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Lessons from Asia on Sustainable Urban Transport

by

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Introduction

Urban transport, the issue of motorization and the development of 'automobile dependence' have become critical factors in the future liveability of cities, not least those in Asia where motorization is reaching an ever wider range of cities. Urban residents and policy makers struggle with the escalating impacts of private transport and how best to provide for people's transport needs in cost-effective and more sustainable ways. These efforts are part of the wider quest for more sustainable, liveable and equitable cities across a broad range of factors, many of which are affected to some degree by the nature of the transport system.

This chapter confronts these large issues with a policy-oriented discussion that focuses on Asian cities in an international perspective. The comparisons are informed by a large data set (discussed below) as well as by earlier investigations by the authors into a subset of these cities (Kenworthy and Laube, et al., 1999; Barter, 1999). The chapter focuses on the regions of East Asia, Southeast Asia and South Asia[1]. This group of regions provides an interesting 'laboratory' on urban transport where we find a host of variations in urban transport patterns.

There are numerous themes that we could explore but in the limited space available we will focus on certain lessons from the past experiences of Asian cities that now have high or middle incomes and which are especially relevant for low-income cities. Two themes arise strongly from this focus, with both relating to the relative priority given to different modes of transport. They are:

- Priorities in investment between the main modes of passenger transport (public transport, private transport and non-motorized transport);
- Policies affecting the pace of motorization and the growth of private vehicle use.

Data on Urban Transport from a Large Sample of Cities

The set of data referred to in this paper is drawn primarily from the *Millennium Cities Database for Sustainable Transport* (Kenworthy and Laube, 2001), which was compiled by the authors over three years for the International Union (Association) of Public Transport (UITP) in Brussels[2]. The database provides data on 100 cities on all continents.

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Data summarized here represent averages for nine groups of cities from 84 of the fully completed cities (listed in Table 1).

A detailed discussion of methodology is not possible in this chapter. The database contains data on 69 primary variables, which can mean up to 175 primary data entries. The methodology of data collection for all the factors was strictly controlled by agreed-upon definitions contained in a booklet of over 100 pages. Data were carefully checked and verified before being accepted into the database. From this complex range of primary factors, some 230 standardized variables have been calculated addressing a wide range of transport-related issues. For this chapter only a selection of salient features are chosen for comment. The data are for the year 1995 (although in certain cities the reference year is a year close to 1995). Data collection commenced in 1998 and was completed at the end of 2000. Currently, data for 1995 provides the latest perspective one can reasonably expect for an urban study of this magnitude.

Table 2 presents relevant data for the nine groups of urban areas. These particular groupings of cities were chosen with the help of several applications of hierarchical cluster analysis. This revealed that the regional groups, USA cities, Canadian (CAN) cities, Australian and New Zealand (ANZ) cities and Western European (WEU) cities generally corresponded with clusters of cities in the data set, suggesting that using these regional groupings would not be misleading. The cluster analyses also found that most of the Asian cities consistently fell into a number of clusters each of which were substantially Asian in membership. However, these Asian clusters generally did not follow sub-regional boundaries. Clusters among the remaining cities (outside East, Southeast and South Asia) were not obviously regional (or even sub-regional) in nature either. Further exploratory investigation of the data set suggested that a combination of income-based and regional groupings was the best option for comparing groups of ‘non-Western’ cities in the sample.

Therefore, the Asian cities were placed into three groups – High Income Asian (HIA), Middle Income Asian (MIA) and Low Income Asian (LIA) cities. The remaining cities in the sample were placed into two groups, Middle Income Other (MIO) and Low Income Other cities (LIO) as shown in Table 1. The choice of cut-off points between the higher-income, middle-income and lower-income groups was influenced by the cluster analyses and other exploratory analysis. For example, the choice of a high cut-off between middle-income and high-income cities allows Taipei to be grouped with Bangkok and Kuala Lumpur, with which it was consistently grouped by the cluster analyses.

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Table 1. Urban Areas in the Millennium Cities Database for Sustainable Transport and Discussed in this Chapter[b].

WESTERN EUROPE (WEU)			**UNITED STATES OF AMERICA (USA)**	**CANADA (CAN)**
Munich	Copenhagen	Berlin	S. Francisco	Vancouver
Frankfurt	Stockholm	London	Washington	Calgary
Zurich	Ruhr	Barcelona	New York	Toronto
Geneva	Nantes	Madrid	Denver	Ottawa
Dusseldorf	Graz	Glasgow	Chicago	Montreal
Bern	Marseilles	Manchester	Atlanta	
Lyon	Helsinki	Newcastle	Houston	**AUST/NZ (ANZ)**
Paris	Amsterdam	Athens	Los Angeles	Sydney
Stuttgart	Brussels		Phoenix	Perth
Vienna	Bologna		San Diego	Melbourne
Oslo	Rome			Wellington
Hamburg	Milan			Brisbane
HIGH INCOME[a] ASIA (HIA)	**MIDDLE INCOME[a] ASIA (MIA)**	**LOW INCOME[a] ASIA (LIA)**	**MIDDLE INCOME[a] OTHER (MIO)**	**LOW INCOME[a] OTHER (LIO)**
Tokyo	Taipei	Guangzhou	Tel Aviv	Bogotá
Osaka	Seoul	Shanghai	Prague	Teheran
Sapporo	Kuala Lumpur	Manila	Curitiba	Tunis
Hong Kong	Bangkok	Jakarta	Riyadh	Cairo
Singapore		Beijing	Budapest	Dakar
		Ho Chi Minh City	Sao Paulo	Harare
		Mumbai	Johannesburg	
		Chennai	Cape Town	
			Krakow	

a. For the purpose of grouping these cities, the cut-off points in terms of Gross Regional Product (GRP) per capita (1995 prices) between high-income and middle-income cities and between middle-income and low-income cities have been chosen to be US$16,000 and US$3,000 respectively.
b. The following cities are also included in the database but unfortunately could not be included in the analysis here due to incomplete data sets: Lille, Turin, Lisbon, New Delhi, Buenos Aires, Rio de Janeiro, Brasilia, Salvador, Santiago, Mexico City, Caracas, Abidjan, Casablanca, Warsaw, Moscow, Istanbul.

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Table 2. Land use and transport system characteristics by groupings of cities, 1995.

		USA	ANZ	CAN	WEU	HIA	MIA	LIA	MIO	LIO
Land Use and Wealth										
Urban density	persons/ha	14.9	15.0	26.2	54.9	134.4	164.3	205.6	53.7	122.1
Proportion of jobs in CBD	%	9.2%	15.1%	15.7%	18.7%	20.1%	13.1%	31.8%	16.8%	21.2%
Metropolitan gross domestic product per capita	USD	$31 386	$19 775	$20 825	$32 077	$34 797	$9776	$1689	$6625	$1949
Transport Investment Cost										
Percent of metro. GDP spent on pub. transport investment	%	0.18%	0.30%	0.18%	0.41%	0.47%	1.22%	0.53%	0.39%	0.62%
Percent of metro. GDP spent on road investment	%	0.86%	0.72%	0.87%	0.70%	0.96%	1.34%	1.82%	0.70%	0.75%
Private Transport Infrastructure Indicators										
Length of expressway per person	m/ person	0.156	0.129	0.122	0.082	0.022	0.027	0.004	0.043	0.009
Parking spaces per 1000 CBD jobs		555	505	390	261	121	164	55	374	134
Public Transport Supply and Service										
Public transport seat kilometres of service per capita	seat km/pers.	1556.8	3627.9	2289.7	4212.7	5535.2	2734.4	2057.4	3282.8	3322.2
Rail seat kilometres per capita (Tram, LRT, Metro, Sub. rail)	seat km/pers.	747.5	2470.4	676.4	2608.6	2719.9	361.8	250.0	1683.6	120.4
% of public transport seat km on rail	%	34.2%	65.2%	27.8%	55.5%	57.2%	13.1%	12.9%	33.6%	10.1%
Overall average speed of public transport	km/h	27.4	32.7	25.1	25.7	33.2	16.4	16.6	24.8	21.1
Ratio of public versus private transport speeds		0.58	0.75	0.57	0.79	1.08	0.78	0.80	0.70	0.71
Private transport supply (cars and motorcycles)										
Passenger cars per 1000 persons		587.1	575.4	529.6	413.7	217.3	198.3	38.0	265.1	71.2
Motor cycles per 1000 persons		13.1	13.4	9.5	32.0	65.8	154.0	95.6	14.7	15.1
Mode split of all trips										
* non motorized modes	%	8.1%	15.8%	10.4%	31.3%	29.1%	19.8%	50.1%	27.9%	36.3%
* motorized public modes	%	3.4%	5.1%	9.1%	19.0%	32.3%	25.6%	28.3%	26.6%	32.8%
* motorized private modes	%	88.5%	79.1%	80.5%	49.7%	38.6%	54.6%	21.6%	45.5%	30.9%

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Private Mobility Indicators		**USA**	**ANZ**	**CAN**	**WEU**	**HIA**	**MIA**	**LIA**	**MIO**	**LIO**
Passenger car passenger kilometres per capita	p.km/person	18 155	11 387	8645	6202	3724	3517	785	4133	1172
Motor cycle passenger kilometres per capita	p.km/person	45	81	21	119	100	1165	416	78	90
Public Transport Mobility Indicators										
Total public transport boardings per capita	bd./person	59.2	83.8	140.2	297.1	464.1	274.2	267.3	340.5	234.4
Rail boardings per capita (Tram, LRT, Metro, Sub. rail)	bd./person	21.7	42.5	44.5	162.2	284.8	38.9	30.0	159.0	15.6
Proportion of public transport boardings on rail	%	25.7%	48.8%	28.9%	50.0%	62.0%	12.8%	11.0%	33.1%	7.6%
Proportion of total motorized pass. km on public transport	%	2.9%	7.5%	9.8%	19.0%	50.3%	26.9%	51.1%	36.6%	54.2%
Public Transport Productivity										
Public transport operating cost recovery	%	35.5%	52.7%	54.4%	59.2%	138.5%	98.8%	138.6%	82.9%	107.9%
Overall Transport Cost										
Total passenger transport cost as % of metropolitan GDP	%	11.79%	13.47%	13.72%	8.30%	5.41%	13.60%	13.63%	15.45%	17.66%
Total private pass. transport cost as % of metro. GDP	%	11.24%	12.39%	12.87%	6.75%	3.81%	11.52%	11.19%	13.11%	13.50%
Total public pass. transport cost as % of metro. GDP	%	0.55%	1.08%	0.85%	1.55%	1.60%	2.08%	2.44%	2.34%	4.16%
Traffic Intensity Indicators										
Private passenger vehicles per km of road	units/km	98.7	73.1	105.8	181.9	118.1	290.4	169.3	137.5	139.7
Pass. vehicles per km of road	units/km	98.9	73.3	106.1	183.1	121.7	300.4	184.4	138.9	154.5
Average road network speed	km/h	49.3	44.2	44.5	32.9	31.3	20.9	20.5	35.9	30.4
Transport Energy Indicators										
Private passenger transport energy use per capita	MJ/person	60 034	29 610	32 519	15 675	9556	10 555	2376	10 569	4052
Public transport energy use per capita	MJ/person	809	795	1044	1118	1500	1583	607	1012	1696
Energy use per private passenger kilometre	MJ/p.km	3.25	2.56	3.79	2.49	2.42	2.03	1.63	2.39	2.10
Energy use per public transport passenger kilometre	MJ/p.km	2.13	0.92	1.14	0.83	0.44	0.74	0.46	0.53	0.69
Air Pollution Indicators										
Total emissions per capita (CO, SO2, VHC, NOx)	kg/person	264.6	188.9	178.9	98.3	31.3	97.2	69.1	157.5	81.8
Total emissions per urban hectare	kg/ha	3563	2749	4588	5304	3894	12 952	13 357	7236	9211
Emissions per kilometre of motorized vehicle travel	kg/p.km	0.020	0.025	0.027	0.021	0.012	0.026	0.069	0.052	0.071
Transport Fatalities Indicators										
Total transport deaths per 100,000 people		12.7	8.6	6.5	7.1	5.9	20.7	10.4	18.3	13.2
Total transport deaths per billion passenger kilometres		7.0	6.8	7.1	9.6	7.4	29.2	37.4	29.3	34.0

Source: Kenworthy and Laube (2001)

Asian Cities in International Context

In this section, we first examine some background issues before moving on to the policy-related issues that are the main focus of the chapter. All references to group averages refer to Table 2. Data on individual cities are from Kenworthy and Laube (2001).

Land use characteristics

A striking feature of the Asian cities as a group is their high density. The average urban densities of the three Asian groups (ranging from 134 to 206 persons per ha) are higher than any of the other groupings, with the Low Income Other (LIO) category coming next with 122 persons per hectare (pph). A number of Asian cities have extremely high urban densities, a fact that has important implications for their range of transport-related options (Barter, 2000). Of the 13 cities with densities of more than 120 persons per hectare, 11 are Asian. They are Ho Chi Minh City (356 pph), Mumbai (337), Hong Kong (320), Seoul (230), Taipei (230), Manila (206), Shanghai (196), Jakarta (173), Bangkok (139), Chennai (133) and Beijing (123). The only other cities in the sample with densities that are comparable to the very dense Asian cities are Cairo (with 272 pph) and Barcelona (197). Several other Asian cities have densities between 85 and 120 pph, which is still higher than any of the European cities except Barcelona. They are Guangzhou (119), Osaka (98), Singapore (94) and Tokyo (89). Only two of the Asian cities have urban densities that cannot be considered high. Kuala Lumpur is the lowest density of the Asian cities, with 58 pph, which is close to the average for the western European cities, and which might be characterized as middle-density. Sapporo in Japan (with 72 pph) also falls within the range of densities for European cities.

Wealth

The income per person of each urban region can also be important for transport development, for example by influencing which options are affordable. There are Asian cities at both extremes of income and at many levels in between. For example, the Asian groups of cities include one of the richest, Tokyo, with a GRP per capita of US$45 425 and the poorest, Chennai, with only $396 per capita. Asian cities offer some surprises when we compare their transport patterns and levels of wealth. We will see in subsequent sections that the wealthy Asian cities typically have much lower automobile dependence than cities with similar incomes per capita and even than many cities with much lower incomes. For example, private vehicle use in the HIA group tends to be comparable or lower than even the Middle Income Asian (MIA) and Middle Income Other (MIO) groups, despite having more than three times the average GDP per capita of these groups.

Key Policy-related Contrasts in the Sample of Cities

This section focuses on policy-related themes arising particularly from Asian transport experiences. It examines data to illustrate contrasts in policy and practice among the cities in the sample, particularly the Asian cities. The focus of the section is on a pivotal choice: which modes of transport should be emphasized and deserve most policy attention? Two key dimensions of this choice are discussed, namely investment priorities and policy towards managing the pace of rising private vehicle use and motorization.

Transport investment priorities

Let us examine what the data set can tell us about recent and past investment priorities. First, we can gain some insight on past investment priorities by looking at their legacy in terms of the stock of transport infrastructure.

Starting with road provision, note that generous expressway provision in particular is a common hallmark of cities that place a high priority on private transport in transport policy (Thomson, 1977). Expressway provision per person is comparatively low in the HIA cities compared to other high income regions (0.022 metres per person, with Singapore being the exception having 0.044 metres per person). Western European cities have almost 4 times more expressway per person on average and US cities have 7 times more than the HIA group, while all three regions have similar averages for GDP per capita. The lowest income groups (LIA and LIO) have low levels of expressway provision primarily due to an inability to afford such large investments. However, the MIA and MIO averages are higher than the HIA group on this indicator of commitment to private transport. Middle-income Kuala Lumpur stands out among the Asian cities for its particularly high level of expressway length per person (0.068 metres per person). It has been engaged in something of a frenzy of privatized toll-road building since the late 1980s. Decisions to build or not to build expressways are policy-driven and not merely an outcome of growing incomes *per se*.

The existence of intensely used reserved public transport routes is an indicator of a commitment to quality public transport. As motorization progresses and there are fewer ‘captive’ riders of public transport, the need for investment in enhancements such as protected, higher speed rights-of-way (rail systems and busways) becomes more important in order to retain competitive speeds. The speed of the public transport system and its ratio to the speed of private transport provide simple indicators of success in giving priority to public transport. The HIA cities have respectable public transport operating speeds reflecting past investments in rail systems that now carry substantial proportions (30 percent or more) of public transport passenger kilometres. Tokyo and Osaka stand out with very high public transport speeds (41 km/h and 50 km/h) that are much faster than private speeds (26 and 33 km/h). Hong Kong and Singapore (and Seoul from the MIA group) have built substantial rail mass transit systems since the 1970s but retain an important role for buses in mixed traffic. Hence their public transport speeds are more modest (about 24 km/h) and slightly slower than private speeds. Nevertheless, they are doing much better than Taipei and Bangkok from the MIA group, which manage public transport speeds of only 13 and 10 km/h respectively, or Kuala Lumpur where the public transport speed is 19 km/h, far slower than the private speed of 28 km/h. The LIA cities also have generally slow public transport, with speeds averaging only 17 km/h. The predominantly road-based public transport of most MIA and LIA cities suffers from the impacts of congestion.

The HIA group has the highest level of public transport seat kilometres per capita of all the groups (at over 5000 seat kilometres per capita, more than 30 per cent higher than the Western European cities , the next most well-served group). Levels of public transport service are much lower in the middle and lower income Asian groups of cities (MIA and

LIA), with less than half of the seat kilometres of service per capita of the HIA group and slightly less even than the levels in the other lower income groups, MIO and LIO.

Consistent with these facts, the HIA group also has the highest public transport use. The group has an average of 464 annual public transport boardings per capita and all the HIA cities, except Sapporo, have more than 45 per cent of the motorized transport task (passenger kilometres) on public transport. These figures are much higher than the MIA group with 274 boardings and 27 per cent of passenger kilometres on public transport (although Seoul and Bangkok do better than Kuala Lumpur or Taipei). The HIA public transport use is also higher than the nearest rival wealthy group of cities in Western Europe which has 297 boardings and 19 per cent. The Low Income Asian (LIA) and the Low Income Other (LIO) groups average high shares (51 per cent and 54 per cent) of motorized passenger kilometres on public transport but these high shares are in the context of much lower overall motorized mobility and are achieved with rather modest public transport usage (as measured for example by boardings). The Middle Income Other (MIO) group achieves the second highest usage of public transport on average with about 340 boardings per capita and 37 per cent of motorized passenger kilometres.

These findings suggest a surprisingly low level of public transport service and use in the MIA group, especially by Kuala Lumpur and Taipei, when compared with other relevant groups. Motorcycles in particular compete strongly with public transport in these cities, offering competitive speeds and relatively cheap mobility.

Table 2 shows data on levels of investment in roads and in public transport systems. These data are 5-year averages of all investment from all sources in roads and public transport (new construction and maintenance). All regions have higher average investment in roads than in public transport but the imbalance between them is lowest in the HIA, WEU, LIO, and MIA groups. The high public transport investment levels in the MIA cities reflect a large, if belated effort to catch up, with large rail investments especially in Taipei but also in Kuala Lumpur and Bangkok during the 1990s, as well as significant expansion of Seoul’s mass transit network. Taipei (and also Singapore) was in fact among the few cities in the sample with higher public transport investment than road. By contrast, the three Japanese cities seem to have been compensating for their earlier very high emphasis on urban rail by having among the highest levels of road investment per capita in the 1990s.

The imbalance between investment in roads versus public transport is greatest in the LIA, USA and Canadian groups, each with well over 3 times more investment in roads than public transport. This imbalance in the LIA cities is particularly worrying since transport spending priorities in the early phases of motorization are likely to have a great influence on whether it is private transport or more balanced transport patterns that become firmly entrenched in the urban fabric. Of particular concern may be Guangzhou and Manila, which seem to have been investing about 5 to 7 times more heavily in roads than public transport.

Data on investment in facilities for walking and non-motorized vehicles is scarce and there is not the scope to examine this issue here. Non-motorized transport, particularly bicycle use, is especially vulnerable and easily discouraged by hostile street conditions. Efforts to provide a more welcoming environment for non-motorized modes clash head on with the demands of private vehicles, especially in dense urban environments where space is at a premium. Promotion of high roles for walking and cycling appears to have been very successful only in contexts where private motor vehicles have been restrained (by low incomes or by policy), for example in China and Vietnam in the 1980s, in Japanese cities, and in a number of northern European cities. Furthermore, success with promoting non-motorized transport is often an important complement to a strong role for public transport.

Managing the Pace of Motorization and Private Transport Demand

This brings us to the second key area which reflects as well as shapes transport policy priorities. As incomes rise cities face difficult choices over the pace of motorization and the management of demand for private vehicle travel. Since the 1970s, many have argued that restraining private vehicles (by slowing the growth of their numbers and/or their use) is necessary in large, rapidly growing, rapidly motorising cities (Linn, 1983; Tanaboriboon, 1992). However, proposals for such measures always generate heated public debate.

We will argue that the experience from a number of the high-income and middle-income Asian cities strengthens the case for the private vehicle restraint, especially at an early stage in the process when slowing the pace of motorization can be the main restraint policy, as a crucial intervention in helping to create balanced and effective transport systems (Barter,1999). There is also a strong link with the investment priorities discussed in the previous section, since restraining private vehicles apparently makes it much easier for a city to devote high priority to public transport over private transport.

Data from Table 2 on motorization and private vehicle use and Figure 1 (which shows the private vehicle use versus income per capita) show that the HIA cities, and to a lesser extent the WEU cities, have levels of private car ownership and use that are surprisingly low considering their income levels. For example, the HIA cities on average have remarkably low private car ownership, with levels (217 cars per 1000 people) that are comparable to the MIA cities (198 per 1000) and lower than the average for the MIO cities (265 cars per 1000). The USA and ANZ groups contrast with the Western European (WEU) group in having significantly higher motorization and vehicle use despite similar (or lower) average income levels per capita than the WEU group. The LIA cities have very low car ownership (of only 38 cars per 1000) and use as might be expected given their low-income levels.

The patterns for motorcycles are also striking, with the Asian groups standing out. The MIA cities tend to have the highest levels of ownership (154 motorcycles per 1000 people on average). The average levels of motorcycle ownership in the HIA, MIA and LIA groups respectively are about 2 times, almost 5 times and about 3 times the average level of the next highest region, the Western European group of cities. The high motorcycle ownership in the middle and low income Asian groups (MIA and LIA) contrasts with the other non-Western groups of cities in the same income ranges (MIO and LIO), which both have very low motorcycle ownership of only 15 motorcycles per 1000 people.

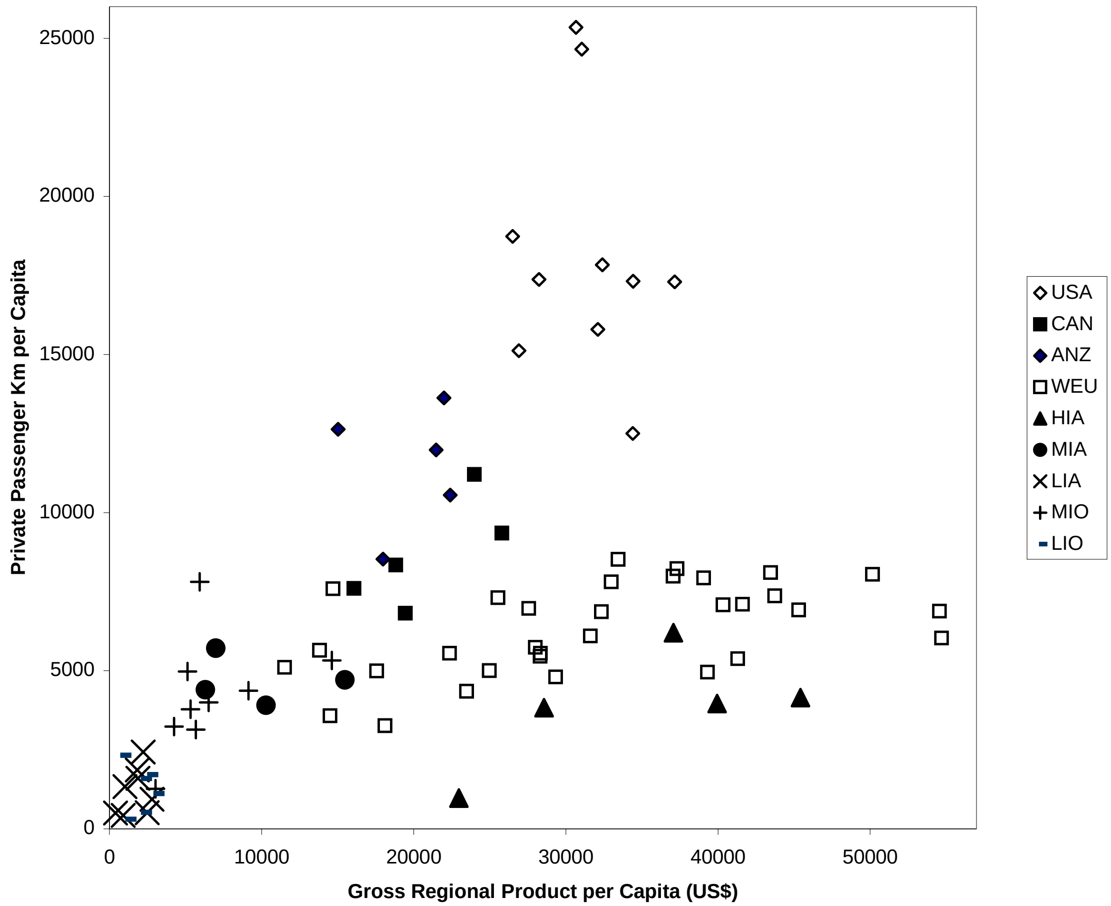

Figure 1 Private Vehicle Use versus Income per Capita in an International Sample of Cities, ca. 1995

Source: Kenworthy and Laube, 2001

These contrasts can be further emphasized by examining specific cities from among the Asian groups. Hong Kong is most dramatic, with only 47 cars per 1000 people and negligible motorcycle ownership despite a higher per capita income than many European, Australian and Canadian cities. Singapore is even wealthier but has constrained private passenger vehicle ownership to only 116 cars and 43 motorcycles per 1000 people in our reference year. The three Japanese cities have much higher vehicle ownership (between 264 and 352 cars and between 45 and 138 motorcycles per 1000 people) but these levels are still rather low considering these cities' very high levels of income per capita.

Among the Middle Income Asian (MIA) group of cities, Bangkok (with 249 cars and 205 motorcycles per 1000 people) and Kuala Lumpur (with 209 cars and 175 motorcycles per 1000 people) most clearly have higher motorization than expected on the basis of income[3]. In this they are similar to many of the MIO cities which also tend to have high car ownership relative to incomes. Seoul and Taipei show some modest restraint of private vehicles according to the data and, despite being richer than Bangkok or Kuala Lumpur, they fall between them and the HIA cities in terms of motorization relative to income, with 160 and 175 cars and 39 and 197 motorcycles per 1000 respectively.

What circumstances and policy decisions underpin these numbers? First let us mention Kuala Lumpur and Bangkok, where the only restraint has been modest price disincentives related to tariff protection for local motor industries. These have had a decreasing impact as incomes have risen, as local production of low-priced vehicles has increased, and as protection has been lowered (at least in Thailand). Despite acute traffic problems, particularly in Bangkok's denser urban fabric, neither city has proposed any policy measures to slow down the pace of motorization. Usage disincentives have never been pursued seriously (Barter, 1999).

At the other extreme within the Asian groups of cities, low vehicle ownership and use in Hong Kong and Singapore can be directly attributed to their well-documented restraint policies, especially to contain ownership since the early 1970s (Ang, 1996; Wang and Yeh, 1993). In Hong Kong's case, this began with car ownership levels of less than 30 cars per 1000 persons. Singapore's restraint began when car ownership was a little higher at about 70 per 1000 persons plus about 50 motorcycles per 1000 persons (Barter, 1999).

The Japanese cities and Seoul and Taipei are now between the above two extremes in terms of their restraint of private vehicles. Seoul and the Japanese cities contrast in many ways but their histories of private vehicle restraint have much in common (Barter, 1999). Both Japan (prior to the 1960s) and Korea (prior to the 1980s) had macroeconomic strategies which involved severe restraint on private consumption, including the purchase of private vehicles. Therefore their motor vehicle ownership remained extremely low (only 16 cars per 1000 people in Tokyo in 1960 and the same in Seoul in 1980) despite each country already enjoying considerable economic success (Barter, 1999). Both Japan and Korea subsequently relaxed their restraints on vehicle ownership and allowed a burst of motorization (in the 1960s in Japan and since the mid-1980s in Korea). However, some disincentives to vehicle ownership and usage remain in force or have been introduced as congestion has become a greater problem (Barter, 1999). In addition, there are important legacies of the earlier period of restraint, such as extensive and well-used rail systems and considerable transit-oriented development in both places.

Taipei's experience has much in common with those of Bangkok and Kuala Lumpur, including very high levels of motorcycle ownership and use. Like these two cities, Taipei also faced rather extreme traffic congestion problems by the mid 1990s and a low level of public transport use. However, Taipei's motorization was somewhat slower than Kuala Lumpur's or Bangkok's. It has currently reached a similar level of motorization but with a very much higher level of income. This difference may relate indirectly to the need to import oil and to the lack of a significant car manufacturing industry in Taiwan, although the motorcycle/scooter industry is among the largest in the world. A very high-density urban fabric may also be important by making traffic impacts such as congestion, pollution and parking shortages, emerge very quickly as motorization took off. It seems that for various reasons and without much fanfare, the costs of buying and using private cars in Taiwan have been kept at a relatively high level. Data from this study suggest that in the mid-1990s overall costs per passenger kilometre for private vehicles were comparable with Japanese and Swiss cities. The World Bank also reports that in 1994 the price of gasoline in Taiwan was about double that in Thailand (World Bank, 1996). It remains to be seen if these subtle differences between Taipei and the Southeast Asian cities will be important for subsequent trends. High motorcycle use and rising car ownership had stifled Taipei's public transport development up until the mid 1990s, but there are signs recently of improvements for public transport via a very successful bus priority system, rapidly expanding mass transit and moves to tighten regulation of parking, including by motorcycles (Hwang, 2001; Her, 2001).

Benefits of Slowed Motorization for Public Transport Development

In a number of the cities examined above, deliberately slowing down the motorization process was an important factor in allowing public transport to build its role, even as incomes increased[4]. Examples include the Japanese cities, Singapore and Hong Kong. For a time, Seoul was also an example of this phenomenon. Many western European cities also probably offer support for this argument, especially when they are compared with the other western groups of cities in this sample, although it is not possible to investigate this question here.

Tokyo, Osaka, Hong Kong, Singapore and Seoul all share a history of having strongly curtailed motorization for a significant period at an early stage (well before motorization reached around 150 vehicles per 1000 people). In the cases of Hong Kong, Singapore and Seoul, high-quality mass transit systems were not yet in operation at the time that private vehicle restraint began. In fact, slow motorization despite rapidly rising incomes allowed all of these cities a window of opportunity during which they could continue to invest in public transport and eventually provide substantial, high-quality public transport systems BEFORE private vehicle ownership reached 150 vehicles per 1000 persons. In doing so these cities avoided many of the transport-related problems and pitfalls that befall many cities with rapidly rising incomes. They were able to maintain bus-based public transport usage at a high level until mass transit became affordable and was built. Public transport never became the mode of last resort or to be seen as only for the poor in these cities. Seoul and the Japanese cities, where constraints on motorization have been relaxed, provide some evidence that the earlier policies helped to provide an irreversible legacy. Tokyo, Osaka and Seoul now have a 'critical mass' of traffic-segregated public transport, which unlike buses in mixed traffic, will not enter a vicious downward cycle even if the roads become grid-locked. Public transport in these cities is therefore likely to be seen as part of the solution.

These experiences contrast with those of Kuala Lumpur, Taipei and Bangkok where motorization has been able to reach rather high levels before substantial mass transit systems were in place and public transport use became stigmatized as a mode of last resort (Barter, 1999). In Taipei, and especially in Kuala Lumpur, public transport's mode share has dropped to low levels, which will be difficult to reverse even with expanding mass transit. Bangkok retains surprisingly high public transport ridership (primarily captive riders of the very slow bus system), but public transport improvements are very slow and ridership seems likely to be extremely vulnerable in the event of a resumption of economic growth and further motorization. Some of the LIA cities seem likely to follow this unhappy trend unless serious steps are taken to slow motorization in order to buy time to enhance the alternatives to private vehicles. Ho Chi Minh City already has a very minimal role for public transport and is dominated by motorcycles.

This argument about the importance of slowing the pace of motorization helps to place mass transit investments into a new perspective. Most commentators agree that expensive investments in rail mass transit are extremely difficult for low-income cities (Fouracre, Allport, and Thomson, 1990). The argument here suggests that the deliberate slowing of motorization can play a key role in allowing a city to set out on a transit-oriented development path. Such a strategy prevents rapid motorization from undermining the role of public transport and instead allows the role of public transport to build up gradually in conditions of rising incomes but low vehicle numbers and relatively low pressure to invest heavily in roads. The delay in motorization means that the decision to spend on mass transit can be delayed until it is relatively affordable to the city and yet still be guaranteed high ridership. This is in contrast to the consequences of allowing unrestrained motorization with congestion and modal competition causing bus services and usage to deteriorate, creating intense pressure to expand roads, and making investments in mass transit appear less and less viable.

Prospects for Restraint in Low-income Cities

The comments above suggest that the early years of the new millennium will be a crucial time for the lower-income groups of cities, especially those enjoying a measure of economic success. Efforts to slow motorization could help to buy time to build a more balanced transport system and avoid some of the worst impacts of explosive motorization. It is generally too soon to tell whether any of these cities are likely to do this but the signs are mostly not promising. Glimmers of hope do appear from time to time, such as Bogotá's referendum in October 2000 which committed the city to aiming for a car-free system by 2015.

Ho Chi Minh City is unique in this sample of cities (but perhaps representative of a small group of other cities in Indochina) in experiencing extremely rapid growth in motor cycle ownership which has almost destroyed what little public transport there had been and is in the process of replacing bicycles. With 291 motorcycles per 1000 people Ho Chi Minh City has by far the highest motorcycle ownership in this sample of cities. Only Bangkok (with 205 per 1000 people), Taipei (with 197), Kuala Lumpur (175) and Jakarta (168) have anything like this many motorcycles per capita. There are as yet no signs of efforts to restrain this motorcycle-based motorization process (MVA, 1997). However, car ownership is still currently very low and, in addition to low income levels, this may be partly attributed to relatively high ownership fees (Heil and Pargal, 1998). The city's motorcycle dominated situation is unprecedented, but the experiences of Bangkok and Taipei suggest that, combined with very high urban densities, the impact of motorcycles on public transport sets the scene for extreme traffic-related problems when economic growth later brings in more private cars.

Jakarta and Manila have both faced rapid motorization in the 1990s which has been slowed or halted since the East Asian economic crisis that began in 1997. Neither has taken steps to slow motorization but both have begun attempts to restrain the use of private vehicles in the most congested places (Barter, 1999). Although modest, these efforts have been accompanied by intense debate, which is likely to intensify if the economic situation improves and rapid motorization resumes. Indonesia's efforts to reduce the huge fuel subsidy has repeatedly met with fierce political resistance. Neither country (or city) is considering efforts to slow motorization itself (Barter, 1999).

Chinese cities are in the early stages of a boom in car ownership. National policies increasingly aim to increase private car ownership in order to encourage the motor vehicle industry. Moves to reduce national-level taxes and fees on cars will soon be complemented by reduced tariffs as China enters the World Trade Organization (China Daily, 22 April 2001. Beijing shows no sign of restricting cars significantly but some cities, most notably Shanghai, have been deliberately slowing the growth of vehicle ownership by various means. Both car and motorcycle ownership are controlled through an auction of certificates to register. These restrictions are despite the status of the Shanghai area as the most important focus of the Chinese motor industry. Shanghai has much lower car ownership than Beijing despite its higher income levels. However, there are signs that the severity of these restrictions is gradually being eased (Shanghai Star, 28 January 2000).

Indian cities are also in the early stages of a boom in private vehicle ownership, with both car and motorcycle numbers rising steeply in the wake of deregulation of the vehicle industry and vehicle imports along with rising numbers of middle income urban dwellers. There are few, if any, signs of efforts to restrain the rate of motorization, although public debate over the impacts of vehicles is increasing. The national government is also gradually trying to reduce the burden of fuel subsidies on the national budget, which will probably lead to slightly higher gasoline prices.

Transport Impacts

Let us now briefly consider data on the impacts of transport. These suggest that policies seeking a balance in transport priorities and avoiding dominance by private vehicles are important for minimising the negative impacts of transport.

Cost effectiveness

Firstly, the data set offers information on cost effectiveness suggesting that an emphasis on the alternatives to private vehicles offers the most thrifty strategy when viewed at a city-wide level. One measure of the cost-effectiveness of urban transport is how much of a city's GDP has to be spent moving people around (public and private transport operating and investment costs). It is obviously desirable to minimize this expenditure while at the same time providing high (or at least satisfactory) levels of access to services, goods and human opportunities.

If we assume that all high-income cities come close to providing satisfactory access for their residents then it is striking that on average the least car-oriented groups are able to do so much more economically than the car-dominated wealthy groups. The HIA group expends on average only 5.4 per cent of GDP (3.8 per cent on private transport and 1.6 per cent on public transport), ahead of WEU cities at 8.3 per cent and far more thrifty that the more car-dependent regions which spend between 11.8 per cent and 13.7 per cent of GDP on passenger transport, the vast majority of which is private transport (11.2 per cent to 12.9 per cent).

In the middle and low-income groups we can not necessarily assume that access needs are being adequately met and levels of spending on the transport task in these groups of cities are typically relatively modest in absolute terms. Nevertheless, this spending amounts to high proportions of GRP (from 13.6 per cent in the MIA group to 17.7 in the LIO group). As we have seen above, there is a tendency among these groups to have comparatively high levels of motorization and vehicle use relative to their economic development level. An exception, is the group of three Chinese cities, which spend a slightly more modest 10.7 per cent of GDP on average on passenger transport. This is almost certainly due to their emphasis on cost-effective non-motorized transport, particularly bicycles.

The data on spending also demonstrate that when public transport is well used it is very cost-effective relative to its proportion of the motorized passenger task. This is most clearly shown by the lower income groups of cities. For example, in the LIA group, 51 per cent of motorized passenger kilometres are carried by public transport for expenditure of 2.4 per cent of GDP (or about 18 per cent of the transport spending), versus 49 per cent carried by private vehicles for 11.2 per cent of GDP (or about 82 per cent of passenger transport spending)! By contrast the USA group has poorly patronized public transport which serves less than 3 per cent of the passenger transport task on average but which accounts for 4.7 per cent of the transport spending. But note that the Canadian group's well-used public transport does better, serving almost 10 per cent of passenger kilometres but taking only 6.2 per cent of the transport spending.

Energy use and air pollution

It is also desirable for a transport system to minimize the energy use and air pollution emissions attributable to transport. Again the HIA cities do well. HIA cities are by far the least energy intensive of the high income groups of cities, having a per capita consumption (private and public transport energy) that averages only 18 per cent of the US group average and having the most energy-efficient private and public transport systems per passenger kilometre. The HIA transport energy usage per capita are in fact slightly lower than those of both middle income groups in Table 2. .

HIA cities, which combine low car use with strong emissions regulations for vehicles, have dramatically lower per capita emissions of CO, SO_2, VHC and NO_X than any other group of cities, including the middle and low income groups. However, HIA cities also tend to have high urban densities. This results in a high spatial intensity of emissions, higher on average than those of the USA and ANZ groups, despite the much higher emissions per capita of those groups. Similarly, despite modest emissions per capita the highest density groups of cities, the MIA and LIA groups, have the highest levels for emission per hectare. This highlights the need for dense cities to work especially hard to ensure low per capita emissions. Unfortunately, currently MIA and LIA cities tend to have a nasty combination of factors with dense urban forms, rising use of motor vehicles, and poor emissions control.

Safety

Contrasts in transport safety outcomes also reveal benefits from restraining private vehicle use. The Middle Income Asian (MIA) group has the highest transport death rate per 100 000 people of all of the groups (at 20.7, slightly higher than the MIO group with 18.3), while the more transit-oriented HIA group has the lowest (at 5.9). The problem for the middle-income groups of cities is that they combine both very high rates of transport deaths per billion passenger kilometres with relatively high vehicle use. The two low-income groups (LIA and LIO) have even higher deaths per billion passenger kilometres but because of lower vehicle use this translates to more moderate rates of deaths per 100,000 people. The USA cities also display the safety problems of high vehicle use. Even though the USA group has among the lowest deaths per billion passenger kilometres, their extremely high levels of vehicle use mean that they still have the highest rate of transport deaths per 100 000 people from among the five high-income groups of cities (at 12.7 versus 8.6, 6.5, 7.1 and 5.9 for the ANZ, CAN, WEU and HIA groups respectively).

Conclusion

Evidence from cities in Asia provides important policy insights for low-income cities everywhere, especially those that are beginning to enjoy some economic success. The evidence in this chapter suggests that an early decision to prioritize public transport and non-motorized transport investments over private transport-oriented investments can bring important long term benefits. Such investment priorities are made enormously easier to carry out in developing cities if the pace of motorization can be deliberately slowed down, especially during the early stages of the process which often accompany periods of rapid economic growth and urbanization. The need for better balanced transport systems is particularly acute for cities that are already large and dense, as is very common in cities throughout the low-income parts of the world, since dense cities are particularly vulnerable to the negative impacts of traffic.

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[1] References to 'Asian cities' in this chapter refer to these three sub-regions and do not include cities in other Asian sub-regions, such as Teheran, Riyadh or Tel Aviv in Southwest Asia.

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[3] Motorization levels in Bangkok and Kuala Lumpur are clearly high, despite some concern that these figures may be slightly inflated due to inaccurate official data, particularly in the case of Bangkok.

[4] A more extensive treatment of this argument is in preparation (Barter, in preparation).