"Transit and the Metropolis: Finding Harmony"

from *The Transit Metropolis: A Global Inquiry* (1998)

Robert Cervero

Editors' Introduction

Rising traffic volume and congestion are leading citizen concerns in most cities and towns the world over, and of course produce other sustainability-related problems such as air pollution, greenhouse gas emissions, depletion of nonrenewable fossil fuels, destruction of open space by roads and suburban sprawl, and degradation of local neighborhood quality of life. Vehicle ownership continues to grow rapidly in most countries, and the number of miles driven per capita has doubled in nations such as the USA over the last generation. How can this situation ever be changed? While there is no easy answer to this question, a number of combined strategies involving land use, public transit, other alternative travel modes, and pricing are likely to make the difference. This chapter explores some of these areas crucial to improving urban sustainability.

University of California at Berkeley professor Robert Cervero has studied relationships between transportation and land use the world over and is a leading authority on strategies to reduce automobile use. In this selection from his book *The Transit Metropolis: A Global Inquiry* (Washington, DC: Island Press, 1998), he asks why automobile use continues to grow and public transit use decline, and what characteristics can lead urban regions to buck this trend. Solutions, he believes, can be of several sorts. Regions may adapt their land use to fit around major transit systems such as subways or light rail lines ("adaptive cities"). Or they might adapt their transit systems to fit their low-density land use by employing on-demand shuttles and vans and/or flexible bus systems ("adaptive transit"). Or various hybrid options are possible. Pricing of transportation and other "transportation demand management" policies will play a role as well. The long-term goal, in Cervero's view, is the "transit metropolis" where strong public transit alternatives exist to balance private vehicle use.

Other resources on the subject of reducing automobile use include Peter Newman and Jeffrey Kenworthy's *Sustainability and Cities: Overcoming Automobile Dependence* (Washington, DC: Island Press, 1999; excerpted later in Part 2), Anthony Downs' *Stuck in Traffic: Coping With Peak-Hour Traffic Congestion* (Washington, DC: The Brookings Institution, 1992), and David Engwicht's *Reclaiming Our Cities & Towns: Better Living with Less Traffic* (Philadelphia: New Society Publishers, 1993). Two excellent internet resources on transportation are the Surface Transportation Policy Project (www.transact.org) and the Victoria Transportation Policy Institute (www.vtpi.org), both of which offer an impressive array of materials on transportation policy and how it might be reformed.

Public transit systems are struggling to compete with the private automobile the world over. Throughout North America, in much of Europe, and even in most developing countries, the private automobile continues to gain market shares of motorized trips at the expense of public transit systems. In the United States, just 1.8 per cent of all person trips were by transit in 1995, down from 2.4 per cent in 1977 and 2.2 per cent in 1983.[1] Despite the tens of billions of dollars invested in new rail systems and the underwriting of more than 75 per cent of operating expenses, ridership figures for transit's bread-and-butter market – the work trip – remain flat. Nationwide, 4.5 per cent of commutes were by transit in 1983; by 1995, this share had fallen to 3.5 per cent.

The declining role of transit has been every bit as alarming in Europe, prompting some observers to warn that it is just a matter of time before cities like London and Madrid become as automobile-oriented as Los Angeles and Dallas. England and Wales saw the share of total journeys by transit fall from 33 per cent in 1971 to 14 per cent in 1991.[2] Since 1980, transit's market shares of trips have plummeted in Italy, Poland, Hungary, and former East Germany. Eroding market shares have likewise been reported in such megacities as Buenos Aires, Bangkok, and Manila.

Numerous factors have fueled these trends. Part of the explanation for the decline in Europe has been sharp increases in fares resulting from government deregulation of the transit sector. Public disinvestment has left the physical infrastructure of some transit systems in shambles in Italy and parts of Eastern Europe. However, transit's decline has been more an outcome of powerful spatial and economic trends that have been unfolding over the past several decades than of overt government actions (or inaction). Factors that have steadily chipped away at transit's market share worldwide include rising personal incomes and car ownership, declining real-dollar costs for motoring and parking, and the decentralization of cities and regions. Of course, these forces have partly fed off each other. Rising wealth and cheaper motoring, for instance, have prompted firms, retailers, and households to exit cities in favor of less dense environs. Spread-out development has proven to be especially troubling for mass transit. With trip origins and destinations today spread all over the map, mass transit is often no match for the private automobile and its flexible, door-to-door, no-transfer features.

Suburbanization has not crippled transit systems everywhere, however. Some cities and regions have managed to buck the trend, offering transit services that are holding their own against the automobile's ever-increasing presence, and in some cases even grabbing larger market shares of urban travel. These are places, I contend, that have been superbly adaptive, almost in a Darwinian sense. Notably, they have found a harmonious fit between mass transit services and their cityscapes.

Some, like Singapore and Copenhagen, have adapted their settlement patterns so that they are more conducive to transit riding, mainly by rail transit, whether for reasons of land scarcity, open space preservation, or encouraging what are viewed as more sustainable patterns of growth and travel. This has often involved concentrating offices, homes, and shops around rail nodes in attractive, well-designed, pedestrian-friendly communities. Other places have opted for an entirely different approach, accepting their low-density, often market-driven lay of the land, and in response adapting mass transit services and technologies to better serve these spread-out environs. These are places, such as Karlsruhe in Germany and Adelaide, Australia, that have introduced flexible forms of mass transit that begin to emulate the speedy, door-to-door service features of the car.

Still other places, like Ottawa, Canada, and Curitiba, Brazil, have struck a middle ground, adapting their urban landscapes so as to become more transit-supportive while at the same time adapting their transit services so as to deliver customers closer to their destinations, minimize waits, and expedite transfers. It is because these places have found a workable nexus between their mass transit services and urban settlement patterns that they either are or are on the road to becoming great transit metropolises.

What these areas have in common – adaptability – is first and fundamentally a calculated process of making change by investing, reinvesting, organizing, reorganizing, inventing, and reinventing. Adaptability is about self-survival in a world of limited resources, tightly stretched budgets, and

ever-changing cultural norms, lifestyles, technologies, and personal values. In the private sector, any business that resists adapting to changing consumer wants and preferences is a short-lived business. More and more, the public sector is being held to similar standards. There is no longer the public largesse or patience to allow business as usual. Transit authorities must adapt to change, as must city and regional governments. Trends like suburbanization, advances in telecommunications, and chained trip-making require that transit agencies refashion how they configure and deliver services and that builders and planners adjust their designs of communities and places. In the best of worlds, these efforts are closely coordinated. This will most likely occur when and where there is the motivation and the means to break out of traditional, entrenched practices, which, of course, is no small feat in the public realm. Yet even transit's most ardent defenders now concede that steadily eroding shares of metropolitan travel are a telltale sign that fresh, new approaches are needed. Places that appropriately adapt to changing times, I contend, are places where transit stands the best chance of competing with the car well into the next millennium.

It bears noting that a functional and sustainable transit metropolis is not equated with a region whereby transit largely replaces the private automobile or even captures the majority of motorized trips. Rather, the transit metropolis represents a built form and a mobility environment where transit is a far more respectable alternative to traveling than currently is the case in much of the industrialized world. It is an environment where transit and the built environment harmoniously co-exist, reinforcing and enhancing each other in the process. Thus, while automobile travel might still predominate, a transit metropolis is one where enough travelers opt for transit riding, by virtue of the workable transit–land use nexus, to place a region on a sustainable course.

It is also important to emphasize . . . connections between transit and urbanization at the regional scale versus the local one. While considerable attention has been given to transit-oriented development (TOD) and the New Urbanism movement in recent years, both by scholars and the popular press, much of this focus has been at the neighborhood and community levels. Micro-scale designs that encourage walking and promote community cohesion have captivated the attention of many proponents of TODs and New Urbanism. While good quality designs are without question absolutely essential to creating places that are physically conducive to transit riding, they are clearly not sufficient in and of themselves. Islands of TOD in a sea of freeway-oriented suburbs will do little to change fundamental travel behavior or the sum quality of regional living. The key to making TOD work is to make sure that it is well coordinated across a metropolis. While land use planning and urban design are local prerogatives, their impacts on travel are felt regionally. . . .

[. . .]

TYPES OF TRANSIT METROPOLISES

[There are] four classes of transit metropolises:

- *Adaptive cities.* These are transit-oriented metropolises that have invested in rail systems to guide urban growth for purposes of achieving larger societal objectives, such as preserving open space and producing affordable housing in rail-served communities. All feature compact, mixed-use suburban communities and new towns concentrated around rail nodes . . . . examples are Stockholm, Copenhagen, Tokyo, and Singapore.
- *Adaptive transit.* These are places that have largely accepted spread-out, low-density patterns of growth and have sought to appropriately adapt transit services and new technologies to best serve these environs. [Models include] technology-based examples (e.g. dual-track systems in Karlsruhe, Germany), service innovations (e.g. track-guided buses in Adelaide, Australia), and small-vehicle, entrepreneurial services (e.g. colectivos in greater Mexico City).
- *Strong-core cities.* [Cities such as] Zurich and Melbourne have successfully integrated transit and urban development within a more confined, central city context. They have done so by providing integrated transit services centered around mixed-traffic tram and light rail systems. In these places, trams designed into streetscapes co-exist nicely with pedestrians and bicyclists. These cities' primacies (high

shares of regional jobs and retail sales in their cores) and healthy transit patronage are testaments to the success of melding together the renewal of both central city districts and traditional tramways.

- *Hybrids: adaptive cities and adaptive transit.* [Cities such as] Munich, Ottawa, and Curitiba are best viewed as hybrids, in the sense that they have struck a workable balance between concentrating development along mainline transit corridors and adapting transit to efficiently serve their spread-out suburbs and exurbs. Greater Munich's hybrid of heavy rail trunkline services and light rail and conventional bus feeders – all coordinated through a regional transit authority – has strengthened the central city while also serving suburban growth axes. Both Ottawa and Curitiba have introduced flexible transit centered around dedicated busways, and at the same time have targeted considerable shares of regional commercial growth around key busway stations. The combination of flexible bus-based services and mixed-use development along busway corridors has given rise to unusually high per capita transit ridership rates in both cities.

[. . .]

TRANSIT SERVICES AND TECHNOLOGIES

I have opted for the term *transit* to describe generically the collective forms of passenger-carrying transportation services – ranging from vans and minibuses serving multiple origins and destinations (many-to-many) over nonfixed routes to modern, heavy rail trains operating point to point (one-to-one) over fixed guideways. *Transit* is the catchall used in the United States and Canada; however, almost everywhere else, *public transport* is the vernacular. And while in much of North America, *public transport* or *public transit* is associated with mass transit services provided by the public sector, almost everywhere else it means services that are available to the public at large, whether publicly or privately deployed. It is this broader, more inclusive definition of public transport that is adopted [here].

Types or classes of transit services can be defined along a continuum according to types of vehicles, passenger-carrrying capacities, and operating environments. The following sections elaborate on the forms of common-carrier transit services – i.e., those available to the general public. . . .

Paratransit

The smallest carriers often go by the name of *paratransit*, representing the spectrum of vans, jitneys, shuttles, microbuses, and minibuses that fall between the private automobile and conventional bus in terms of capacities and service features. Often owned and operated by private companies and individuals, paratransit services tend to be flexible and highly market-responsive, connecting multiple passengers to multiple destinations within a region, sometimes door-to-door and, because of multiple occupants, at a price below a taxi (but enough to more than cover full operating costs). Driven by the profit motive, paratransit entrepreneurs aggressively seek out new and expanding markets, innovating when and where necessary. Much of their success lies in their flexibility and adaptability. Unencumbered by strict operating rules, jitney drivers will sometimes make a slight detour to deliver someone hauling groceries to his or her front door in return for an extra charge. Besides being more human-scale, jitneys and minibuses can offer service advantages over bigger buses – often, they take less time to load and unload, arrive more frequently, stop less often, and are more maneuverable in busy traffic, and, studies show, passengers tend to feel more secure since each one is closer to the driver.[3]

In many parts of the developing world, jitneys and minibuses are the mainstays of the transit network. The archetypal service consists of a constellation of loosely regulated owner-operated collective-ride vehicles that follow more or less fixed routes with some deviations as custom, traffic, and hour of day permit. Jitney drivers respond to curbside hails pretty much anywhere along a route. Every paratransit system, however – whether the 2,000 *matatus* of Nairobi, the 15,000 *carros por puesto* minibuses in Caracas, or the 40,000-plus jeepneys

of Manila – differs in some way. Some load customers in the rear of vehicles and others on the side; some are governed by federations of jitney owners while others engage in daily head-to-head competition; some have comfortable padded seats and others have hard wooden benches. Manila's jeepneys (converted US army jeeps that serve up to twelve riders on semifixed routes) carry about 60 per cent of all peak-period trips in the region. They cost 16 per cent less per seat mile than standard buses and generally provide a higher quality service (e.g., greater reliability, shorter waits) at a lower fare. Jeepney operations have historically been the last to petition for fare increases.[4]

Although banned in most wealthy countries, a handful of US cities today allow private minibus and jitney operators to ply their trade as long as they meet minimum safety and insurance requirements. New York City has the largest number of privately operated van services of any American city – an estimated 3,000 to 5,000 vehicles (seating 14 to 20 passengers) operate, both legally and illegally, on semifixed routes and variable schedules to subway stops and as connectors to Manhattan. Surveys show that more than three-quarters of New York's commuter van customers are former transit riders who value having a guaranteed seat and speedy, dependable services. Miami also has a thriving paratransit sector that caters mainly to recent immigrants from Cuba and the West Indies who find jitney-vans a more familiar and congenial form of travel than buses. Today, virtually all US cities allow private shuttle vans to serve airports.

Studies consistently show that jitneys and minibuses, whether in United States or Southeast Asia, confer substantial economic and financial benefits, both to the public sector and to private operators – namely, they are more effective at coaxing motorists out of cars than conventional transit in many settings, and do so without costly public subsidies.[5] However, as passenger volumes rise above a certain threshold (usually 4,000 or more per direction per hour), the economic advantages of paratransit begin to plummet, reflecting the limitations of smaller vehicles in carrying large line-haul loads. In both the developing and developed worlds, paratransit best operates in a supporting and supplement rather than substituting, role.

Bus transit

Urban *bus transit* services come in all shapes and sizes, but in most places they are characterized by 45- to 55-passenger pneumatic-tire coaches that ply fixed routes on fixed schedules. Buses are usually diesel propelled, though in some larger metropolises (e.g., Mexico City, Toronto), electric trolley buses powered by overhead wires also operate. Because they share road space, buses tend to be cheaper and more adaptive than rail services. However, on a per passenger kilometer basis, bus transit is generally a less efficient user of energy and emits more pollution than urban rail services. It is partly because of environmental concerns, as well as image consciousness, that some cities have sought to trade in their bus routes for urban rail services.

Bus transit is particularly important in developing countries, such as India, where some 40 per cent of all urban trips are by bus. In the Third World, the private sector serves more than 75 per cent of bus trips. In Karachi, Pakistan, private enterprises operating medium-size buses handle 82 per cent of transit journeys.[6] Because they are highly vulnerable to traffic congestion, buses are notoriously slow in megacities such as Shanghai, China, where it is generally faster to pedal a bike for trips under 14 kilometers in length.[7] One remedy is to reward high-occupancy travel through preferential treatment, such as reserved bus lanes and traffic signal preemptions. Bangkok, Thailand, has opened some 200 kilometers of reserved, contra-flow bus lanes to expedite bus flows in a city where rush-hour speeds often fall below 10 kilometers per hour.

In most developed countries, bus transit falls largely under the domain of the public sector, though concerns over rising subsidies have prompted more and more public transit agencies to competitively tender services to private contractors. In much of the United Kingdom and Scandinavia, public bus services have been turned over to the private sector outright. For many small to medium-size metropolitan areas of the United States, Canada, and Europe, conventional coaches (operating over fixed routes on published schedules) are the predominant transit carriers; in larger areas, buses often function mainly as feeders into mainline rail corridors. Providing exclusive

busways can allow buses to integrate feeder and line-haul functions in a single vehicle. In . . . Ottawa and Curitiba, dedicated passageways are provided for buses, enabling rubber-tire vehicles to emulate the speed advantages of conventional steel-wheel trains on line-haul segments, yet perform as regular buses on surface streets as well. Guided busways, or O-Bahns, introduced so far in Essen, Germany; Adelaide, Australia; and two British cities, Leeds and Ipswich, are particularly suited to corridors (such as freeway medians) with restricted right-of-ways. Because of faster operating speeds, the theoretical maximum passenger throughputs of busways are as high as 20,000 persons per direction per hour, more than twice that of conventional surface-street buses.[8]

Trams and light rail transit

Rail transit systems are mass transit's equivalents to motorized expressways, providing fast, trunkline connections between central business districts, secondary activity centers, and suburban corridors. The oldest and slowest rail services – *streetcars* in the United States and *tramways* in Europe – functioned as mainline carriers in an earlier era, but as metropolitan areas grew outward, those that remained intact were relegated to the role of central city circulators. In cities such as Zurich, Munich, and Melbourne, aging tramways have been refurbished in recent times to improve vehicle comfort, safety, and maneuverability. Trams are enjoying a renaissance in a number of European cities because their slower speeds, street-scale operations, and Old World character blend nicely with a pedestrian-oriented, car-free central city.

The modern-day version of the electric streetcar, *light rail transit* (LRT), has gained popularity as a more affordable alternative to expensive heavy rail systems, particularly in medium-size metropolitan areas of under 3 million population. Compared to tram services, LRT generally operates along exclusive or semi-exclusive right-of-ways using modern, automated train controls and technologies. The LRT vehicles tend to be roomier and more comfortable than tram cars, with more head clearance and lower floors. In the United States, where the most LRT trackage has been laid since the early 1980s, costs are often saved by building along disused railroad corridors. Medium-size US cities with fairly low densities, such as Sacramento, California, have managed to build LRT for as low as US$ 10 million per route mile; in Sacramento's case, costs were slashed by sharing a freight railroad right-of-way, building no-frills side-platform stations, and relying predominantly on single-track services. Light rail transit is generally considered safer than heavy rail because electricity comes from an overhead wire instead of a middle third rail. There is thus no need to fence in the track, not only saving costs but also allowing LRT cars to mix with traffic on city streets.

Today there are more than 100 tramways and LRT systems worldwide (mostly in Europe and North America), with the number continually rising. Among the factors behind the growing popularity of LRT and refurbished tramways are their lower costs relative to heavy rail investments and their ability to adapt to the streetscapes of built-up areas without much disruption. Other advantages include: they operate relatively quietly, thus are fairly environmentally benign and unobtrusive; they are electrically propelled, thus are less dependent than buses on the availability of petrochemical fuels; and they can be developed incrementally, a few miles at a time, eliminating the need for the long lead times associated with heavy rail construction.

. . . With four-car trains running as closely as three minutes apart, LRT can carry some 11,000 passengers per direction per hour; cutting the headways to ninety seconds (as found in some German cities, including Karlsruhe), maximum capacity can be doubled to more than 20,000. Advanced light rail transit (ALRT) systems – such as the skytrains in Vancouver, Toronto, and London's Docklands propelled by linear induction motors – can accommodate more than 25,000 passengers per direction per hour because of their higher engineering and design standards (though automated train control in lieu of on-board drivers constrains carrying capacities). It is for this reason they are also called intermediate capacity transit systems (ICTS).

Heavy rail and metros

In the world's largest cities, the big-volume transit carriers are the *heavy rail* systems, also called *rapid rail transit*, and known as *metros* in Europe,

Asia, and Latin America. Metros . . . work best in large, dense cities. Indeed, the relationship is symbiotic. The densities found on Hong Kong's Victoria Island and New York's Manhattan Island could not be sustained without heavy rail services. And heavy rail service could not be sustained without very high densities. Presently, more than 90 per cent of all peak-period trips to and from central London are by transit, mainly via the underground "tube"; for the remainder of greater London, transit serves fewer than a quarter of all peak-hour trips.[9]

Today, worldwide, there are some 80 metro systems, including 27 in Europe, 17 in Asia, 17 in the former Soviet Union, 12 in North America, seven in Latin America, and one in Africa. Some metros have been enormously successful, including Moscow's and Tokyo's, each of which carries 2.6 billion to 2.8 billion customers a year, more than twice as many as London's or Paris's metro systems, both of which are double the size of Moscow's and Tokyo's. On a riders per track kilometer basis, the world's most intensively used metros are, in order, São Paulo, Moscow, Tokyo, St Petersburg, Osaka, Hong Kong, and Mexico City. Most Western European, Canadian, and US metros have one-third to one-quarter the passenger throughput per track kilometer of these cities, in large part because more of their residents own cars and the cost of driving is relatively low.

In contrast to light rail systems, few new metros are being built today, partly for fiscal reasons and partly because most areas that can economically justify the costly outlays already have them. Except for Southern California, no new heavy rail lines or extensions are being planned, designed, or constructed in North America. The World Bank lending for metro systems ceased completely in 1980 and has resumed again only recently. The Bank generally frowns on funding rail projects, even in megacities paralyzed by traffic congestion, viewing them as cost-ineffective means of achieving the Bank's principal missions of alleviating poverty and stimulating economic growth.[10]

The niche market of heavy rail services is high-volume, mainline corridors. Accommodating more than 50,000 passengers per hour in each direction, heavy rail services provide high-speed, high-performance connections within built-up cities as well as between outlying areas and central business districts. In city cores, heavy rail systems almost always operate below ground, thus the names undergrounds (in Great Britain and its former colonies) and subways. To justify the high costs for right-of-way acquisitions, relocations, and excavation, undergrounds require very high traffic volumes (toward the upper end of the capacity threshold). Outside the core, metro lines are normally either above ground (called elevated or aerial alignments) or at-grade within expressway medians. Most heavy rail stations are far more substantial and sited farther apart than LRT stops, usually two or more kilometers from each other, except in downtowns, where they might be three or four blocks away. Because heavy rail systems are often the most expansive metropolitan rail services and operate at the highest speeds, their impacts on accessibility, and accordingly on urban development, tend to be the greatest.[11]

Heavy rail systems are almost universally electrically propelled, usually from a third rail, and each car has its own motor. Since contact with the high-voltage third rail can be fatal, rapid rail stations usually have high platforms and at-grade tracks are fenced.

Commuter and suburban railways

In terms of operating speed and geographic reach, *commuter rail* or *suburban rail*, stands at the top of the rail transit hierarchy. In Germany and central Europe, where suburb-to-city rail links are widespread, these services go by the name *S-Bahn*. Today, commuter rail services can be found on five continents in over 100 cities in more than 100 countries. Japan dominates the world's commuter rail market. In 1994, Tokyo carried almost six times the number of suburban rail commuters as Bombay, the largest commuter rail market outside Japan. Metropolitan New York's suburban rail is today only 2 per cent of Tokyo's. Nevertheless, metropolitan New York, along with a dozen or so other North American metropolises, is in the midst of a commuter rail renaissance. More commuter rail tracks are currently being planned, designed, and constructed in the United States and Canada than any form of rail transit. In all, twenty-one US and Canadian cities either have commuter rail services or hope to have them

within the next decade. This would raise the total US and Canadian commuter rail trackage to some 8,000 kilometers, more than five times as long as LRT and seven times as long as heavy rail.

Commuter rail services typically link outlying towns and suburban communities to the edge of a region's central business district. They are most common in big metropolitan areas or along highly urbanized corridors and conurbations, such as the Richmond–Boston axis in the northeastern United States. Commuter rail is characterized by heavy equipment (e.g., locomotives that pull passenger coaches), widely spaced stations (e.g., 5 to 10 kilometers apart), and high maximum speeds that compete with cars on suburban freeways (although trains are slow in acceleration and deceleration). Services tend to be of a high quality, with every passenger getting a comfortable seat and ample leg room. Routes are typically 40 to 80 kilometers long and lead to a stub-end downtown terminal. Outlying depots are normally surrounded by surface parking lots that enable suburbanites and exurbanites to access stations conveniently by car. With the exception of the greater New York area (along the MetroNorth corridor to Connecticut), relatively little land-use concentration or redevelopment can be found around US commuter rail stations – after all, the very premise of commuter rail is to serve the low-density lifestyle preferences of well-off suburban professionals who work downtown. Serving commuter trips almost exclusively also means that ridership is highly concentrated in peak hours, more so than any other form of mass transit service.

NOTES

1 Urban Mobility Corporation. 1997. The 1995 Nationwide Personal Transportation Survey, *Innovation Briefs*, 8(7), p. 1; Pisarski, A. 1992. *Travel Behavior Issues in the 90's*. Washington, DC: Federal Highway Administration, US Department of Transportation.

2 Pucher J. and Lefèvre, C. 1996. *The Urban Transport Crisis in Europe and North America*. Basingstoke, UK: Macmillan Press.

3 Cervero, R. 1997. *Paratransit in America: Redefining Mass Transportation*. Westport, CT: Praeger.

4 Roth, G. and Wynne, G. 1982. *Learning from Abroad: Free Enterprise Urban Transportation*. New Brunswick, NJ: Transaction Books.

5 Roth and Wynne, op. cit.; Walters, A. 1979. The Benefits of Minibuses, *Journal of Transport Economics and Policy*, 13, pp. 320–334; Takyi, I. 1990. An Evaluation of Jitney Systems in Developing Countries, *Transportation Planning and Technology*, 44(1), pp. 163–177.

6 Armstrong-Wright, A. 1993. *Public Transport in Third World Cities*. London: HMSO Publications.

7 Shen, Q. 1997. Urban Transportation in Shanghai, China: Problems and Planning Implications, *International Journal of Urban and Regional Research*, 21(4), pp. 589–606.

8 Under ideal conditions (e.g., very light traffic, flat terrain, straight lanes, no interruptions to flow such as traffic signals), buses operating on a conventional highway can move as many as 9,000 passengers per lane per direction. Sources: Trolley, R. and Turton, B. 1995. *Transport Systems and Policy Planning: A Geographical Approach*. Harlow, Essex: Longman Scientific & Technical; Vuchic, V. 1992. Urban Passenger Transportation Modes, in G. Gray and L. Hoel (eds), *Public Transportation in the United States*. Englewood Cliffs, NJ: Prentice-Hall, pp. 79–113.

9 Dasgupta, P. and Bly, P. 1995. *Managing Urban Travel Demand: Perspectives on Sustainability*. London: Department of Transportation.

10 The International Institute for Energy Conservation. 1996. *The World Bank & Transportation*. Washington, DC: The International Institute for Energy Conservation; Gutman, J. and Scurfield, R. 1990. Towards a More Realistic Assessment of Urban Mass Transit, in *Rail Mass Transit for Developing Countries*, Institute of Civil Engineers, London: Thomas Telford, pp. 327–338.

11 Knight, R. and Trygg, L. 1977. Evidence of Land Use Impacts of Rapid Transit Systems, *Transportation*, 6(3), pp. 231–247; Cervero, R. 1984. Light Rail Transit and Urban Development, *Journal of the American Planning Association*, 50(2), pp. 133–147; and Huang, H. 1996. The Land-Use Impacts of Urban Rail Transit Systems, *Journal of Planning Literature*, 11(1), pp. 17–30.