Unfortunately, the full time series for Vienna's private mobility was not available to be included in Figure 7.4 but its trends since 1980 matched London's quite closely, with a big leap in public transport travel, after its rate of public transport use had been relatively static between 1960 and 1980, much like that of Paris.

Figure 7.4 Historical trends in motorised mobility (private versus public) in Sydney, Hamburg, London and Paris, together with Singapore, Bangkok and Jakarta shown for comparison



Notes: 1. Data for Sydney for 1901 and for 1947 are from Moriarty (1996).
 2. The abbreviations are: Bangkok (BK), Jakarta (JA), Hamburg (HH), London (LD), Paris (PA), Singapore (SP) and Sydney (SY).

7.5 Transport and Land-use Trends in Terms of the Framework

As highlighted previously, beginning in the late 1960s, the large, dense, rapidly developing cities in the Asian sample have faced a difficult predicament in the form of a potential flood of private vehicles into urban fabrics that were generally ill-suited to cope. It was from that point onwards that these cities have tended to take either one of two rather different transport development paths: one, in which the role of private transport is low relative to income levels, and another in which the role of private transport is high relative to income levels. For a large, dense, bus-oriented city where incomes are rising and private vehicle numbers are beginning to rise quickly, there may be little choice but to try to avoid too rapid a surge of private vehicle numbers. The arguments in this thesis suggest very strongly that in that situation the wisest course of action would be to attempt to at least slow the rate of growth of private vehicles. If cars are restrained, it is possible to guide the development from a bus-based city towards a transit city.

7.5.1 New Asian transit cities

Early restraint of private vehicle ownership did indeed play a key role in the transitions of Seoul, Singapore and Hong Kong from bus cities in the 1960s to transit cities by the 1990s. Restraint of private vehicles was also important in Tokyo's continued evolution as a transit city since the Second World War. Details of the policies and choices that were involved in this transition are presented in Chapter 8. Between 1970 and 1990, Seoul, Singapore and Hong Kong all made spectacular economic progress but at the same time, all of them managed to retain a high role for public transport, relative to private vehicles, in their passenger transport systems. They achieved this despite rapid rises in income levels. All three also dramatically increased the role of rail-based mass transit and by the 1990s all three had achieved a substantial increase in public transport speeds. However, it should not be forgotten that in the early stages of the traffic limitation strategies of these cities in the 1970s, buses remained the mainstays of their transport systems and the emphasis on private vehicle restraint actually represented a low cost approach of maintaining the cities as bus cities. The transition to transit cities then followed as increased incomes allowed heavy investment in urban railways. Evidence has also been presented that the land-use patterns of these three cities are also becoming increasingly oriented around their rail networks. For example, their densities have not dropped significantly, their CBD job densities have been increasing, their non-central centres of activity tend to be located at mass transit stations, and new urban developments tend to be planned to be intrinsically transit-oriented (Kenworthy et al.,

1994). On Figure 5.6, all three cities have been generally following a path roughly parallel to the large arrow from the bus cities part of the plot into the transit cities part.

These new Asian transit cities, like bus cities, are still probably unable to cope with a large influx of cars. However, even if cars are no longer restrained, each of these cities now has assets for resisting them - namely a large mass transit system and a transit-friendly urban form that can still function effectively despite any traffic jams that emerge. Hong Kong and Seoul in particular have very high densities, higher than any that were seen in Western cities earlier this century. These very high densities mean that Hong Kong and Seoul face much stricter spatial limitations than Singapore (or European cities) on how much they can afford to welcome private cars. For example, it was seen in Chapter 5 that Seoul's car ownership levels have surged upwards since the mid-1980s. This has created great problems, such as a very saturated road network, which can in turn be understood in terms of these strict spatial limits having been exceeded. The framework suggests that, like Hong Kong, Seoul will be unable to quickly increase its private transport use much further, without serious problems and dislocation.

7.5.2 Bangkok and Kuala Lumpur

Both Bangkok and Kuala Lumpur have motorised rapidly since 1970, and especially since 1980. Although public transport has expanded in these cities, it has not improved its quality and has declined in importance relative to private vehicles. In terms of Figure 7.1, Kuala Lumpur and Bangkok have been moving along arrows upwards out of the bus city region of the plot into the part of the graph occupied by relatively high-mobility cities.

Kuala Lumpur, with its relatively low density and moderate population size, has apparently been able to accommodate and adapt to an influx of private cars and motorcycles to a greater extent than Bangkok (although there have, of course, been some difficulties in Kuala Lumpur too). Kuala Lumpur's middle-density means that its road infrastructure can cope better than in denser cities. Kuala Lumpur has also built an extensive network of expressways (on both a per capita and on a per hectare basis). There is evidence that car-oriented styles of development are beginning to become more common in some of the Southeast Asian cities and Kuala Lumpur is the most extreme case with more genuinely car-oriented land use patterns than any of the others. It was seen in Chapter 6 that Kuala Lumpur has had the fastest drop in density of the Asian cities, from its already unusually low level compared with the other Asian cities (Table

6.2). Thus, the trend to adapt the Kuala Lumpur metropolitan region to the needs of cars appears to be strong. However, a large network of mass transit railways is also being built resulting from an apparent recognition that access to the inner area by private vehicles alone will soon become unworkable (Tai, 1994).

Thus in terms of both its transport characteristics and its land-use patterns, Kuala Lumpur appears to have the potential to approach a situation similar to some European cities, or perhaps in the longer term, the less car-oriented of the Canadian cities, of having high mobility, primarily by private transport, but retaining a significant role for public transport as well. In Figure 7.1 Kuala Lumpur might be thought of as moving from being a bus city towards something akin to Thomson's weak centre strategy. Such a direction should of course also be weighed in the broader context of the social and global costs of an increasingly energy-intensive, car-oriented transport system. However, the immediate emphasis here has been to highlight the feasibility in spatial terms of transport trends in the Asian cities, and from that perspective, this scenario appears to be feasible for Kuala Lumpur. Thus Kuala Lumpur is perhaps unique among the Asian cities in this sample in now sharing many of the same policy dilemmas that face European cities. Like European cities, further rapid increases in private mobility may yet bring Kuala Lumpur's transport system up against spatial limitations. As with other cities, this would be manifested in the forms of crises of congestion, air pollution, and widespread degradation in the liveability of the urban environment in the face of heavy traffic throughout the urbanised area. In Kuala Lumpur particularly, there is also the danger that an increasingly car-oriented and car-dependent urban form may develop over time, further entrenching the patterns.

In Bangkok, the upsurge in vehicle numbers between 1980 and 1990 was particularly rapid and occurred in the spatial context of a high density city with no significant rail system. Its predicament by 1990 with traffic was possibly without an historical precedent in the Western world⁶⁹. The transport changes since 1980 in Bangkok have been so rapid that overall, the city retains most features of the bus city structure described in Chapter 3. For example, its overall urban density remains high and it remains rather centralised in its employment distribution. It has been unable to increase the road network or build expressways at anything like the rate that would be required

⁶⁹ It is possible that some of the large Latin American cities, such as Mexico City or Sao Paulo, may have been facing a similar situation in the late 1970s, although they may have had somewhat lower densities than most Asian cities. Economic turmoil in the 1980s in Latin America dramatically slowed the motorisation process there. Athens is another city that by 1990 may have been facing a similar predicament to that of Bangkok, namely an influx of cars into a large, dense city that was almost totally dependent on buses for public transport.

to accommodate traffic demands. Nor has the city yet been able to complete any major improvements to public transport, such as improved or new rail systems or high quality bus priority systems (Poboorn, 1997).

Bangkok is a city where the transport and land use patterns are drastically out of equilibrium, as described at the end of Chapter 6. Any car-oriented urban developments that have been built in the last 15 years have not substantially altered the overall character of Bangkok's urban form. Bangkok in the 1990s could be called a "traffic-saturated bus city". This term is suggested in order to emphasise that, despite having been overrun by cars, Bangkok is very far from being an automobile-oriented city in terms of its land-use patterns, overall transport network characteristics and levels of car use per person.

7.5.3 Jakarta, Manila and Surabaya: Following Bangkok?

The trends in motorised mobility of Jakarta, Manila and Surabaya can also be interpreted in terms of the framework in Figure 7.1 and Figure 7.2. Surabaya has been moving from a position of low rates of travel on both public and private motorised modes in 1980 and earlier, towards the "motorcycle city" part of the framework, with private mobility rising faster than public. Jakarta's trend has been along a similar trajectory at a slower rate and from a starting point in 1970 that had a much higher level of public transport use than Surabaya. Its trend line parallels Bangkok's but lags far behind that city's mobility levels. Manila in 1980 had a surprisingly high level of public transport travel and a low level of private mobility. The 1980s were years of stagnation in Manila but since then it is likely that private mobility has risen further with public transport usage little changed.

These trends appear to be dangerous when considered in the light of the spatial perspective of Figure 7.2. With urban densities higher than Bangkok's and with bus-oriented transport systems that are vulnerable to the impacts of congestion, these cities are clearly prone to facing a similar crisis to that faced by Bangkok. Rapidly rising car ownership levels in the early 1990s will have taken them further towards a Bangkok-like predicament. Even though Manila starts with the advantage of having more plentiful public transport than Jakarta, if traffic is allowed to increase quickly, this jeepney and bus-based public transport system would be severely affected. Without active measures to protect public transport speeds, the city would not be saved from a Bangkok-type congestion crisis. Surabaya is also prone to the same trends, if car ownership rises quickly. However, so far it has remained remarkably uncongested. This

may be due in large measure to the significance of motorcycles in the city's transport system.

The above comments now need to be tempered with the reality of the Asian financial crisis since mid-1997, which has seen economic growth fall dramatically in all of the Asian countries included in this study. In particular, Indonesia has been hit harder than the others have. The crisis changes the urban transport trends that can be expected in the near future in the Asian cities in this sample. Nevertheless, the observations here that are based on events during times of rapid growth have a wider relevance and will again be relevant in Asia should high rates of growth return in the future.

7.6 Motorcycles in Light of the Framework

How can the popularity of small motorcycles be interpreted in light of this framework? Although their affordability is clearly an important factor, allowing relatively high ownership rates in some low-income cities, this is not the only factor. High motorcycle use may also represent a coping mechanism for congested cities in the face of spatial constraints. A dense city can apparently increase its private mobility further, faster and more economically with motorcycles than with cars, without facing such severe spatial constraints. This is because of the spatial characteristics of motorcycles, particularly the small motorcycles that are popular in Asia. A further important factor is that their high motorcycle numbers may in part be a reaction to inadequate public transport. Furthermore, numerous motorcycles then provide fierce competition for public transport.

Urban motorcycles ownership rates of over 150 motorcycles per 1000 persons are unique to Asia and are unprecedented. Countries that now have particularly large numbers of motorcycles include Taiwan, Thailand, Malaysia, Indonesia, Vietnam, Laos, Cambodia and India. Although motorcycles are also becoming significant in some western African countries, no other region of the world has such high levels of motorcycle ownership (Flood, 1997). Because such high ownership of motorcycles in cities is a new development, the understanding of its implications and appropriate policy responses to it are both poorly developed. This new phenomenon has unknown long-term implications which urgently need further study, including the potential influence of motorcycles in facilitating more dispersed, lower density land use patterns.

It was seen in Chapter 5 that motorcycles are very numerous in a number of the Asian cities in the sample, in particular Kuala Lumpur, Bangkok, Jakarta and Surabaya. It had earlier been expected that, as incomes rose beyond lower-middle-incomes, the

proportion of motorcycles relative to cars would begin to drop (Zahavi, 1976: 18) and this has indeed been happening in Singapore and Hong Kong. Recent transport studies in Jakarta and Surabaya cities have continued to predict a decline in the relative importance of motorcycles (Dorsch Consult et al., 1996b; Dreesbach and Wessels, 1992). However, against expectations, motorcycle ownership rates have continued to increase in congested middle-income cities where public transport options have been poor and unattractive, such as Bangkok, Kuala Lumpur and Taipei (Feng, 1994). Taipei is significant here, with income levels much higher than Bangkok or Kuala Lumpur, but also with higher motorcycle ownership and an urban fabric that appears to be higher in density than Bangkok's.

Bangkok's experience provides evidence that suggests a link between the popularity of motorcycles, rising congestion and spatial constraints in general. Unlike Kuala Lumpur, Jakarta and Surabaya, Bangkok's motorcycle ownership rate was quite low at the beginning of the 1980s and has only increased rapidly since then. In 1980, Bangkok's motorcycle ownership rate was only 35 per 1000 persons compared with 71 for cars. By 1993, motorcycles had reached 179 per 1000 persons, not far below cars, which stood at 220 per 1000 persons. Furthermore, the rate of increase of motorcycle ownership between 1990 to 1993 was double the rate for 1980 to 1990 (Tables 5.2 and 5.3). The rise of motorcycles in Bangkok has thus coincided with the advent of the severe congestion crisis and a collapse in traffic and bus speeds since the mid-1980s. This upsurge in motorcycle ownership occurred just as incomes were rising rapidly and previous predictions might have been for a lower role for motorcycles relative to cars, rather than an increase.

Small motorcycles are able to manoeuvre through stalled traffic and to park in tight spaces and busy areas where car parking is hard to find. The time-area concept provides an approach that focuses attention on the very high rate of urban space consumed by private transport modes compared with public transport (Bruun and Schiller, 1995). It compares not only the road space used for a trip but also the parking space used, weighted by the length of time that it is occupied. Motorcycles' use of road space may only be slightly more efficient than cars but they are very thrifty with parking space. Since parking space accounts for a large proportion of time-area consumption by private transport modes, motorcycles consume much less urban space (in time-area terms) than cars. These observations suggest that the popularity of motorcycles in middle-income Asian cities is at least partly a reaction to high urban densities. Motorcycles appear to serve as something of a "safety valve" in cities that are facing severe spatial constraints.

Cervero (1991b) also suggests that the significant role of small and diverse vehicles, including motorcycles and various vehicles used in public transport and in taxi-like service, might be a coping mechanism in the face of road network constraints. He argues that the number and diversity of such vehicles in developing Southeast Asian cities was a response to poor road networks and poor road hierarchies. This dissertation appears to mostly confirm this. It has also shown that low road capacity per person is in turn linked to high urban densities, as has been demonstrated in Chapter 6.

In addition to being able to cope with and penetrate dense, traffic-saturated cities, motorcycles also have significant interactions with the role of public transport. The rapid influx of motorcycles in many cities may partly be a result of the inadequacy of public transport. However, motorcycles also play a role in threatening the viability of public transport in Asian cities. Being more affordable than cars, they can begin to do so at lower income levels than can cars. Furthermore, they can continue to compete with public transport even in conditions of scarce parking and congested roads where cars have greater problems. In part, the space-saving features of motorcycles allow them to compete very effectively with public transport for trips to congested centres. For such trips, their ease of parking and ability to weave between rows of stationary larger vehicles, mean that motorcycles are better able than cars to compete with public transport for this particular class of trips. Like, public transport, their cost to users is also comparatively low.

Plate 7.1 Motorcycles park on footpaths throughout Taipei filling every available space in the dense inner area



In the light of these arguments, it is difficult to know exactly why motorcycles have never become popular in congested Manila. The literature is silent on the question. It has been suggested that the large numbers of typhoons in Manila may be a factor

(Benedicto Guia, Jnr., July 1997, pers. comm.). However, it seems more likely that an important reason may be the relative success of Manila's economical public transport. Manila's system, dominated by jeepneys, provides a frequent, plentiful and well-used service that penetrates all areas of the city with a dense network. Data presented in Chapter 5 showed Manila's public transport to be much more successful than that of Bangkok, Jakarta, Surabaya or Kuala Lumpur.

In contrast, motorcycles have become dominant in Surabaya without any intervening period of public transport dominance and now account for about 46% of motorised trips (Dorsch Consult et al., 1996b). In Surabaya, collective transport has apparently never played a major role and as recently as the 1970s, non-motorised transport accounted for the vast majority of trips. Motorcycles have also been relatively important in Kuala Lumpur ever since the early 1970s and public transport has never been the predominant mode in that city either.

Another factor in the rise of motorcycles may be a history of high bicycle use. Many cities where motorcycles have become very numerous previously had high levels of bicycle use. Examples include Taiwanese cities, Vietnamese cities, small Indian cities, Malaysian cities, and to a degree, Indonesian cities. To some extent, this factor may also interact with the lack of public transport. It may be that high bicycle use (like high motorcycle use today) was, in part, a reaction to poor public transport, and in turn inhibited the expansion of public transport. In addition, certain urban characteristics may encourage both low public transport and high bicycle use, for example small population size may be such a factor. There is clearly a need for further research into the factors influencing the role of motorcycles in Asian cities.

It is uncertain what the long-term outcomes of these motorcycle trends in Asia will be and there is an urgent need for further debate on appropriate policies towards motorcycles. In terms of the framework that has been developed in this chapter, motorcycles appear to offer some relief for dense cities facing traffic saturation of their road systems. If a substantial proportion of vehicle travel is by motorcycles, then such a city can apparently tolerate higher levels of VKT per hectare (and per unit of road capacity) than would otherwise be possible. In this way, such a city might "buy time" to make other changes or reforms that would allow it to adjust to greater motorised mobility. However, motorcycle usage must eventually also face spatial limits and it is unclear what options would then be open to such cities. In fact, the numerous motorcycles may have inadvertently cut off other options. By competing effectively with public transport, a high role for motorcycles may tend to make a transit-oriented

strategy very difficult for a city. Will the developing mass transit systems in cities such as Bangkok, Kuala Lumpur and Taipei suffer from motorcycle competition or will they eventually provide sufficient improvement to public transport quality to halt the increase in motorcycle use?

In terms of their potential impacts on land use, motorcycles can serve dispersed urban activity patterns, thus potentially encouraging the development of a dispersed urban form that is not suited to public transport. Therefore, although they do not contribute as much to congestion as cars or use as much energy, motorcycles may be operating as a vanguard for an explosion in the numbers of cars by encouraging dispersed land-use patterns. By directly damaging the competitors to cars, they may also be reducing the capacity of cities to react to this onslaught.

As for social and environmental impacts, motorcycles are an extremely dangerous mode and the two-stroke machines that are common in the region are extremely polluting of the air. For example, 96 of Kuala Lumpur's 250 road deaths in 1990 were motorcyclists or their passengers. This represents 58% of the victims who were in vehicles, whereas motorcycles represented 32% of the traffic stream (Aziz Baba, 1992: 31). Such considerations may lead cities in the region to decide to restrain motorcycles. However, it is not yet clear how this could be most effectively and fairly achieved. Perhaps stricter safety and emissions standards offer potential methods of raising the price of motorcycles while also tackling two of their worst problems?

To sum up, for many cities it was apparently the affordability of small motorcycles along with failures in public transport which initially promoted motorcycle ownership growth. However, by the 1990s in upper-middle-income cities such as Bangkok, Taipei and Kuala Lumpur, spatial issues, such as congestion and parking space appear to have taken over as the primary impetus for motorcycles' continued popularity (along with continued poor public transport). The popularity of motorcycles can be seen as an example of an ad-hoc response by numerous private individuals to these situations. However, it is also important to consider what active policy choices have been most significant in taking the different cities along their various paths of development. This is the main theme of the next chapter.

7.7 Chapter Summary and Conclusions

This chapter has provided a way of looking at the transport and land-use development of cities at a very "broad brush" level. Many details were ignored, of course, in the interests of providing a view of the "big picture" for the development paths of entire

cities over many decades. The main features of this framework are embodied in Figure 7.2 which shows the various city types (auto cities, walking cities, bus cities, transit cities, etc.) on a plot of private transport mobility versus public transport mobility and shows how spatial constraints and urban density relate to the mobility patterns of the city types. The framework provides a new perspective on some of the major transport choices that are available to cities of each type.

In this thesis most attention is devoted to the bus cities and the choices available to them as their incomes rise and wider transport options open up. The framework and the related arguments developed in this chapter suggest that, in spatial terms, the least problematic choice for large bus cities is to restrain private vehicles and to promote the alternatives. At first, this may mean adopting a low-cost approach which involves maintaining the bus city model for a time, while laying the foundations for a transition towards the transit city model, which involves subsequent investment in more capital-intensive public transport systems. The detailed discussion of the choices and events in Singapore, Hong Kong and Seoul in the next chapter will elaborate on just such a strategy and how it was engineered in those cities.

Of course, bus cities do also have the choice of allowing a rapid increase in private vehicle ownership and usage. However, the arguments above have suggested that this option is fraught with enormous difficulties, since dense bus cities are particularly vulnerable to the impacts of increasing traffic. The framework presented here has also shown how motorcycles provide something of a safety valve for cities in this predicament, although how far this can go and what are the long term implications of this response, are not yet clear. Many Asian cities are apparently bypassing the bus city model altogether and instead moving directly from walking cities (or NMT cities) to become motorcycle cities. These cities retain high densities and the framework presented here suggests that, as motorisation continues to increase, these cities will begin to also confront spatial (and environmental) constraints. Thus, motorcycle cities will also face stark and difficult choices, just as Asian bus cities do.

This chapter has further addressed Research Question 2, which asked about unusual challenges and opportunities in Asian cities and then went on to ask if distinctive Asian models of urban transport and land use can be identified. The framework developed in this chapter has shown how the paths taken by the Asian cities compare in an international perspective with urban transport evolution elsewhere. This framework also includes the spatial insights that are essential to understanding these cities' transport systems. It thus clarifies the context for many of the main choices that confront

transport and urban planning in Asian cities. This sets the scene for the next chapter, which turns to much more detailed information on policies. This perspective will complement the framework developed in this chapter and the detailed comparative data in Chapter 5 and Chapter 6 in providing a clearer understanding of key transport choices in middle income cities in the late twentieth century and their interrelationships with transport and land-use paths of development.

CHAPTER EIGHT

KEY CHOICES IN ASIAN URBAN TRANSPORT

8.1 Introduction

This chapter turns to identifying and examining in detail some of the key choices that have been taken as these Asian cities have followed their paths of urban transport development since 1970 or so. This focus on actual choices and responses includes an examination of some recent policies and events in the 1990s. This relates to Research Question 3, which asked what are the most significant transport-related choices that have been made in Asian cities over recent decades and also asked how those choices relate to the urban transport and land-use comparisons and to the transport challenges and opportunities faced by each city. The discussion of these choices and recent policies in the light of the descriptive theoretical framework also includes a brief assessment of possible future choices and scenarios for the middle-income Asian cities in the sample. This is in answer to Research Question 4, which asked about the implications for future choices in these cities of the comparisons in this dissertation and of the answers to the other research questions.

The arguments of the previous three chapters justify a focus here on three main policy arenas. These are restraint of private vehicles, the development of improved public transport, and land use planning. Of the three, most attention is devoted to the restraint policies, for reasons that will be explained. In addition, policies on the development of major roads will be mentioned briefly, as will policies and choices that affect the environment for walking and the use of non-motorised vehicles.

Chapters 5 and 6 presented large amounts of data in order to place the characteristics of each Asian city into an international context and to show how each has evolved over the last few decades. However, little mention was made of how and why these conditions had come about. What key choices have made the most crucial difference to which development path has been taken by each of the Asian cities in this sample? Several of them have followed a development path that emphasises public transport. It was shown that Tokyo, Seoul, Singapore and Hong Kong have moved increasingly towards becoming transit-oriented cities in both their transport and urban form characteristics. In contrast, Bangkok, Kuala Lumpur, Manila, Jakarta and Surabaya have so far been tending to allow private vehicles to flood their bus and NMV-oriented urban fabrics.

Although Kuala Lumpur has been able to cope adequately, Bangkok, which is denser than Kuala Lumpur and further along the path of motorisation than Jakarta, Manila or Surabaya, can increasingly be characterised as a traffic-saturated bus city. The spatial arguments of Chapter 6 suggest strongly that the traffic-saturated bus city represents a “dead end” or a non-viable state, with Bangkok being the most dramatic example to date. To truly embrace the car in such cities would require a radical and traumatic restructuring of their urban fabric at much lower densities and with dispersed activity patterns. The framework presented in the previous chapter suggested that dense cities with increasing potential for private vehicle ownership and use would be wisest to slow the rate of growth of private vehicle use to avoid a severe spatial imbalance, such as Bangkok’s. To increase the mobility (and accessibility) in such cities would instead require an emphasis on other modes, especially public transport. In terms of the framework, a development path from a bus city to a transit city was shown to be much less problematic in spatial terms than an attempt to rush headlong towards high private transport use.

The chapter concludes with a section that presents a descriptive generic model of transport and land-use change in Asian cities and with a brief examination of the future choices available to these cities in light of this model (and in light of the other arguments in the thesis).

8.2 Review of Key Policy Arenas

It will be argued that the first policy arena, private vehicle restraint, has played a crucial role in setting Singapore, Hong Kong, Seoul and Tokyo on a transit-oriented path. The other key choices have also had their impact, but ‘restraint’ policies have been a particularly important factor.

8.2.1 Restraint⁷⁰

Since the early 1970s, many of the large transport studies by international consultants in Asia have recommended some form of “restraint” on private vehicles. This was a change from the earlier widespread recommendations for large road infrastructure expansion, as mentioned in Chapter 3. In the 1970s, restraint of private vehicles became part of a package that was frequently recommended by the World Bank as part of loans for urban transport (Rimmer, 1987). There has, in fact, been broad academic and professional agreement that slowing the growth of private vehicle numbers is necessary

⁷⁰ The word “restraint” is taken here to include both ownership disincentives and various Transport Demand Management (TDM) policies targeting vehicle usage.

in large, rapidly growing, rapidly motorising cities. This conclusion was reached even without reference to spatial arguments of the kind that have been presented in this thesis.

Wherever such measures have been proposed they have generated heated public debate (Spencer and Madhavan, 1989: 432-434). Both the political will and the enforcement capabilities that are needed for effective restraint measures have often been difficult to achieve (Kirby et al., 1986). The various arguments in favour of restraint that have been put forward by professionals have often failed to convince politicians and the public (especially the middle-class car-owners and aspiring car owners). One reason for this failure may be that there has been insufficient awareness of the spatial constraints that are faced by large, dense cities. The spatial arguments that were presented in Chapters 6 and 7 provide a more compelling case for policies to slow the growth of private vehicle numbers in dense Asian cities.

Tokyo, Seoul, Singapore and Hong Kong have been able to implement strong restraint policies during recent decades. Chapter 5 provided evidence that these four cities had lower motorisation and lower vehicle use than might be expected according to their income levels. The policies that underpinned these restrained levels of motorisation are elaborated in detail below. A willingness to make driving expensive in these places is also apparent from a quick comparison of the pump prices of premium gasoline in around 1993 (World Bank, 1996: 92). Fuel was most costly in Japan (US\$1.33 per litre) and Hong Kong (US\$1.06) (with prices similar to or higher than most European countries), followed by Korea (US\$0.77), and Singapore (US\$0.69). However, the Southeast Asian developing countries, Malaysia (US\$0.41), the Philippines and Indonesia (US\$0.36) and Thailand (US\$0.30), all had much cheaper fuel, similar to the United States figure of US\$0.36 per litre. Further information on relative prices of private car ownership and usage is presented later in the chapter in Table 8.2 on page 306 and confirms the general picture provided by these gasoline prices.

It will also be argued that the timing of restraint policies is particularly important. The examples of Tokyo, Seoul, Singapore, and Hong Kong in contrast with Bangkok and Kuala Lumpur suggest that private vehicle restraint has the greatest impact if it begins before motorisation reaches around 150 vehicles per 1000. In cities, such as Bangkok and Kuala Lumpur, where private vehicles were not restrained early, a surge in vehicle numbers tended to occur before major investments in improving public transport or high-capacity roads were possible. With emerging traffic problems, the pressure to improve both roads and public transport became more intense. However, congestion and

modal competition caused bus services and ridership to deteriorate in such cities, making investments in mass transit appear relatively unattractive. This sequence of events is also beginning to happen in Jakarta and Manila. On the other hand, Singapore, Hong Kong and Seoul restrained private vehicle ownership and usage growth during a crucial period before mass motorisation, thus gaining some “breathing space” in coping with transport challenges. They could afford to wait and gradually build transport infrastructure as it became economically viable to do so. Having restrained private vehicle ownership and/or usage, the pressure on these governments to increase road capacity was less intense than it would otherwise have been. Demand for public transport continued to rise along with incomes and expansion and improvements to bus systems became a high political priority. With high ridership these improvements could be very cost effective. A little later, continued demonstrated high demand for public transport encouraged decisions to invest heavily in high-quality, high-capacity public transport, such as rail systems. The delay in motorisation meant that this decision could also be delayed until it was relatively affordable to the city.

8.2.2 Public transport promotion

At least in their rhetoric, all of the governments of Asian cities in this sample have long had a policy of increasing the role of public transport. However, the results have varied very widely over the last three decades or so. Seoul, Singapore and Hong Kong have managed to establish substantial mass transit systems that have some prospect of being able to compete with private vehicles. They were able to do this before motorisation in each city had passed 150 private vehicles per 1000 persons. Kuala Lumpur and Bangkok are also in the process of building mass transit systems and it might be thought that their slower progress is simply because of their lower income levels. However, in both Kuala Lumpur and Bangkok, motorisation will have reached high levels by the time that substantial mass transit systems are in place. Each already has about 200 cars per 1000 persons and a similar number of motorcycles.

Improvement of public transport has been a central element of the transit city path taken by Tokyo, Hong Kong, Singapore and, to a great extent, Seoul. The speed of public transport provides a simple indication of success in developing public transport and the key to fast public transport appears to be the expansion of urban passenger rail, at least within this sample (Table 8.1). For example, public transport speeds increased dramatically in Hong Kong and Singapore between 1980 and 1990, during which time the role of urban rail systems went from zero to 31 percent of public transport passenger kilometres in Singapore and from 14 to 42 percent in Hong Kong. In contrast Bangkok,

Kuala Lumpur, Jakarta, Manila and Surabaya still had very slow public transport in 1990 (well below 20 km/h).

Table 8.1 Public transport in-vehicle speeds in Asian cities and regional averages in an international sample, 1970 to 1990 (km/h)

	1970	1980	1990
Tokyo	38	38	39
Hong Kong	?	17	28
Singapore	?	19	26
Seoul	?	?	26
Kuala Lumpur	18	?	16
Bangkok	13	?	9
Jakarta	?	?	15
Manila	?	14	17*
Surabaya	?	?	18
European	30	33	37
Canadian	21	22	24
Australian	26	30	31
American	23	26	28

Note: * It is reported that by 1996/97 public transport speeds within Metro Manila have dropped significantly to 12 km/h for buses and 9 km/h for jeepneys (Joson, 1997).

The timing of improvements to public transport relative to the progress of motorisation must be emphasised. High-quality public transport systems were not yet in operation in Seoul, Singapore or Hong Kong at the time that private vehicle restraint began. On the contrary, private vehicle restraint was probably a key factor in allowing these cities to retain high mode shares on buses and eventually to be able to provide substantial, high-quality public transport systems by the time that private vehicle ownership reached 150 vehicles per 1000 persons. By contrast, in Bangkok and Kuala Lumpur, motorisation has been allowed to reach a high level and public transport's mode share has dropped to 30 percent or less, before significant improvements to public transport have been possible. Jakarta, Manila and Surabaya have generally not quite reached such a point, but seem likely to follow Bangkok and Kuala Lumpur rather than the four transit-oriented cities.

8.2.3 Road expansion

Most of the Asian cities have also made strenuous efforts to expand their road networks and to build urban expressways to try to cope with rising demands for vehicular travel. However, as has been argued in Chapter 6, high density cities face insuperable obstacles to achieving a high level of road capacity per person. In almost all cases in the Asian sample of cities, increases in traffic have more than overwhelmed any road

expansions⁷¹. Nevertheless, in the following examination of choices, some comments will be made about the building of major roads, especially expressways, since this may provide some indication of a commitment to high-speed private vehicle movement.

8.2.4 Urban planning policies

Land use is a further key issue that has helped to define the cities' transport destinies. Exploring how developing cities can retain or reinforce mixed-use, transit-oriented urban land-use patterns, even as incomes rise, is an important area for study (Gakenheimer, 1995), especially in light of the spatial arguments in this thesis. Data on land use were presented in Chapter 6 which allowed some assessment of the Asian cities' land use patterns in terms of their bus-orientation, mass transit-orientation or suitability for private vehicle access. Here the concern will be on whether such urban land use outcomes were explicitly planned or were a natural evolution in the context of transport trends and other policies. For example, land use outcomes might be indirectly influenced by private vehicle restraint policies. Periods of rapid urban development have tended to coincide with periods of rapidly rising potential to own cars in each of the Asian cities. In the four Asian cities with strong restraint policies, public transport was able to firmly establish its dominance of motorised travel, before private vehicle numbers were allowed to surge upwards (if ever). Therefore public transport could remain an important influence on the evolving urban form. Thus the decision to restrain private vehicles at an early date could have been a key factor in influencing the pattern of transport infrastructure and urban development investments in such cities. However, since most cities with such policies also tried consciously to establish transit-oriented land-use patterns through urban planning, it may well be difficult to know if such urban planning was essential or if the traffic restraint and transit-promoting strategy would have been sufficient to achieve a similar outcome.

8.2.5 Non-motorised transport policies

Policy towards walking and non-motorised vehicles is another arena that is receiving increasing attention in the literature and by governments, after having long been neglected. There is not the scope to examine such policies in any great detail here. A number of policy initiatives (and deficiencies) will be examined but there is often insufficient evidence to properly assess the importance of these policies, except in a somewhat anecdotal fashion. As was mentioned in Chapter 5, the role of non-motorised transport is vulnerable to the impact of a hostile street environment. Non-motorised

⁷¹ Singapore is an exception due to its middle-density and very strong private vehicle restraint policies, which leave major roads relatively free for efficient commercial and freight traffic movement.

vehicle use is especially vulnerable and easily discouraged by hostile conditions. However, this also suggests that policy efforts to achieve a more welcoming environment for non-motorised modes may potentially have large effects (Barter, 1996b; Replogle, 1992).

Policies and major choices on non-motorised transport appear to be influenced by the extent to which the movement of private vehicles receives priority. Those cities, such as Singapore, Tokyo and Hong Kong, that have been willing to restrain private vehicles have tended to also be more receptive to the needs of non-motorised transport (especially walking but in some cases also non-motorised vehicles), although none has gone as far in promoting these modes as certain northern European cities (Hass-Klau, 1990; Pharoah and Apel, 1995). The lack of attention to non-motorised transport in Bangkok, Kuala Lumpur, Jakarta, Manila and Surabaya is very obvious⁷².

8.2.6 Is private vehicle restraint essential?

It has been suggested above that the restraint of private vehicles may be particularly important for any dense, middle-income city wanting to avoid facing the kind of problems that are plaguing Bangkok. For large, dense bus cities in modern circumstances, is restraint an essential part of any attempt to follow a more transit-oriented strategy and to avoid becoming a traffic-saturated bus city? Would a move towards a transit-oriented strategy be possible even in the absence of strong restraint of private vehicles? One possibility in this regard is that a city might avoid Bangkok's predicament by having a very strong commitment to giving priority to public transport. This would probably need to involve extensive on-road priority to jitneys and buses and a high commitment to public transport infrastructure rather than roads for general traffic.

There are no examples of such a strategy within this Asian sample, with which to compare. However, Curitiba in Brazil may represent an example of a middle-income city where car ownership was rising quickly but which was able to dramatically improve its public transport system through significant priority measures, especially high-quality busways. Curitiba seems to have avoided the car-oriented path that had seemed inevitable in the 1970s when it embarked on its new policies. Strict land-use planning has also been used successfully to promote the development of transit-oriented development patterns. Restraint has not been reported as a key part of Curitiba's

⁷² An exception is the *Kampung* Improvement Programme (KIP) in Indonesian cities, which by paving the narrow alleys of low-income settlements that have been upgraded, has improved the environment for NMT within these settlements which are essentially free of motorised traffic.

successful strategy. The only important restraint on private vehicles that has been highlighted in the literature on Curitiba is the implementation of an extensive CBD pedestrian zone (Cervero, 1995; Rabinovitch and Leitmann, 1993). However, the 1980s were also a time of economic hardship in Brazil in which most Brazilian cities saw a decrease in their levels of motorised mobility (Poole et al., 1994). It is likely that this economic slowdown helped to prevent further rapid increases in car ownership in Curitiba, thus giving time for the World Bank-assisted bus system and busway improvements to become well established. In other words, if Brazil's economy had continued to boom, then private vehicle restraint may have become essential to the success of the strategy in that city as well.

It is also likely that Curitiba's urban density is lower than many Asian cities. As an intermediate-sized city that has been relatively prosperous since the 1950s, Curitiba is likely to have an urban density in the upper-middle density range. Furthermore, insufficient data are available to this author to be sure where Curitiba falls in the framework presented earlier. So although it may be possible that a concerted set of policies along the lines of Curitiba's strategy might also be suitable for other middle-income and high-density bus cities, even in the absence of strict private vehicle restraint, it would appear that they will have a better chance of success where significant restraints exist on private transport.

The next few sections of the chapter turn to the details of the above policy arenas in the nine Asian cities in the sample. The primary focus is on private vehicle restraint with briefer discussions on other major choices. Further evidence is presented for the arguments made so far in this chapter. These discussions of key choices since about 1970, present a narrative on events that provides a useful complement to the more data-oriented approach in Chapters 5 and 6 and the large-scale view provided by the framework developed in Chapter 7. To some extent this narrative also picks up at the point where the historical background of Chapter 3 left off in relating the history of key transport events in these cities.

8.3 Choices in Singapore, Hong Kong, Seoul and Tokyo

8.3.1 Restraint

Tokyo, Seoul, Hong Kong, and Singapore have all had strong and effective policies restraining the ownership of private vehicles for some or all of their recent history. In all cases, strong ownership restraint was in place before car ownership reached 70 cars per 1000 persons. In addition, most of them have also restrained the use of private vehicles,

at least to some extent. Singapore's and Hong Kong's experiences with restraint share much in common with each other and are distinct in a number of ways from those in Tokyo and Seoul.

In both Hong Kong and Singapore restraint of car ownership began in the early 1970s in response to upsurges in traffic. Usage restraints soon followed, such as increased petrol prices, area licensing (in Singapore), and parking restrictions. In both cities, the measures have been strengthened several times since they began and remain in place to this day (Ang, 1996; Hau, 1995). These policies dramatically slowed motorisation in the two city states, despite tremendous increases in incomes (as commented upon in Chapter 5).

Some general awareness of spatial limits played a role in both Hong Kong and Singapore, but this was never systematically analysed as in this thesis. Decision-makers in both cities recognised that they could ill-afford the spatial demands of many cars and that road expansion to meet expected rises in demand was impractical (Hau, 1995; Pendakur et al., 1989). They explicitly recognised that private vehicles must be limited and that the most space-efficient modes must be promoted. Thus in both Singapore and Hong Kong restraint of private vehicles has been explicit and proactive and has been implemented as a centre-piece of urban transport policy. Despite autocratic tendencies in their governments, both have been somewhat responsive to public opinion and the two governments have been at great pains to persuade the public of the need for such policies. They have generally been successful in this.

Seoul and Tokyo have also long had policies restraining private vehicle ownership and/or use, in fact these policies pre-date Hong Kong's and Singapore's measures. However, unlike Singapore and Hong Kong, the restraint measures in Seoul and Tokyo were strongest in the past, at a very early stage of the motorisation process. These early measures applied at the national level rather than just to these cities. By 1990, they had been substantially relaxed (see for example Table 8.2 on page 306) but have nevertheless left an enduring legacy in the development patterns of the two cities. It is perhaps paradoxical that two countries with among the world's largest motor vehicle industries, Japan and Korea, have, at least in the past, had extremely strong restraint of private vehicle ownership. The lack of any significant motor vehicle industries in either Singapore or Hong Kong makes ownership restraint policies less surprising there.

The early Japanese and Korean car restraint policies were primarily a part of national macro-economic industrialisation strategies rather than being explicitly urban transport

policies. Nevertheless, transport factors may also have motivated such policies to some extent. For example, both Japan and Korea are densely populated and mountainous which makes space, especially flat land, extremely precious. Furthermore, both countries depend on imports for a very high percentage of their petroleum. This dependence on foreign oil has been a further motivation to restrain gasoline-fuelled vehicle use. Whatever their main motivation, the policies had the effect of keeping private vehicle ownership levels much lower than would otherwise have been expected.

8.3.1.1 Singapore

Singapore's forthright restraint of private car ownership is now world famous (Dolven et al., 1997). With relatively minor changes over the years, Singapore has consistently been pursuing almost the same integrated transport and urban development strategy that it embarked upon in the late 1960s and early 1970s, as enshrined in the transport plan of 1971 (Rimmer, 1986c: 124). Growth in vehicle numbers in Singapore between 1960 and the early 1970s had been quite rapid and by the early 1970s serious congestion had already become a problem that was considered by the Government to be a serious economic threat. Two influential studies were carried out in the early 1970s, one with the assistance of the UNDP was completed in 1971 and the other with World Bank help was completed in 1974. Both recommended restraint of both private vehicle ownership and usage (Pendakur et al., 1989). Decision makers acted quickly. Starting in 1972, vehicle-related taxes began to be increased with the explicit goal of dampening demand (Ang, 1996). The first major step in restraining vehicle ownership was taken in October 1972, when the "additional registration fee" (ARF), payable at the initial registration of a new car, was raised from 15 to 25 percent of the open market value of the car. At the same time the import duty was raised from 30 to 45 percent and annual road taxes were increased slightly for cars larger than 1000 cc and a sliding scale imposed with higher road tax rates for larger cars (Phang, 1993).

Over the next 18 years until 1990, the ARF and the road taxes were increased at regular intervals (January 1974, March 1975, December 1975, February 1980, October 1983, October 1984 and November 1988). These two fiscal policies were the main ownership restraint measures. Between December 1975 and February 1980, the ARF was 100 percent of open market value, and road taxes were four times their 1972 rates for a typical car. Between October 1983 and November 1990, the ARF was 175% and by 1990 the annual road tax payable on a 1600 cc car was S\$1,500 (about US\$850 at that time).

Although these fiscal restraints on ownership were very significant, it was a usage restraint initiative, the Central Area Licensing Scheme (ALS), that captured greater international attention. Under the ALS, vehicles are charged a fee to enter the central area of the city. This initiative began in 1975 and has been slightly modified a number of times since. It had an immediate dramatic effect in decreasing private car travel to the city centre and increasing the public transport mode share (Pendakur et al., 1989). Vehicles entering the CBD have remained well below 1975 numbers ever since the imposition of the ALS (Land Transport Authority, 1996: 34). Parking policies were also aimed at restraining private vehicle access to congested central locations (Pendakur et al., 1989). In 1975 a parking space surcharge tax was introduced at a rate of S\$20 per month per space within the CBD and S\$10 in the nearby areas beyond the CBD but within the restricted zone. In addition, developers were given an incentive to reduce the amount of car parking that they built⁷³.

Plate 8.1 An entrance to Singapore's Area Licensing Scheme (ALS) area



In 1990 a major change took place in the method of restraining private vehicle ownership growth, with the introduction of the Vehicle Quota Scheme. Under this scheme, which has attracted almost as much international interest as the ALS, Certificates of Entitlement (COEs) are issued each month and bids are made for the limited number in each category of vehicles. All successful bidders pay the amount of the lowest successful bid. The aim is to ensure that the vehicle fleet is allowed to increase only as fast as the road network, at approximately 3 per cent per year.

Phang (1993: 331) shows the effect of restraint measures on the affordability of car ownership in Singapore over the years. In 1971, a basic car cost 3.59 times the per

⁷³ Developers were given the option of paying a 'deficiency charge' in exchange for building fewer than the specified number of parking spaces according to their floor area. The deficiency charges were higher within the CBD but are nevertheless set substantially lower than the cost of building parking space.

capita indigenous GNP. By 1986, despite the increases in taxes, cars had become more affordable at 2.71 times. However, with the imposition of the vehicle quota system in 1990, cars had returned in 1991 to close to their 1971 affordability with the typical car priced at 3.65 times per capita GNP (Phang, 1993). By 1994 cars had become even less affordable at 4.5 times per capita GNP (Land Transport Authority, 1996: 32). It has been estimated that with a lower level of restraint in Singapore (such that car capital and running costs would be half and 70 percent respectively of actual 1990 levels), then car ownership in 1990 would have been 200 per 1000 people (almost double the actual level) and fuel consumption by vehicles would have been 46 percent greater (Ang, 1996).

Singapore has also restrained motorcycles to some extent. Motorcycles were initially exempted from the ALS charges but in 1989 an ALS fee of S\$1 per day or S\$20 per month (one third of the private car rates) was introduced (Ang, 1996). Over the years since the early 1970s, motorcycle taxation rates were not raised at anywhere near the rates for cars. Motorcycles were included in the vehicle quota system but the price for a motorcycle COE has been very low (reflecting low demand for motorcycles (Phang, 1993). Nevertheless, other regulations in Singapore may have had the effect of also restraining motorcycle ownership. Examples include increasingly strict safety rules, parking enforcement, and standards on air pollutant emissions. These latter standards have effectively removed the cheapest and most polluting models from Singapore.

Singapore may be approaching the limits of feasibility of relying primarily on ownership restraint to manage private vehicle usage. The Singapore Land Transport Authority (LTA) has recently expressed concern that too much of the cost of motoring has been moved into ownership and not enough into usage with the result that those who can afford to own vehicles tend to use them very intensively (18,600 kilometres per year per car according to the LTA⁷⁴) (Land Transport Authority, 1996: 33). Public and political pressure has also been rising to allow more Singaporeans to own cars. Ways are being sought to respond to these pressures while maintaining restraint of vehicle use and limiting congestion. Singapore is now implementing a wider system of road pricing, which began in 1995 with a simple manual system on one congested expressway. It is being progressively followed by a system of automated Electronic Road Pricing (ERP) that began in 1997 on certain routes. In addition, a trial of European-style car-sharing⁷⁵

⁷⁴ The 1990 figure from this study of 18,400 kilometres per year per car agrees closely with the LTA figure.

⁷⁵ Car-sharing companies provide an alternative to car ownership by offering flexible car hire from neighbourhood locations. Membership of a car sharing scheme maintains access to a car while avoiding car ownership and the need to amortise one's investment by using a car for all trips. Car sharing thus tends to encourage rationalised car use.

has been launched in 1997 in two housing estates. The explicit aim is to allow more people access to cars for appropriately priced and limited use, while still meeting policies goals of restraining car use growth (New Straits Times, 11 February, 1997).

8.3.1.2 Hong Kong

Hong Kong is not quite so famous for its restraint of private vehicles as Singapore but its efforts have been even stronger. For example, see Table 8.2 on page 306 which shows costs of car ownership and use in the various Asian cities, with Hong Kong being by far the most expensive. These efforts have been very effective in containing the growth of vehicle ownership. With the extremely constrained space available for development and consequent very high density of development, Hong Kong's planning bureaucracy has recognised since at least the early 1970s that opportunities for road development and expansion are inherently very limited and very expensive (Hau, 1995). Therefore at that time the restraint of private cars and other space-inefficient modes became one of three main transport policy thrusts. The other two are the promotion of urban rail and efficient sharing of the limited road space among the different modes of transport. Despite steeply rising incomes, vehicle ownership in Hong Kong has been kept to extraordinarily low levels (Figure 5.2).

During the 1960s and early 1970s Hong Kong had, like Singapore, a steep rise in vehicle numbers, especially private cars, (Hau, 1995). Leung (1993) notes that this period saw a serious deterioration of traffic conditions in the city. The decision was made that the simplest method of ensuring more efficient use of road space was to use fiscal measures to restrain both car and motorcycle ownership. Hau (1995) outlines the development of these fiscal measures. The first major increase of taxes took place in March 1974 when the First Registration Tax (FRT), which is a purchase tax on the value of the vehicle, was increased to 15 percent of the cost-insurance-freight value of cars and motorcycles. In addition, annual vehicle license fees (ALF) were approximately trebled. These changes had the desired effect and the numbers of these vehicles did not pass their 1974 levels again until five years later. There was a further increase in the FRT to 30% in 1975 and an FRT was also imposed on goods vehicles and taxis but at a lower rate of 15%.

Further rises in prosperity gradually eroded the effect of the existing disincentives and by the early 1980s traffic conditions had deteriorated again. This prompted the next major increase in restraint in May 1982, when the FRT was doubled to 70%-90%, the ALF was tripled and the petrol tax was doubled. Again private vehicle numbers dropped

and did not reach their 1982 levels again until 1990. However, goods vehicle numbers continued to rise steadily throughout the 1970s and 1980s. Hau sees this as providing evidence that it was primarily the fiscal restraints and not other factors, such as recessions and oil shocks, that explain the dips in private passenger vehicle numbers. In Hong Kong motorcycles have always been a target for restraint of ownership along with cars. Generally each major hike in the strength of restraint has included motorcycles (Hau, 1995).

In the 1979 White Paper on Internal Transport Policy, other restraint options such as parking restraint, physical restrictions and supplementary licensing had been considered but rejected. Fiscal measures were reaffirmed as the preferred method. However, concern was rising that despite vehicle ownership restraint, private cars and taxis accounted for 75 percent of traffic flow (in roughly equal shares). This prompted the 1983 announcement of a trial of Electronic Road Pricing (ERP). The trial took place from 1983 to 1985 and was technically a great success, demonstrating a very high benefit-cost ratio. However, political concerns about personal privacy and the suspicion that this was simply a revenue-raising device prevented the implementation of the scheme (Hau, 1995).

In the period 1987 to 1993, annual growth in car numbers was around 9 to 10 per cent. This, along with increasing congestion, was viewed with alarm and again strong consideration was given in a November 1994 document to further increases in the FLT and the ALF with the aim of restricting growth of car and motorcycle ownership to 2 percent per year. However, there is increasing recognition among Hong Kong decision makers (as in Singapore) that the current methods are blunt instruments which may be reaching their limits as incomes have risen and the levels of the disincentives which are now required are very high. More sophisticated methods are therefore being considered. In 1995 public consultations indicated that road pricing was preferred to other restraint options, such as the Singapore style quota system and further increases in fiscal restraints on ownership of vehicles (Hau, 1995).

8.3.1.3 Tokyo

In Japan a number of government policies (especially credit and land-market policies) in the post-war era restrained private spending on both cars and urban sprawl (Hook, 1994). Except for a spurt in the 1960s, the motorisation process in Tokyo has been relatively slow, considering Japan's consistently high economic growth rates throughout the period from 1950 to 1990 (Figure 5.2). A number of historical factors led to Tokyo's

early policy of restraint of car ownership and usage (Hook, 1994). At the end of World War II, Japan had very low private vehicle ownership and a poorly developed road system. This was partly the result of the war but also due to pre-war promotion of rail investment over road based transport. At that time, the rail industry was Japanese controlled and used electricity from local coal, whereas the motor vehicle industry was dominated by American companies and depended on imported oil.

In the post-war era, the primary underlying reason for private vehicle restraint policies has been Japan's post-war national economic strategy. Under the set of policies known as the "*Maruyu*" system, a key goal was to constrain private consumption in order to maximise savings, investment and exports. Thus despite rapid industrialisation and increasing national incomes in the 1950s, Tokyo's car ownership rate by 1960 was still only 16 cars per 1000 persons, a much lower rate than in the much poorer cities of Singapore or Kuala Lumpur at the same date (Table 5.2). Such policies included high levels of car-related taxes, charges and duties in Japan, and these set a precedent for the future. With high prices in place at an early stage in motorisation, it has apparently been politically possible to substantially maintain them, even as vehicle ownership has risen.

Current disincentives to car ownership include the "*shaken*", a compulsory inspection every two years for every vehicle at a cost of approximately US \$900, and annual taxation of approximately US\$1,285 (Hook, 1994). Another recent measure is an explicit response to the problems of motorisation in dense established urban areas. In Tokyo, proof of ownership of an off-street car parking place is required before a car can be registered (with the exception of very small cars of 550cc or lower engine capacity) (Bernick and Cervero, 1997: 312). Furthermore, there are also disincentives to private vehicle use, including high fuel prices, toll charges and parking costs. High parking costs are partly associated with extremely high property values in Tokyo and also due to the inherent shortage of space for parking in the large inner area (and even many suburban areas) that were built up in the pre-car era. Strong property owners' and tenants' rights which allow them to resist redevelopment pressures also probably constrain parking expansion, as they do road building (Hook, 1994). Tolls are expensive on Japan's expressway system, including Tokyo's expressways, the "*Shutoko*". One factor in this is that the early development of the system (at a time when there were very few vehicles in the country) was funded by borrowings from the government pension and postal savings funds rather than with tax revenues (Sakamaki, 1993).

8.3.1.4 Seoul

Seoul's experience with restraint is a particularly interesting case because Korea's earlier very strong private vehicle restraint policies were relaxed in the mid 1980s and since then there has been a dramatic surge in vehicle ownership and use. The motivation for the earlier restraint policies, as in Japan, was the national macro-economic strategy of promoting exports while constraining private consumption. Nevertheless, these restraint policies have also left a lasting legacy in the transport patterns of urban areas. Spatial constraints in Seoul are so extreme (as discussed in Chapter 6) that the impact of the recent surge of motorisation has been felt very quickly. This has encouraged the rise of public campaigns for less car-focussed transport policies. The authorities have had to quickly consider the need for even stronger promotion of public transport and to again restrain traffic. This time the restraint policies are aimed primarily at vehicle usage and are an explicit urban transport policy rather than part of a national economic strategy.

It is perhaps surprising that Korean car prices during the era of strong restraint were not unusually high by world standards (with total acquisition taxes coming to 60% of cost in the early 1980s). Rather, effective restraint of vehicle numbers was achieved primarily with high yearly ownership taxes (more than US\$400 at that time) and a very high petrol price in the country, especially prior to the early 1980s (World Bank, 1986: 12). Petrol prices in Seoul have also been slightly higher than in the rest of the country due to additional taxation (Kim, 1991). Insurance costs were also high, reflecting high accident rates and a small vehicle insurance market during the period when motorisation was very low (Kim, 1991). In another scheme which even now dampens demand for cars and directly benefits public transport, buyers of new cars in the largest Korean cities of Seoul and Pusan must buy subway construction bonds that are repayable at the end of 5 years. The rate of interest is below market rates so, in effect, the subway corporations receive concessional loans from car buyers (World Bank, 1995: 37).

Other public policies, which reduced access by private consumers to credit may have been among the most important barriers to car ownership. At least until the late 1980s it was very difficult to get credit in Korea for private consumer purchases, such as automobiles (Kim, 1991). This was one result of the strategy of export-led industrialisation that the Korean Government had been following since the 1960s. Very similar to Japan's slightly earlier strategy, this involved a combination of policies that encouraged national savings, restricted domestic consumer consumption, and encouraged exports by offering large exporting manufacturers priority in access to subsidised and rationed credit (Economist Intelligence Unit, 1996a). Although these

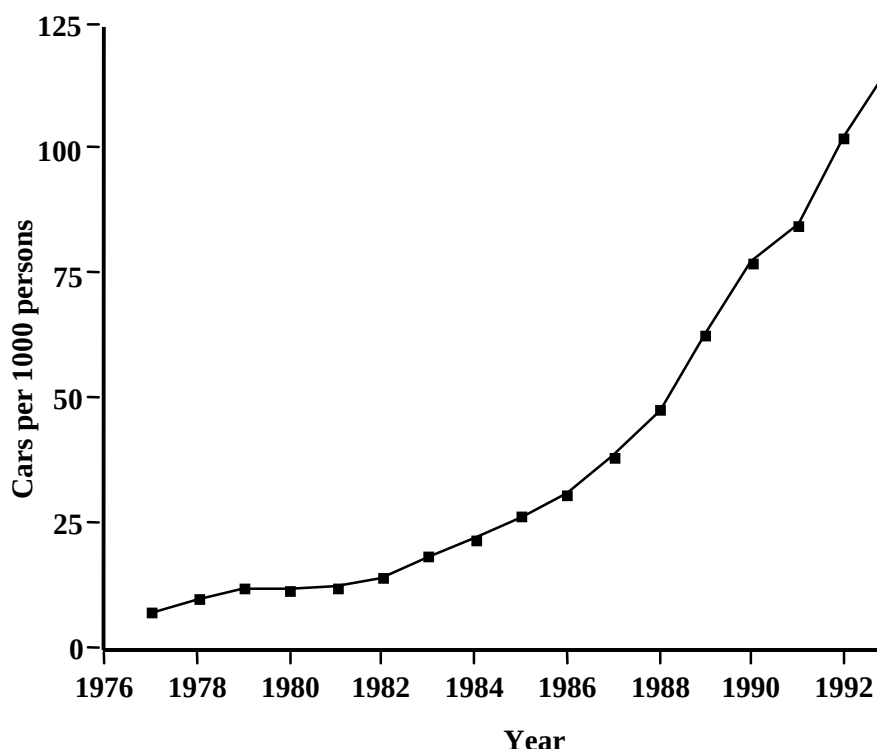
policies were not primarily intended to prevent traffic congestion getting out of hand, they did have that effect. Even by 1980, the City of Seoul's rate of car ownership was only 16 cars per 1000 people, the same rate as Tokyo in 1960 and lower even than Surabaya's 1980 rate (Table 5.2).

However, the vehicle restraint situation in Korea changed drastically during the mid-1980s when many of the constraints to motorisation were relaxed. The cost of driving decreased significantly during the 1980s while incomes increased dramatically. For example, the acquisition taxes for a representative small car (the Pony 2) had by 1986 dropped to a little less than 40 percent of the pre-tax cost of the car (Kim, 1991), compared to the 60 percent reported earlier. Real fuel prices also decreased so that by 1990/91 the real price of gasoline was less than half of its typical levels in the period, 1975 to 1985 (World Bank, 1995:47). The effective tax rate on gasoline fell from 358 percent in 1975 to 172 in 1980, 137 in 1985 and 115 percent in 1990. This was still a relatively high level however, especially when compared with the middle-income Southeast Asian cities. For diesel, the effective tax rate fell from 75 percent in 1975 to 34 in 1980 and 35 in 1985, then to 21 percent in 1990 (World Bank, 1995: 47 citing Shon (December 1991)).

Meanwhile, the local car manufacturing industry developed rapidly during the 1980s. In 1982 Korea produced only 95,000 cars. In 1986 it produced 457,000 and by 1990 almost 987,000 cars were made in the country (Korea Transport Institute, 1993: 64). The determination to make this national-priority industry a success naturally encouraged changes in Government attitudes to the local car market. Even though the car industry was focused heavily on exports, the local market also needed to be boosted. Although protective barriers remained high, cars became more affordable because of the availability of the locally produced vehicles and the lower acquisition tax levels.

However, the legacy of earlier restraint could not be immediately wiped away. There is a limit to the number of vehicles that can enter the market in a short period. Thus even by 1990, after car ownership had been increasing rapidly for several years, the level of ownership in Seoul was still very much lower than in Bangkok or Kuala Lumpur despite those cities having lower income levels than Seoul (as mentioned in Chapter 5). Figure 8.1 plots private car ownership in Seoul between 1977 and 1993 and shows the sudden surge in car ownership from the mid-1980s onwards that resulted from the relaxation of the constraints, combined with rapidly rising incomes.

Figure 8.1 Private passenger car ownership in the City of Seoul, 1977 to 1993



Source: Seoul Statistical Yearbooks data on vehicle numbers and mid-year population.

Note: The figures in this graph do not match exactly some of the figures presented in Chapter 5, because they use a slightly more restrictive definition for private cars than those used in the motorisation data presented in Chapter 5.

A result of the earlier private vehicle restraint is that Seoul avoided major traffic problems until very recently. Congestion has rapidly become a problem in the 1990s (as discussed in Chapter 5). This is not surprising considering the extreme nature of the spatial constraints to the expansion of private vehicle use in this very dense city, as noted in Chapter 6. Parking has also become a serious problem in a short time. The low level of demand for parking until the late 1980s means that parking supply throughout the pre-existing built up areas is low and difficult to expand quickly. Most of the housing stock, including apartment complexes built as recently as the late 1980s, was planned before the recent surge in car ownership with low levels of parking provision (Kim and Choe, 1997: 89). This is resulting in an enormous problem with illegal parking in streets and alleyways, not only in commercial areas but in residential areas at night. The increasing congestion in Seoul very quickly forced it to begin to reconsider efforts to restrain traffic, to enhance bus priority and further expand urban rail (Chae et al., 1994; Lim, 1993). Growing community opposition to traffic impacts has emerged, especially since the early 1990s (Lim, 1996), so there is now a new interest in the various transport demand management options. The organisation, “Networks for Green Transport”, with over 4,000 members by 1997, has been particularly prominent and

highly successful in raising awareness and bringing about policy changes (Lim, 1998). The price of gasoline has risen again since 1990, although it has not returned to its very high levels of the early 1980s. By 1999, almost 80 percent of Korea's gasoline price was accounted for by taxation, a rate similar to many northern European countries and higher than Japan's (Korea Times, 1999; Lim, 1996).

Seoul has experimented with no-drive days, which in Seoul has been called the "10th day holiday" ("*sibbuje*") system, whereby every vehicle is kept off the road for one weekday out of ten according to license plate number. This was first used during the Seoul Olympics. However, since then it has been voluntary and enforced strictly only upon government servants (World Bank, 1995:64). It has been promoted by the city government since 1989 as a social campaign. Although most participants are government-related, large firms with severe parking problems are also involved and 58 percent of workplaces in Seoul voluntarily participate (primarily by excluding the affected vehicles from their parking lots). However, the 5 percent reduction in vehicles that the measure represents was estimated to be wiped out by only 46 days worth of Seoul's growth in vehicle numbers at early 1990s rates of growth (Hwang, ca. 1995).

There was previously no official parking restraint policy in Seoul but now the City Government divides Seoul into three zones and sets different prices for public parking lots. Most expensive are the old CBD and six other major employment centres. In 1991, a 100 percent increase in CBD parking price reduced the demand for CBD parking by 20-30 percent (Hwang, ca. 1995). However, a World Bank document (1995:64) reports that much of the public parking stock was built with general funds so that, because of the high value of land, this parking is still effectively subsidised even in financial terms. There is also a proposal for a requirement to prove ownership or access to a parking place prior to being allowed to register a new vehicle (as is done in Tokyo). This is aimed at reducing the severe problems with cars parked overnight in streets in dense residential areas. Hwang (ca. 1995) also reports that in 1995 the City was in the process of introducing employer-based Transport Demand Management programs, such as eliminating free employee parking, flexible work-hours, public transport incentives and car-pooling matching services. Enterprises receive an incentive to participate through a rebate on their Traffic Impact Fee (which is levied on all building owners of over 1,000 square metres of floor space). However, it has been suggested that the effect of this measure will be small compared to other influences (World Bank, 1995: 64).

In November 1996 Seoul introduced a congestion toll on two tunnels beneath the Namsan mountain (which is just to the south of the old CBD) in conjunction with new

exclusive bus-lanes. These are heavily congested routes from the prosperous southern areas to the old CBD. During peak hours 85 to 90 percent of vehicles using the routes were private cars (Kim, Oh, and Kim, 1997). The congestion charge is 2,000 won (approximately US\$2.10 in late 1996) and is in effect on weekdays for every vehicle carrying fewer than three people during rush hours. Early results included a reduction of traffic by 26%, an increase in average car speed in the tunnels, and an increase in the use of public transport. The number of passengers using car pools of more than 3 persons during rush hours increased by 76%. The feasibility of introducing a city-wide congestion charge in Seoul is under study. More generally, a system of tolls is being studied to reduce the number of cars entering heavily congested areas at peak times. Revenues from such charges are to be invested in transport infrastructure (of all kinds, presumably). This is seen as being important in raising the political acceptability of such measures (Asia Pacific Economic Cooperation Forum, 1997).

It is noteworthy that the rate of increase in motorisation in Seoul dropped significantly in the mid-1990s, even before the economic crisis that broke out in mid-1997. Lim (1998) cites official statistics for the rate of increase in car numbers in the City of Seoul. These show increases of above 17 percent per year from 1985 until 1990, then 15.2 percent in 1991, 13.6 percent in 1992, 12.1 percent in 1993, 10.3 percent in 1994, 5.7 percent in 1995, 6.1 percent in 1996 and 3.7 percent in 1997. There was also a drop in the rate of increase of motorisation in the country but the change was much more pronounced within Seoul than in the nation as a whole (which still had increases in car numbers of 14.3 percent, 12.8 percent and 9 percent in 1995, 1996 and 1997 respectively). The change in Seoul may partly be a result of the new efforts at demand management, but it is also likely that increasing congestion and the lack of parking spaces had begun to make car ownership less attractive, while at the same time efforts to maintain the attractiveness of public transport were making some headway (see later).

Clearly, early restraint policies in both Tokyo and Seoul had a very strong effect by delaying the motorisation process in both cities. Furthermore, in both cases some restraint has been retained after the relaxation of the earlier more severe policies. Even these milder measures probably had some effect in Tokyo during the 1970s and 1980s and in Seoul after 1985. Recently both have also been forced to consider additional usage restraints as a direct response to rising congestion, parking and other traffic problems.

The next few sections now turn to looking at other policy arenas in these four cities, including public transport, roads, urban development and non-motorised transport choices. The relationships between these choices and the restraint policies are also examined.

8.3.2 Other key choices in Tokyo

As with its experience of private vehicle restraint, many of the other key choices that set Tokyo on its transit city path were taken before the Second World War or in the early post-war period. Some of these have already been discussed in Chapter 3. Figure 8.3, which is presented at the end of Section 8.3, summarises most of these key choices and events and their chronology. A similar diagram is presented for each of the Asian cities in this study. These chronologies will later be helpful in allowing a generic model to be presented of how Asian cities have come to follow their respective transport development paths.

8.3.2.1 Public transport

Tokyo had already established a substantial suburban rail system well before motorisation became significant. As mentioned in Chapter 3, much of the suburban rail system (although not the subway system) was already built by the 1940s. Japanese infrastructure spending in the 1950s and 60s also emphasised rail over road spending (Hook, 1994). This dovetailed with the concurrent policies that restrained private vehicle ownership, as described in the previous section. Tokyo's rail system already dominated transport in the city by the 1950s and this was reinforced by further large investments in the next two decades, especially in the subway system, most of which was built in this period (City Bureau and Building Research Institute, 1990; Cybriwsky, 1991: 93, 135). Thus by the 1960s, Tokyo had built a large public transport system which was characterised by high speeds and which was mostly immune to the effects of traffic congestion. This system was in place well before private passenger vehicle ownership reached 100 vehicles per 1000 person by the late 1960s. This was primarily a result of Japan's pre-war industrialisation that emphasised rail, but it was also assisted by restraint of private vehicle ownership and use. This restraint allowed further development of the rail and subway systems to occur before competition from private vehicles became severe.

Developments in public transport since 1970 in Tokyo are not as relevant to the comparisons with the other Asian cities as the pre-1970 events. Since 1970, the main development in Tokyo's public transport has been the deterioration in bus speeds and

service quality as car use and traffic congestion have risen. This particularly affected the role of the bus system in feeding rail (and was largely responsible for the increasing popularity of bicycles in that role). Bus priority measures have been expanded but buses now account for a small part of public transport in the city (Tokyo had 96 percent of its public transport passenger kilometres on rail in 1990). On the rail system by contrast, there has been an almost never-ending battle against overcrowding. Crowding in peak periods remains acute even though it has gradually been reduced from the extremes seen in the early 1970s through continued investment in capacity expansion and new rail lines. These rail improvements have tended to further reinforce the dominance of rail and also the dominance of the centre and inner areas as employment centres. This is despite an official policy of promoting suburban sub-centres.

8.3.2.2 Roads

Road building expanded in the 1970s and motorisation has continued to rise steadily. Nevertheless, the dominance of public transport in the Tokyo region's passenger transport has declined only slightly (Table 5.7 and Table 5.8). The increased road spending in Japan in the 1970s led to a surprisingly insignificant amount of urban road expansion in Tokyo and its suburbs. Strong rights of land-owners and tenants along with high land prices have meant that land acquisition costs have been a very high proportion of road building costs in Tokyo (around 70% typically) (Hook and Replogle, 1996: 76). There has also been consistent and strong community opposition to many of the urban highway projects, especially in the 1970s (Hook, 1994: 20). In addition, the Tokyo region's expressways had always been planned as a rather sparse network (Rimmer, 1986b: 55). Almost all of them were built with only 2 lanes in each direction. This decision was taken at a time when there were very few vehicles in the country and the expressways were envisaged as being primarily for goods movement. Furthermore, Tokyo's expressway network is primarily a radial one and would thus tend to reinforce rather than undermine the prevailing travel patterns and urban form that are based on radial railways (Rimmer, 1986b: 51).

8.3.2.3 Non-motorised transport policies

Of the Asian cities in this study, Tokyo has seen the greatest efforts to create a safe and pleasant environment for pedestrians and cyclists. This has undoubtedly been important in retaining a very significant role for these modes in the city, as shown in Chapter 5. Japan has a long independent history of experimenting with traffic calming and these efforts have benefited both pedestrians and cyclists (Fujitsuka, 1990; Kubota, 1995; Yamanaka and Odani, 1990). With traditionally narrow local streets in Japan, conflicts

between traffic, pedestrians and cyclists quickly became a problem as traffic increased. In 1974, an area-wide traffic regulation began, called “*Seikatsu Zone*” (Life Zone) with lowered speed limits and by the mid-1990s there were 10,000 such zones in Japan. More recently physical changes have also been used very widely. Since 1980, “Community Street” projects have been carried out with “zigzag” shaped streets, increased tree planting, bumps and raised intersections.

As was noted earlier, bicycle use in Tokyo has been significant throughout the 20th century but paradoxically, bicycle use has actually boomed since the mid-1970s even as motorisation has increased. By the late 1980s, bicycles accounted for 15 percent of all trips in the Tokyo region (Table 5.12). A major reason for the increasing popularity of bicycles was the deterioration of bus services due to traffic congestion. Bicycles substantially took over from buses as a means to reach railway stations (Yamakawa, 1994). Bicycle users also benefited directly from investments in the pedestrian realm because in Japan bicycles are permitted to use the footpaths. This law meant that many people remained confident to cycle despite rising traffic levels. The national Bicycle Law that was enacted in 1980 was partly a reaction to the upsurge of bicycle use that was already under way, but it also encouraged local governments to provide bicycle facilities, including lanes, paths and parking facilities at railway stations (Padeco Co. Ltd., 1995; Yamakawa, 1994).

8.3.2.4 *Land-use development*

Despite rising car ownership and substantial investments in road building since the early 1970s, the dominance of rail that had been established earlier was relatively resilient. Rail-oriented land-use development patterns were also a factor in the continuing importance of rail. It was mentioned in Chapter 6 that the land use patterns of the Tokyo metropolitan area are dominated by the rail system. This in turn has promoted high usage of the rail system. In Tokyo the market has played a significant part in maintaining transit-oriented land-use patterns. In the conditions of public transport dominance that prevail in Tokyo, strong planning controls have not been necessary to bring this about. In fact, Japanese land-use control is relatively weak (Hook, 1994) but nevertheless, most development in Tokyo remains rail-oriented (Cybriwsky, 1991: 93, 135). This is primarily because it is rail that still provides the greatest accessibility in the metropolis. Urban rail has been the dominant form of transport in Tokyo throughout the post-war decades which saw incomes increase many-fold and the population rise from about 10 million in 1950 to around 30 million in 1990.

Thus the patterns of urban development which have taken place have been influenced primarily by the urban rail network.

All real-estate activity is influenced by the rail-oriented accessibility patterns of the city. In addition, transit-oriented land-use patterns have also been built through the actions of large corporate players in the Tokyo area. In particular, most of the private rail companies in Tokyo are parts of parent conglomerates that also include major developers of real estate along their lines (Bernick and Cervero, 1997:312-323). Legislation prevents the rail system being directly subsidised by development gains but nevertheless, the overall profitability of both rail and urban development are enhanced by each other and benefit the parent company which controls both. Following the lead of the private conglomerates, government agencies and local government have joined in this process of explicitly tying land development to mass transit development and ensuring that they complement each other closely. Tama New Town in western Tokyo is a large example of a transit-oriented new Town with government involvement (Kenworthy et al., 1994). Transit-oriented new town development is likely to continue in Japan under new cost sharing guidelines for mass transit links to new towns that provide for substantial developer contributions for rail construction as a condition for some government capital funding (World Bank, 1995).

Plate 8.2 Rail and bicycles play important roles in large Japanese cities



High-capacity bicycle parking facility at a subway station in suburban Fukuoka, Japan



Single family housing in a Fukuoka suburb. Commuters heading towards the subway station shown on the left

8.3.3 Other key choices in Hong Kong

The choice in Hong Kong to strictly restrain private vehicles has been the one to be highlighted so far. In fact, the circumstances that made Hong Kong's early development occur at very high densities and the explicit decision in the 1950s to continue to build at very high densities, even in the New Territory new towns, have left transport planners in Hong Kong with little choice except to adopt a transit-oriented strategy. Most choices with respect to public transport and roads have complemented this overall strategy. In

addition, recent urban development initiatives have further strengthened the integration between land use and the mass-transit-oriented transport system. The development of the road system has been focused on the needs of goods transport (not private passenger vehicles), while also providing bus priority. The chronology of the major policies and events in Hong Kong's transport development is shown in Figure 8.4.

8.3.3.1 Public transport

Urban rail development has been a central part of transport strategy in Hong Kong since the early 1970s. The Mass Transit Railway (MTR) system, which serves the main contiguous urban areas of Hong Kong and Kowloon, was mooted in 1967, approved in 1972 and opened in 1979/80 with a single line of 15.6 km (Rimmer, 1986c: 90). By the early 1990s there was a three-line system of 43 route kilometres and 38 stations. It is now considered to be the most heavily used railway per length of track in the world (Lo, 1992: 95, 97). The Hong Kong part of the Kowloon-Canton Railway (KCR) which serves a number of new towns in the north-eastern part of the New Territories, was upgraded in the early 1980s with service on the fully electrified and double-tracked line beginning in 1983 (Lo, 1992: 88, 94). According to data collected for this international study, the service speed on the KCR increased from 27 to 53 km/hr between 1980 and 1990. In addition a new 23 kilometre light rail system was built which operates in the north-western New Territories area on six routes linking Tuen Mun with Yuen Long (Lo, 1992: 97).

High quality mass transit services in Hong Kong thus began about 8 years after vehicle restraint had begun in the early 1970s. However, the decision to go ahead with the development of a rail mass transit system was taken at about the same time as the restraint began. Even just the prospect of mass transit may have helped contribute to the political acceptability of the restraint policies. Restraint also ensured that private vehicle ownership remained very low throughout the development of the mass transit system. Public transport remained very much dominant by the time that the bulk of the rail system was put in place. Rail development decisions in Hong Kong have been controversial at times (Rimmer, 1986c: 92-96). However, with hindsight it would appear that the key decision, to proceed with a very high-capacity mass transit system, was an extremely sound one. Hong Kong's urban characteristics are suited to successful rail service better than perhaps anywhere else in the world and the need to prevent rapid increases in private vehicle use has been made clear in Chapters 6 and 7.

Rail-based transport development is continuing in Hong Kong. A Western Corridor railway to be built by the KCR is at the planning stage (targeted to be completed in 2001) and the railway serving the new airport was completed in 1998 (Lau, 1997). Hong Kong has also placed a high strong emphasis on providing on-road priority to its road-based public transport. Priority to the most efficient modes is a central plank of transport policy in Hong Kong and there are extensive priority lanes for both buses and trams (Wang, 1993). Hong Kong has also been praised widely for its relatively flexible but nevertheless efficient regulation of public transport, which is credited with ensuring a wide range of efficient, competitive bus services (Meakin, 1993). These include the public light buses (PLBs), which provided a model for the World Bank in its promotion of similar “free-enterprise” micro and mini-bus services in other developing cities (Roth and Wynne, 1982). Without minimising the impact of all of these public transport initiatives in Hong Kong, in fact the very high-density urban fabric and the early commitment to private vehicle restraint probably deserve most of the credit for ensuring that such a wide range of profitable public transport services has remained viable despite increasing incomes.

8.3.3.2 Non-motorised transport

Due to Hong Kong’s extremely high urban density and mixed land-use patterns, particularly in the inner areas, walking retains a very important role, as was mentioned in Chapter 5. The vast majority of motorised trips are by public modes and public transport is the centre-piece of the transport strategy. Such a transit-oriented strategy is dependent on pedestrian access to the public transport stops and stations. Therefore, providing sufficient space for pedestrian movements has been absolutely necessary in Hong Kong. Nevertheless, pedestrian facilities are not always sufficient and much of the emphasis has been on segregating pedestrians from vehicles (with grade-separated crossings and elevated walkways for example), as much in the interest of improving the traffic flow as those of the pedestrians (Kam, 1993). As with Hong Kong’s restraint policies, the approach to pedestrians reflects a certain desperation to keep traffic moving in this city, despite formidable challenges. Similarly, Hong Kong’s attitude to bicycles and human-powered taxis (hand-pulled rickshaws and pedicabs), that were formerly plentiful, has been to view them as private modes that have a relatively high demand for road space, and therefore to be discouraged (Skriabine and Mouret, 1993). One major piece of new pedestrian infrastructure that is worth noting is the hillside escalator opened in the early 1990s, which connects the central area with the nearby

Mid-levels residential area. This escalator is aimed at reducing vehicle movements (Kam, 1993).

8.3.3.3 *Land-use development*

Even before the development of mass transit, Hong Kong already had an urban form that was intrinsically public-transport friendly due to its very high density. The public housing program that began in 1953 in response to an influx of Chinese refugees, continued the high density style in its developments, including the new towns which have been developed in the New Territories beyond the older areas of Hong Kong and Kowloon. By 1990, about half of Hong Kong's people lived in public housing (Lo, 1992). Most urban development in Hong Kong (and all of it prior to 1979) was built in advance of the high quality urban rail systems. However, the extremely high-density style of development has allowed the MTR to quickly come to serve a high proportion of the urban population. Thus with a system of only 43 kilometres in length and only 38 stations, 50 percent of all residents and 55 percent of all jobs were within a 10 minute walk of an MTR station by the early 1990s and approximately 66 percent of all residents rode the MTR at least once per week (Noble, 1993).

Further integration of the mass transit system has been encouraged by the fact that right from the beginning of construction of the system, the Mass Transit Railway Corporation has had the right to develop properties above stations and depots (Kenworthy et al., 1994). This has been done on at least 18 sites. Over 31,000 flats and 440,000 square metres of commercial floor area have been developed and sold. In addition, 3 shopping centres with over 71,000 square metres of retail space have been retained by the corporation. These developments contribute 8 percent of total revenue of the corporation (Noble, 1993). It is also estimated by the MTR that property profits had provided about 15 percent of the capital cost of the system (World Bank, 1995). More recently it is reported that approximately 3.3 million square metres of total gross floor area is being developed along the new Airport Railway (Far Eastern Economic Review, May 15, 1997: 71, citing the MTR Corporation's annual report). Hong Kong's integration of property development with the MTR has been a success story for several reasons, one of them being the buoyant property market during the relevant time period. The Kowloon-Canton Railway also has the right to help finance the capital cost of its rail system in this way.

The level of government involvement in land-use decisions is high in Hong Kong. However, it is likely that in Hong Kong's public transport-oriented and land-scarce

situation, even purely private decisions might have produced a transit-oriented urban form, as they have in Tokyo. Private vehicle restraint has helped ensure the viability and attractiveness of transit-oriented development instead of car-oriented patterns. Car ownership levels have been very low (less than 50 cars per 1000 persons) throughout the period of greatest real estate development and during the period of greatest expansion of rail in 1970s and 1980s. Indeed car ownership is still very low by any standards, and particularly for a city of Hong Kong's wealth.

8.3.4 Other key choices in Singapore

Like Hong Kong, an awareness of tight limits on the potential spread of the urban area helped contribute to Singapore's decision to adopt an explicit policy package of private vehicle restraint, public transport development and transit-oriented development patterns. Even more so than in Hong Kong, these choices have been part of an integrated package. In addition, the Singapore Government has been able to exercise an unusually strong and direct influence over most aspects of the transport system and the land-use development system. It is therefore difficult to muster evidence on which elements of the policy package have been most crucial. Nevertheless, some conclusions can be made on the basis of the timing of various initiatives, which is illustrated in Figure 8.5.

8.3.4.1 Public transport

In Singapore, the Mass Rapid Transit (MRT) system was only opened in 1987, about 15 years after private vehicle restraint began. The decision to build the Singapore MRT was taken in the early 1980s, ten years after restraint policies began, although mass transit had been mooted in the early 1970s plan. The decision to build a rail mass transit system was not without controversy (MRT Review Team (also known as the Hansen Review Team), 1980; Pendakur et al., 1989; Wilbur Smith and Associates, 1977; Wildermuth, 1980). By 1990 the full initial system of 67 kilometres was operational. At that time, private vehicle ownership was only 146 vehicles per 1000 people (101 cars plus 45 motorcycles). It has already been argued that this low level of motorisation is largely the result of Singapore's restraint policies. It seems certain that in the absence of restraint policies, higher private vehicle ownership would have made the rail system much less viable, and may even have influenced the decision of when to build it. As it is, rail construction is continuing. In early 1996, a 16 kilometre MRT extension to Woodlands was completed. As of writing, the 20 kilometre North-east MRT line and an LRT line are under construction.

At the time that private vehicle restraint was being introduced the Singapore authorities did provide a boost to the bus system. Singapore was unhappy with its bus services in the late 1960s and 1970s. Fares had been kept low and this had discouraged the companies from investing further (Rimmer, 1986b). Concurrently with the beginning of efforts to restrain demand for private car travel, a major effort was made to regulate, improve and expand the bus-based public transport system in Singapore. First, private bus operators were amalgamated into the Government controlled Singapore Bus Service (SBS) (Spencer, 1989: 199). Some have argued that this in itself has nothing to do with improvements (Rimmer, 1986a). However, the amalgamation was followed up with a major program of fleet expansion (Pendakur et al., 1989: 9). In addition, in 1974 a new service began, called the Supplementary Public Transport System (SPTS), which used school buses to carry commuters in peak hours only. This was possible because school hours are staggered with office work hours in Singapore. At the same time, a system of bus priorities was introduced including 40 kilometres of peak-period bus lanes (Pendakur et al., 1989). The commitment to bus priority has continued despite the building of mass transit.

8.3.4.2 Roads

Road building has also been important in Singapore, especially in the 1980s. There has been a focus on avoiding congestion in many of Singapore's policies and this is also reflected in road expansion. Major arterials increased from 313 km in 1980 to 529 in 1990 and expressways increased from 39 km to 104 in 1990. Thus road expansion more than kept pace with growth in vehicle numbers. This would not have been the case without restraint of private vehicle ownership. Since 1990, the stated rationale behind the Vehicle Quota System has been that the vehicle fleet must not be allowed to increase any faster than the road supply, with a figure of approximately 3 percent per year cited (Land Transport Authority, 1996). An ambitious system of underground roads to bypass the city centre was seriously considered during the early 1990s.

8.3.4.3 Non-motorised transport

Since the early 1970s, when the major decision to adopt a public transport-oriented strategy was taken, there have accordingly been steady improvements to the pedestrian environment in Singapore. Established areas have had footpaths upgraded and expanded but the most impressive pedestrian facilities are in the new towns, which were fitted with a high-quality pedestrian environment from the start. Although the level of priority to pedestrians is not yet as high as is now common in northern Europe, and the convenience of pedestrians is often sacrificed to the desire for uninterrupted traffic

flows, the policy commitment to providing for pedestrians had increased to a high level by the early 1990s (Urban Redevelopment Authority of Singapore (URA), 1991). The vicinities of MRT stations have been receiving particularly strong attention, with new shaded walkways for example, in recognition of the synergy between non-motorised transport and mass transit. This recognition is also an important factor in the new interest in bicycle facilities in the city state. Singapore's level of cycling has been very low in recent decades but bicycle parking has now been installed at most stations of the new Mass Rapid Transit (MRT) system and in 1995 these parking spaces were observed by the author to be well used. Bicycle-ways have also begun to be built and there is an official policy commitment to build more such facilities, especially within housing areas to access MRT stations and the commercial districts which surround the stations (Urban Redevelopment Authority of Singapore (URA), 1991).

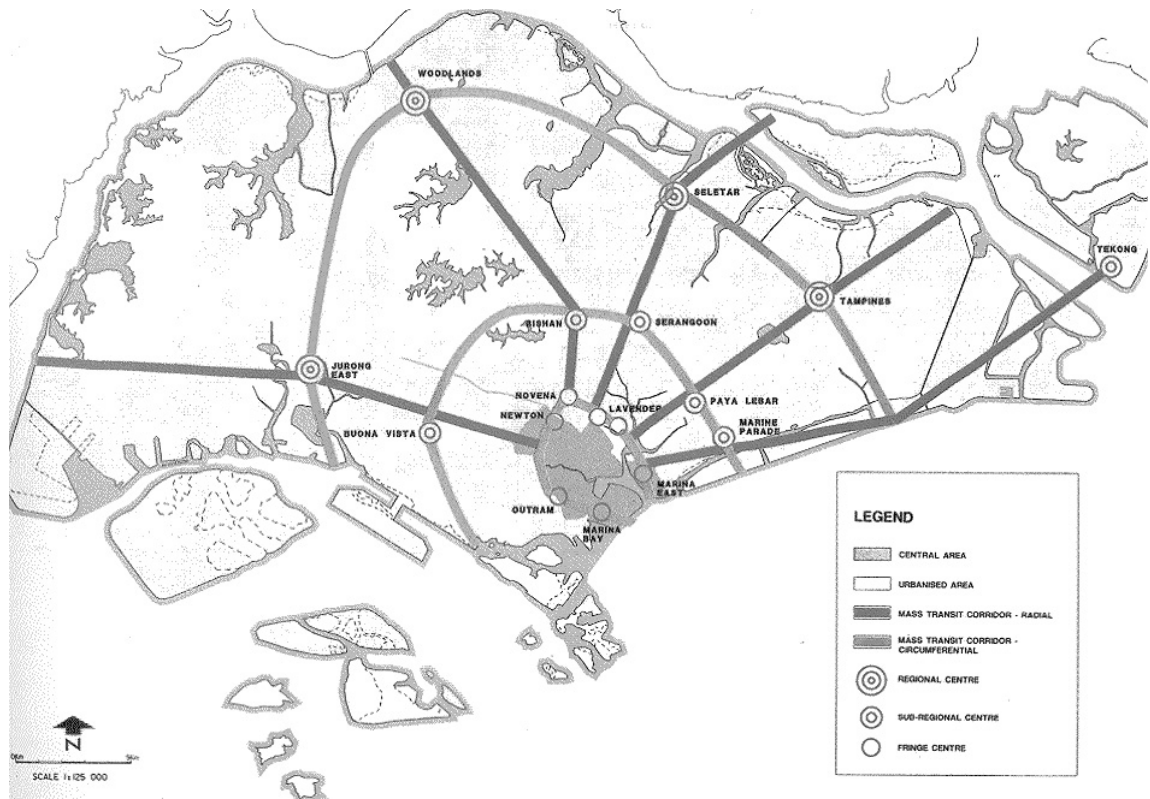
8.3.4.4 *Land-use development*

Singapore has taken very active planning steps to achieve a transit-oriented urban form. Planning for this began more than a decade before the mass transit system actually opened. Most of Singapore's existing new towns were already developed before the mass transit system opened. Nevertheless, they were planned to be transit-friendly from the beginning. Key public transport corridors were identified long before the decision was taken to supply these corridors with a rail system. The "ring" or "constellation" plan of the 1971 Concept Plan for Singapore set the basic outline of new town locations and transport corridors. Recent planning has produced a "revised constellation plan" (Figure 8.2) and continued to emphasise a highly transit-oriented layout for the entire urban area (Land Transport Authority, 1996; Urban Redevelopment Authority of Singapore (URA), 1991). Some evidence was provided in Chapter 5 that Singapore's overall urban form is increasingly transit-oriented. The transit-oriented characteristics of Singapore's New Towns have been widely documented elsewhere, for example in Bernick and Cervero (1997) and Cervero (1998).

The transit-oriented pattern of development in Singapore has been primarily a result of explicit government planning. Without the strict planning control and the high level of commitment to creating a transit-friendly urban form, it is possible that the pattern of urban development in Singapore over the last two and a half decades would have been substantially different. Restraint policies in Singapore began at a higher level of vehicle ownership than in Hong Kong, Tokyo or Seoul. Private vehicle ownership was between 100 and 150 vehicles throughout the 1970s and 1980s. Even at these moderate levels, a substantial percentage of households owned private vehicles and developers may have

been tempted to cater to a wealthy car-owning clientele by building car-oriented developments.

Figure 8.2 Singapore's revised "Constellation Plan" for a transit-oriented metropolis



Source: URA, 1991

8.3.5 Other key choices in Seoul

In addition to the policies of private vehicle restraint that were documented previously, important choices in Seoul have included continued development at very high densities and the building of an extensive system of electric railways. The chronology of key choices and events in Seoul is summarised by Figure 8.6.

8.3.5.1 Public transport

In Seoul active government-led initiatives to substantially improve public transport began in the 1970s. These efforts primarily involved investment in rail-based mass transit systems. Private vehicle restraint had long been in place and continued to be strongly enforced at that time. The decision to embark on the planning and building of a subway system and to begin the upgrading and electrification of regional/suburban railways was taken in the early 1970s when the Ministry of Construction produced its Development Plan for the Capital Region (1972-81) (Kwon, 1981: 321). In 1974 the first of Seoul's subway lines opened (with a length of 9.5 km). Also in 1974 two electrified suburban lines opened for commuter service (the 27 km Kyongin line to

Inch'on in the west and the 41.5 km Kyongbu -or Kyonggi- line to Suwon in the south). A second large increase in the extent of the mass transit system took place in the mid 1980s. In 1984 the 54.3 km (circular) subway line No. 2 opened to connect the rapidly developing areas south of the Han River to the older north. In 1985 subway lines 3 (with 36.9 km) and 4 (with 34.3 km) opened for service. In 1986 the suburban Kyongwon line (18.6 km) to the north opened and in 1988 the 20.4 km Ansan line to the south-west opened (Kim and Choe, 1997: 93).

So by 1986 the Seoul metropolitan area had a substantial mass transit system in place (with over 200 kilometres of double-tracked, electrified railway). This was just before the surge of motorisation really got under way. In 1986 car ownership was still well below 50 cars per 1000 persons (Figure 8.1). Again it is clear that, like Singapore, without Korea's earlier private vehicle ownership restraint, motorisation would have been very much greater by the time that such a rail system could have been built and might have seriously threatened public transport's viability by that time. For comparison, in 1985 Kuala Lumpur had a lower income per capita than Seoul, but its car ownership already stood at about four times Seoul's figure, with about 113 cars per 1000 persons along with 105 motorcycles per 1000 (JICA, 1987b).

Demand for public transport remains very robust despite rising motorisation in Seoul. In 1993, subway prices were increased 35 percent but there was almost no drop in ridership (World Bank, 1995: 121). Furthermore, large-scale expansion of the metropolitan rail system is continuing. By 1997, subway line 5 had been completed. This was the first of the current "second" phase of subway expansion, consisting of an extra 145 km of route in four lines (Liu, 1994). This phase had been due to be completed by 1997 but is now delayed somewhat by the economic crisis. A total network of 12 lines and about 500 km of electric urban rail is scheduled to be operating by soon after the year 2000 (Kim and Choe, 1997: 93).

Seoul was later than Singapore or Hong Kong to begin on-road priority for its bus services. Only since 1993 has Seoul begun to implement bus priority measures (bus lanes). By 1994 it had quickly established a total of 126 km of bus lanes on 23 arterial roads (Liu, 1994). The City of Seoul plans to have a bus-lane network of 341 km by 1998 and bus lanes are also now planned in the satellite areas in Kyonggi province. Seoul's late start with bus priority may partly be because it was not really necessary earlier, since car-related congestion has only become serious since around 1990. Although Seoul's buses have been a remarkable success from the 1960s to the late 1980s, recently bus companies in and around Seoul have suffered greatly from the

recent surge of congestion, as well as from increasing competition from cars, rail and taxis. These have eroded profitability, so that by 1994 it was reported that most of the 97 companies within Seoul were marginal or running at a loss (Liu, 1994). This has contributed to a recent lack of additional investment to improve services and to a great reluctance by the companies to take risks, such as rearranging routes to better complement each other and the increasingly important rail system (World Bank, 1995). It is to be hoped that the expanding system of bus lanes is helping, but stronger steps may be required to ensure a continuing successful bus system in Seoul. Buses remain vital to Seoul's transport system. In 1990 they carried 35 percent of all motorised passenger kilometres in the metropolitan region compared with 19 percent by rail (Figure 5.8).

An earlier step that enabled buses in Seoul to continue to attract affluent passengers (to some extent), was the initiative since the 1970s to add deluxe or "seat" buses to the mix of services. In seat-buses all passengers are seated and there are fewer stops. Over time the number of deluxe services has gradually been increasing to meet rising expectations for speed and comfort (Liu, 1994). A further service is now provided by community or shuttle buses, which serve as local feeders to subway stations from nearby housing areas. They first began operations in 1992, with 4 routes of 19.5 km in total (Seoul Development Institute, 1994:51).

8.3.5.2 Roads

The Seoul metropolitan area has seen significant road building, especially in the 1970s boom years, although the city faces enormous spatial constraints on road expansion. A large network of expressways has been built but, on a per-capita basis, Seoul's 16 km of expressway per million people (in 1995) is less than half of Singapore's rate in 1990 and less than a quarter of Kuala Lumpur's mid-1990s rate (Table 5.10). Furthermore, Seoul has very little expressway within the main contiguous urbanised area. The City of Seoul itself had only 16 kilometres of expressway in 1990 (Korea Transport Institute, 1993). Nevertheless, within the City of Seoul, the proportion of the urbanised land area that is devoted to roads has been rising steadily. In 1980, the figure was 16.1 percent but this had risen to 19.2 percent by 1990 (Seoul Metropolitan Government, various years). This has been achieved primarily through more generous road standards in newly developed and redeveloped areas. However, the wholesale redevelopment of large areas of the city has come at a price, with the older urban fabric being swept away entirely and replaced with a modern cityscape of high rise apartments and regular street layouts.

Road building slowed in the early 1980s with political uncertainty and a brief economic slowdown (Kim and Choe, 1997). A further problem that has slowed road expansion just as motorisation has been shooting up, is the increasing price of land. In recent years the proportion of the cost of road projects which is taken up by land acquisition has risen enormously. In cases where there is no low cost alignment, such as along a river or through undeveloped or government-owned land, then acquisition costs frequently account for more than 70 percent of recent road project costs⁷⁶.

8.3.5.3 *Non-motorised transport*

South Korea's rapid onslaught of motorisation in the late 1980s caused sudden deterioration in the pedestrian and bicycle environment and an upsurge in pedestrian fatalities (Lee, 1994). The authorities in Seoul have struggled to improve the pedestrian environment in the face of these changed circumstances, while simultaneously battling to keep traffic moving. As in Hong Kong, the focus has too often been on segregation alone, pursued primarily in the interests of traffic flow, without sufficient regard for the convenience of pedestrians. The CBD of Seoul has become notorious for the numerous underpasses that must be negotiated to cross almost every major street. The lack of parking space has led many motorists to park on footpaths, further hindering pedestrians. In the 1990s community organisations have become increasingly organised in their protests at these and other problems for pedestrians and cyclists (Lim, 1996). Successful lobbying by such organisations has directly resulted in the enactment of a National Bicycle Law and a Local Pedestrian Law in Seoul in January 1997, both of which are encouraging significant improvements, including pedestrianisation schemes and the recent preparation of a pedestrian master plan for Seoul (Lim, 1998).

8.3.5.4 *Land-use development*

The Seoul metropolitan area of more than 16 million people established a highly transit-oriented urban form (Plate 8.3) during the 1970s and 1980s, a period of very rapid population and economic growth and redevelopment of the urban fabric. Reasons for this pattern of urban development have included transport factors, such as the low level of motorisation, the dominance of public transport during the whole period, and the rapid expansion of urban electric rail services. Arguably, even if land-use planning in Korea had been weak, a transit-oriented pattern would most likely have developed under such conditions. However, since the early 1970s, urban planning powers of government in Seoul and its surrounding areas have in fact been quite strong and

⁷⁶ This is based on data on 21 Seoul road projects supplied by Dr Kim and Dr Hwang Kee-yeon of the Seoul Development Institute, pers. comm. December 1995.

various urban planning decisions encouraged a high density and transit-friendly pattern to emerge. Strong planning continues to encourage high-density new-town developments that are favourable to public transport, thus reinforcing the transit-oriented urban form despite the recent surge of car ownership.

In the 1970s Seoul was a mono-centric city. In 1976, the two wards which make up the old CBD of Seoul had

74 percent of all government agencies within the SMA, 73 percent of the public enterprises, 88 percent of the mass media, 94 percent of the financial institutions, 77 percent of the tourist hotels, 84 percent of the department stores and 51 percent of shopping arcades (United Nations, 1986b).

However since then, active planning efforts, complemented by transport infrastructure provision, have transformed the metropolis into one of the least centralised of the Asian cities (Figure 6.3). Strong sub-centres within Seoul were designated in an early 1970s plan and over the next two decades there was considerable success with strengthening these centres, even though some are only now being provided with urban rail connections (Kim and Choe, 1997). The most spectacular development was of a “second CBD” in Kangnam south of the Han River. This centre was also stimulated by the opening of the circle subway line in the mid-1980s. This line was developed with reinforcement of these new centres south of the river firmly in mind. In addition, a number of the new towns beyond the City of Seoul have their own significant centres of employment. Government has assisted further by relocating many of its offices out of the old CBD into Kangnam or other sub-centres or new towns. Despite this movement away from the traditional centre, development is not dispersed as in Western car-oriented urban areas, but tends to be highly concentrated into compact, transit-oriented nodes.

Plate 8.3 Transit-oriented developments in Seoul and its satellite cities



In Seoul's Kangnam area - a concentration of commercial and office development along a street beneath which runs Subway Line 2



Subway station in the partially-developed central commercial area of the new Pyungch'on satellite city south of Seoul

Rail and new-town development are now integrated to a significant extent. New satellite towns and redevelopment areas within Seoul are highly planned places and infrastructure (including transport infrastructure) is planned and built as an integral part of the development process. The planning of the recent new towns has been explicitly transit-oriented (Korean Research Institute for Human Settlements (KRIHS), 1991). Both Korean National Railways (KNR) suburban rail expansions and the Seoul subway expansion program benefit from the proceeds of land sales by the Korea Land Development Corporation (KLDC) which develops satellite cities around Seoul and the Seoul Development Corporation (SDC) which undertakes major redevelopment projects within the City of Seoul. The SDC buys land in advance of subway construction, assembles sites and profits from any change in land use. For example, in 1994 SDC was expected to contribute about 5% of the capital outlays for the current subway expansion through the proceeds of its urban redevelopment projects (World Bank, 1995:119).

Other planning decisions that were independent of transport considerations have also ensured that the density of development in Seoul has remained very high. For example, it has not been possible to develop far towards the nearby demilitarised zone in the north and north-west (Kwon, 1981: 324). Another factor promoting high-density has been concern by the authorities to protect precious farmland in this densely settled and mountainous nation. The overall gross population density of South Korea in 1990 was about 4 persons per hectare. This, along with a desire to slow the growth of Seoul, led to the declaration of a green belt around the City of Seoul in early 1971 (Kim and Choe, 1997). The new towns are all beyond this green belt which has been rigorously enforced. Land scarcity, the green belt decision, speculation and rising incomes generally all encouraged land prices to escalate rapidly, especially after 1973. The very low numbers of private vehicles throughout the 1970s and first half of the 1980s meant that spatial needs of transport remained very modest and were no obstacle to the very high densities of the emerging compact, high-rise development patterns. In fact, both buses and rail thrived on serving such dense urban areas in the period before the emergence of congestion in around 1990.

Despite the rapid surge of car ownership since the mid-1980s, there has been little sign that car-oriented urban development patterns are emerging. The only possible exception may be the provision of multi-storey car parking facilities in large shopping malls. There is, so far, no major trend towards far-flung suburban-style development. In any case, the existing transit-oriented urban fabric with more than 16 million people will inevitably remain for a long time to come. It appears that there is little prospect of Seoul

adapting itself to the car. It is therefore little surprise to see transport policies in the city again beginning to reorient to the reality that this must remain a public transport-oriented city.

8.3.6 Conclusions on Tokyo, Hong Kong, Singapore, and Seoul

In summary, all four of these cities have taken many overt choices that have led them towards a transit-oriented transport and land-use system. Common features in the chronology of key choices and events in the four cities can be observed by comparing Figures 8.2, 8.3, 8.4 and 8.5 which are presented below. Foremost among those choices was an early commitment to slowing the rate of growth of private vehicle ownership and usage. In doing so these cities have avoided many of the transport-related problems and pitfalls that befall many cities with rapidly rising incomes. They were able to maintain public transport usage at a high level until mass transit was built. Public transport never became the mode of last resort or the mode for the poor in these cities, and thus avoided gaining the stigma that is attached to public transport in so many cities. These four cities now all have significant rail systems and extensive bus priority systems that are capable of handling a substantial proportion of total peak demand for passenger travel. Therefore, even if motorisation and congestion increase further, their public transport systems will not enter a vicious downward cycle, but rather are likely to be seen as the solution, and the subject of concerted policy attention to rectify any inadequacies, as in Seoul and Hong Kong.

Figure 8.3 Some key policies and events in Tokyo, 1930s to 1990s

Tokyo

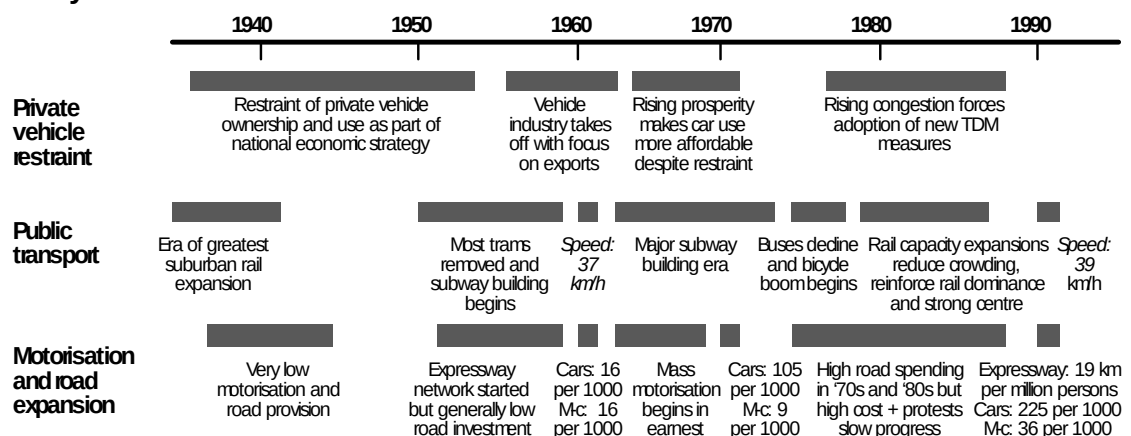


Figure 8.4 Some key policies and events in Hong Kong, 1960s to 1990s

Hong Kong

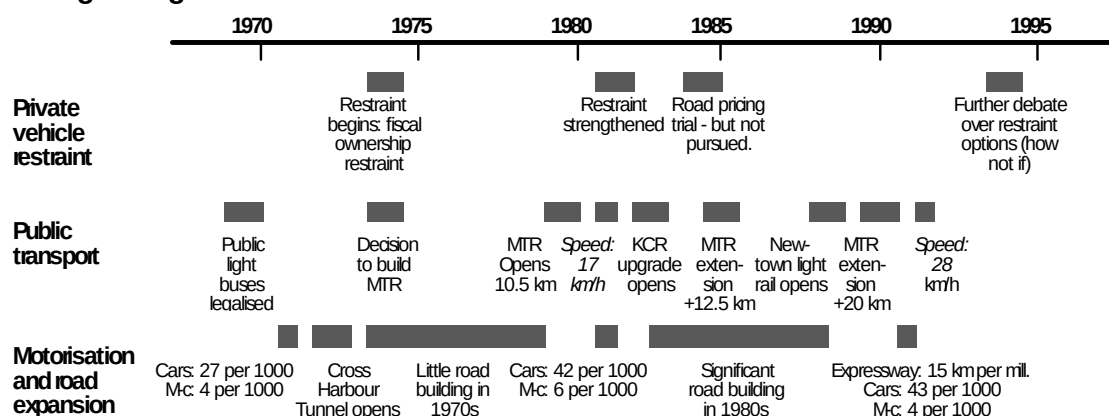


Figure 8.5 Some key policies and events in Singapore, 1960s to 1990s

Singapore

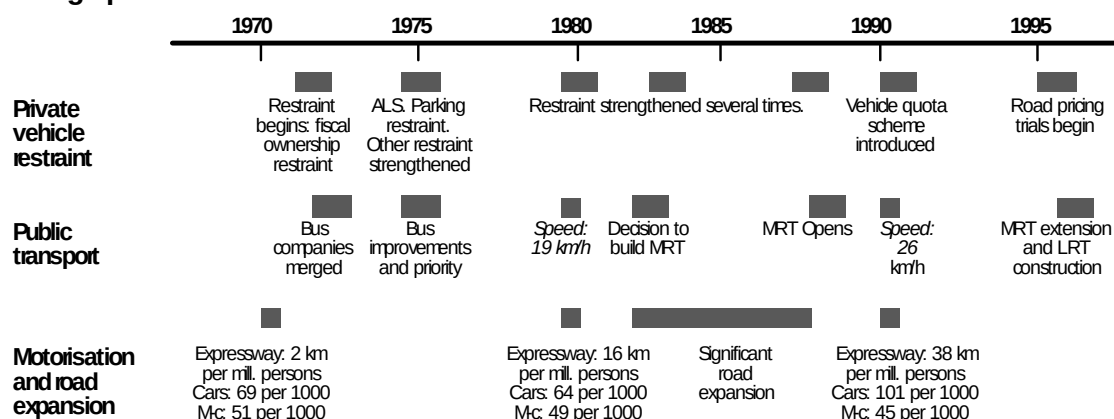
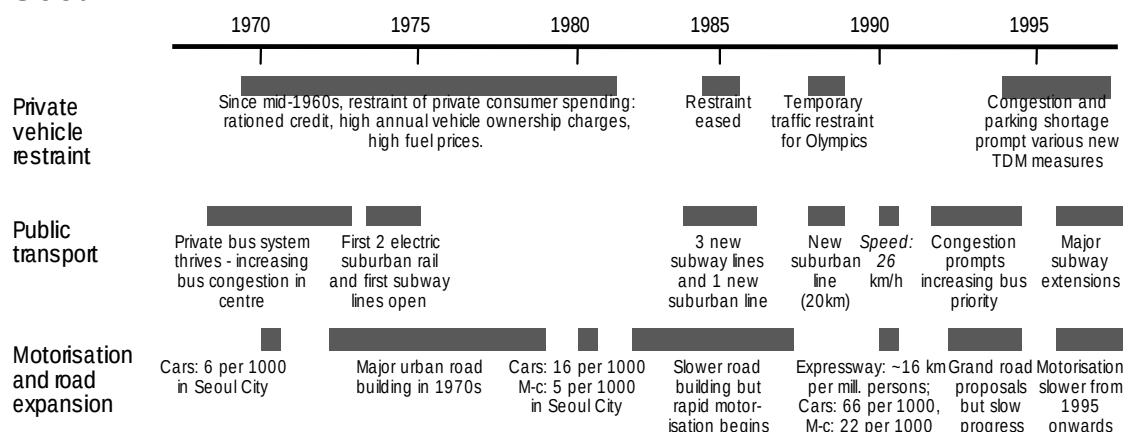


Figure 8.6 Some key policies and events in Seoul, 1960s to 1990s

Seoul



8.4 Choices in Bangkok and Kuala Lumpur

8.4.1 Restraint

This section now turns to an examination of the choices and events over the last few decades that have led Bangkok and Kuala Lumpur along their similar paths. Chapters 6 and 7 emphasised that by the early 1990s Bangkok had reached a situation of being a traffic-saturated bus city. The spatial perspective combined with the plot of mobility trends over time suggested that probably the only way for Bangkok to have avoided its current predicament would have been to slow the growth in vehicle numbers. This would have allowed time for either a gradual expansion of the city and its road network to cope with more vehicles or a change of direction towards a transit-oriented approach. A headlong rush towards high private mobility is just not a viable path for a large, dense city like Bangkok. However, the authorities in Bangkok have been generally unable to act in a co-ordinated way to establish policies on private vehicle restraint, public transport, roads and urban development that might complement each other to establish a successful transport and land-use system.

Kuala Lumpur's development does have more elements of a relatively consistent strategy. A number of decisions on private vehicle numbers growth, on the building of roads and some features of the planned patterns of urban development point towards a broadly car-oriented strategy. It was pointed out in Chapter 7 that, unlike most other Asian cities, such a choice may not be impossible for Kuala Lumpur because of its pre-existing middle-density urban form and small size at the beginning of the period in question. Nevertheless, efforts have also been made to develop the public transport system but this aspiration may be undermined by many of the other choices.

The policies of Bangkok and Kuala Lumpur toward private vehicle ownership and use stand in marked contrast with those of the four cities above. A number of studies have recommended the restraint of private vehicles (usually usage restraint). However, very few of these recommendations have ever been implemented. By the mid-1990s, Bangkok and Kuala Lumpur had reached levels of private vehicle use per person that were far higher than those of Singapore, Hong Kong or Seoul, with little sign yet of any substantial restraint on private vehicles, whether of ownership or usage. The examples of Singapore and Hong Kong (Singapore in particular) are well known to decision makers in Bangkok and Kuala Lumpur. However, they are often dismissed as unsuitable models with reasons that include their unique "city state" status, their unusually strong governments, and the fact that these cities are said to have had good public transport which provided a viable alternative to private vehicles, thus allowing restraint to be

viable. It is generally not well known in Kuala Lumpur or Bangkok that Japan, South Korea and even many European countries, also had relatively strong restraint of private vehicles and high private vehicle-related prices during their early periods of motorisation. Nor is it generally appreciated that the good public transport systems in Asian cities to which they refer did not exist at the time vehicle restraint was introduced, but rather were developed after restraint had come into effect.

8.4.1.1 Ownership restraint

Almost none of the major transport studies carried out in these cities has ever recommended restraints on ownership of private vehicles (as opposed to usage restraints, see later). An exception was the 1975 Greater Bangkok Area Transportation Study, conducted by a German team, which recommended both ownership and usage restraint (Tanaboriboon, 1992: 62.).

Midgley (1994) points out that most countries in the Asian region actually did have a form of vehicle ownership restraint in the sense that most have tried to protect their nascent vehicle manufacturing industries with tariffs and taxes, especially on imported vehicles (and they have raised much needed revenue in this process). However, the impact of these taxes was generally moderate. Some comparisons of vehicle prices and taxation rates between countries are presented in Table 8.2. In 1990 in Malaysia, tax rates on the first national car, the Proton Saga, were only 26 percent of the purchase price for the 1300cc model in 1990. Proton commenced production in 1985 and has since dominated the local market. For example, it had 62.6 percent of Malaysian car sales in the first half of 1990 (Padeco Co. Ltd and Perunding Atur Sdn. Bhd., 1990).

Before 1991, completely knocked down (CKD) kits imported into Thailand faced higher tax rates and in 1990 approximately 53 percent of the selling price of a representative small (1300cc) car could be attributed to taxation (Padeco Co. Ltd, 1990). However, in Bangkok, the basic model car could be considered to be the ubiquitous “pickup”, which was priced at a similar level to the basic Proton Saga of Malaysia. Pickups made up 23 percent of private passenger cars in Bangkok and, because of being taxed as commercial vehicles, were much cheaper than sedans (Poboon, 1997). Furthermore, in 1991 Thailand reduced tariff protection of the local vehicle industry, resulting in a substantial decrease in the price of vehicles (Birk and Bleviss, 1991).

In Table 8.2, Seoul’s cars are shown to have been very affordable in 1990, the result of relaxation of ownership restraint there, of rapidly rising incomes, and of the fact that

Korea's private vehicle restraint never relied primarily on acquisition taxes. By 1990 rising incomes had also resulted in somewhat reduced effectiveness of Singapore's earlier fiscal restraints on car acquisition. That year marked a high point for the affordability of cars in Singapore and in the following year, the COE system was introduced as a direct response, quickly raising the price of cars to new heights.

Table 8.2 Prices and relative affordability of representative private passenger cars in Asian cities in an international sample of cities, 1990

	Price of a representative basic model car (1990 US \$)	Basic model car affordability ratio (Car price/GRP per capita)	Total cost per km for a representative car (1990 US\$ per km) ^{a,b}
Hong Kong	39,260	2.8	0.80
Singapore	41,251	3.4	0.44
Manila	15,505	14.1	0.31
Bangkok ^c	10,201	2.7	0.33
Tokyo	21,800	0.6	0.29
Seoul	7,408	1.2	0.28
Surabaya	10,805	14.9	0.25
Jakarta	10,805	7.2	0.24
Kuala Lumpur	9,495	2.3	0.21

Notes: a. Column three, total cost per km, is for cars only and does not include motorcycles. If motorcycles are considered in the cities where they are significant, then the weighted figures for cost per km become: Kuala Lumpur 0.18, Bangkok 0.23, Jakarta 0.18, Surabaya 0.10
b. The total cost per km includes all capital costs and variable costs, except parking.
c. Column one uses the pickup as the representative car in Bangkok. Column three uses a weighted average of costs for the basic pickup and the more expensive basic sedan for Bangkok.

The effect of even such moderate tax disincentives to car ownership in Bangkok and Kuala Lumpur have eroded because of rapidly rising incomes in both cities, especially between 1987 and 1996. In addition, during the late 1980s and early 1990s, plentiful and easy credit was available for car purchases in both Malaysia and Thailand. This was partly an initiative of the motor vehicle industry itself, but was also part of the wider boom in lending by the finance industries of the region⁷⁷. This factor was a further stimulus to rapidly rising car ownership, despite some rises in vehicle prices that were associated with the appreciation of the value of the yen since the late 1980s.

There seems to be very little prospect of any increase in restraint of vehicle ownership in Kuala Lumpur or Bangkok because both governments are highly committed to the continued development of their local car manufacturing industries. Politicians in Malaysia, for example, frequently preface any comments on some proposed restraint on usage by emphasising that nothing will be done to reduce demand for new vehicles

⁷⁷ Imprudent lending for property development and speculation and private consumer spending during the boom of the early 1990s was a key part of the chain of events that resulted in the financial meltdown of mid-1997 (Bello, 1997).

because that would damage the national car industry⁷⁸. Indeed, in the early 1990s Malaysia launched a second national car company (Perodua) which is producing extremely affordable small cars with 600 to 850 cubic centimetre engines. In addition, car ownership in these cities has reached the point where a majority of households own a car which would tend to make restraint even more politically difficult than before.

8.4.1.2 Usage restraint

Restraint on the usage of private vehicles has been more explicitly debated as an urban transport policy. Ever since the 1970s there have been proposals for private vehicle usage restraint in most of the developing Southeast Asian cities. Consultants' reports on Bangkok, Kuala Lumpur, Manila, Jakarta and Surabaya have all recommended some form of traffic restraint and warned that supply-side approaches are doomed to failure (Dorsch Consult et al., 1996b; Freeman Fox and Associates, 1977; Inter-Departmental Working Group, 1993; Jakarta Government, 1987; Spencer, 1989; Tanaboriboon, 1992; Wilbur Smith and Associates and Jurutera Konsultant (S.E.A.) Sdn. Bhd., 1981). These recommendations were argued on the basis of predictions of the transport systems modelled with plausible investment levels and other trends. They echo the warnings in this study, which are instead based primarily on an assessment of the spatial realities for dense cities. However, there has generally been little action on these recommendations.

One of the simplest of usage restraints (and one that is often imposed for reasons other than urban transport policy) is taxation on the prices of fuels. However, as mentioned previously, gasoline prices are low in all of the developing Southeast Asian countries in this sample. In Malaysia, motorists are protected from international market fluctuations by a fixed price, which is occasionally reviewed. So, for example, the depreciation of the currency in mid 1997 has, by January 1999, resulted in no rise in the price of fuel within the country in local currency terms.

Usage restraint was seriously considered in the past in both Bangkok and Kuala Lumpur. Like those in Singapore and Hong Kong, the authorities in both Bangkok and Kuala Lumpur felt a growing sense of alarm at the increasing traffic congestion in the central areas during the 1970s. As with Singapore, foreign consultants recommended traffic restraint for both Bangkok and Kuala Lumpur. In the case of Kuala Lumpur, the World Bank's Second Kuala Lumpur Urban Transport Project in 1975 recommended the adoption of an area licensing scheme based on the Singapore model (Jamilah

⁷⁸ For example, on the Malaysian television programme, 'Global' in May 1997, the Malaysian Deputy Minister of Transport was emphatic on this point.

Mohamed, 1992). However, the Malaysian cabinet eventually rejected the proposals because a last-minute but ferocious lobbying effort by car users argued that the public transport alternatives were not good enough (JICA, 1986; Pendakur et al., 1989; Spencer and Madhaven, 1989; Spencer, 1989). The introduction of minibuses had been, in part, intended to improve public transport to allow for the introduction of the traffic restraint measures (Bushell, 1991: 163). However, this initiative was not sufficient to overcome the opposition.

Given the rejection of the ALS for central area traffic restraint, the authorities in Kuala Lumpur raised parking fees slightly in the city centre as an interim measure. However, such prices were not subsequently increased to account for inflation, so that by the early 1990s, it was reported that central city parking in Kuala Lumpur was cheap and underpriced (Sir William Halcrow and Partners (Malaysia) Ltd., Halcrow Fox, and Transplan, 1994). Since the rejection of the ALS scheme, authorities in Malaysia and in Kuala Lumpur have often remarked that “car-pooling” incentives and stronger central-area restraint measures would not be implemented until the completion of the double tracking and electrification project (suburban rail upgrade) and the first phase of the light rail transit system (Straits Times, 23 Aug. 1993). However, when these conditions were met at the end of 1996, restraint measures were again deferred, this time until the rail mass transit network was substantially complete. Announcements during 1997 suggested that any restraint would primarily take the form of parking restraint. In early 1998 central area restraint was again deferred on the grounds that public transport remained insufficient. High-occupancy-vehicle (HOV) lanes have also been considered in Kuala Lumpur as a TDM measure. In early 1995 a “car pooling” public awareness program began. Abdullah Abdul Rahman (1995) suggests that this was phase one of an HOV/Car-pooling plan. However, the idea seems to have been quietly abandoned. Instead, a significant bus lane network has been implemented in early 1997.

In Bangkok, many studies have recommended usage restraints but none resulted in action (Tanaboriboon, 1992). The above-mentioned German study in 1975 was the first to recommend private vehicle usage restraints. Then in about 1980, Singapore-style demand management measures including a cordon-pricing scheme (area licensing scheme or ALS) and parking restraint for commuter parking were suggested by the World Bank funded Bangkok Traffic Management Project (BTMP). These measures were not implemented for fear of strong opposition, despite earlier Government “in principle” approval. Like Kuala Lumpur’s ALS proposal, the BTMP also included associated improvements to public transport. Indeed, significant bus-priority measures

did go ahead in Bangkok in 1980 (these will be discussed later). ALS-type proposals were also raised and rejected in 1985 by consultants Halcrow Fox, in their Metropolitan Bangkok Short-Term Urban Transport Review (Tanaboriboon, 1992). Setchell (1991) reports that ALS was again proposed in the early 1990s by SPURT - the Seventh Plan Urban and Regional Transport Final Report but again postponed until at least 1997. Bangkok has not yet implemented parking restraint in any systematic way. A ban on kerb-side parking along 314 streets faced great difficulties and delays in implementation and enforcement (Tanaboriboon, 1992: 64). No significant restraint measures have yet eventuated as of early 1998.

Motorcycle ownership and usage have also faced no active restraint in Kuala Lumpur or Bangkok. In fact, in Kuala Lumpur their use has been encouraged to some degree by the building of a major piece of infrastructure, the motorcycle lanes along the length of the Federal Highway in the Klang Valley. This facility provides completely segregated carriageways for motorcycles with underpasses to avoid conflicts at all exits. Illegal parking of motorcycles on footpaths is also widely tolerated in both cities except in the busiest of localities and this also encourages their use. Small motorcycles are manufactured locally in both cases and attract very low levels of taxation (Padeco Co. Ltd, 1990; Padeco Co. Ltd and Perunding Atur Sdn. Bhd., 1990). This has been an explicit policy that has been argued on equity grounds. In Malaysia, motorcycles are also exempted from tolls on most toll roads.

Surprisingly, the most severe restrictions on traffic in these cities are actually not on private passenger vehicles at all but on large goods vehicles, which are banned from many major traffic routes or whole areas during busy times. Such restrictions exist in both Kuala Lumpur and Bangkok and are particularly severe in Bangkok. This probably causes significant costs to business and industry (Spencer, 1989). This contrasts with the explicit promotion of goods traffic over private traffic in the transit-oriented cities.

8.4.2 Other key choices in Bangkok and Kuala Lumpur

Other key choices besides the lack of resolve to restrain private vehicles have also been important in defining the models of transport and land use that have been followed by Bangkok and Kuala Lumpur. Figure 8.7 and Figure 8.8 provide a chronological picture of some of the main choices and events in urban transport in Kuala Lumpur and Bangkok since about 1970. The timing of these key events may be contrasted with the chronologies of Tokyo, Singapore, Hong Kong and Seoul that were presented previously. Particularly noteworthy are the timing of private restraint relative to

motorisation and the timing of motorisation relative to major improvements in public transport.

8.4.2.1 Roads

The emphasis of urban transport planning in both Kuala Lumpur and Bangkok has long been on efforts to increase the flow of traffic (Jamilah Mohamed, 1992; Poboon, 1997; Spencer, 1989). Most of the grandiose road proposals of some of the earlier consultants' studies, that were mentioned in Chapter 3, were not implemented in full. Nevertheless, Kuala Lumpur did manage to build a significant network of expressways and bypasses around the central city (Plate 8.4). Bangkok focused instead on managing and improving its ordinary main roads, starting later on a program of building expressways. If expressways are used as a simple indicator of commitment to high-capacity roads, then Kuala Lumpur stands out in the Asian sample (as shown in Table 5.10). Kuala Lumpur was estimated to have about 60 km of expressway per million persons in 1985, compared with Bangkok's 1993 figure of 8.5 km and well above the next contender, Singapore, with a 1990 figure of 38.4 km per million persons. Kuala Lumpur, in particular, has been involved in something of a frenzy of privatised toll-road building since the late 1980s. By 1997, Kuala Lumpur's expressway network was estimated to be 70 km per million persons with numerous additional expressway projects under construction or in advanced planning. For comparison, the 1990 figure for expressway length per capita in London was 9 km per million persons, in Paris it was 61 and in Los Angeles 163 km per million persons.

Plate 8.4 Part of Kuala Lumpur's extensive network of urban expressways



8.4.2.2 Public transport

In the absence of restraint on private vehicle growth, expansion of public transport has been an uphill struggle for these cities. Both Bangkok and Kuala Lumpur had poor bus services in the early 1970s that were nevertheless the backbones of their passenger transport systems, especially in Bangkok's case. However, authorities in both cities

were concerned to improve the services. One step taken in Bangkok in the 1970s was to emulate Singapore and bring the buses under public ownership with the establishment of the Bangkok Mass Transit Authority (BMTA), although it is not clear if this helped much (Rimmer, 1986a). During the late 1970s or early 1980s, significant steps aimed at improving their bus-based public transport systems were indeed taken in both Kuala Lumpur and Bangkok. These had some apparent success at first. In contrast to Bangkok's amalgamations, in 1975 Kuala Lumpur acted on World Bank recommendations that became part of the Second Kuala Lumpur Urban Transport Project 1976 and introduced minibuses with a jitney-style of operation. This initiative followed on from a number of other reforms of the existing bus system, including eliminating the seat-tax, a rise in fares and an improved route coverage (Rimmer, 1986c: 208-211). Rimmer canvasses both sides of a vigorous debate in the literature over whether or not the minibuses were a net benefit to Kuala Lumpur's transport scene. He is not conclusive on this point, but it does seem likely that the minibuses represented at least an increase in the supply of public transport and to the quality of the system overall. However, another element of the World Bank project, a busway (the Pudu Busway), was not implemented. Kuala Lumpur later had a trial of bus lanes on one major route briefly in the early 1980s but this lapsed with no enforcement (Jamilah Mohamed, 1992). In Bangkok, as mentioned above, the World Bank-funded Bangkok Traffic Management Project (BTMP) resulted in 1980 in the introduction of a network of bus lanes in Bangkok. These were reported to be highly successful in their early years of operation (Marler, 1982).

Notwithstanding some early success, Bangkok's bus services tended to deteriorate during the 1980s and 1990s, in the absence of policies restraining the rate of growth of private vehicle numbers. The initial success of attempts to improve the bus systems in Kuala Lumpur and Bangkok have been overwhelmed by the impacts of rising motorisation, including congestion and competition from cars and motorcycles. For example, by 1990, except for a few contra-flow lanes, the bus-lanes network in Bangkok had become ineffective (Tanaboriboon, 1992:63). In Kuala Lumpur, no on-road priority was provided for buses until early 1997. In both cities, public transport has not increased its capacity enough to keep pace with rising demand for mobility and has not improved its quality of service to meet the rising expectations of their increasingly prosperous populations. In fact, public transport speeds have dropped or stagnated (Table 8.1). By the early 1990s, as increasing numbers of people obtained access to other options, buses became the mode of last resort in Kuala Lumpur and Bangkok.

In the context of failing bus systems, but with rapidly rising incomes in the early 1990s, Bangkok and Kuala Lumpur have turned to plans for urban rail. Both cities have long had plans for rail systems but these had remained on the shelf, for lack of funding (whether public or private). For example, light rail systems similar to those now being put in place, were proposed in the 1980 Kuala Lumpur Structure Plan (JICA, 1987b; Wilbur Smith and Associates and Jurutera Konsultant (S.E.A.) Sdn. Bhd., 1981). In Malaysia, strict conditions that ruled out any significant government assistance to the proposed private light rail lines delayed the plans for many years (Joy, 1990). However, in the 1990s, significant urban rail investments have begun in both Bangkok and Kuala Lumpur. A large network is being built quickly in Kuala Lumpur, but in Bangkok, mass transit investments have had a slow and uncertain start. Most of the projects have involved the private sector with variations on “build, operate, transfer” (BOT) arrangements.

In late 1990 there was no urban rail service in the Klang Valley. However, by the year 2000, there are scheduled to be approximately 280 kilometres of double-tracked electrified urban railway in the Klang Valley area. This would be a remarkable expansion in a very short time. Three separate “light rail” systems are also under construction (with large parts of two systems already operating by early 1999) and the heavy suburban rail system began to operate in 1996. Bangkok has had a skeletal suburban rail service for many years and since 1990 there have been some improvements to these services, especially in the northern corridor, but they are still insignificant in the context of the whole city (Poboon, 1997). Although Bangkok is a much larger and higher-density city than Kuala Lumpur with similar income levels, its proposed rail system for the year 2000 was more modest at 166 km (Wright and Wilson, 1995) and with the current economic crisis this target will now not be reached.

These systems will certainly be significant boosts to public transport in these cities when they are completed. However, their potential impact may be somewhat undermined because they are opening in a context of poorly patronised bus systems and relatively high private vehicle ownership⁷⁹. Furthermore, land use patterns that have developed without reference to public transport may also undermine the potential of rail systems to attract high ridership. This is especially so in the case of Kuala Lumpur, where during the last two decades the patterns of population and activities have dispersed in a way that are not very well served by the growing network of urban rail

⁷⁹ Taipei’s experience may be comparable in this respect. It has also been building a mass transit system in the 1990s, the first sections of which opened in 1996 in a similar context of high car and motorcycle usage (Feng, 1994).

services. In Bangkok, higher-density corridors and the extreme levels of traffic congestion may guarantee that the mass transit systems will be well used.

8.4.2.3 *Non-motorised transport*

Both Kuala Lumpur and Bangkok phased out pedicabs in the 1960s, an indication of a negative attitude to non-motorised transport from early on. The headlong rush of motorisation in the 1970s and especially in the 1980s in these cities, quickly had an impact on the pedestrian environment. As in Seoul and Hong Kong, the early reaction was to place a high priority on improving traffic flows. This led to the erosion of pedestrian space and the replacement of many pedestrian crossing places with overhead bridges. By the 1990s, large parts of these two metropolises had an extremely hostile environment for walking or cycling (Barter, 1996a; Kenworthy, 1995; Poboon et al., 1994). There are small signs of change however. In Kuala Lumpur, recent investments in urban railways have prompted new efforts to improve the pedestrian environment, especially around key stations (Kamalruddin Shamsuddin, pers. comm., Nov. 1997) and both cities now have pilot projects of bicycle infrastructure (SUSTRAN News Flash #25, 30 July 1997).

8.4.2.4 *Land use*

High private vehicle ownership in Bangkok is rather recent, and the city was already very large by the early 1980s. So the overall, large-scale urban land use patterns in Bangkok have not yet adjusted very much to changed mobility patterns. As previously suggested, it is a “traffic-saturated bus city”. Important features of Bangkok’s land use pattern are the strips of intense commercial land uses along major roads within the inner area of the city. Planning has played no role in this and the phenomenon has arisen as a response initially to the bus-based transport system and then increasingly as a reaction to congestion (as CBD functions spread outwards along major roads). However, this pattern is probably quite well suited to being “retrofitted” with mass transit systems following the major streets. This is, in fact, where all of the proposed mass transit systems are planned to run.

In Kuala Lumpur, transit orientation of the land use patterns has not occurred, whether as a result of market forces or through planning. The planning system has imposed a “British new town” style on most new formal development. These areas are not radically car-oriented but neither are they transit-oriented. New towns such as Shah Alam, Bangi and the new administrative centre of Putra Jaya, all have planned densities in the middle-density range (roughly 40 to 50 persons per hectare, which is a

“European” level). Kuala Lumpur’s metropolitan region has been growing rapidly in population throughout the 1980s and 1990s. The period has also seen booms in real estate development (interrupted by recession in 1985 and 1986). There has been a rapid expansion of the urbanised area and much of the new outer-area development built throughout the 1980s and 1990s in Kuala Lumpur has been developed in a situation of relatively high private vehicle ownership. Developers have clearly been influenced in their location choices by the knowledge that a substantial proportion of customers will have access to private vehicles. There is also a trend for the design details of new development to be oriented to access by private vehicles. Many new housing, office or shopping complexes built in the recent boom decade have designs predicated upon private access (such as an expressway exit or interchange) and are in locations with little prospect of quality public transport service being provided. Examples around Kuala Lumpur include the office and commercial centre of Kelana Jaya and the shopping centres of One Utama or IOI Puchong. Although such private decisions to locate developments in uncongested locations may avoid congestion in the short term, the longer term result is a pattern of development that is impossible to serve effectively by public transport and which “builds-in” high car use. Eventually even dispersed suburban areas experience congestion (Cervero, 1986).

In addition, some elements of the land-use patterns that are emerging in the Kuala Lumpur area are not really compatible with either a car-oriented strategy or a transit-oriented strategy. In particular, many high-density developments are being allowed to occur in locations that have little prospect of good public transport service. Condominiums that target high-income earners are frequently found on hill tops. Even low-cost flats are frequently located in inaccessible and undesirable corners of a development far from the main routes served by frequent public transport. Therefore, the opportunity presented by such concentrations of sustaining a plentiful public transport service is lost (to the detriment of both the residents and the public transport system). These developments will inevitably be served primarily by private vehicles which will place a great burden on the traffic system.

Figure 8.7 Some key policies and events in Kuala Lumpur, 1970 to 1990s

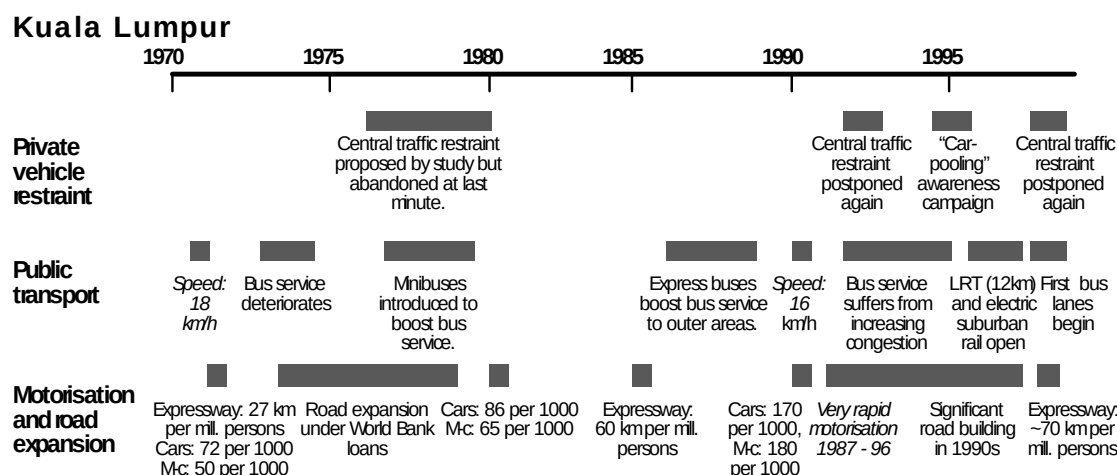
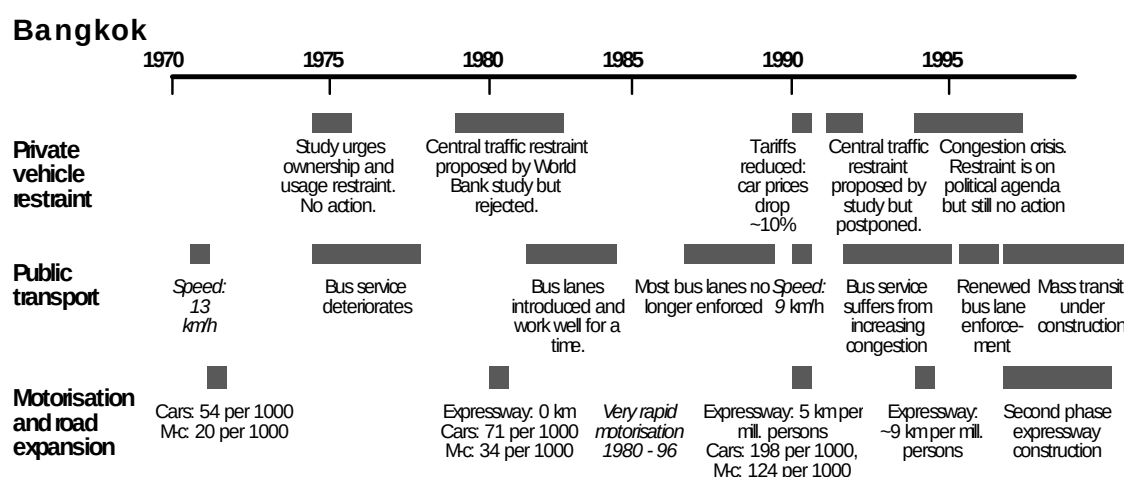


Figure 8.8 Some key policies and events in Bangkok, 1970 to 1990s



8.5 Choices in Manila, Jakarta and Surabaya

This section now considers the key decisions that have been taken in the lower-middle-income Asian cities in the sample. The important choices are summarised in chronological diagrams (Figures 8.8, 8.9 and 8.10) at the end of the section.

8.5.1 Restraint

The discussions of the Asian cities above have emphasised private vehicle restraint as a major distinguishing factor between the two main paths, the transit city path and the traffic-saturated bus city path. Jakarta, Manila and Surabaya are all somewhat higher in density than Bangkok and therefore face the potential of severe impacts if private vehicle ownership, especially car ownership, is allowed to rise quickly. It is therefore important to examine the restraint issue in these three cities.

As mentioned previously, private vehicle restraint has in the past been urged upon both Manila and Jakarta and has recently also been suggested for Surabaya. Until recently there has been very little concrete action. However, in Manila and Jakarta there are now signs of an increased willingness to restrain private vehicle use, although the restraints that have been imposed so far are relatively mild compared to the measures in the four wealthier Asian cities.

Car ownership has not been actively restrained in Manila, Jakarta or Surabaya but the lower-middle incomes of these cities have meant that cars still remained relatively unaffordable in 1990. In Manila, a combination of circumstances in the 1980s conspired to keep vehicle numbers slightly lower than might have been expected relative to incomes. In 1990 a representative car cost more in Manila than in the other developing Southeast Asian cities and with relatively low income levels in Manila, cars were obviously less affordable there (Table 8.2). Economic recession in the Philippines in the 1980s also meant that vehicle numbers in Manila have not grown as much as expected. Several local assembly companies went out of business in the dying years of the Marcos regime (Spencer and Madhaven, 1989). The low number of motorcycles is also an important feature that distinguishes Manila's situation from those in the other Southeast Asian cities.

In 1990, a locally assembled representative car in Indonesia was relatively cheap, nearly as cheap as in Malaysia, although less affordable because of lower average income levels. There were generally low levels of acquisition taxation in Indonesia, especially for vehicles that are commonly used as goods vehicles (Dreesbach and Wessels, 1992). Some such vehicles can also be used as passenger cars and the low tax rates make them popular for this purpose. Thus in 1994, the tax component of the price of the popular and cheap Toyota *Kijang* van was only 23 percent, but for a representative 1500cc sedan (the Honda Civic Grand) it was 55 percent (China Engineering Consultants, 1995a). *Kijang* make up a large proportion of private cars in both Surabaya and Jakarta. The well-known involvement of three Suharto children in vehicle manufacturing and toll roads lowered the prospects for any serious restraint of vehicle ownership while Suharto remained in office.

The signs on usage restraint in Jakarta are mixed. Indonesia has a system of fuel subsidies which have kept fuel prices very low. In 1991 the Indonesian petrol price was raised by 22 per cent but remained very low by international standards⁸⁰ (Dreesbach

⁸⁰ In early May 1998 fuel subsidies were cut further, and gasoline and motor diesel prices in Indonesia rose 71

and Wessels, 1992:III-23). By contrast, the Jakarta 2005 planning document of the mid-1980s states ambitious goals for traffic restraint, namely to achieve an 85 percent modal split in favour of public modes for peak hour vehicular trips to the central area (Jakarta Government, 1987). However, Cervero (1990: 2) reports that central Jakarta had a “surfeit of cheap, on-street parking and a deficit of higher priced off-street facilities”. Building codes in Jakarta have required major developments to provide relatively generous minimum levels of car parking spaces (DeLeuw Cather International and PT Cakra Manggilingan Jaya, 1991). As of 1991, parking policy was a component a three phase traffic restraint process, with phase one including removal of 5800 on-street parking places. However, the effect of this was said to be negligible because all such displaced parkers would have easy alternatives on nearby side-streets (DeLeuw Cather International and PT Cakra Manggilingan Jaya, 1991: 3.2). Phase 2 included substantial bus priority on all major approach corridors to the central area and phase 3 included an area licensing scheme. These were essentially the recommendations of a major early 1980s study (Colin Buchanan and Partners et al., 1983). These latter recommendations have, in fact, slowly been introduced in some form, as described below.

As in Kuala Lumpur and Bangkok, politicians in Jakarta, such as the former Governor of Jakarta, have at times seen improvements to public transport as a prerequisite to restraint policies (Forbes, 1990: 117). Nevertheless, without such improvements, the first serious traffic restraint in Jakarta began in April 1992. From 6.30 am until 10 am, a substantial length of the city’s most heavily trafficked corridor is out of bounds to cars with fewer than three occupants. It is known as the “three-in-one” policy. Early results 3 months after the policy was imposed showed a decrease of 24 percent in the number of private cars entering the zone, and dramatic increases (over 150 percent) in average travel speed by private cars (Sukardiman and Abubakar, 1996). The scheme has been undermined to some extent by the practice of youths and children offering themselves as passengers for a small fee to allow motorists to meet the occupancy requirement. Nevertheless, this has served to demonstrate some “willingness to pay” for access. More recently it has been proposed by the City Administration to replace the 3-in-1 policy with an area pricing scheme. This proposal has generated controversy, coming as it does in the midst of the economic crisis (Jakarta Post, 1998). It will probably be several years

percent and 58 percent respectively (in local currency terms). This was one of the conditions imposed by the International Monetary Fund in its late 1997 rescue package for Indonesia’s troubled economy. However, these price rises were quickly reversed on May 17 in the wake of severe rioting in many Indonesian cities that was said to have been triggered by these price rises and associated rises in public transport fares. However, social unrest continued until the resignation of President Suharto in June. This experience is likely to make the Government very wary of any future fuel price rises.

(at least) before economic recovery brings such issues back onto the political agenda in Indonesia. Rather different problems are currently the focus of attention. In the short term, it seems likely that vehicle numbers and traffic may decrease in Jakarta and Surabaya as a result of reduced economic activity and spending power. However, the economic crisis is also in danger of crippling public transport services. It is to be hoped that the economic crisis also leads to an increased willingness to consider new approaches to urban transport problems in the longer term.

Motorcycle use has been restrained to a certain extent in Jakarta, although motorcycle ownership is high. For example, they are banned from the fast lanes of major roads (that is they are restricted to the service lanes near the kerb on roads that have such a division) and they are also banned from toll roads (Dreesbach and Wessels, 1992). Jakarta has lower motorcycle ownership than Surabaya and other smaller Indonesian cities and this may perhaps be partly attributed to such policies, combined with the higher level of public transport service associated with a large city.

In Manila, the MMETROPLAN study in the late 1970s recommended the introduction of bus/jeepney exclusive lanes and a cordon-pricing system for entry to the CBD (Freeman Fox and Associates, 1977: 11, 41-45). However, the MMUTSTRAP study argued that enforcement capabilities in Manila were insufficient to make these restraint measures work and the idea was dropped (Kirby et al., 1986: 265). Like Jakarta, Manila has also taken recent steps towards serious traffic restraint. There are now restrictions in peak hours on 12 major roads according to license plate numbers, with one-fifth of cars banned on each weekday (Villoria, 1996:125-126). The restraint has triggered vigorous debate and several changes (with the authorities backing away from a more severe rationing scheme) but is still substantially in place. This particular style of restraint has several problems, such as the fact that it is difficult to adjust according to changing circumstances and may be quickly overwhelmed by rising car ownership. Nevertheless, its imposition does demonstrate a new willingness to take traffic restraint measures.

With relatively low motorisation, low incomes and a moderate size, Surabaya has not yet faced the need for traffic restraint but the day must be approaching very rapidly. Surabaya has an opportunity to act now to restrain private vehicle use before the political muscle of car users increases. Surabaya has never before had any restraint measures nor even proposals for restraint. However, a recent major study has argued that mild restraint will be necessary in Surabaya in the future (Dorsch Consult et al., 1996b).

It is not yet clear if the restraint measures in Jakarta and Manila will be further strengthened in the long term. However, assuming for a moment that they do represent the beginning of a concerted policy, then it may be useful to make a comparison of the overall transport conditions in 1990 in Jakarta, Surabaya and Manila with those of Singapore in the early 1970s when Singapore first introduced its restraint policies. In 1970 Singapore had car ownership of 69 per 1000 persons and motorcycle ownership of 51 per 1000 persons. In 1990, Manila had car ownership of 66 per 1000 persons and low motorcycle ownership of only 4 per 1000 persons. Jakarta's car and motorcycle ownership rates (75 and 98) were already higher in 1990 than Singapore's had been in 1970. Surabaya's car ownership was lower (at 40 cars per 1000 persons) but its motorcycle ownership was much higher (at 147 per 1000 persons). These comparisons suggest that Manila is at a similar stage in motorisation as Singapore was when it began to restrict cars. However, in the Indonesian cities, motorisation has already progressed further than it had in Singapore at the time that restraint was imposed, suggesting that the implementation of such policies would be a more difficult process. However, the current severe economic reversal that is being faced by Indonesia may mean that Jakarta and Surabaya will have a second chance at this. Their rates of motorisation may actually drop in 1998 and 1999. They will then have a choice of how fast to allow motorisation to rise when the economy begins to grow again.

Restraint measures in Jakarta and Manila have been controversial but, on balance, they are actually rather modest so far. Jakarta's parking restraint is ineffective at this stage. Its restricted zone is circumvented to an extent and consists of only one major corridor. Manila has no parking restraint and its restraint system is not capable of being adjusted as motorisation increases. It must be concluded that as of early 1998, neither city has yet shown a very strong determination to give priority to non-automobile modes, nor to impose significant restraints on private vehicle ownership or usage. Surabaya's proposed restraint policies are mild and their implementation is probably many years in the future.

8.5.2 Other choices in Jakarta, Manila and Surabaya

The focus of this discussion is on what level of commitment has been devoted to the improvement of public transport service or to road building, especially of expressways. An aim is to assess whether such choices are likely to complement any strengthening of private vehicle restraint, or if they would run counter to such a policy. Land use choices are dealt with only very briefly, since motorisation is at a relatively low level in these three cities and land use patterns generally remain primarily in keeping with the

characteristics of low cost or bus cities, as previously discussed. The focus here must be on relatively recent choices, since the framework that was developed earlier in the chapter suggested that these cities were at a stage in their transport development from which they can potentially take either of the alternative paths that have been demonstrated by the other Asian cities. The key choices in Jakarta, Manila and Surabaya are summarised in Figure 8.9, Figure 8.10 and Figure 8.11.

8.5.2.1 Public transport

First, what signs are there that these cities have made a committed choice to give buses high on-road priority and to improve the bus system generally? Manila has had a relatively plentiful public transport system that provided an effective service during the 1970s and 1980s when car ownership remained at a low level. However, recently speeds have dropped to a dangerously low level (12 km/h for buses and 9 km/h for jeepneys) due to congestion (Joson, 1997), despite early initiatives in the late 1970s to provide on-road priority for buses and jeepneys. Bus/jeepney lanes were implemented on certain major roads at the recommendation of the MMETROPLAN study. However, by the early 1980s these had stopped being effective due to poor enforcement (Kirby et al., 1986: 265). By the late 1990s, the police had begun to enforce a ruling that buses not be permitted to leave the lanes, that are marked with a yellow line. On streets with very heavy bus flows such as EDSA, this ruling amounts to a restriction on buses rather than priority for them.

Jakarta and Surabaya have long struggled to improve their bus and jitney-based public transport systems but without any great success. Motorcycle ownership levels, and to a lesser extent, car ownership, have risen quite rapidly since 1980 in both Jakarta and Surabaya, at a time when the level of mobility by public transport had remained low. This phenomenon was most extreme in Surabaya, where public transport was very poorly developed and where motorcycles have risen quickly in number. Without going into the detailed problems that have faced attempts to improve the bus system in Jakarta, broadly speaking there has been very little improvement in recent decades (Colin Buchanan and Partners, Mott Hay and Anderson International Ltd., P.T. Bina Asih, and P.T. Pamintori Cipta, 1990b). Recently, efforts have been made to improve the on-road priority for buses in major corridors, such as the *Jalan Thamrin* corridor. Since 1990 an extensive network of bus lanes has been in operation and these were reported to have led to reductions in travel times for inbound morning traffic of 15 to 25 percent (Sukardiman and Abubakar, 1996). A brief trial of placing the bus lanes in one of the fast lanes (rather than the service lanes of the major corridor) increased speeds

even more dramatically, but was abandoned in the face of opposition from car users and on safety grounds (passengers were not provided with a safe way to cross the service lanes).

As they currently stand, many of Jakarta's bus lanes are restrictive, since like Manila's lanes, buses are forbidden to stray out of the lanes. This author's observation is that by 1995, the lanes were not an effective bus-priority system at times and places with heavy bus flows, where they are most needed (Plate 8.5). Bus priority lanes have been recommended in Surabaya by reports in the 1990s but have not yet been implemented to this author's knowledge (Birk and Zegras, 1993: 70; Colin Buchanan and Partners et al., January 1994). Policy in Jakarta, and increasingly also in Surabaya, has also been aimed at replacing small public transport vehicles with larger buses, with the aim of increasing the capacity of the system and the efficiency of road space consumption. However, little progress has been made in practice with this goal which is controversial within the cities involved and is debated in the literature (Dick, 1981; Dorsch Consult et al., 1996b; Mogridge, 1992).

Plate 8.5 Bus lanes in Jakarta and in Taipei



In 1995 the bus lanes in the "slow lanes" of Jakarta's *Jalan Thamrin* appeared not to provide much help to buses



In 1996 Taipei introduced a successful network of busways in the centre of many major streets

Both Jakarta and Manila have invested in the development of rail systems. Such large investments (like large roads) are inevitably difficult in cities with their level of incomes and are often dependent on overseas aid or concessional loans. With loans from Japan, the Jakarta region has been upgrading its regional rail system, at very significant expense, since the mid-1980s. However, progress on improving the rail system in the Jakarta region has been slow. The system of 160 km of line and 55 stations plays a small role in the transport of the city, with only about 1 percent of total passenger kilometres in 1990 (Figure 5.8). The rail improvement program has been criticised as not being cost-effective, of missing major centres of activity and of being

too focused on long-distance suburban service rather than the more critical urban service improvements (Colin Buchanan and Partners, Mott Hay and Anderson International Ltd., P.T. Bina Asih, and P.T. Pamintori Cipta, 1990a; Inter-Departmental Working Group, 1993; Mogridge, 1992). Recently, as a response to these and other problems with the existing rail development program, a system of several new mass transit lines was proposed, with an emphasis on light rail and on serving the main, dense urban core area. This consists of a consolidated network of 80 km of new LRT alignment, 65 km of existing rail line converted to LRT, and 80 km of existing suburban rail, amounting to a system of 225 km altogether by the year 2015 (Inter-Departmental Working Group, 1993). However, little progress on the 55 km first phase of the proposals had been made by the time of the 1997/98 economic crisis, which has put all such large projects on indefinite hold. One cause of delay was a decision to go underground and have higher capacity on the 15 km line from Kota in the old CBD area to the major suburban sub-centre of Blok M, along the important Thamrin-Sudirman corridor.

In Manila, an elevated light-rail system has operated since 1984 for 15 km along the densest corridor through the old CBD and to the north and south. The line has achieved high levels of ridership and farebox returns exceed operating costs. It is also very popular with the public. However, difficulties repaying loans in Japanese yen for the project were exacerbated by currency fluctuations in the early years of operation (Dans and von Einsiedel, 1990; Gimenez, 1991; Razon, 1994). By 1996 it carried 2.3 percent of all person trips in Metro Manila and 3 percent of work trips which is remarkable for just one 15 km line in a city of almost 10 million people (JICA, 1997). A second mass transit line of 17 km is under construction along Manila's large middle-ring-road, EDSA, which has developed into a major spine of the urban area (Villoria, 1996: 124). Plans for a substantial network of mass transit railways are at an advanced stage and appear likely to reach fruition much more quickly than Jakarta's proposals. One further mass transit line to run 14 km eastward from the old CBD has been approved along with a 50 percent expansion of the original line by 1999. Three other projects are being negotiated (a 104 km regional line to the Clark airbase redevelopment, a 12 km extension of the original line southward, and a 15 km line north-east from the old CBD to Quezon City). Preliminary approval has been granted for an upgrade of 56 km of the Philippine National Railways (PNR) line that runs through Metro Manila with currently a very limited suburban passenger service (Tuazon, 1997). A proposal for a busway has also been approved for construction along a major circumferential road (C5) in late 1997. This plan is for a high-quality busway that should be considered as a mass transit

facility (Yuseco, 1997). Some of these projects may be delayed due to the regional economic slowdown, although the Philippines has been somewhat less badly affected than most of the other Asian countries in this study.

In Surabaya, intercity trains play a very small role in local transport (Dorsch Consult et al., 1996a). The recent Surabaya Integrated Transport Network Planning Project study has recommended two mass transit rail lines (a 19 km north-south line and an 11 km east-west) and a 9 km east-west busway in Surabaya, along with some small improvements to allow some suburban rail service on the existing long-distance rail line to the south (Dorsch Consult et al., 1996b: 8.1). These were proposed for phased construction beginning in the year 2002, but this target date must now be in doubt in light of economic turmoil in Indonesia.

To summarise, of these three cities, the potential for major improvements to public transport looks brightest in Manila. But even there, and even if all of the rail and busway projects are completed quickly, on-road buses and jeepneys will remain extremely important. This suggests that if motorisation begins to rise again and if a further erosion of public transport is to be avoided, then both on-road public transport priority and further traffic restraint will need to be seriously pursued in all three cities, including Manila.

The spatial arguments that have been presented in this thesis and the framework in Chapter 7 suggest that for dense cities like Manila, Jakarta and Surabaya, a mass-transit oriented transport strategy is a desirable one. However, such expensive infrastructure is difficult to establish quickly in lower-middle income cities (Fouracre, Allport, and Thomson, 1990; Gardner et al., 1994). The examples of Singapore, Seoul and Hong Kong suggested that one of the best ways to “buy time” to gradually move in a transit-oriented direction is to first emphasise restraint of private vehicles. The aim is to prevent rapid motorisation from undermining the role of public transport and instead to gradually build up the role of public transport in conditions of low vehicle numbers. This would allow these cities to gradually develop mass transit systems in a staged and affordable way.

8.5.2.2 Roads

The building of major roads is also often a financial burden for cities with these levels of income. Concessional loans from bilateral aid program or multilateral lenders have been a source of many of the financing packages for such roads in these cities. If expressway construction is taken as a simple indicator of the level of commitment to

high-speed private traffic flows, then the Indonesian cities seem to have moved faster in this direction than Manila. By 1990 Jakarta's metropolitan region (Jabotabek) had 15.5 km of expressway per million people, Surabaya had 9.4 km per million by 1995 and in 1990 Manila had about 5 km of expressway per million people (Table 5.10). There are currently no inner urban expressways in Manila, just one super-highway (toll road) to the north and one to the south, both built in 1970s. Construction is now under way however, on a toll road that will link these two expressways through the inner city. In Surabaya, despite low levels of motorisation, there has been a high level of commitment to private traffic flows at the expense of both public transport convenience, non-motorised vehicles and pedestrians. This is indicated by the traffic management practices in that city that have produced an extensive one-way system in the central area with very few traffic lights or pedestrian crossings (Gunawan, 1992; Rennie Park and Associates (GmbH) and BIEC International, July 1991).

8.5.2.3 Non-motorised transport

It is difficult to rigorously compare how different cities at different levels of income have treated non-motorised modes and again only a somewhat anecdotal treatment of the issue is provided here. It is clear that so far, pedestrians and non-motorised vehicles have not been a high priority of urban decision makers in Jakarta, Manila and Surabaya (Plate 8.6). Indeed, their needs and safety have often been sacrificed to the imperative of creating space for the rapid movement of motor vehicles. Many arterial roads in all of these cities still lack footpaths. However, the vernacular housing areas (known as "*kampung*" in Indonesian cities) with their intricate networks of narrow alley ways are a haven for pleasant walking, cycling and *becak* riding. Indeed, non-motorised modes are the only way to penetrate many such areas. The residents of many *kampung* demand that motorcyclists dismount and push their machines through the alleys (Plate 8.6). The "*Kampung* Improvement Programme" (KIP) in Indonesian cities has done much to preserve and enhance the pedestrian environment within *kampung*, especially in Surabaya, by improving paving and drainage and with extensive plantings which provide shade (Silas, 1989).

Bicycles and their special needs have generally been ignored in all three cities, as they have in most of the Southeast Asian cities. However, pedicabs (*becak*) have faced restrictions in both Jakarta and Surabaya, reflecting a generally negative attitude to non-motorised modes. After many years of gradually tightened restrictions, pedicabs were banned in Jakarta in 1989 (Hook and Replogle, 1996). However, pressure to lift Jakarta's ban on pedicabs increased during 1998 as a response to the economic crisis.

The Governor of Jakarta moved to lift the ban at the urging of local social activists, in an effort to relieve the suffering of the poor during Indonesia's severe economic downturn (Abdul Hakim, pers. comm., 22 July 1998). However, the issue is not yet finalised as of early 1999. In Surabaya, pedicabs have faced increasing restrictions and a ban has been mooted (Darmaningtyas, pers. comm., 5 June 1998). In Manila, pedicabs have reappeared within recent decades after a long absence and have found a niche in which they apparently operate without official harassment (Williams, 1994).

Plate 8.6 Extremes of the pedestrian environment in Indonesian cities



Main roads can be extremely hostile for pedestrians as on this Jakarta street



The alleyways of *kampung* (especially those improved under KIP) are a haven for non-motorised modes. Alleyway residents often enforce a ban on motorised modes as in this case in Surabaya

8.5.2.4 Land-use development

As mentioned above, land use choices will not be discussed in any detail in this brief review of key choices in Jakarta, Manila and Surabaya. It will suffice to briefly point out that it is not too late for these cities to adopt a transit-oriented strategy. The densities of new development are still quite high, and therefore supportive of a high level of public transport. Furthermore, the intense strips of development along major transport routes, such as Jakarta's Thamrin-Sudirman corridor or Manila's EDSA, are well-suited to mass transit. This is indeed beginning to be exploited with mass transit systems proposed or under construction along these corridors and certain others that are similar in Manila, Jakarta, and Surabaya. In most cases the proposals are elevated above the roads (Jakarta Post, 1997; Dorsch Consult et al., 1996a; Tiglao, 1993; Wright and Wilson, 1995).

On the other hand, a lower density, car-oriented strategy would be extremely difficult for these cities, if not impossible. Jakarta and Manila especially, have grown to very large populations with high urban densities. They would need to sprawl outwards at

very low densities for long distances to achieve a significant drop in their overall densities. This is not likely to happen unless high speed travel is possible in such corridors, which would require enormous spending on expressways. Upper-income groups in all of these cities are, of course, attracted to low-density suburban-style developments that are advertised by highlighting their easy access to existing or proposed expressways. Many of these developments are enclosed by walls and divorced from their urban or village neighbours. Such developments are so far a small proportion of new building in these cities, although they do take up a disproportionately large amount of land, and could cause various problems for future planners (Kidokoro, 1992; Leaf, 1994).

Figure 8.9 Some key policies and events in Jakarta, 1970 to 1990s

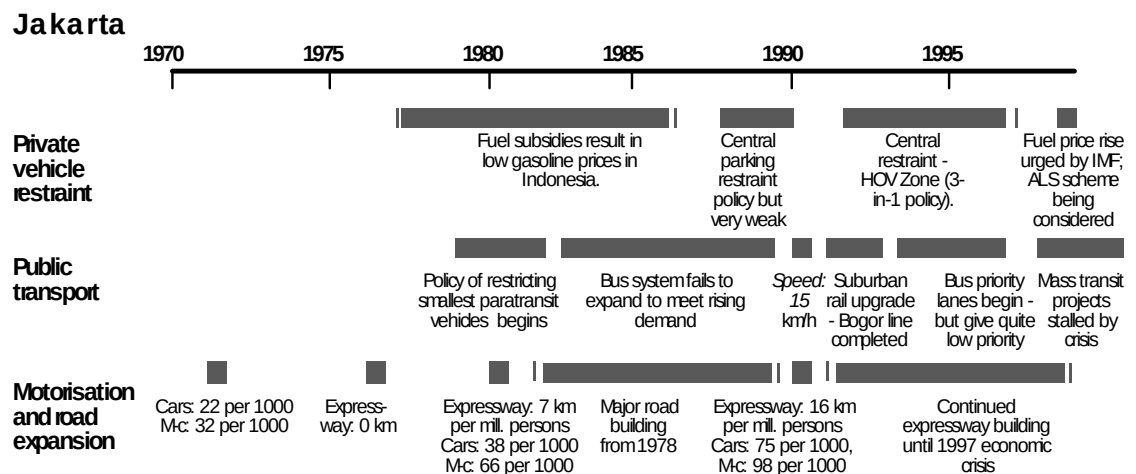


Figure 8.10 Some key policies and events in Manila, 1970 to 1990s

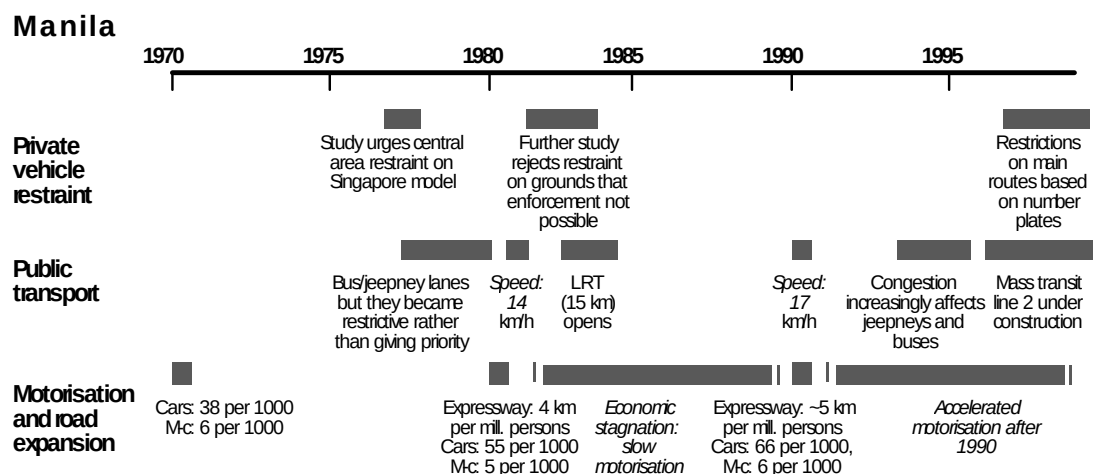
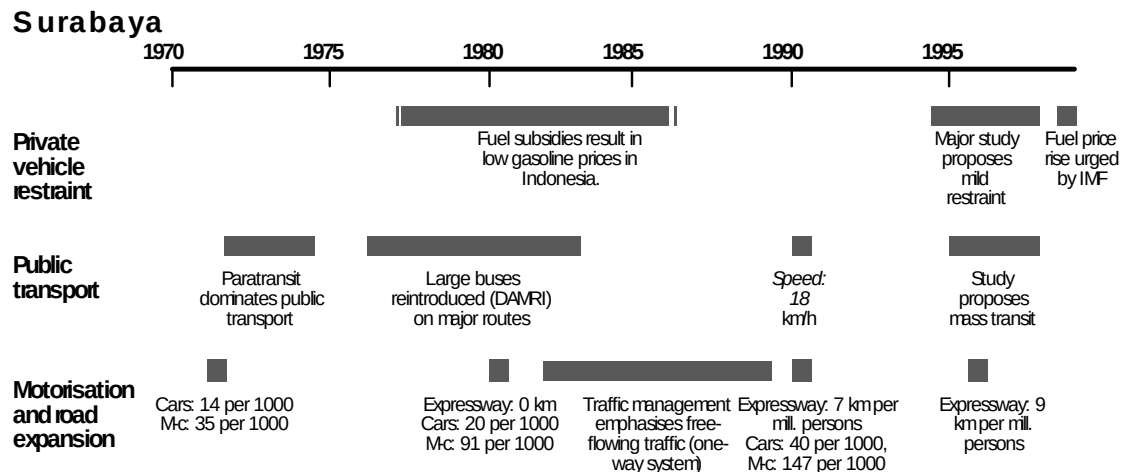


Figure 8.11 Some key policies and events in Surabaya, 1970 to 1990s



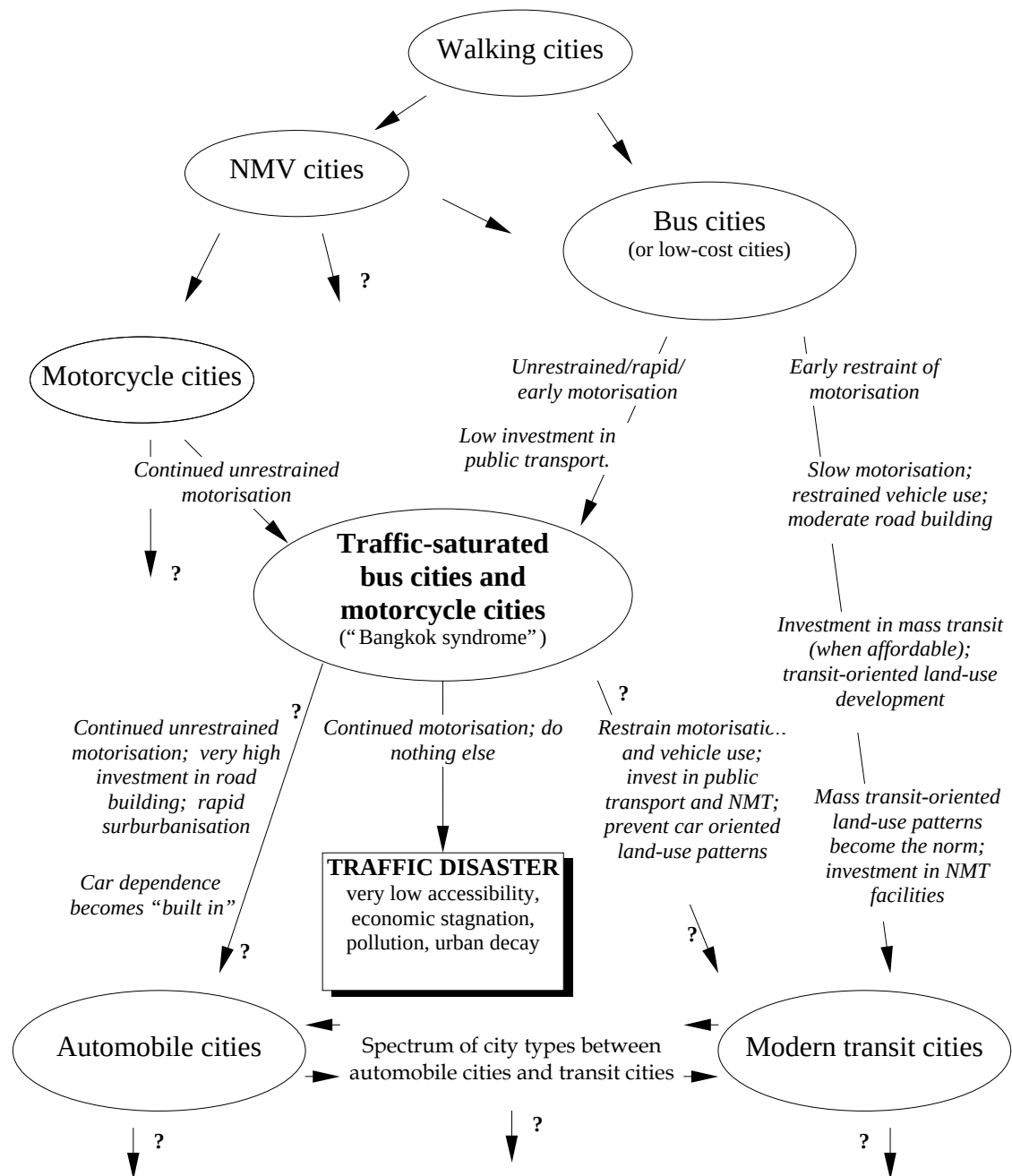
8.6 Towards a generic model of transport and land-use evolution in Asian cities: the role of key policy choices

The detailed examination of key choices in the Asian cities in the sample has revealed some important patterns. Certain choices and their timing appear to have been crucial in influencing the transport and land-use trends of these cities and in particular, which path they have followed of the two main paths that were identified earlier. The diagrams of the chronology of key choices provide evidence of the pathways and timing involved in transitions between city types by the Asian cities of this sample. This evidence, along with the framework that was presented early in this chapter, can be combined to suggest a simple generic model of the evolution of transport and land-use patterns in Asian cities.

8.6.1 Evolutionary paths in long-industrialised cities compared with developing cities

As argued previously, most Western cities and Tokyo began the era of mass motorisation as transit cities, whereas most of the Asian cities began their eras of mass motorisation (or potential mass motorisation) as dense bus cities. An awareness of this difference has been important in understanding the recent evolution of transport and land use patterns in the Asian cities in this sample. Figure 8.12 provides a simple summary of the evolution of Western cities and Tokyo, or more generally, cities in countries that were already relatively industrialised by the time of the Second World War. They are shown as changing from walking cities to transit cities and then to modern cities lying at various points along a spectrum depending on their dependence on automobiles or continued orientation to public transport. Figure 8.13 shows a simplified generic model of the evolution of Asian cities and others that have been part

Figure 8.13 Simple generic model of urban transport and land-use evolution in developing cities



Note: This scheme is intended to describe the paths taken or potentially to be taken by cities that are in the so-called developing world or which were in the “developing world” until the 1960s or so.

Figure 8.13 requires further explanation. It has been shown in the last several chapters of this thesis how most of the Asian cities in this study have evolved since the late 1960s when they could be described as bus cities. Several of them followed the path portrayed on the right-hand side of the model, from bus cities towards modern transit cities. In each such city this path involved early restraint of private vehicles resulting in a slow motorisation process, which contributed to the ability to retain high ridership on

buses and eventually to invest in mass transit. By contrast, the other bus cities have not restrained private transport and to a greater or lesser extent have become “traffic saturated” without fundamentally altering their urban form or transport network characteristics. They have thus become “traffic-saturated bus cities” as shown in the centre of the diagram.

The upper-left part of the diagram describes paths and types of cities that are not found within the main sample of Asian cities for this study. However, cities that are characterised by high use of non-motorised vehicles (such as Chinese cities or Vietnamese cities in the 1970s and 1980s) or by motorcycles (such as Denpasar, Chiang Mai or Vietnamese cities today) were identified in Chapter 5. Therefore the generic model here includes these city types along with some conjectural paths for their future evolution.

8.6.2 Mass transit investment in perspective

It should again be emphasised that the actual building of mass transit systems was able to come rather late in Singapore, Hong Kong and Seoul, and was not the initial impetus behind their “transit-oriented” paths. It is worth noting that the early stages of this path were, in fact, almost identical to the low cost approach that was urged upon many low-income and middle-income cities by the World Bank (and others) since the 1970s (which was discussed in Chapter 2, Section 2.4). This puts the choice of investing in expensive mass transit systems into a clearer perspective.

Most commentators agree that in low-income cities such investments are not affordable, nor the best use of scarce capital funds. However, the experiences of the cities in this sample suggest that the adoption of private vehicle restraint, the promotion of bus priority and a low emphasis on road building are policy choices that can tend to set a city on a development path that, as incomes rise, will make mass transit both affordable and viable at an earlier date than otherwise. This is in contrast to low-income or lower-middle-income cities that allow unrestrained motorisation, fail to improve or prioritise bus services and attempt to supply roads to meet demand. These cities, represented by Bangkok and Kuala Lumpur, have tended to find that by the time they can afford to build mass transit systems, their levels of motorisation have risen to such high levels, their bus usage has dropped so low, and their patterns of urban land-use have dispersed to an extent, so that the possibilities for mass transit to play a major role have become restricted. These findings have implications for the debates over mass transit proposals in large, low-income cities such as Delhi, Karachi and many others.

8.6.3 Where next for these and other low and middle-income cities?

The simple generic model of Figure 8.13 also includes some possible future paths for the cities in this Asian sample. Which of these paths is chosen will depend upon the outcomes of debates (whether public or among decision makers) in each city. It is hoped that the framework developed in this study can help to inform such debates. Though the paths shown in Figure 8.13 are speculative, the data and analysis in this thesis has provided a strong basis for these assessments. They are based on an understanding of transport and land-use trends in the Asian cities from an international perspective, of spatial constraints and of the key choices that have influenced their development paths to date.

Possible future paths for traffic-saturated bus cities, such as Bangkok, are emphasised in the model. Since cities of this type have not yet substantially reoriented their urban fabric towards the needs of private cars, it is considered that a transit-oriented path still remains an option. However, such a path will only be possible if the choice is taken to embark vigorously on new policies that consistently restrain further motorisation and vehicle use, and which increase investment in, and priority for, public transport and non-motorised transport. While clearly it would be many years before such policies produced a genuine transit city, they would tend to push it in that direction. In the highest-density examples of traffic-saturated bus cities, the changed emphasis would likely have the most dramatic benefits. The need for such policy changes is most clear cut in these cities. The catalyst for change could potentially come as a result of the success of some specific public transport investment (such as a mass transit line or a high-quality bus priority scheme) which might provide enough political will for substantial policy change. Mounting traffic impacts may prompt organised campaigns in response and influence public attitudes enough to bring about significant policy changes, as has been happening in Seoul in the 1990s.

Figure 8.13 also suggests that cities such as Manila, Jakarta and Surabaya, which are apparently following paths similar to Bangkok's, can turn away from the path towards "traffic disaster" by adopting vigorous policies aimed at switching to a transit-oriented path. There are signs that Manila may be more able to do so than the Indonesian cities.

In the dense, traffic-saturated bus cities, continuing on the current path of allowing unrestrained motorisation is clearly an extremely problematic choice. Nevertheless, it is a choice that some cities may make. The result is depicted on the generic model as "Traffic Disaster". This scenario is likely to be associated with economic stagnation for

the city, chronic pollution, and urban decay. Small motorcycles may continue to proliferate in such cities as the only mode that remains viable. Activities would most likely continue to disperse and gradually make the option of turning to the transit-oriented strategy more and more difficult. For dense, middle-income, traffic-saturated bus cities with modest financial resources, road investments are unlikely to be sufficient to allow the cities to spread out rapidly enough to relieve the pressures of pollution, congestion and traffic impacts generally. Such cities can apparently continue to function, but an unpleasant scenario emerges. Traffic will tend to dominate every public space, the city will expand outwards at upper-middle or high densities but with centres of activity widely scattered, traffic speeds will be low and conditions for walking or cycling will be unpleasant. Public transport will become increasingly unattractive due to low speeds and poor service levels. This kind of city will have moderate levels of mobility but a very low level of accessibility. Unfortunately, this description can already be applied to Bangkok today.

Some traffic-saturated bus cities might choose to vigorously embrace private vehicular transport. This path is shown in the lower left corner of Figure 8.13. It is certainly not the choice recommended here, but for some cities in this category, it may potentially be a viable choice. For some cities with relatively high incomes, moderate densities and smaller population sizes, it may be possible to make high investments into roads and low-density suburban development and hence to allow a car dependent city to emerge. Although this “strategy” is car oriented, it may also be accompanied by significant investments in public transport, aimed at maintaining access to older central areas. The signs are that Kuala Lumpur is attempting to follow just such a path. It is likely to be a high-cost strategy that depends on continued very high investment in transport infrastructure. It is a path that ultimately leads to a city with many of the same problems of “automobile dependence” that are seen in Australian and American cities today. In the medium-term, the kind of city that may emerge from such a trend might have similar transport and land-use characteristics to the more car-oriented of the European cities or to the less car-oriented of the Canadian cities today. That is, private vehicles dominate overall, but public transport has a significant role and the city has an urban density in the lower-middle density range. Motorcycles may also continue to be popular in such a scenario, especially if public transport continues to provide relatively unattractive service for many trip purposes, and since spatial constraints will persist in the older established areas of such cities.

It is more difficult to speculate on future possibilities for cities in which non-motorised vehicles or motorcycles are currently predominant. The prospect of an influx of cars into such cities, which now have very limited public transport, is a relatively new phenomenon. There is an urgent need to examine the question of which choices can best contribute to sustainable, equitable and efficient urban transport development in such cities in the future, especially as incomes rise further and bring car ownership within the reach of even a small part of the populations of these cities. Like the large bus cities that have been a focus of this thesis, non-motorised vehicle cities and motorcycle cities tend to be dense or very dense. Therefore, like the dense cities discussed in this study, these cities face severe spatial constraints to the widespread use of four-wheeled private vehicles. In many cities of this type, public transport plays an extremely small role and will be difficult to improve quickly. For example, in Ho Chi Minh City by 1996, public transport accounted for only 2 percent of all mechanised trips (which include bicycle trips but exclude walking trips) (MVA Consultancy, 1997).

What choices now face the four Asian cities in the sample that embraced the transit-city path? Of course, these cities will continue to face a choice among a range of paths ranging from even greater commitment to non-car modes, to a relaxation of these policies and greater orientation to automobiles. However, it is likely that even if the latter choice is taken, these cities would be able to avoid the kind of traffic disaster that confronts large bus cities. This is because of the fact that transit use has become substantially “built-in” to their urban fabrics, along with a significant network of mass transit that is immune to congestion and competitive with cars in terms of speed. These cities have apparently gained some resilience to be able to resist or deal with the effects of rising vehicle use. To a significant extent, the mass transit systems will continue to provide effective accessibility to established centres of activity, even if traffic congestion increases. For the middle-density transit cities, Singapore and Tokyo, there is also the possibility of a gradual trend toward greater automobile orientation in at least some outer areas. However, Hong Kong and Seoul are so dense and large that there is little chance that they can allow significant car-oriented transport or land-use patterns to emerge without causing major problems. These two cities are therefore likely to seek to further entrench mass transit as the basis of their transport systems.

8.7 Chapter Summary and Conclusions

This chapter has focused on the key choices that underlie the different paths of transport and land-use development that have been occurring in the Asian cities in this study. The

bulk of the chapter was devoted to a detailed examination of the policies that have been most influential in each city. The analysis was guided by the insights provided by previous chapters. Common themes emerged among the choices taken in cities that have been identified as having followed similar models of transport development. Thus, it was emphasised that the four higher-income Asian cities all restrained private transport early and vigorously while the other Asian cities did not do so. It was argued that this choice was among the most crucial in influencing their transport and land-use outcomes since the early 1970s. Several other important arenas of policy were also highlighted. It was shown that, to some extent, these other choices have been influenced by the fundamental choice of whether or not to restrain the ownership and/or use of private vehicles.

The chapter has provided insights that answer Research Question 3 on what have been the most important transport-related choices in the Asian cities and on how these choices relate to the comparisons and the transport challenges and opportunities that were highlighted earlier in the thesis. Spatial insights have been especially emphasised as being fundamentally important to the viability of the different choices for each city. The chapter has also addressed Research Question 4, which is concerned with the implications of the findings in the dissertation for future choices in the Asian cities of the sample and for other similar cities outside the sample. Some further policy implications for these Asian cities and for other low-income cities around the world will also be spelled out in Chapter 9, the conclusion of the thesis. Chapter 9 will also briefly summarise the main conclusions of the dissertation and will highlight suggestions for further research to follow up issues raised by this study.

CHAPTER NINE

CONCLUSIONS

This chapter reviews and summarises the findings of this study and assesses whether the thesis has successfully answered the research questions that were posed in Chapter 1. It then briefly assesses the significance of the results and analysis as they relate to theoretical and policy debates that were introduced early in the thesis. The key policy implications of the study are then summarised. Finally, suggestions are made for a number of important lines of follow up research that have been opened up by the findings presented in this dissertation.

9.1 Summary of Main Findings and Conclusions

9.1.1 Preliminary groundwork

This thesis began by providing a sense of a transport crisis in several selected Asian cities. The comparative data and analysis of this study have confirmed that such a sense of crisis is warranted. However, the study has also put the situation into a clearer perspective than has previously been presented in the literature on Asian cities. A number of motivations for this study were mentioned in Chapter 1, including rapid change in the cities of the region, awareness of urban transport problems and opportunities, a desire for policy alternatives, the need to recognise spatial issues in dense cities and, finally, the importance of a long term perspective in dealing with complex problems of transport and urban development. These motivations have been substantially addressed by the thesis as it has unfolded.

Four research questions have guided and focused the study. The first called for international comparisons of urban transport and land use characteristics. The second asked about unique or unusual transport challenges in Asian cities. The third was about choices and the fourth asked about implications of the answers to the earlier questions for future choices in Asian cities and for other similar cities. The introductory chapter also clarified the scope of the thesis. The main focus of the study has been on the large-scale, relatively long term transport characteristics, trends and interactions with other urban characteristics. The study particularly sought to understand paths of transport development.

Chapter 2 provided an essential theoretical background for the research. First it summarised evidence of the need for a better quantitative and internationally comparative study such as this one. This was done by assessing previous comparative studies from the literature and finding them wanting in a number of important respects. None was suited to providing the kind of internationally comparative, long-term, reliable and comprehensive perspective on the city-wide transport and land-use evolution of Asian cities that was the aim of this study.

The theoretical discussion then briefly presented some of the chief influences on urban transport as identified in the literature. Infrastructure investment choices, incomes and economic development, land-use patterns and urban planning, price settings and technology choices were all mentioned. A number of key debates over urban transport in Pacific Asian cities were then reviewed, with a focus on those controversies that have been addressed to some extent by this thesis. It was argued that a major deficiency of these debates was the lack of sufficient spatial awareness or consideration of urban form. This has led many commentators to give inadequate attention to these important factors in the genesis of urban transport difficulties (as well as in their potential amelioration).

Chapter 2 also provided a review of a number of previous efforts to describe urban transport and urban land use evolution in terms of descriptive models that address both transport and land use together. The review focused on Newman and Hogan's walking city, transit city and automobile city types and on Thomson's five strategies, namely the full motorisation, strong centre, weak centre, traffic limitation and low-cost archetypes. These later provided a solid basis for discussing descriptive models for the somewhat unique patterns that have developed in the sample of Asian cities in this study and which have not been covered by previous studies.

Chapter 3 continued to lay the groundwork for the study by providing essential background information on each of the Asian cities included in the sample. It provided a description of the Asian cities in terms of their levels of income or GRP per capita in 1990 (using labels that are generally applied by the World Bank to national economies). Tokyo, Hong Kong and Singapore were labelled high-income cities. Seoul, Kuala Lumpur and Bangkok were found to be upper-middle-income cities. Jakarta, Manila and Surabaya were labelled as lower-middle-income cities.

9.1.2 Historical review

Chapter 3 also provided a historical review of the major trends in urban transport and land-use patterns in the Asian cities from around 1900 until the late 1960s. Key features of the evolution of the Asian cities were also compared with those of Western cities. This review provided conclusions that were important to the development of the arguments in this thesis:

- Most of the transport trends seen in large Western cities during the period up to the 1940s, could also be seen to some extent in the Asian cities, although motorised mobility remained low in the Asian cities, except for Tokyo.
- Beginning as walking cities in the late 19th century, the land use patterns of the Asian cities developed in the first half of the 20th century under the influence of higher mobility offered by non-motorised vehicles and by public transport. In the West and in Tokyo, rail systems offered high speeds, so these cities were able to spread out to greater distances than was possible in the poorer Asian cities, where public transport was slower.
- Between the 1940s and late 1960s, Tokyo's land-use patterns continued to develop with strongly rail-oriented features.
- The other Asian cities could best be described as bus cities by the 1960s. The concept of the bus city was developed in Chapter 3, building upon the typologies of cities that were presented in Chapter 2. Features of bus cities were identified as: a preponderance of buses and jitneys in the transport system; a centralised, but not highly concentrated, distribution of jobs; generally high urban densities; mixed land use in most areas; commercial activity in long strips along major roads; and a radius of at most 15 km or so.
- Their bus city characteristics made these Asian cities more vulnerable to the impacts of increasing private motor traffic than Western cities had been when cars first began to intrude in large numbers. Unlike Western cities (or Tokyo) at the equivalent stage, the Asian cities lacked significant traffic-segregated public transport and had much higher urban densities.

This final point provided the beginnings of an answer to Research Question 2 on whether the Asian cities faced unusual or unique urban transport challenges or opportunities and on whether distinctive Asian models of urban transport and land use can be identified. The above historical conclusions set the scene for the presentations of comparative data on urban transport and land-use patterns for recent decades that

comprised the bulk of Chapters 5 and 6. These data placed the urban transport and urban form of these Asian cities into an international comparative perspective.

9.1.3 Compilation of a comparable data set

Chapter 4 detailed the procedures that were used to compile the data set that was the main focus of the study. The context of this study, being a part of the wider effort to collect data for the update of Newman and Kenworthy's "Cities and Automobile Dependence", was explained. In addition, the specific role of this author in that effort was outlined; namely the collection and analysis of all data in Kuala Lumpur, Jakarta, Surabaya and Seoul (along with some of the data from Singapore and Manila) and primary responsibility for the adaptation of the wider methodology to be used in the middle-income cities in the Asian sample of cities. The intensive efforts to ensure the quality, reliability and comparability of the data set were explained in some detail to demonstrate that the figures that were used later in the thesis could be relied upon. Definitions were provided of the indicators that were collected, along with definitions of metropolitan boundaries, inner areas and central business districts that were used in the study. The unique problems associated with such definitions in the Asian cities were discussed.

Finally, Chapter 4 provided an extensive review of many of the specific data issues and complications that arose in the process of the data collection and processing. The ways in which these difficulties were dealt with were clearly explained. These explanations further served to underline the intensive effort that went into the data set. They also showed that the data are truly comparable on an international basis, that such a data assembly effort has not been undertaken previously on Asian cities and that the results are superior to previous efforts in this area (as reviewed in Chapter 2).

It can be concluded that the experiment that was proposed by this author of extending to middle-income cities the basic methodology of Newman and Kenworthy (which was originally applied only to high-income cities) has proved to be successful in producing a reliable and internationally comparable data set on six middle-income Asian cities, along with the original three high-income Asian cities. This was despite the extra difficulties and obstacles that were faced in the collection and interpretation of data in the less wealthy cities.

9.1.4 Asian urban transport and land-use patterns in an international comparative perspective

Much of the contents of Chapters 5 and 6 provided a comprehensive answer to Research Question 1 on how the urban transport and urban form characteristics and development trends in the Asian cities compare with each other and with a large sample of other international cities. The focus was on data for 1990, together with some analysis of trends since 1970 (and earlier).

9.1.4.1 Comparisons between regions, 1990

The Asian cities typical land-use characteristics in 1990 contrasted with the other regions. Compared with the other regions, the Asian cities, on average:

- were more than three times as dense as the average European city in the sample and more than eleven times the density of the average Australian and American city;
- had much higher population densities in their CBDs and inner areas than the other cities;
- were slightly more centralised in their distribution of employment; and
- had much higher job densities in their inner areas.

The main findings when comparing the average transport characteristics of the Asian cities with the other regions were that in 1990 the Asian group of cities had:

- the lowest levels of motorisation (although only in the Asian group of cities were there significant levels of motorcycle ownership);
- the lowest levels of private vehicle use per capita;
- the highest share of their motorised travel on public transport;
- the lowest average public transport speed;
- the lowest rates of provision of roads per capita;
- similar levels of road provision per hectare as other cities;
- the lowest average levels of CBD car parking spaces relative to CBD employment;
- the highest rates for the use of walking and NMVs for the trip to work (although the European average was only slightly lower);
- the lowest emissions from transport of noxious air pollutants per capita, lowest use of energy per capita in transport and lowest CO₂ emissions per capita from transport;
- the highest average emissions from transport of noxious air pollutants on a per hectare basis;
- the highest traffic intensity levels (VKT per hectare); and
- the most congested traffic.

9.1.4.2 Contrasts within the Asian sample of cities

In addition to the above generalisations, the presentation of data also revealed sharp contrasts among the Asian cities in the international sample of cities. A key finding was that since 1970, Kuala Lumpur and Bangkok have been following a fundamentally different path in their transport development from Seoul, Singapore, Hong Kong and Tokyo. These two upper-middle-income Southeast Asian cities were not simply at earlier stages of a path similar to that taken by the four higher-income cities, but were developing in a way that was distinctly more oriented toward private transport. Bangkok and Kuala Lumpur had high motorisation (both cars and motorcycles) relative to their incomes per capita, while the four higher-income Asian cities within the international sample had low motorisation relative to their income levels and were emphasising public transport to a much greater extent than the first group of cities. Manila, Jakarta and Surabaya could not as yet be clearly said to be following either of these paths by 1990, but the signs suggested that a Bangkok-like model was already more likely, especially in the Indonesian cities. These points again addressed Research Question 2.

Although urban density was not a factor that distinguished between the above groups within the Asian sample of cities, other aspects of urban form did vary systematically. Seoul, Singapore, Hong Kong and Tokyo had less centralised distributions of employment than the other Asian cities but, nevertheless, had much higher densities of jobs within their CBD areas. They also had lower numbers of CBD residents relative to the number CBD jobs. A qualitative discussion of other centres of activity in the Asian cities showed that transit-oriented employment centres, primarily based around rail, were becoming important in the four higher-income Asian cities that were emphasising public transport and restraining private vehicles. The locations of commercial activity in the other Asian cities were influenced primarily by the road network.

9.1.4.3 Insights on spatial factors in Asian urban transport

Among the Asian cities in the sample, Hong Kong, Seoul, Manila, Jakarta, Surabaya and Bangkok were shown to have very high or high densities (with urban densities above 100 persons per hectare). The others, Singapore, Tokyo and Kuala Lumpur had upper-middle densities (that is, higher than most European cities but under 100 persons per hectare).

The second half of Chapter 6 highlighted some of the implications of high or very high urban densities for transport. This provided further substantive contributions towards answering Research Question 2. The main findings were that:

- road capacity per person is inherently limited in high density cities so that low road lengths per person in most of the Asian cities are a fundamental consequence of their spatial characters and not just the result of a failure to build “enough” roads;
- the impacts of traffic per unit of urbanised land area can quickly reach very high levels in dense cities even if the level of motorised travel per person is low;
- even though high urban densities create difficulties in accommodating private vehicles, they also create the potential for high accessibility levels and for alternative modes of transport, such as public transport, non-motorised vehicles and walking, to flourish. However, this is not inevitable, even in high density cities, without appropriate policy settings;
- spatial issues are at their most intense in Seoul and Hong Kong, with their very high urban densities, and are also extreme in Bangkok where a high urban density is combined with relatively high vehicle use. However, spatial constraints (and opportunities) are an important factor in all of the Asian cities and in many European cities.

These spatial constraints and opportunities influence the range of transport and urban policy choices that are open to Asian cities. The later chapters of the thesis sought to integrate understanding of the spatial insights, the comparative data and contrasting transport development trends in the Asian cities.

9.1.5 Contrasting models and choices for Asian urban transport and land-use development

The contrasts in the transport and urban characteristics within the Asian group of cities were interpreted as revealing distinct models of development in the transport and land use of the Asian cities in this study. This provided the completion of an answer to Research Question 2. The models were not simply different stages along a similar path but represented fundamentally distinct choices in transport and urban development. The framework presented early in Chapter 7 and the generic model that was presented late in Chapter 8 brought together comparative data, spatial awareness and knowledge of the key choices in Asian cities to provide new perspectives on transport development over time in these cities.

Figure 7.2 showed various city types (auto cities, walking cities, bus cities, transit cities, etc.) on a plot of private transport mobility versus public transport mobility and at the same time highlighted the spatial constraints. It was shown, using primarily spatial arguments, that dense bus cities are particularly vulnerable to the impacts of increasing traffic. Large bus cities need to restrain private vehicles and to promote the alternatives if they are to avoid enormous problems as they motorise. This strategy could be described as adopting a low-cost approach which involves maintaining the bus city model for a time, while laying the foundations for a later transition towards the transit city model. The framework also suggested spatial reasons for the popularity of motorcycles in many Asian cities.

A key insight when discussing transitions between the different dominant modes of transport and the associated city types, is that land-use considerations or spatial constraints vary depending on which transition is involved. Transport systems with high roles for walking, non-motorised vehicles, buses or mass transit are all compatible with high urban densities. Large, dense cities can apparently make transitions between an orientation to any of these transport modes without facing unmanageable spatial constraints. Even a transition towards a major role for small motorcycles appears to be feasible for large, dense cities (although it has been argued that the longer-term consequences are uncertain). However, serious spatial problems arise if significant use of cars emerges quickly in cities that were previously dominated by non-motorised vehicles, buses or motorcycles. On the other hand, rail-oriented cities appear somewhat better equipped to cope with and to resist an onslaught of cars. This has been shown in this thesis both through some historical analysis of Western cities and through data on the Asian cities.

Thus by showing how spatial insights are essential to understanding these cities' transport systems, Chapter 7 clarified some of the key choices that confront transport and urban planning in Asian cities. Chapter 8 then focused on these key choices and showed how they relate to the contrasting paths of transport and land-use development seen in the Asian cities in this study. These findings were summarised in simple terms by a schematic diagram, Figure 8.13, which illustrates the main paths of evolution between the different Asian city types and the key choices that have played a role.

It was argued that early restraint of private vehicles was a crucial choice. The four higher-income Asian cities all restrained private transport while the other Asian cities generally did not. Other choices were heavily affected by whether or not private vehicles were being restrained. Research Question 3, which asked what have been the

most important transport-related choices in Asian cities, was thus addressed strongly by Chapter 8. To some extent, the chapter also addressed Research Question 4, on the implications of the findings for future choices in the Asian cities of the sample and for other similar cities outside the sample. The conditions that led Bangkok to face such extreme transport-related problems are widespread among large cities in the developing world. Any such city with high urban densities and a bus-oriented, non-motorised or motorcycle-oriented transport system and a high rate of income growth must consider the “Bangkok syndrome” to be an imminent danger. Fortunately, the range of choices that have been highlighted in this Asian sample also demonstrate that policy action can help a city to avoid Bangkok’s fate. In fact, even Bangkok has not yet fundamentally rebuilt itself as a car-oriented city, and continues to face a choice between an ongoing traffic disaster and a different, more sustainable path.

9.2 Significance of the Results

The findings of this study are significant for a number of reasons which will be explained with reference to issues raised in the introductory chapter and in the theoretical background provided in Chapter 2.

9.2.1 Importance of spatial awareness

Early in this thesis a lack of attention to urban form and urban density in the literature on Asian cities was highlighted. The study subsequently showed that this lack of attention is a serious shortcoming and is often accompanied by incorrect specification of the density of these cities, leading to further obfuscation of the role of urban form in transport issues in dense cities. The high density urban forms that are common in Asia (and throughout the developing world) are of great consequence for transport policy and must be taken into account in policy debates. This is primarily because of the extreme difficulty of quickly accommodating significant numbers of cars and car-related infrastructure into such cities. Large, dense, middle-income cities run a great risk of facing a crunch of traffic related problems that has been termed here, the “Bangkok syndrome”, with very high traffic levels on a per hectare basis (high VKT per hectare).

A low-cost strategy, including restraint of private vehicles, has long been urged for developing cities by various commentators, consultants and lending bodies, including the World Bank (Linn, 1983: 108-113). However, very few of these have focused upon spatial arguments as a compelling reason for the necessity of these policies. Most have noted the rates of growth in vehicle numbers and the shortfall in road building to justify their recommendation of restraint policies. However, they have not explicitly

highlighted the fact that it is extremely difficult, if not impossible, to match the supply of road infrastructure in these cities to the unrestrained demand. Financial prudence has been used to argue against large, capital-intensive infrastructure spending. An auto-restraint policy is also argued to be more equitable than an emphasis on private mobility (especially in cities with large numbers of very poor people who cannot afford private transport) (Linn, 1983: 105-108). A further common argument is, of course, the local and global environmental impact of a predominance of private transport. However, none of these arguments has proved to be very convincing to most decision makers in developing cities. Perhaps this may change if a more widespread awareness of the importance of spatial factors becomes a feature of public debates over transport policy in such cities. Such awareness would tend to promote greater scepticism towards road expansion proposals generally and perhaps generate greater willingness to accept traffic restraint proposals.

9.2.2 Framework for alternative paths of transport development

Chapter 2 introduced a number of prominent typologies of cities that were based on both transport and land-use factors. However, it was shown that low-income and middle-income cities were not adequately dealt with by any of these frameworks and thus a gap in knowledge existed as to where such Asian cities fit within these city typologies. This study has introduced and worked with the idea of the “bus city” and the related idea of the “traffic-saturated bus city”. The concepts of the “NMV city” and the “motorcycle city” were also introduced but not developed in any great detail. These concepts have provided a vocabulary and conceptual framework for discussing the pathways in the evolution of the transport and land-use systems of Asian cities in the last few decades. The spatial circumstances and policy choices that give rise to these city types have been discussed in some detail. It is hoped that the frameworks provided here will prove to be useful in the analysis of transport evolution in other similar low and middle-income cities around the world.

9.2.3 Restraint policies as the “bridge” between a low-cost approach and the transit city

Chapter 2 mentioned a number of important policy debates in the literature on transport in developing Asian cities. Most prominent were debates over Rimmer’s “unconventional wisdom” (or the World Bank’s policy prescriptions of the 1980s), which was similar to Thomson’s “low-cost strategy”. One important related debate was intense argument over the merits of urban rail investments versus buses in developing cities.

Most of the debate arising from the World Bank's, Rimmer's and Thomson's contributions tended to centre on policy towards public transport, such as arguments over private sector versus public involvement, small-scale organisation versus incorporation, small versus large buses, and bus versus rail. The other important elements of the "unconventional" or "low-cost" approach did not get so much attention. Most important among these neglected elements were the de-emphasising of major road building and measures to strongly restrain private cars in low-income cities. The experiences among the group of nine Asian cities described in this study have suggested that these elements, especially restraint of private vehicles, are particularly important and did deserve much greater attention.

Results in this sample of cities suggest that private vehicle restraint is a central policy that provides a "bridge" for a city to transform itself from a low-cost city or bus city to a transit-oriented city and to avoid the Bangkok-like predicament of becoming a dense, bus-based city overrun by traffic. Or to put it another way, it is much easier and smoother to go from a low-cost city to a transit city via restraint (which allows delayed road and mass transit investment), than to allow a slide from a low-cost city to a traffic-saturated low-cost city and then belatedly try to improve public transport in order to cope. Restraint was the key that made it easier for Singapore, Hong Kong and Seoul to make this transition from something very close to a low-cost strategy in the early stages of their evolution into modern transit-oriented cities.

Rising incomes present challenges to the role of public transport in any city and Asian cities are no exception. Rising incomes tend to make private vehicle use more and more affordable which poses a direct challenge to public transport, since few people with access to a private vehicle will choose public transport if it remains overcrowded, unreliable and slow. The World Bank's hostility to rail was primarily based on cost grounds and on the assumption that motorisation was not as much of a threat as it subsequently turned out to be in cities such as Bangkok. The arguments in this study show that successful investment in mass transit is actually the long term outcome of a low-cost strategy of retaining buses and restraining private vehicles in a low income city. As incomes rise, such a city can win breathing time in which the bus systems remain viable, congestion is kept at bay and car ownership is kept relatively low, even up to the time that urban rail is considered to be affordable and viable. High levels of motorcycle ownership also appear to be avoidable through effective traffic restraint policies and improvement of public transport. Conversely, in the absence of restraint of private vehicles, the problem is that rail is not considered to become affordable until

well after motorisation has already begun to take off, contributing to a decline in bus service, so that many have already deserted the public transport system. This has been the experience of Bangkok, Kuala Lumpur and Taipei. It is then much more difficult politically and practically to begin to restrain traffic and to regain a strong role for public transport.

Of course, to some extent urban traffic restraint and the enhancement of public transport are linked. Allport (1994) argues that much of the importance of mass transit investment is in making traffic restraint politically palatable. A major reason for Kuala Lumpur and Bangkok's rejection of area licensing in the 1980s was the argument that public transport must improve first (Spencer and Madhavan, 1989: 434). Similar arguments have been used in Jakarta (Forbes, 1990: 117). Although it has been politically influential, this argument that mass transit must be provided *before* restraint can be imposed is not necessarily supported by the evidence from this study. It was shown in Chapter 8 that restraint *preceded* major investments in mass transit in most of the Asian cities that have had strong restraint and now boast successful mass transit systems. Furthermore, in the cities without traffic restraint, motorisation can quickly reach high levels as incomes rise before improved public transport can be put in place. This is especially likely if cheap motorcycles find a ready market. In each of Bangkok, Kuala Lumpur and Taipei, private vehicle ownership, including motorcycles, passed 400 per 1000 people soon after 1990, before any significant mass transit was opened.

9.2.4 Road expansion is no panacea in dense cities

It was shown in Chapter 7 that transport problems in dense Asian cities are not due simply to a failure to build enough roads. It is not often realised that urban form is a major underlying reason for the low road provision per person in dense Asian cities. Road space is inherently a scarce commodity in such cities. A city of 150 persons per hectare would have to provide 10 times more road capacity per hectare than a city of 15 persons per hectare in order to achieve the same road capacity provision per person. Perhaps some Asian cities could substantially expand road capacity through extraordinary measures such as smart highways, and multilevel or underground roads and parking stations. However, the fact that Asian cities already have high traffic intensities suggests that this might be disastrous. Further expansion of road capacity will lead to increased traffic volumes and hence to increased traffic intensity (unless cities rapidly reduce their density). Very dense cities, perhaps more so than any others, do not have the choice of building enough roads to satisfy demand. Simple calculations reveal that this would destroy the fabric of the city long before the demand for private

travel could be satisfied (Zahavi, 1976: 26). In fact, a case can be made that even in low density cities, the burden of attempting to cater for demand for roads is overwhelming (Goodwin, 1991).

It has already been shown here that the densities of most of the Asian cities are such that they are intrinsically suited to walking and public transport. Ironically, although major road-building is unlikely to solve the transport problems of dense cities, it could seriously undermine these alternatives to private motorised transport. Peter Hall (1983) suggests that servicing of land and the building of transport infrastructure are the two most powerful tools with which to guide the pattern of urban development, especially in developing Asian cities where direct urban planning controls are weak. In conditions of pervasive congestion, any new infrastructure tends to have a major influence on urban form. The influence of large roads on the patterns of peripheral growth in Asian cities has been discussed. If the aim is to foster an urban form suited to public transport and non-motorised transport, then their infrastructure must be used to guide development and not just roads. Trying to first build the roads and leaving the public transport until later will tend to shape the city around private vehicle use and make the tasks of later installing public transport and changing travel behaviour more difficult. In low-income cities, the public transport and non-motorised transport infrastructure need not be capital intensive. The important thing is that these modes receive priority in capital spending.

9.2.5 Policy implications: a summary

This section presents a set of broad policy suggestions that, based on the findings of this study, are thought to suit large, dense low-income or middle-income cities and which can put them into a good position to remain accessible even as incomes rise and even as the threat of motorisation increases. This thesis (Chapter 8 in particular) has shown that public policies can indeed make a very big difference to the evolution of the transport and land-use system of a city. In the 1990s, there is a trend for increasing community activism on transport issues in Asian cities. Such civil-society activity is helping to focus attention on alternatives and is challenging past policy approaches.

Policy implications for large, dense, low-income and middle-income cities that flow most strongly from the findings of this study are summarised as follows:

- Transport decision makers need to be more aware of the implications (challenges and opportunities) of high urban densities for the transport choices that are feasible in such cities and to shape their policies accordingly;

- Aiming for a transition from bus city (or NMV city) towards a transit city is a more desirable and feasible course of action than allowing a rapid and uncontrolled increase in private vehicle ownership and usage (which leads to intractable traffic and environmental problems in dense cities);
- A vital part of achieving such a desirable transition is the imposition of private vehicle restraint or TDM policies aimed at dramatically slowing the rate of increase of private vehicle ownership and use;
- Restraint policies directed at both private cars and motorcycles appear to be important for a successful transit-oriented strategy, since motorcycles are able to undermine public transport at lower levels of income than cars and under conditions of congestion and constrained parking space;
- Private vehicle restraint seems to be most easily imposed and to have the most desirable effect if it is imposed while motorisation remains low (less than about 100 private vehicles per 1000 persons);
- Strong steps to improve public transport are also desirable at an early date but vigorous private vehicle restraint helps to delay the need for expensive investments and allows effective public transport policies to remain low-cost for many years;
- Eventually, if incomes rise and the potential for motorisation rises further (despite restraint) it becomes necessary to make larger investments in higher-quality public transport to ensure that it remains attractive in speed and comfort relative to private transport;
- Non-motorised transport modes deserve much greater priority at all levels of income and their neglect especially undermines efforts to promote public transport;
- To some extent, the evolution of transit-oriented land-use patterns will tend to follow from strong policies that consistently give priority to public and non-motorised modes. However, planning to promote a transit-oriented pattern of land uses will obviously be helpful and will further improve the chances of overall success.

9.3 Suggested Follow-up Research

This study has raised a number of issues that could not be explored deeply enough here but which deserve further investigation. The main examples of such issues are listed below.

This study has highlighted high levels of traffic in Asian cities as measured on a per-hectare basis. Even when discussed at a broad, city-wide level, this variable provided some useful insight. There is thus a strong case for a more detailed exploration of the value of traffic intensity as an indicator in urban transport, especially in dense, newly motorising cities. This could include study of traffic intensity figures at a local level, as well as the city-wide level. The relationship between vehicle travel per hectare and the negative impacts of traffic on the local population should be quantified. This study also came to some strong conclusions concerning the implications of high urban density for road capacity per person. These findings could be enhanced and strengthened through a more detailed investigation, for example using a larger set of cities and with alternative, better measures of road capacity.

There appears to be an urgent need to better understand the new phenomenon of motorcycle cities and to investigate their longer-term policy options. There is a need to confirm which conditions help to bring about high popularity of motorcycles. This study has offered some suggestions but questions remain, such as why motorcycles have never become popular in certain cities, such as Manila, but are very popular in other apparently similar cities, such as Surabaya and Jakarta. Taipei and other Taiwanese cities may be a particularly useful focus for an investigation of motorcycle cities since they are the ones with the longest history of high motorcycle ownership.

In light of this study, there is probably a need to reassess transport strategies of all large, dense cities where buses and jitneys dominate the public transport system and which have the potential to motorise rapidly. The extent of the risk of a Bangkok-like scenario needs to be assessed in each such city. This finding is relevant to much of the developing world.

This study has emphasised the importance of private-vehicle restraint policies. This suggests that there is an urgent need for thorough investigations into the various restraint and TDM options that are available for large, dense, low-income and middle-income cities. The various restraint techniques need to be carefully assessed with the aim of finding those that are both politically achievable and efficient at achieving their goals. It is also important to identify which TDM policies can benefit vulnerable social groups, such as the urban poor and on rural dwellers, and which ones will have a negative impact on these groups. A long-term perspective will be required in such a study.

The above point raises the issue that the findings of this study address a number of policy debates that are essentially political. However, the politics of policy making were largely beyond the scope of the study. In the context of increasing democracy in Asia, there is a great need for a better understanding of how to foster the conditions in which public policy debates on urban transport issues and civil-society involvement in these debates can be as constructive and well-informed as possible. A relevant aim here is to maximise the chances that such debate can generate policies that are truly in the public interest and which take account of realistic long-term visions, of sustainability and of social justice and the needs of disadvantaged groups.

9.4 Concluding Comments

This study has confirmed that Asian cities face a number of distinctive challenges and opportunities in urban transport. The issues involved are of great importance since they have an impact on the quality of life, the health and the livelihoods of many millions of people across the continent. Urban transport trends in many cities are on a disastrous path, notwithstanding the current economic crisis. This study has clarified the nature of the options open to Asian cities using a broader perspective than most previous investigations. It is hoped that the findings of this study will be useful to urban communities across the region.

APPENDIX 1

Raw and Standardised Urban Data on Nine Asian Cities

a. Raw Data

Please refer to:

Kenworthy, J. R. and Laube, F.B. with Peter Newman, Paul Barter, Tamim Raad, Chamlong Poboorn and Benedicto Guia (Jr) (1999) **An International Sourcebook of Automobile Dependence in Cities, 1960-1990**. University Press of Colorado, Boulder.

b. Standardised Data

Please refer to:

Kenworthy, J. R. and Laube, F.B. with Peter Newman, Paul Barter, Tamim Raad, Chamlong Poboorn and Benedicto Guia (Jr) (1999) **An International Sourcebook of Automobile Dependence in Cities, 1960-1990**. University Press of Colorado, Boulder

APPENDIX 2

A Selection of Key Standardised Urban Data Items in an International Sample of Cities, 1990

City	Density (pph)	CBD density (pph)	CBD job density (jobs per ha)	Inner density (pph)	Inner job density (jobs per ha)	Outer density (pph)	Road length per capita (m)	Parking per 1000 CBD jobs
Australian cities								
Perth	10.6	9.5	131.5	16.3	15.9	9.8	10.7	631.1
Brisbane	9.8	11.8	528.6	20.3	20.7	8.9	8.2	321.7
Melbourne	14.9	27.1	530.6	27.2	43.0	14.4	7.7	337.3
Adelaide	11.8	10.2	408.1	18.7	26.0	11.3	8.0	580.2
Sydney	16.8	20.8	422.2	39.2	38.1	15.3	6.2	222.2
Canberra	9.6	2.9	160.9	8.6	13.4	9.8	8.8	806.8
American cities								
Houston	9.5	17.9	303.3	18.4	21.6	8.8	11.7	612.3
Phoenix	10.5	16.6	89.7	16.4	31.1	10.4	9.6	905.6
Detroit	12.8	16.5	256.9	28.6	10.9	10.5	6.0	705.7
Denver	12.8	16.7	175.9	16.3	14.5	11.7	7.6	605.6
Los Angeles	23.9	28.2	506.1	28.7	15.6	21.6	3.8	520.4
San Francisco	16.0	111.1	744.3	59.8	48.3	13.6	4.6	136.6
Boston	12.0	71.2	297.5	43.1	34.1	9.8	6.7	285.0
Washington	13.7	27.3	688.5	38.1	45.1	12.0	5.2	252.9
Chicago	16.6	30.3	921.0	47.3	23.8	11.4	5.2	128.2
New York	19.2	226.6	989.1	91.5	52.4	12.6	4.6	59.9
Portland	11.7	34.0	371.0	23.7	23.5	9.9	9.1	403.0
Sacramento	12.7	26.6	117.1	19.4	12.7	10.8	8.8	777.1
San Diego	13.1	27.2	128.0	32.1	19.6	10.9	5.5	688.5
Canadian cities								
Toronto (Metro)	41.5	51.1	927.0	60.0	44.3	35.4	2.6	175.8
Vancouver	20.8	25.6	308.6	41.5	29.9	17.4	5.1	442.8
Calgary	20.8	33.6	290.9	22.7	23.8	20.2	4.9	522.0
Edmonton	29.9	21.6	212.8	26.8	?	31.5	4.8	593.5
Montreal (region)	33.8	51.5	223.2	64.1	42.8	28.5	4.5	346.8
Ottawa	31.3	39.7	364.0	49.2	97.7	30.1	7.1	230.3
Winnipeg	21.3	42.5	155.9	41.2	29.1	18.0	4.2	545.5
European cities								
Hamburg	39.8	29.9	331.7	85.7	95.1	33.6	2.6	177.3
Frankfurt	46.6	65.5	498.9	61.0	93.6	39.7	2.0	246.3
Zurich	47.1	37.3	417.2	73.5	72.8	36.1	4.0	136.7
Stockholm	53.1	101.4	262.3	91.7	126.4	42.9	2.2	193.2
Brussels	74.9	50.3	470.5	91.0	82.5	62.7	2.1	314.1
Paris	46.1	179.7	369.6	96.8	56.1	27.0	0.9	199.5
London	42.3	63.0	423.7	78.1	63.8	33.2	2.0	?
Munich	53.6	96.6	276.1	106.9	150.2	47.7	1.8	266.2
Copenhagen	28.6	74.8	269.8	53.9	35.2	22.6	4.6	223.2
Vienna	68.3	60.4	378.4	128.6	110.4	56.5	1.8	186.5
Amsterdam	48.8	93.2	98.0	89.3	43.1	29.7	2.6	354.3
Asian cities								
Bangkok	149.3	324.6	132.2	288.6	119.5	89.1	0.6	396.6
Hong Kong	300.5	113.8	1712.6	803.9	775.1	258.0	0.3	32.9
Jakarta	170.8	235.1	203.5	266.7	135.2	138.0	0.5	?
Kuala Lumpur	58.7	123.1	178.5	68.8	35.7	53.7	1.5	296.7
Manila	198.0	444.8	226.5	391.2	141.3	96.3	0.6	27.0
Seoul	244.8	203.7	579.5	298.8	209.7	235.7	0.8	48.7
Singapore	86.8	82.8	386.2	124.2	132.9	80.5	1.1	163.8
Surabaya	176.9	360.2	355.6	265.1	?	144.9	0.3	?
Tokyo	71.0	63.2	546.8	132.1	108.3	61.2	3.9	42.9

City	Cars per 1000 persons	Motorcycles per 1000 persons	Car km per capita	Total VKT per capita	Private passenger energy use (MJ/capita)	Private passenger km per capita	Public passenger km per capita	Public % of motorised passenger km
Australian cities								
Perth	523	21	7,203	8,861	34,579	12,029	544	4.3
Brisbane	463	16	6,467	8,309	31,290	11,188	900	7.4
Melbourne	518	11	6,436	7,924	33,527	9,782	844	7.9
Adelaide	537	16	6,690	7,956	31,784	11,173	572	4.9
Sydney	449	9	5,886	7,051	29,491	9,417	1,769	15.8
Canberra	457	15	6,744	8,100	40,699	11,195	660	5.6
American cities								
Houston	608	?	13,016	14,117	63,800	19,004	215	1.1
Phoenix	644	23	11,608	13,049	59,832	15,903	124	0.8
Detroit	693	?	11,239	12,487	54,817	15,846	171	1.1
Denver	753	30	10,011	10,511	56,132	13,515	199	1.5
Los Angeles	544	17	11,587	13,054	55,246	16,686	352	2.1
San Francisco	603	24	11,933	13,304	58,493	16,229	899	5.2
Boston	521	6	10,280	11,422	50,617	17,373	626	3.5
Washington	620	?	11,182	11,896	49,593	16,214	774	4.6
Chicago	547	13	9,525	10,355	46,498	14,096	805	5.4
New York	483	5	8,317	9,181	46,409	11,062	1,334	10.8
Portland	764	20	10,114	11,238	57,699	14,665	286	1.9
Sacramento	563	22	13,178	15,194	65,351	19,239	117	0.6
San Diego	559	21	13,026	14,557	61,004	18,757	259	1.4
Canadian cities								
Toronto (Metro)	606	17	5,019	6,051	30,746	7,027	2,173	23.6
Vancouver	565	13	8,361	8,750	31,544	12,541	871	6.5
Calgary	630	?	7,913	9,201	35,684	11,078	775	6.5
Edmonton	527	?	7,062	8,397	31,848	10,028	728	6.8
Montreal (region)	420	6	4,746	5,274	27,706	6,502	952	12.8
Ottawa	510	?	5,883	6,534	26,705	8,236	850	9.4
Winnipeg	412	?	6,871	7,635	32,018	9,620	635	6.2
European cities								
Hamburg	410	12	5,061	5,799	20,344	7,592	1,375	15.3
Frankfurt	478	16	5,893	6,636	24,779	8,309	1,149	12.1
Zurich	444	?	5,197	?	19,947	7,692	2,459	24.2
Stockholm	409	16	4,638	5,050	18,362	6,261	2,351	27.3
Brussels	428	13	4,864	5,404	21,080	6,809	1,427	17.3
Paris	360	?	3,459	4,100	14,269	4,842	2,121	30.5
London	348	11	3,892	4,641	12,884	5,644	2,405	29.9
Munich	468	22	4,202	4,417	14,224	5,925	2,463	29.4
Copenhagen	283	8	4,558	5,201	14,609	7,749	1,607	17.2
Vienna	363	27	3,964	4,587	14,990	5,272	2,430	31.6
Amsterdam	319	7	3,977	4,420	13,915	6,522	1,061	14.0
Asian cities								
Bangkok	199	124	2,036	3,198	11,764	4,634	2,313	33.3
Hong Kong	43	4	493	1,459	2,406	813	3,784	82.3
Jakarta	75	98	716	1,597	5,536	1,546	1,323	46.1
Kuala Lumpur	170	180	2,920	4,944	12,339	6,299	1,577	20.0
Manila	66	6	701	901	3,347	1,582	2,568	61.9
Seoul	66	22	1,483	1,899	5,293	2,464	2,890	54.0
Singapore	101	45	1,864	3,597	11,383	3,169	2,775	46.7
Surabaya	40	147	262	1,483	2,633	1,568	555	26.1
Tokyo	225	36	2,103	3,795	8,015	3,175	5,501	63.4

City	Traffic speed (km/h)	Public transport speed (km/h)	Rail % of total motorised pass. km	Bus + tram % of total motorised pass. km	Public trips (boardings per capita)	Public transport service km per ha	Public transport % of trips to work	Walk + bike % of trips to work
Australian cities								
Perth	45.0	26.3	1%	4%	54	500	9.7	4.1
Brisbane	50.1	38.8	5%	3%	69	539	14.5	5.1
Melbourne	45.1	27.1	4%	3%	101	744	15.9	4.7
Adelaide	46.4	23.0	1%	4%	76	546	11.5	5.4
Sydney	37.0	33.5	10%	5%	160	1,581	25.2	5.5
Canberra	49.5	34.5	0%	6%	89	652	10.0	6.0
American cities								
Houston	61.2	23.6	0%	1%	26	159	4.1	2.6
Phoenix	51.5	24.5	0%	1%	15	104	2.1	4.2
Detroit	56.3	22.5	0%	1%	24	179	2.6	2.0
Denver	58.1	24.2	0%	1%	30	271	4.4	4.3
Los Angeles	45.0	19.9	0%	2%	55	473	6.7	4.0
San Francisco	44.3	33.2	3%	3%	112	790	14.5	5.5
Boston	52.3	29.5	3%	1%	114	433	14.7	7.4
Washington	42.4	32.2	3%	2%	106	512	15.1	4.5
Chicago	45.0	36.8	4%	2%	96	687	14.9	4.5
New York	38.3	34.2	8%	2%	155	1,207	26.6	6.7
Portland	49.7	27.0	0%	2%	46	317	5.8	3.9
Sacramento	63.9	25.2	0%	0%	15	126	2.5	4.7
San Diego	55.7	28.9	0%	1%	29	311	3.4	5.8
Canadian cities								
Toronto (Metro)	35.0	26.1	10%	13%	350	4,082	30.1	5.3
Vancouver	38.0	25.3	2%	5%	117	1,046	12.4	5.7
Calgary	47.1	27.7	3%	4%	94	1,033	16.5	5.3
Edmonton	40.0	20.7	1%	6%	109	1,533	11.0	6.0
Montreal (region)	43.3	25.1	6%	6%	221	2,034	21.3	6.1
Ottawa	40.0	24.0	0%	9%	135	1,750	27.0	7.0
Winnipeg	35.0	19.0	0%	6%	98	861	19.9	8.0
European cities								
Hamburg	30.0	33.2	11%	4%	228	2,828	38.1	12.5
Frankfurt	30.0	45.8	9%	3%	217	2,232	42.1	8.5
Zurich	36.0	44.7	16%	8%	515	6,975	39.8	24.2
Stockholm	30.0	38.2	18%	?	348	7,078	55.0	14.0
Brussels	37.9	28.8	10%	7%	260	4,700	35.3	19.1
Paris	25.7	38.0	25%	5%	295	3,276	36.2	14.9
London	30.2	43.4	22%	8%	325	5,857	40.0	14.0
Munich	35.0	42.6	24%	5%	404	4,900	46.0	16.0
Copenhagen	50.0	47.1	11%	6%	164	3,463	25.0	32.0
Vienna	27.5	25.1	13%	19%	422	4,959	43.9	11.9
Amsterdam	35.0	22.5	5%	9%	325	2,944	25.0	35.0
Asian cities								
Bangkok	13.1	9.2	0.1%	33%	423	16,470	30.0	10.0
Hong Kong	25.7	27.9	34%	46%	570	42,186	74.0	16.9
Jakarta	23.6	15.2	1%	45%	238	9,308	36.3	22.3
Kuala Lumpur	29.4	16.3	0.1%	20%	227	2,915	25.5	16.9
Manila	25.5	17.1	4%	58%	481	51,077	54.2	17.8
Seoul	24.0	25.7	19%	35%	460	27,868	59.6	19.8
Singapore	32.5	25.7	15%	32%	457	9,900	56.0	22.2
Surabaya	27.0	17.5	0%	26%	173	10,997	21.0	23.5
Tokyo	24.4	38.5	61%	3%	461	6,335	48.9	21.7

City	Private VKT per hectare	Total VKT per hectare (including bus + tram)	Transport deaths per 100,000 persons	Air pollution emissions per capita index (see p. 170)	Air pollution emissions per hectare index (see p. 170)	GRP per capita (US\$ 1990)	Car cost per km (car only) (capital + operating) (US\$ 1990 per km)	Accessibility indicator (see p. 233)
Australian cities								
Perth	94,218	94,667	11.9	109	25	17,697	0.40	14
Brisbane	81,283	81,560	12.5	136	29	18,737	0.31	18
Melbourne	118,176	118,610	11.6	103	34	21,088	0.38	20
Adelaide	93,527	93,996	12.9	98	25	19,761	0.41	16
Sydney	118,594	119,265	11.1	118	43	21,520	0.35	23
Canberra	77,859	78,511						
American cities								
Houston	134,340	134,498	20.8	159	33	26,155	0.25	28
Phoenix	136,397	136,501	20.2	126	29	20,555	0.29	21
Detroit	159,248	159,427	13.9	149	41	22,538	0.31	24
Denver	134,256	134,528	14.1	129	36	24,533	0.36	24
Los Angeles	311,962	312,436	16.8	123	64	24,894	0.25	38
San Francisco	213,285	213,774	13.0	130	45	31,143	0.27	34
Boston	137,342	137,550	10.4	144	38	27,783	0.27	30
Washington	163,515	163,805	11.6	125	37	35,882	0.30	34
Chicago	171,375	171,743	13.7	120	43	26,038	0.29	30
New York	176,362	176,809	11.8	123	51	28,703	0.31	33
Portland	131,088	131,384						
Sacramento	192,764	192,869						
San Diego	191,252	191,529						
Canadian cities								
Toronto (Metro)	250,984	253,527	6.5	142	128	22,572	0.28	44
Vancouver	182,149	182,941						
Calgary	191,344	192,194						
Edmonton	250,682	252,118						
Montreal (region)	178,062	179,400						
Ottawa	204,390	206,139						
Winnipeg	162,552	163,414						
European cities								
Hamburg	230,899	231,969	8.1	174	151	30,421	0.47	36
Frankfurt	309,317	310,489	7.9	75	77	35,126	0.48	46
Zurich	?	?	7.7	44	45	44,845	0.46	60
Stockholm	268,308	271,829	7.3	123	142	33,235	0.80	36
Brussels	404,832	408,130	11.7	73	119	30,087	0.51	50
Paris	189,147	190,112	10.6	85	86	33,609	0.42	45
London	196,415	198,319	8.1	83	77	22,215	0.36	38
Munich	236,684	238,068	11.7	59	69	36,255	0.59	50
Copenhagen	148,512	150,027	7.5	?	?	29,900	0.45	36
Vienna	313,288	316,865	10.7	77	115	28,021	0.39	52
Amsterdam	215,830	217,707	5.7	?	?	25,211	0.40	38
Asian cities								
Bangkok	477,474	493,612	16.1	86	278	3,826	0.33	22
Hong Kong	438,411	472,916	5.7	49	321	14,101	0.80	89
Jakarta	272,892	282,112	4.5	65	241	1,508	0.24	17
Kuala Lumpur	290,233	293,148	22.7	84	107	4,066	0.21	19
Manila	178,355	229,253	13.8	68	293	1,099	0.31	12
Seoul	464,843	488,949	24.9	50	264	5,942	0.28	53
Singapore	312,307	320,485	8.7	?	?	12,939	0.44	40
Surabaya	262,326	273,322	7.8	45	173	726	0.25	12
Tokyo	269,353	270,538	5.3	26	41	36,953	0.29	95

Note: Variables collected for the World Bank were not collected for all cities, which is the reason for the gaps in the table above.

APPENDIX 3

Data Sources for Asian Cities in an International Sample of Cities

Cities for which the author was Primary Data Collector

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Encik Hadri Department of Road Transport Planning Department Jalan Dungun Bukit Damansara 50490 Kuala Lumpur Malaysia	Mr Ho Khong Ming Director General Town and Country Planning Department. Jalan Cenderasari Kuala Lumpur Malaysia	Dr Chiam Soon Hock Master Planning Department City Hall Kuala Lumpur 19th Floor, Menara Tun Razak Jalan Raja Laut 50350 Kuala Lumpur Malaysia
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Jabatan Perangkaan Malaysia (Malaysian Statistics Department) (1984-85). "Banci Penduduk dan Perumahan Malaysia 1980 (Population and Housing Census of Malaysia 1980)".	Miss Kate Van, Statistics Department Jalan Cenderasari Kuala Lumpur Malaysia	Mr Ahmad Zakaria International Division Ministry of Transport 3rd Floor Wisma Perdana Jalan Dungun Bukit Damansara Kuala Lumpur
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APPENDIX 4

Maps of the Asian cities in an International Sample of Cities, 1990

The format of these maps and the standardised process for their compilation was devised by Felix Laube. The process was used for all of the cities included in this international sample, although only the maps of the Asian cities are shown here. Felix Laube also carried out the final laying out of the maps into the standardised format. In most cases the primary data collector for each city obtained and processed the raw maps and the other necessary information to be included in these standardised maps. Preliminary input to the computer via scanning and initial processing was also usually done by the primary data collector. Thus, this author compiled and inputted the information for the mapping of Seoul, Kuala Lumpur, Jakarta, Surabaya and Singapore, and contributed substantially to the mapping of Manila, Bangkok, Tokyo, Sydney and Adelaide.

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