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Contrasting Visions of Urban Transport

Critique of "Fixing Transit: The Case For Privatization"

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Private shuttles typically charge $15-30 per trip in a van that serves a few destinations, such as an airport and a few downtown hotels.

Public transit typically charges $1-4 per trip in a bus or train that connects numerous destinations and usually accommodates wheelchairs and bicycles.

Summary

This report critiques the Cato Foundation paper, *Fixing Transit: The Case For Privatization*, which recommends that all transit services be privatized and self-financed. It claims this would improve efficiency and service quality, but all the private transit examples described are inferior quality or high price; none offer the level of integration, quality and affordability provided by public transit systems in most communities. *Fixing Transit* argues that public transit provides little economic, social or environmental benefit, but the analysis is incomplete, biased, and inaccurate. It ignores the multiple roles public transit plays in an efficient and equitable transport system, and overlooks many benefits. It uses extreme examples to suggest that transit employees are overcompensated although average bus drivers' wages are actually lower on average than those paid by private firms. Although transit policy should encourage innovation, competition and true efficiency, the approaches advocated in *Fixing Transit*, which eliminate public agency's role in coordinating services and maintaining standards, are likely to reduce system efficiency and service quality, and therefore reduce total benefits to users and society.

Introduction

This report evaluates two contrasting visions of urban transportation. On one hand, most cities and towns around the world are working to improve their *personal transport* (generally called *transit*) service quality.[1] They recognize that public transit plays a critical role in an equitable and efficient transport system by providing basic mobility for non-drivers, efficient mobility on major urban travel corridors, and support for strategic development. Even where public transit serves a minor share of total travel, the travel it serves tend to be high value, and so tend to provide large benefits, as discussed later in this report.

In contrast, a recent paper titled, *Fixing Transit: The Case for Privatization* (O'Toole 2010), recommends that transit systems be privatized and unsubsidized. It claims that this would increase transport system efficiency and service quality, but evidence suggests otherwise. O'Toole' examples of private transport services – airporters, dollar vans, intercity bus services, and unregulated buses and vans common in developing countries – are either low quality or expensive services to limited destinations. None provide the relatively high quality, affordable, integrated service offered by public transit agencies in most cities.

For example, our local private airport shuttle service charges $19 for a 20-kilometer trip, operates uncomfortable cube vans, serves limited destinations, pays drivers low wages resulting in high turnover and requests for tips, has a loose schedule (vans leave about hourly, after sufficient passengers accumulate), and cannot accommodate wheelchair users (who must pay $60 for a taxi).[2] In contrast, our public transit service charges $2.50 to numerous regional destinations, has more comfortable vehicles, more professional drivers, more reliable service, and accommodates wheelchair users.[3] Even accounting for subsidies (about $2.00 per trip) it is far cheaper per passenger-mile. This is just one of many examples illustrating the superior efficiency and service quality that public transit can provide.

Private transport providers sometimes offer cheaper or higher quality service than public transit, but these are exceptions, available only under high demand conditions. Private companies cannot provide an integrated network of transit services needed to achieve strategic planning objectives, such as basic mobility for non-drivers and significant reductions in urban traffic problems.

This is an important issue. To be efficient and equitable a transport system must provide diverse options so people can choose the best one for each trip. This requires high quality public transit that is convenient, comfortable, reliable and relatively affordable. The quality and efficiency of public transit service affects overall transport system performance, and therefore a community's economic productivity and quality of life. Even people who do not currently use public transit can benefit significantly from high quality service.

This is not to suggest that public transit cannot be improved or that privatization is never appropriate. Many reforms may be justified. However, it is important to apply comprehensive analysis when evaluating such options, including consideration of impacts on service quality and overall transport system performance.

Appropriate Privatization

There is often debate concerning whether particular goods and services should be provided by public agencies, private firms or a combination. Generally, services that are considered critical to society and require strategic coordination to achieve social objectives are best provided by public agencies, although many specific tasks can be contracted out. For example, most policing and schooling is planned and operated by public agencies, although many tasks are contracted out to private industry. Other goods and services are provided by private firms, but with strategic public support. For example, private farms produce most foods but with support from public irrigation systems, agricultural research and extension programs, public port and roadway systems, and food safety regulations. Table 1 lists examples of public and private goods.

Table 1 **Production Of Goods And Services**

Typically Public	Typically Private
National security	Building construction and operations
Policing	Farming
Schooling	Manufacturing
Public health services	Retailing
Road construction and operations	Healthcare delivery
Parks	Financing and insurance

Most experts conclude that, because transportation infrastructure provides critical services and requires strategic coordination, governments should control overall planning and management, and provide subsidies as needed to achieve strategic objectives.[4] This is why canals, ports, roads and airports are generally developed and operated by public agencies, with many specific tasks contracted out to private firms. This report explores whether that approach is appropriate for personal transit services, or whether it can be left entirely to private industry.

Is transit a critical service? Although public transit serves only a minor portion of total travel in most communities, its trips are sometimes critical and often valuable. It provides basic mobility for non-drivers, and an efficient alternative to driving on major urban corridors. At some point in their life most people rely on public transit themselves, live in a household with somebody who relies on public transit, or live in a city where public transit contributes significantly to transport system efficiency.

Does transit require strategic coordination? Like any transport mode, public transit is most efficient and beneficial if efficiently integrated into the overall transport system. For example, public transit becomes more effective if some roads are designed with bus lanes; if walking and cycling conditions are improved and park-and-ride facilities built around transit stations; if transit systems have integrated routes, schedules and fares; if land use policies support transit-oriented development; and other supportive policies are implemented.

This indicates that public transit does meet criteria for public planning and operation. This is not to suggest that private enterprise and competition have no role in transit service provision, but it does suggest that transit is most efficient and beneficial with public planning and coordination.

Fixing Transit claims that privatization increases transit service quality and efficiency, but all the examples it cites are either low-quality or high priced, as summarized in Table 2. None are affordable, reliable, regionwide services that provide basic mobility for non-drivers or attract large numbers of travelers who would otherwise drive. Although some private operators offer cheaper fares, or premium features such as on-board WiFi service, this only occurs on major corridors with high demand. Overall, privatization tends to reduce service quality or increase fares, which reduces ridership and total benefits compared with public transit services. It is therefore inaccurate to claim that private services are more *efficient*.

Table 2 **Comparing Public and Private Transport Services**

	Examples	Typical Fares	Vehicles	Wheelchairs?	Coverage
Public transit	Any North American public transit agency.	Low ($1-$4 for 1-50 mile trips).	Good	Usually	Region wide
Private local transit services	Atlantic City Jitneys, The Wave, Quick Transit	Low to medium ($2-$5 for 1-10 mile trips)	Poor to good	Usually not	Major urban corridors
Airporters	SuperShuttle, Airport Shuttle	High ($15-$30 for 20-50 mile trips)	Poor to good	Generally not	To and from airports
Conventional taxis	Any taxi company	High ($5-$80 for 2-50 mile trips)	Poor to good	With a few special taxis	Region wide
Premium bus services	Hampton Jitney, Red Arrow Bus Line	High ($20-$70 for 50-100 mile trips)	Very good	Sometimes	Major corridors

Compared with public transit, most private transport services have higher prices, lower service quality, reach fewer destinations, and are less accommodating to people with disabilities.

In many cases, privatization has reduced transit system efficiency and service quality. For example, after UK urban transit systems were privatized during the 1990s, service quality and ridership declined in most cities. An exception was the City of London, which experienced ridership growth during this period due to strong planning and regulation (London's Mayor can award tenders based on service quality rather than just cost minimization), and adequate subsidies to maintain system quality and affordable fares.[5]

In 2003 the London Underground became a Public-Private Partnership, but the private partners went bankrupt in 2007, so the system is again fully public.[6] British Rail privatization is generally considered a failure with regard to passenger transport.[7] Costs and fares increased, service quality declined, accidents increased and accountability declined. Even the Conservative Party's transport spokesman, Chris Grayling, admitted the mistake: "We think, with hindsight, that the complete separation of track and train into separate businesses at the time of privatisation was not right for our railways. We think that the separation has helped push up the cost of running the railways - and hence fares - and is now slowing decisions about capacity improvements. Too many people and organisations are now involved in getting things done - so nothing happens. As a result, the industry lacks clarity about who is in charge and accountable for decisions."[8]

When Clayton County, Georgia stopped funding the local C-Tran public transit system, the private Quick Transit company that replaced it tripled fares, reduced service from five to two routes, and reduced service frequency, making non-drivers much worse off.[9]

When Santiago, Chile eliminated public management and regulation of transport services in the 1970s, operating efficiency declined, which increased fares, congestion and pollution.[10] The city subsequently reintroduced regulation and invested in a major new Bus Rapid Transit system.

Sydney, Australia's privately-built Airport Link rail line charges $15.00 per trip between the city and airport, compared with $3.60 for similar distance trips on the public rail system.[11] Ridership is significantly below targets and the line has generated little new development around stations. In 2000, the Airport Link Company went into receivership, forcing the government to develop a new revenue and patronage agreement which involves significant public costs.[12]

Victoria, Australia privatized much of its tram and passenger rail services during the last decade, in order to improve efficiency, but user complain that this has reduced service quality. A 2010 survey found that a much greater portion of Victorians favor a reduced private sector role in transport than do residents of other states that have experienced less privatization.[13]

Private, unregulated paratransit services common in developing countries (called publicos, colectivos, or shared taxis) are often crowded, dirty and dangerous.[14] Drivers sometimes race for passengers, vehicles are often crammed, and operators work long hours. Most developing countries are trying to formalize their transit services to increase efficiency and service quality.[15]

Many efforts to build fully privatized highways have also proven unsuccessful, resulting in uncompleted projects, higher tolls, bankruptcies, and government bailouts.[16] For example, two dozen private toll roads went bankrupt in Mexico after 1994, and twenty-one toll road projects in Hungary, Indonesia, Mexico, and Thailand were subsequently taken over by the government.[17]

Jarrett Walker (www.humantransit.org/2010/09/on-privatization-scares.html)

There are many different ways to involve private enterprise in providing transit services, and these are so diverse that vague talk of "privatization" simply doesn't illuminate what's going on. At one extreme, you can privatise operations, planning, fleet, information, branding and almost everything else. In this model, prominent in Britain (but not London) and British-influenced countries like Australia and New Zealand, governments subsidise services but do not control overall network planning. This sometimes works in a political sense, in areas with low expectations for transit overall, such as rural areas. It's been very problematic in urban areas, because it deprives government of the control that its subsidies should be buying, and makes it impossible to plan rational networks that would meet the shared goal of a city and its people. Sydney, Brisbane, and Auckland all went far down this path and are now trying to pull back and re-assert government control over most aspects of planning and marketing.

At the other extreme, you can privatise operations only. This is the model used in a number of lean North American operators such as Southern California's Foothill Transit. In Australia, only Perth takes this approach, but it's very successful there. A public agency answerable to voters keeps full control of planning, and also owns the fleet and facilities. Private operating companies are hired only to provide operations and maintenance under contracts that are periodically re-opened to competitive procurement. This is a targeted kind of privatisation aimed at the functions that are the biggest budget-killers for all-public agencies: labor costs, labor relations, and liability related to operations and maintenance. Many agencies - especially newer agencies that don't have legacy labor commitments - are finding this a very good model.

Justifications for Transit Subsidies

Markets are generally most efficient and fair if consumers pay directly for the goods they use. However, subsidies are justified to achieve specific objectives, such as those in Table 3. Such subsidies should be allocated carefully, since money spent to subsidize transit reduces the funds available to support other public services. However, most economists agree that significant subsidies are often justified to support public transit services.

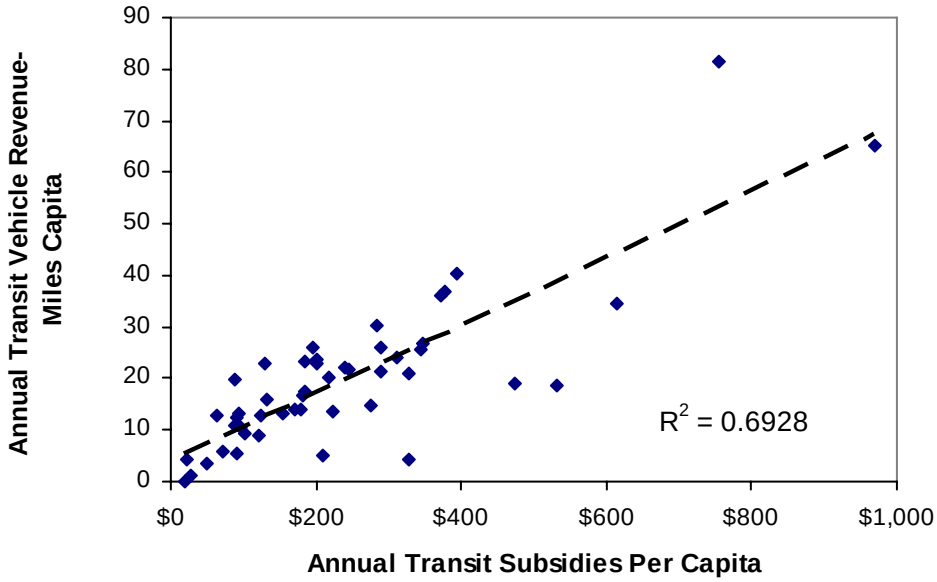
Public transit subsidy benefits can be particularly large due to their interactive effects. For example, subsidies provide direct equity benefits by providing basic mobility for non-drivers, and indirectly by leading to service expansion, and reductions in traffic impacts imposed on non-drivers, such as reduced congestion delay to bus riders, and reduced accident risk to pedestrians and cyclists. This implies, for example, that bus riders benefit from subsidies to regional commuter rail service and rail commuters benefit from subsidies to local bus service if together they increase total transit service supply, help create more walkable neighborhoods, make public transit use more socially acceptable, and increase public support for future transit improvements.

Table 3 **Potential Justifications for Transportation Subsidies**

Type	Public Transit	Automobile
Vertical equity: Physically, economically or socially disadvantaged people benefit	Transit often provides basic mobility and cost savings to disadvantaged people.	Although used by disadvantaged people, they represent a small portion of total use.
Scale economies: Unit costs decline with system expansion, so users benefit as a system grows and demand increases.	Transit service experiences economies of scale and scope. As transit systems expand their unit costs and subsidies per passenger-mile tend to decline.	Once a road system matures there are generally no scale economies; unit costs tend to increase once roads become congested.
Externalities: It provides external benefits or reduces external costs (impacts on non-users).	High quality public transit services tend to reduce external costs of automobile traffic, including congestion, accidents and pollution.	Automobile travel often causes congestion, parking costs, accident risk and pollution emissions.[18]
Land value gains. Improved accessibility increases nearby land values, reflecting the transport cost savings.	Land values often increase near transit stations, reflecting user benefits and increasing tax revenue.[19]	New roadways can increase nearby land values, but there is little shortage of automobile-oriented land in most regions.
Strategic objectives: It helps achieve strategic objectives such as support for a strategic industry or preferred land use development patterns.	Transit investments can help achieve various economic, social and environmental objectives including more efficient land use patterns, and economic development.	Increased automobile dependency and sprawl tend to contradict many strategic development objectives.

There are several justifications to subsidize public transit, less for automobile travel.

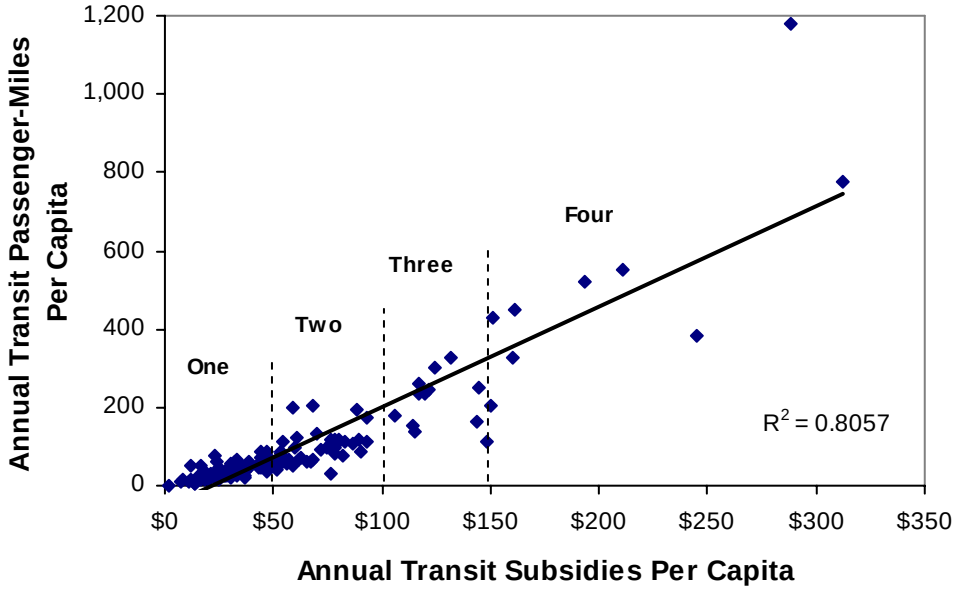
Figure 1 **Per Capita Annual Transit Subsidies and Service[20]**



As subsidies increase, so does transit service.

What do public transit subsidies achieve? As subsidies increase, so do transit service and ridership, as illustrated in figures 1 and 2. Increased service directly benefits transit-dependent users, and by attracting travelers who would otherwise drive, helps reduce traffic problems.

Figure 2 **Per Capita Annual Transit Subsidies and Ridership[21]**



As subsidies increase, so does transit ridership.

Table 4 **Transit Ridership By Subsidy Group**

Group	Number in Group	Subsidy Range	Average Subsidy	Average Ridership
One	67	$2-49	$29	38
Two	37	$52-93	$70	98
Three	12	$106-148	$125	216
Four	8	$150-312	$215	576

Transit ridership tends to increase proportionately more than subsidies.

Table 4 shows that ridership tends to increase proportionately more than subsidies:

- Compared with Group One, Group Two has 241% higher subsidy but 258% higher ridership.
- Compared with Group Two, Group Three has 179% higher subsidy but 220% higher ridership.
- Compared with Group Three, Group four has 172% higher subsidy but 267% higher ridership.

High quality transit service tends to leverage additional reductions in automobile travel, as discussed on the following page. This indicates scale economies, that is, unit costs decline, service quality increases, and benefits per dollar increase with more subsidies. Of course, at some point transit services and investments experience diminishing marginal benefits, but that appears to be at a relatively high level of subsidy.

Increased subsidies allow more transit service to be provided at times and locations with lower demand. This reduces efficiency, but provides basic mobility.

Because of these benefits it is rational for residents and businesses to support policies that create high quality public transit which attracts discretionary users (people who would otherwise drive).[22] On average, residents of communities with high quality public transit must pay about $200 in additional taxes to support public transit service, but save about $500 annually per capita in reduced transportation expenses, plus various indirect savings and benefits including substantial reductions in traffic fatality rates and improved public fitness and health.[23]

Indirect Impacts Of High Quality Public Transit

Several studies indicate that high quality public transit (grade-separated urban bus or rail, with comfortable vehicles and stations) tends to have significant indirect impacts that increase transport system diversity, leverage additional reductions in motor vehicle travel, and help create more accessible, walkable communities (ICF 2008; Litman 2008). Conventional planning analysis often ignores these indirect impacts and so underestimates the potential of public transport improvements to achieve objectives such as congestion reduction, road and parking cost savings, consumer savings, traffic safety, energy conservation, emission reductions, and improved public fitness and health. It is important to understand these impacts for comprehensive analysis.

Direct travel impacts consist of a passenger-mile of automobile travel that shifts to a passenger-mile of public transport travel. Indirect impacts result from the following factors:

- *Reduced vehicle ownership*. Motor vehicles are costly to own but relatively cheap to use, so once a household purchases a vehicle they tend to drive it thousands of annual miles, including some trips that provide only marginal user benefit. Households located in areas with high quality transit can reduce their vehicle ownership, leading to additional reductions in lower-value automobile travel.
- *More non-motorized travel.* Since public transit and non-motorized travel are complements (most transit trips involve walking or cycling links) high quality transit tends to be a catalyst for more walkable and bikeable communities. Public transit users and residents of transit oriented communities tend to walk and bike more, and drive less, than they would in more automobile dependent areas.
- *More accessible, multi-modal land use patterns*. High quality public transit encourages more compact and mixed development by reducing the amount of land required for roads and parking facilities, and by increasing the desirability of locating near stations. The resulting *smart growth* land use patterns improve accessibility and transport diversity, which reduces the amount of driving required to reach destinations and encourages use of alternative modes (walking, cycling and public transit).
- *Social Norms.* In automobile-dependent communities, use of alternative modes tends to be stigmatized. High quality public transit helps change community attitudes, making walking, cycling and public transit more socially acceptable. This tends to create more support for public transit, for example, increasing employer's willingness to cash out parking or provide other benefits to transit commuters.

Not every transit improvement has all these effects, but many small changes can contribute to making a community more multi-modal, and therefore reducing total automobile travel. A portion of the differences in travel activity between different neighborhoods often reflects self-selection, that is, people who out of necessity or preference rely on active modes locate in multi-modal areas. As a result, such areas have less vehicle traffic, but overall regional vehicle travel does not necessarily decline. However, various studies indicate that, taking self-selection into account, people do tend to reduce their vehicle ownership and use when they move from automobile-dependent to multi-modal locations (Cervero 2007).

Consumer preference surveys indicate significant and growing latent demand for more multi-modal home locations (Litman 2009), which suggests that expanding high quality public transit networks and creating more transit-oriented communities can benefit consumers directly and provide external benefits including congestion reductions, road and parking facility cost savings, improved traffic safety, energy conservation and pollution emission reductions.

A Productivity Crisis?

Fixing Transit claims (p. 3) that public transit has a "productivity crisis," indicated by a decline in passenger trips per operating employee between 1955 and 1995. But such analysis should consider changes in operating conditions and service during that period, including declining transit demand, suburbanization, and new services such as paratransit. During that period transit service expanded to many new areas, including suburban and rural communities. In 1965 transit agencies provided no special services for people with disabilities, but by 2008 paratransit services represented 30% of transit vehicle-hours.[24] Paratransit has low passenger-trips per employee due to smaller vehicles, door-to-door service, and more loading and unloading time required. This indicates that nearly a third of what *Fixing Transit* calls a productivity decline actually results from more services for people with severe disabilities.

Calling this a "productivity crisis" assumes there is no value to serving suburban locations or accommodating people with disabilities. It is also wrong to assume that such trends will continue. The decline in trips-per-operator stopped about 1995. Transit ridership is now increasing due to factors such as aging population, rising fuel prices, increasing urbanization, changing consumer preferences, and planning innovations such as busways, more convenient payment systems, and transit-oriented development.[25]

As evidence of transit inefficiency, *Fixing Transit* estimates that transit subsidies have totaled more than $800 billion since 1965 (p. 5). This is a large but meaningless number since virtually no other costs are measured in 45 year totals.[26] These subsidies average about $18 billion annually, $65 per capita annual, or 18¢ per capita per day, which is small compared with total vehicle, road and parking costs. For example, the $18 billion annual subsidy is only about 10% of government roadway expenditures,[27] 4-8% of parking subsidies,[28] and just 2% of consumer motor vehicle expenditures.[29]

Using recent data, in 2008 U.S. transit agencies spent $54 billion in total, of which $42 billion was public subsidy, which averages about $140 per capita.[30] During that year governments spent $182 billion on roadways,[31] about $550 per capita, of which about half was funded by user fees. A typical urban parking space has an annualized value of $500 to $1,500, and there are estimated to be at least three government-supplied or mandated parking spaces per vehicle, with a total annualized value of about $3,000.[32] This suggests that for each dollar of public transit subsidy, governments, businesses or consumers spend about $20 to subsidize roads and vehicle parking facilities, plus about $20 to own and operate personal motor vehicles.

Fixing Transit claims that public transit agencies pay excessive wages and benefits (p. 4), but its evidence is biased and exaggerated, describing exceptional examples but providing no information on overall industry compensation practices.[33] According to the Bureau of Labor Statistics, transit and intercity bus drivers earn $16.32 median hourly wages,[34] somewhat less than those in comparable private sector jobs such as Greyhound bus drivers ($19.35 per hour).[35] Bus operation is a demanding job, requiring responsibility, physical skill and ability to deal with the public. Of course, as with any industry, some public transit agency employees earn more than average, including those with professional or specialized training, and those located in large cities, but O'Toole provides no evidence that public transit compensation is overall excessive.

Focusing on wage rates overlooks other, more important factors that affect transit service cost efficiency. Analysis by leading transportation economists found that contracted transit services are sometimes, but not always, less costly than those operated directly by transit agencies, but other factors, such as labor and vehicle utilization rates, have greater impacts on overall system cost efficiency.[36] A high wage transit system that has high ridership is more cost efficient overall than a low-wage system with lower ridership.

Fixing Transit criticizes New York, Chicago and Portland, for high *wages* (dollars per hour) and *operating costs* (dollars per vehicle-mile or –hour),[37] although they are actually more *cost efficient* (lower cost per passenger-mile and higher cost recovery) than most other cities, illustrated in Table 5. These cities have better *service quality* (portion of regional destinations served, speed relative to driving, service frequency, and hours of operation). As a result, transit is significantly more efficient overall (more service per dollar spent) in the cities *Fixing Transit* criticizes as financially wasteful.

Table 5 **Transit Ridership and Total Expenditures In Selected U.S. Cities[38]**

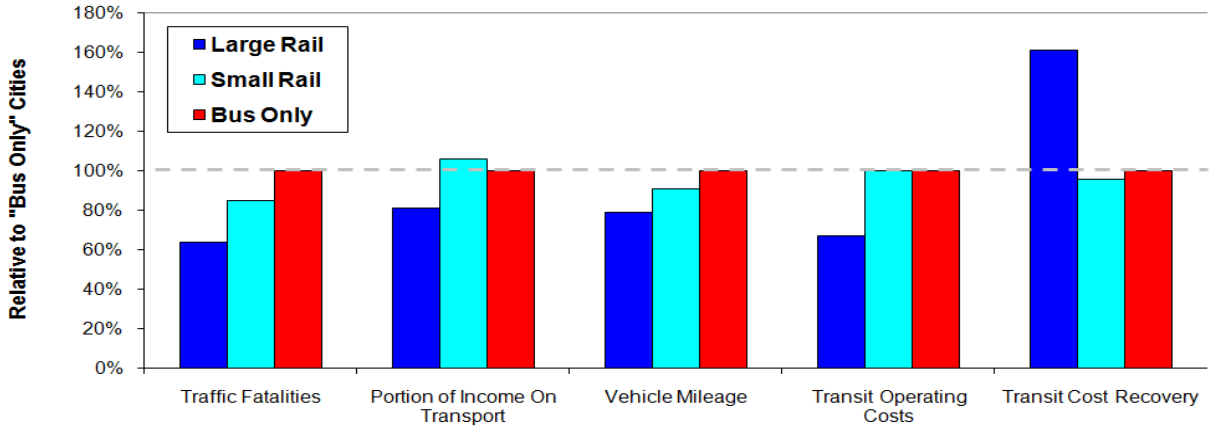
	Total Ridership	Total Expenditures	Unit Costs	Cost Recovery
	Million Pass.-Miles	Million Dollars	Per Pass.-mile	
National Total	*55,157*	*$54,162*	*$0.98*	*22%*
New York MTA	11,877	$10,849	$0.91	28%
Chicago CTA	1,940	$1,902	$0.98	27%
Portland TriMet	470	$604	$1.29	15%
Houston	590	$640	$1.08	12%
Durham-Chapel Hill	21	$26	$1.24	11%
Las Vegas	213	$301	$1.41	18%
Kansas City	61	$81	$1.33	14%
Little Rock	14	$15	$1.07	13%

New York and Chicago have lower total costs per passenger-mile than most other cities, despite higher average wages and more intense congestion. Portland has relatively high total costs because it is currently investing in significant service expansion, but its operating costs (82¢ per passenger-mile) are average for cities of its size, and will decline if its ridership continues to grow at current rates.

Fixing Transit argues that cheaper basic bus transit systems work as well as the higher capital cost rail systems, but evidence indicates otherwise. *Fixing Transit* claims that, "The presence or absence of expensive rail transit does not seem to be an important factor in the overall use of transit" (p. 5), but examination of O'Toole's Table 1 clearly shows this to be wrong. Excluding college towns such as State Collage, Ames and Campaign-Urbana, most cities with high transit ridership have large rail systems, including New York, San Francisco, Washington DC, Boston, Chicago and Philadelphia. O'Toole makes the mistake of categorizing all cities with rail transit together without accounting for system size and age, an error I pointed out previously.[39]

Higher quality transit (grade separated, relatively fast and reliable, frequent, nice vehicles and stations, and affordable) attracts more discretionary riders. As a result, cities with high quality rail transit have better transport system performance (lower traffic fatality rates, smaller portion of household budgets devoted to transport, lower public transit costs per passenger-mile, and higher public transit cost recovery) than other cities, as illustrated in Figure 3.

Figure 3 **Transit Service Cost Efficiency[40]**



Cities which have large rail transit systems tend to have better transport system performance (lower traffic fatality rates, smaller portion of household budgets devoted to transport, lower per capita vehicle mileage, lower public transit operating costs, and higher transit cost recovery) than cities with basic bus systems.

An Innovation Crisis?

Fixing Transit argues (p. 13) that public transit agencies never innovate, demand response is always better than fixed-route service, buses are always better than rail, everybody prefers automobile travel and sprawl, and newer technologies are always better. These conclusions are wrong.

Many transit agencies are implementing appropriate innovations. North American transit agencies are implementing all the innovations *Fixing Transit* mentions, plus many more, including demand response and telephone dispatching, vehicle tracking, electronic payment systems, and improved user guidance information systems. The Transportation Research Board has a special program called the Transit Cooperative Research Program, which sponsors numerous studies on transit innovations. However, it is true that, as public organizations providing critical services, transit agencies tend to be cautious about introducing change.

Although demand response is appropriate for serving people with disabilities and dispersed destinations, and is already provided by most North American transit agencies, it is inherently inefficient and costly. It typically cost several times more than conventional transit (the *SuperShuttle* airporter service O'Toole cites as an example of efficient private transit typically charges $15-30 per trip) and is generally slower and has less predictable arrival times than fixed-route transit, due to flexible routing and numerous stops. Because of its low load factors, demand response provides little or no congestion reduction or energy savings compared with driving.

As discussed previously, high quality rail transit tends to provide greater benefits to users and society compared with conventional bus transit, including greater comfort, speed and reliability, reduced traffic congestion and accident rates, more energy savings and emission reductions.[41] As a result, under appropriate conditions, rail transit is the most appropriate transit option. Although Bus Rapid Transit can provide similar benefits, it also requires substantial investments.

Surveys indicate that many people would prefer to drive less, rely more on alternative modes, and live in more accessible, multi-modal communities.[42] Market research described in this reports indicates that Americans' housing preferences are diverse and changing.[43] Although many families (especially those with young children) prefer single-family homes, an increasing portion will choose more compact houses in exchange for improved accessibility and financial savings, and many young people and seniors prefer dense urban environments. Similarly, although few motorists want to give up automobile travel altogether, many would prefer to drive less and rely more on alternatives, provided they are convenient, comfortable, safe and affordable. These shifts are large and rapid, resulting from durable demographic and economic trends. The Urban Land Institute's 2009 *Emerging Trends in Real Estate* report explains:[44]

> Energy prices and road congestion accelerate the move back into metropolitan-area interiors as more people crave greater convenience in their lives. They want to live closer to work and shopping without the hassle of car dependence. Higher-density residential projects with retail components will gain favor in the next round of building. Apartment and townhouse living looks more attractive, especially to singles and empty nesters—high utility bills, gasoline expenses, car payments, and rising property taxes make suburban-edge McMansion lifestyles decidedly less economical.

It is silly to assume, as *Fixing Transit*, does, that newer transportation technologies are always better than those that are well established and tested. History of rife with proposals for transport system innovations that are technically feasible but not worthwhile, including flying cars and rocket belts. Although Segways can replace non-motorized travel, they have few practical uses. Walking and cycling are generally better overall. Similarly, buses and trains are have proven to be efficient and reliable transport modes, which can be improved, but not replaced, by technological innovation.

1949 ConvAIRCAR Flying Car

1961 Bell Rocket Belt

Evaluating Costs

Fixing Transit (p. 2) claims that, "urban transit is the most expensive way of moving people in the United States." This is untrue, based on incomplete analysis that overlooks these factors:

- A major portion of transit service is designed to provide basic mobility for non-drivers, including service at times and locations where demand is low. This is often cheaper than alternatives, such as taxi service or motorists making special chauffeur trips, which often require empty backhauls.
- *Fixing Transit* only considers a portion of total costs. Both automobile and transit require a complete system of vehicles and facilities. Transit service costs include a vehicle, route and terminal. Automobile transport requires vehicles, roads and parking facilities.
- Transit services are concentrated in urban areas where any transport infrastructure is costly to provide. It is therefore wrong to compare transit service costs with overall average automobile costs, rather, transit costs should be compared with the costs of accommodating additional automobile travel under urban conditions.
- Transit users tend to travel far fewer annual miles than automobile travelers. As a result, motorists tend to receive greater total per capita transportation subsidy than transit users, particularly if government-mandated parking facilities are considered in the analysis.

The claim that transit is the most expensive of transport is based on analysis that only considers two modes (automobile and transit) and two costs (vehicle and roads/tracks). It does not answer the more relevant question, "What is the most cost effective way of providing basic mobility and efficient transport on congested urban corridors, considering all costs?"

The analysis in *Fixing Transit* is based on overall average vehicle costs, although these tend to be significantly higher under urban-peak travel conditions due to traffic congestion, high insurance costs, high road and parking facility costs, and lower vehicle occupancy rates. Similarly, the costs of expanding road and parking facilities is much higher in urban areas. According to a Federal Highway Administration study, expanding major urban highways costs $1.00 or more per additional peak-period vehicle.[45] Measured differently, tolls on privatized urban roadways typically range from 10¢ to 50¢ per vehicle-mile (for example, California State Route 73 fees are about $5 for a 15-mile peak-period trip, or about 33¢ per mile, and more for shorter trips), although such tolls seldom cover total roadway land, construction and operating costs. Parking typically costs $20 to $35 per day in large city downtowns, and perhaps half that in suburban areas, averaging perhaps $16 per day overall, or 50¢ per mile for a 32-mile commute.[46] This suggests that a single-occupant urban automobile commute costs about 45¢ per mile in vehicle costs (O'Toole's 35¢ per vehicle-mile increased to account for higher costs under urban-peak travel conditions), plus 30¢ for roadway costs and 50¢ for parking, or $1.25 per mile.

In contrast, total transit capital and operating expenses average $0.91 to $1.29 per passenger-mile in large U.S. cities, as illustrated in Table 5. Of course, actual travel costs vary. Driving is cheaper under some conditions and more costly under others. Similarly, transit is more convenient and cost effective for some trips than others. If high quality public transit service exists, users can choose the most cost effective travel option for each trip. If transit service is inferior, travelers are forced to drive even when it is cost inefficient.

Scope of Benefits Considered

Fixing Transit ignores many benefits provided by high quality public transit. It criticizes public transit agencies for having multiple objectives (p. 3), but that is the nature of major public infrastructure: it serves multiple functions and users. For example, most citizens probably want their police departments to prevent and investigate crimes, manage traffic, rescue lost children, and control parade crowds. They don't evaluate policing services based on a single performance indicator, such as minimal wages or maximum citation revenues. Similarly, public transit agencies can maximize benefits by balancing multiple objectives. Public transport helps achieve two different and sometimes conflicting categories of objectives:

1. *Basic mobility for non-drivers*. This requires providing broadly distributed service (including service at times and locations where demand is low, resulting in low operating efficiencies) and accommodating people with special needs (including wheelchair lifts and other design features to accommodate people with disabilities, and demand response services).
2. *Efficient mobility on major urban corridors*. Public transit is often cheaper overall (including vehicle, road, parking, accidents and pollution emissions) than accommodating additional automobile travel on major urban corridors. This requires high quality service to attract discretionary riders who would otherwise drive.

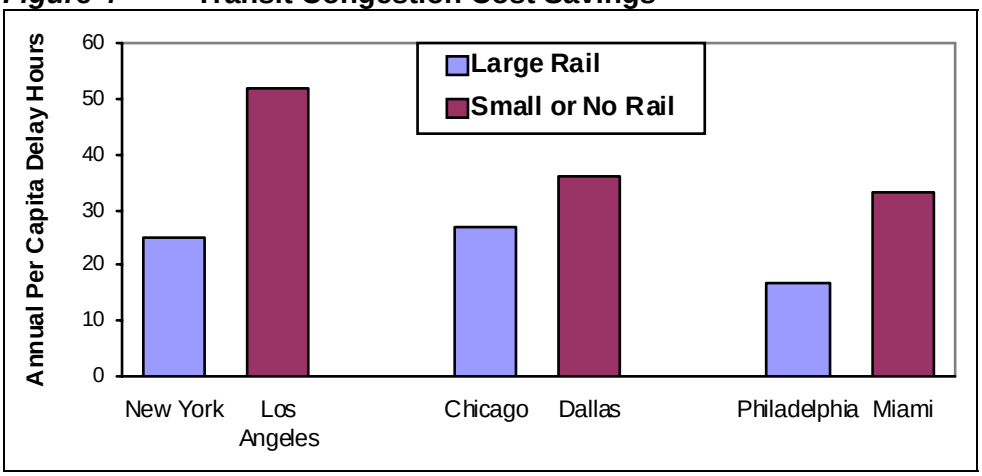
As a result, *equity-justified transit* (service where or when demand is low, and features to accommodate passengers with special needs, such as wheelchair lifts and paratransit services) may seem inefficient, while *efficiency-justified transit* (high quality, grade separated rail and commuter bus services on major corridors) may seem inequitable, but those simply reflect different types of services intended to provide different types of benefits. All these objectives and benefits should be considered when evaluating public transit cost efficiency.

Comparisons between cities indicate that those with high quality transit systems (grade separation, nice vehicles and stations, integrated with land use development, and other supportive polities) have:

- Higher per capita transit ridership.
- Higher transit commute mode share.
- Lower per capita motor vehicle ownership and travel.
- Lower per capita traffic fatality rates.
- Lower per capita consumer expenditures on transport.
- Lower transit operating costs per passenger-mile.
- Higher transit service cost recovery.
- Better mobility options for non-drivers.
- Improved fitness and health (since most transit trips have walking or cycling links, so transit travelers are much more likely to achieve physical activity targets than motorists).
- Increased money circulating in local economies (since transit travelers spend significantly less on imported vehicles and fuel, leaving more money to spend on other goods which tend to have more local input).

Numerous studies indicate that high quality public transit tends to reduce traffic congestion on parallel roadways.[47] These impacts can be difficult to measure at the regional level because both transit ridership and traffic congestion tend to increase with city size, so aggregate analysis can indicate that congestion costs increase with transit ridership. However, when similar size cities are compared, those with higher quality public transit tend to experience less per capita annual congestion delay than in cities with lower quality transit as illustrated in Figure 4.

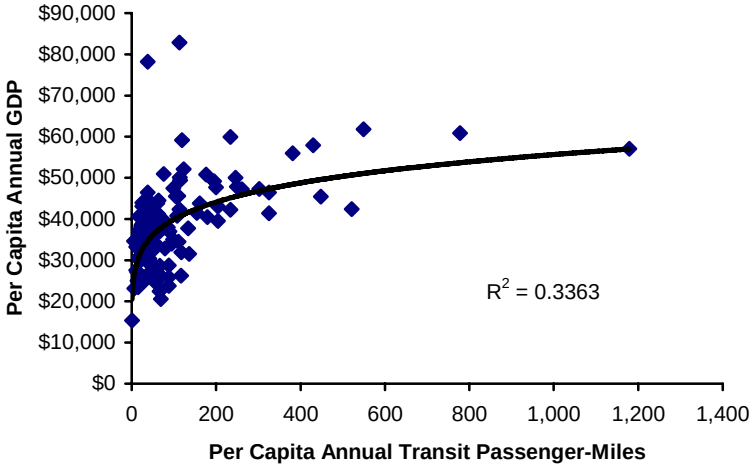
Figure 4 **Transit Congestion Cost Savings[48]**



Cities with large rail transit systems have less per capita traffic congestion delay than similar size cities with lower quality transit.

There is theoretical and empirical evidence that high quality public transit supports economic development (increased productivity, employment, wages and property values) by reducing transportation costs, and creating more efficient land use development which provide agglomeration efficiencies. The figure below shows that per capita GDP increases with per capita public transit ridership in U.S. cities.

Figure 5 **Per Capita GDP and Transit Ridership[49]**



GDP tends to increase with per capita transit travel. (Each dot is a U.S. urban region.)

Impacts on Transit-Dependent People

Fixing Transit claims (p. 22) that "Privatization will make transit responsive to users, not politicians, and will actually lead to better services for many transit users," but provides no evidence. In fact, the type of privatization recommended in *Fixing Transit* generally leads to a spiral of declining service and ridership, and increasing fares. *Fixing Transit* ignores the harm this would impose on transit dependent people (and their families, friends and employers). Although some transit users have alternatives (walking, bicycling, being chauffeured by family members or friends, driving, or hiring a taxi), others face severe difficulties, including inability to access essential services and activities, or excessive financial burdens to pay for higher fares or alternatives such as taxis.

End Of C-Tran Leaves Many Without Rides
Atlanta Journal Constitution, 31 March 2010 (www.ajc.com/news/clayton/end-of-c-tran-421823.html)

As Clayton County's C-Tran buses made their last morning rounds on Wednesday, many riders were still wondering how they would get to work without the service.

Constance Glenn of Hampton said she has been riding C-Tran buses to and from her job at Hartsfield-Jackson International Airport for two years. "I don't know how I'm going to get to work," Glenn said. She had tried talking to friends about catching a ride, "but nobody has a car, so I'm out of luck. I'm going to be out of a job. It makes me very angry."

Tyrone Maze has been riding C-Tran for about three years. "I use it to go to work, to go downtown and to doctor's appointments. It's really going to throw [my routine] off," Maze said. He called C-Tran "the last resort some people have, including myself. It's really going to take a toll on the people in this area."

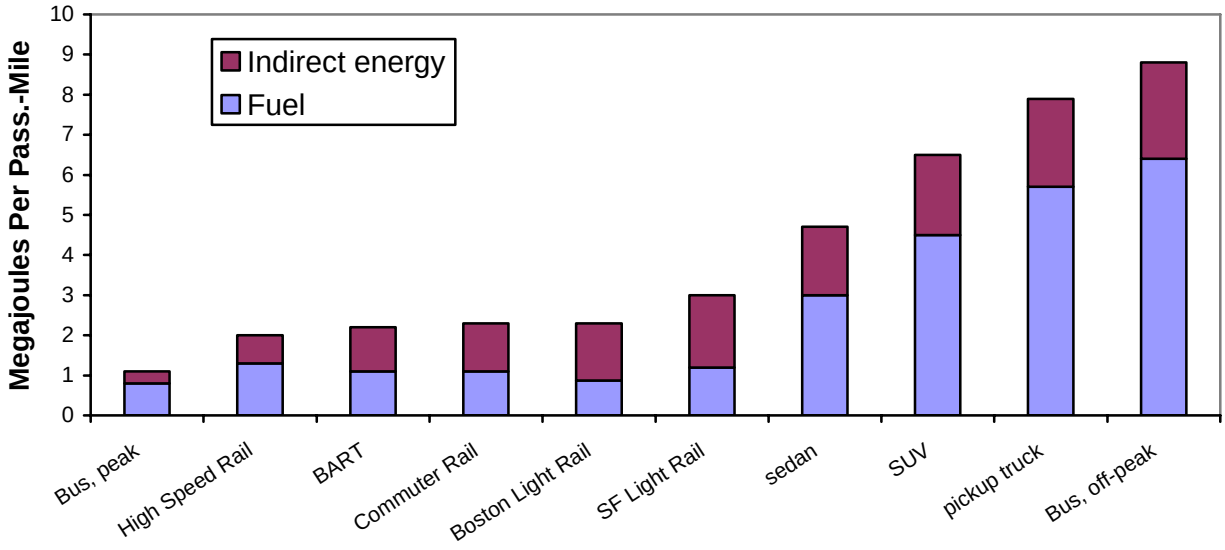
High school senior Antionette Mellerson, 18, has been riding C-Tran off and on for a couple of years, and daily for about three months. She said her mother will "be getting up early in the morning and taking me to school. I don't want her to do that, but we have no other choice." Mellerson said she knows people who "are actually going out to buy cars with no insurance and no driver's license. It interferes with your everyday life when you don't have transportation," she said.

Fixing Transit recommends (p. 22) that any subsidies should be provided directly to users. Although this could benefit some people, it would reduce total transport services due to lost scale economies. For example, assume transit service costs $100 per trip to provide on a route, fares average $2 per trip, and there are 20 transit-dependent users and 20 discretionary users. With supply-based subsidies the public transit agency spends $20 per trip to maintain the service (40 riders paying $2 per trip generates $80 in revenue, which is $20 short of the $100 operating costs). If the same subsidy is provide directly to users, the service would only continue if the 20 subsidy recipients continue using the route. If any users shift mode the route becomes unprofitable. For example, if 5 subsidy recipients shift to taxi, revenue declines to $85, making the route unprofitable. Without supply-based subsidies the transit service collapses because it experiences scale economies and requires a critical mass of users. In such a situation, efficiency requires either regulation or subsidies to concentrate demand to particular routes and services.

Energy Efficiency

Fixing Transit argues that public transit is not very energy efficient. It cites research by Mikhail Chester and Arpad Horvath on lifecycle energy analysis to argue that driving consumes 5,500 BTUs per passenger-mile, while rail transit consumes 6,400 BTUs. That misrepresents their analysis, which actually indicates that urban rail consumes less than half as much total energy per passenger-mile as an average car, and less than a quarter as much as energy as a typical van, SUV or light truck, as illustrated below. Buses are very efficient under peak conditions and inefficient during off-peak periods. For example, in 2008, conventional bus transit averaged 10.6 passengers per revenue-mile, or about 55 miles per gallon, more than twice the efficiency of an average automobile under urban travel conditions.[50]

Figure 6 **Lifecycle Energy Consumption and Emissions[51]**



This figure compares fuel and indirect energy (energy used in vehicle and facility construction and maintenance) for various transport modes.

In response to an earlier version of this report, O'Toole argued that public transit is always energy inefficient due to low load factors (passengers per vehicle).[52] It is true that currently, most North American transit systems are relatively inefficient because much of their service is intended to provide basic mobility for non-drivers, and so operates at times and locations with low demand. However, just because *some* transit service is energy inefficient does not mean that all transit service is inefficient, or that efficiency cannot be improved.

Table 6 evaluates various transit improvement strategies. Expanding service helps achieve equity objectives (basic mobility for non-drivers) but by itself tends to reduce efficiency, due to low load factors, and because much of the additional ridership is transit-dependent so there is little reduction in automobile travel. However, other strategies can reduce energy consumption by increasing operating efficiency, attracting more motorists, using off-peak capacity, and leveraging additional automobile travel reductions. As a result of these impacts, residents of communities with high quality transit services tend to consume 20-40% less transport energy than they would in more automobile-dependent locations.[53]

Table 6 **Equity and Efficiency Impacts of Various Transit Improvement Strategies**

Transit Improvement Strategy	Equity Impacts	Efficiency Impacts
	Impacts on mobility and accessibility of non-drivers.	*Impacts on traffic congestion, energy consumption, pollution emissions and other external costs.*
Service expansion. More routes and service frequency, including times and locations with low demand.	Improves basic mobility.	Reduces efficiency if load factors are low.
Improve vehicle fuel efficiency. Smaller vehicles where appropriate, hybrid drives, and alternative fuels.	Generally no impact.	Reduces energy use per vehicle-mile.
Improve operating efficiency. Grade separation and bus priority, faster boarding (such as prepaid fares).	Improves transit travel speeds and reliability.	Reduces energy use per vehicle-mile.
Financial incentives. Lower fares, subsidized transit passes, parking pricing and cash out.	Positive incentives (reduced fares and parking cash out) benefit users, particularly those with lower incomes.	Increases efficiency, particularly if it reduces automobile travel and increases ridership on routes with excess capacity.
Improved convenience and comfort. Better user information, nicer vehicles and stations, marketing programs.	Improves the convenience and comfort of travel by disadvantaged people. Helps reduce the stigma of transit travel.	Increases efficiency, particularly if it reduces automobile travel and increases ridership on routes with excess capacity.
Better modal integration. Improved walkability near transit stops. Bicycle racks and lockers. Better connections with vanpools, ferry terminals and airports.	Improves the convenience and comfort of travel by disadvantaged people.	Increases transport system efficiency, particularly if it reduces automobile travel and increases ridership on routes with excess capacity.
Offpeak incentives. Discounts for off-peak transit travel.	Provides financial savings that benefit some disadvantaged people (those with flexible schedules).	Increases efficiency by filling otherwise unused capacity.
Transit-oriented development. More compact, mixed development, pedestrian improvements and parking management near high-quality transit service.	Benefits disadvantaged people, particularly if appropriate affordable housing is included. By providing a catalyst for more accessible development, provides additional benefits (besides just improved transit access).	Increases efficiency, both directly, but encouraging transit travel, and indirectly by creating communities where travel distances are shorter, and people own fewer cars, drive less, and rely more on walking, cycling and public transit.

Transit service expansion helps achieve equity objectives (basic mobility) but by itself tends to reduce system efficiency. Other transit improvement strategies can increase transport system efficiency, and some strategies (service quality improvements and transit-oriented development) tend to leverage additional energy savings and efficiency gains.

With appropriate improvements, public transit can provide substantial energy savings and efficiency gains, including direct savings from more efficient transit operations, and indirect savings that result when high quality transit leverages additional vehicle travel reductions.

Recommendations for Transit Privatization

There is certainly an appropriate role for private enterprise in transit service provision.[54] An excellent mode is often used for Bus Rapid Transit (BRT) systems, in which governments build and own the bus lanes and stations, collect fares, and establish performance standards, while private companies (including worker cooperatives) bid for the right to operate buses which compete based on cost efficiency and service quality.[55] This allows privatization to support strategic planning objectives, including efficient use of infrastructure and vehicles, and high service quality that attracts discretionary travelers. The following are recommendations for effective transit privatization.

- Public agencies should maintain overall control of strategic planning and performance standards.
- Transit system routes, schedules, fare structures, user information, and marketing should be integrated to maximize user convenience and system efficiency.
- Encourage development of competitive supply markets. For example, encourage the development of multiple companies that can bid on service contracts.
- Establish policies that prevent strikes and other labor disruptions that reduce transit services.
- Establish and maintain high service quality standards. Reward operators based on meeting service quality requirements.
- Design data collection and evaluation methods to monitor performance.

Conclusions

Claims that private, self-financed transport services would provide more efficient and higher quality than public transit systems are unsupported by evidence. All private transport services identified in *Fixing Transit* – airporters, jitneys, and coach buses – are either inferior quality or expensive, and serve limited destinations. None offer the relatively affordable, reliable, integrated services provided by public transit systems in most cities.

Without public coordination and subsidies private companies only provide transit on limited routes with high demand. Some private transport services have low fares, but this skims the cream, leaving public agencies with the less profitable routes, causing total service to decline or subsidies to increase. As a result, private companies do little to achieve community objectives such as providing basic mobility for non-drivers and reducing traffic problems.

Public transit is an important component of an integrated transport system. It provides an essential service for disadvantaged people, experiences scale economies, and offers indirect benefits to non-users. For these and other reasons, most experts agree that transit requires government coordination and support for equity and efficiency. Purely privatized, self-financing public transit provides less service and higher fares than socially optimal, creating a cycle of declining service quality, ridership and benefits.

Fixing Transit makes numerous analytic errors. It ignores the multiple roles public transit plays in an efficient transport system and so underestimates the costs that result from transit service reductions. When comparing automobile and public transit costs it significantly underestimates total automobile costs under urban conditions. It assumes that without transit, users could otherwise drive, rather than requiring more costly taxi or chauffeured travel. It uses extreme examples to suggest that transit employees are overcompensated, although average bus drivers' wages are lower than those paid by private firms. It underestimates public transit energy savings and other benefits. It criticizes the transit industry for failing to innovate, although public transit agencies are now implementing all the innovations described, plus many others. It overlooks the efficiencies and benefits of high quality urban transit: the transit agencies it criticizes for excessive wages actually provide some of the most cost effective service (passenger-mile per dollar) in North America. Similarly, it ignores the tendency of high quality public transit to leverage vehicle travel reductions, which provides significant benefits including energy savings.

Fixing Transit is outdated. During the 1990s many experts advocated transport infrastructure privatization (roads, rail and urban transit), but subsequent experience found that these experts had understated problems and costs, and exaggerated benefits. As a result, many transport privatization efforts have since been scaled back, restructured or abandoned.

This is not to suggest that innovation and privatization undesirable. Many transit systems have outdated policies and practices deserving reform, and agencies should implement appropriate innovations. Many transit agencies could contract out more services. Although transit policy should encourage innovation and appropriate competition, the approaches advocated in Fixing Transit are likely to reduce system efficiency and service quality, and therefore reduce total benefits to users and society.

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[8] "Tories Change Policy On Railways," *BBC Online*, BBC, 17 July 2006 (http://news.bbc.co.uk/1/hi/uk_politics/5186196.stm).

[9] "C-Tran Reaches End of The Line," *Clayton County New*, 29 March 2010 (www.ajc.com/news/clayton/c-tran-reaches-end-416424.html).

[10] Estache and Gómez-Lobo 2003.

[11] *Sydney Airport Link Fees Insane Abusrd*, Psychopyk Blog (http://psychopyko.com/general/sydney-airport-link-fees-insane-abusrd), 27 Feb. 2010.

[12] Wikipedia (http://en.wikipedia.org/wiki/Airport_and_East_Hills_railway_line,_Sydney).

[13] ITLS 2010; at http://sydney.edu.au/business/itls/tops.

[14] See, *Taxi Hell In South Africa* (www.therightperspective.org/2009/03/24/taxi-hell-in-south-africa).

[15] World Bank 2009.

[16] Ragazzi 2006.

[17] Silva 2000.

[18] Until automobile travel is efficiently priced, transit subsidies can be justified on second-best grounds.

[19] Johns, et al. 2010; Smith and Gihring 2004.

[20] FTA (2010), *Transit Profiles: The Top 50 Agencies*, National Transit Database 2009 Report Year (www.ntdprogram.gov/ntdprogram/pubs/top_profiles/2009/Transit_Profiles_Top%2050%20Agencies-Complete.pdf).

[21] FTA 2010.

[22] In this case "rational" means that they are ideologically unbiased and so will support the mix of public and private ownership that provides the greatest net benefits, considering all benefits and costs.

[23] Litman (2010).

[24] APTA (2010), "Table 8," *2010 Public Transportation Fact Book*, American Public Transportation Association (www.apta.com); at www.apta.com/resources/statistics/Documents/FactBook/APTA_2010_Fact_Book.pdf.

[25] Litman 2006a.

[26] See discussion in my Planetizen blog, *A Trillion Dollars, or Cents Per Day* (www.planetizen.com/node/39892).

[27] www.fhwa.dot.gov/policyinformation/statistics/2008/hf10.cfm.

[28] Delucchi estimated that non-residential parking subsidies totaled $148-$288 billion annually in 1991, or $225 - $438 billion in 2007. See Delucchi (1996), *Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991*, Vol. 6, Institute of Transportation Studies (http://engineering.ucdavis.edu), Table 6-B.1 as summarized in "Parking Costs," *Transportation Cost and Benefit Analysis*, (www.vtpi.org/tca/tca0504.pdf).

[29] According to the Bureau of Labor Statistics' *2009 Consumer Expenditure Survey* (ftp://ftp.bls.gov/pub/special.requests/ce/standard/2009/income.txt), households spent $7,658 on transportation, of which $479 is for public transport and $7,179 is for automobiles, or $2,872 per capita since there are 2.5 average household members. $65 annual transit subsidy is 2.2% of this amount.

[30] (www.apta.com/resources/statistics/Documents/FactBook/APTA_2010_Fact_Book.pdf).

[31] FHWA (2010), "Table HF10," *Highway Statistics 2008*, Federal Highway Administration www.fhwa.dot.gov/policyinformation/statistics/2008/hf10.cfm.

[32] www.vtpi.org/tca/tca0504.pdf.

[33] For example, O'Toole cites a commuter train conductor who earned $240,000 in one year, giving the impression that is typical; in fact the worker had cashed out many years of sick and vacation time in preparation for retirement.

[34] www.bls.gov/oco/ocos242.htm.

[35] www.glassdoor.com/Hourly-Pay/Greyhound-Bus-Driver-Hourly-Pay-E93_D_KO10,20.htm.

[36] McCullough, Taylor and Wachs (1998).

[37] The higher transit operating costs in larger cities are not necessarily true inefficiencies. They can be attributed to a combination of factors including congestion (which slows vehicle operations), higher wages common in larger cities, major new investments (particularly in cities such as Portland that are expanding their transit systems), and outdated policies and practices. Only the last can be considered a true inefficiency.

[38] APTA data.

[39] See critique of "Great Rail Disasters" in, *Evaluating Rail Transit Criticism* (www.vtpi.org/railcrit.pdf).

[40] Litman 2004a.

[41] Litman 2004a.

[42] Litman 2006a and 2009.

[43] Helen Chernikoff and Al Yoon (2010), *Smart Money in Real Estate Is on Smart Growth*, ABC News (http://abcnews.go.com); at http://abcnews.go.com/Business/wireStory?id=11311919.

[44] ULI (2009), *Emerging Trends in Real Estate*, Urban Land Institute (www.uli.org); at www.uli.org/ResearchAndPublications/EmergingTrends/Americas.aspx.

[45] Decorla-Souza and Jensen-Fisher (1997)

[46] Colliers (2009), *Global CBC Parking Rate Survey*, Colliers International (www.colliers.com). Also see "Parking Costs," *Transportation Cost and Benefit Analysis*, VTPI (www.vtpi.org/tca/tca0504.pdf).

[47] Aftabuzzaman, Currie and Sarvi 2010; Litman 2007.

[48] Litman 2004a, based on the Texas Transportation Institute's *Urban Mobility Index*.

[49] Based on data from the FHWA's *Highway Statistics* and the Bureau of Economic Account's *Gross Domestic Product By Metropolitan Area* (www.bea.gov/regional/gdpmetro).

[50] APTA 2010. Tables 6 shows 21,757 million bus passenger-miles and Table 8 shows 2,052 bus revenue miles, and assuming that buses average 5.0 miles per gallon.

[51] Aurbach (http://pedshed.net/?p=219), based on Mikhail V Chester and Arpad Horvath (2009), "Environmental Assessment Of Passenger Transportation Should Include Infrastructure And Supply Chains," *Environmental Research Letters*, Vol. 4; at http://iopscience.iop.org/1748-9326/4/2/024008. Also see "Resource Costs" chapter of *Transportation Cost and Benefit Analysis* (www.vtpi.org/tca/tca0512.pdf).

[52] Randal O'Toole (2010), *Why Transit Will Never Be Energy Efficient*, Antiplanner (http://ti.org/antiplanner/?p=4086).

[53] ICF 2008; Litman 2004a.

[54] Zegras 2006; van de Velde, et al. 2010; . Macário 2010.

[55] Wright 2007; www.reavaya.org.za; www.planetizen.com/node/45041.