Victoria Transport Policy Institute
1250 Rudlin Street, Victoria, BC, V8V 3R7, CANADA
www.vtpi.org   info@vtpi.org
Phone & Fax 250-360-1560
"Efficiency - Equity - Clarity"

Evaluating Rail Transit Criticism

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Todd Litman
Victoria Transport Policy Institute

Abstract
This report evaluates criticism of rail transit systems. It examines claims that rail transit is ineffective at increasing public transit ridership and improving transportation system performance, that rail transit investments are not cost effective, and that transit is an outdated form of transportation. It finds that critics often misrepresent issues and use biased and inaccurate analysis. This is a companion to the report "Rail Transit in America: A Comprehensive Evaluation of Benefits."

Contents

Introduction

Many cities have developed, or are considering developing, rail transit systems. Some critics argue that such systems are ineffective and wasteful. This report evaluates these critics' arguments.

Previous research shows that rail transit can provide a variety of significant benefits (Litman, 2004a). However, these benefits are conditional, they only occur with suitable geographic conditions and supportive transportation and land use policies. Rail transit is not appropriate in every situation, and even the best transit program can be improved. People who support rail transit therefore welcome legitimate criticism that helps identify possible problems and opportunities for improvement. However, some transit criticism is unhelpful because it is inaccurate and biased. It is important to carefully evaluate rail transit criticisms to discern legitimate and helpful analysis from misrepresentations and errors.

Good research provides readers with the information they need to make informed assessments of an issue, including discussion of differing perspectives and evaluation methods, and data that both support and contradict (if any exists) the authors' conclusions (Litman, 2004c). Many transit studies do this. But rail transit critics often violate these practices. They provide inaccurate information and biased analysis intended to present rail transit in a negative way. They ignoring other perspectives, and suppress data that contradict their arguments. They consider a relatively limited set of transit impacts, as summarized in Table 1. As a result, they tend to understate the total benefits of transit improvements and overstate the benefits of roadway improvements.

Table 1 **Impacts Considered and Overlooked** (Litman, 2004b)

Usually Considered	Often Overlooked
Financial costs to governments	Downstream congestion impacts
Vehicle operating costs (fuel, tolls, tire wear)	Parking costs
Travel time (reduced congestion)	Vehicle ownership costs (depreciation, insurance, etc.)
Per-mile crash risk	Impacts on non-motorized travel
Project construction environmental impacts	Project construction traffic delays
	Impacts of generated traffic
	Indirect environmental impacts
	Strategic land use impacts
	Equity impacts
	Per-capita crash risk
	Impacts on physical activity and public health

Older transportation evaluation models tended to focus on a limited set of impacts, which tends to undervalue transit services and improvements.

Some problems cited by critics are legitimate issues to consider when evaluating and developing rail transit projects, but are not fatal flaws. With good planning, rail transit can provide significant net benefits, and problems identified by critics can be addressed.

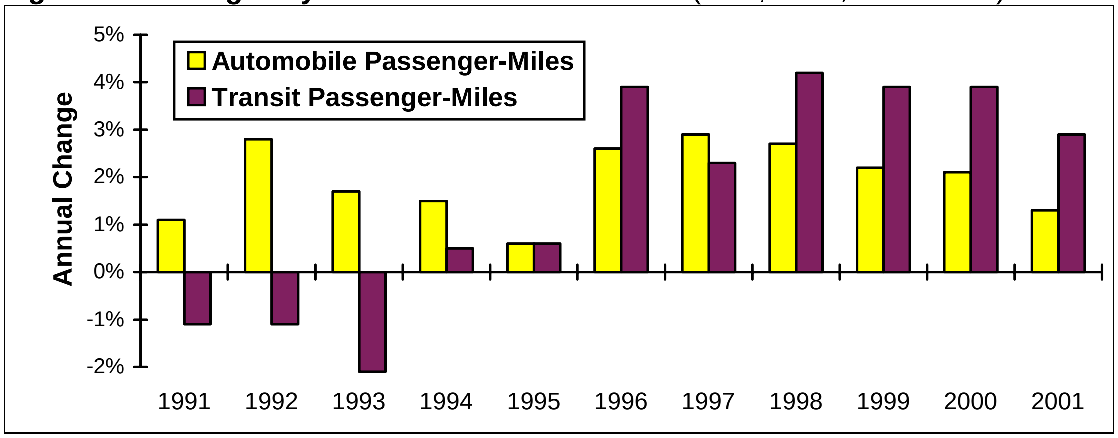
Common Criticisms

This section describes various arguments often raised by critics.

Transit Is Outdated

Some critics claim that public transit is outdated. During much of the Twentieth Century automobile use (here *automobile* includes cars, light trucks, vans and SUVs) grew, while transit declined in investment, service quality and ridership. Many cities experienced population declines during the second half of the Twentieth Century.

Figure 1 **Highway and Transit Travel Trends** (BTS, 2003, Table 1-34)



Between 1998 and 2001 transit travel grew faster than automobile travel.

During this period, various economic and demographic trends favored automobiles over transit: increased per capita vehicle ownership, suburbanization, declining real fuel prices. Extrapolating those trends suggested that transit demand would eventually disappear. But these trends have leveled off. Various indicators suggest that transit is becoming increasingly important (Litman, 2005a; "Transit Examples," VTPI, 2005):

- Demographic and consumer trends (more seniors, increased popularity of urban living, growing preference for walkability, etc.) support increased transit use and more transit-oriented development (Reconnecting America, 2004).
- Fuel prices are expected to increase in the future.
- Since the mid-1990s transit ridership has increased, and many U.S. cities have experienced population growth (Figure 1).
- Most of the cheapest urban highway projects have been built. Further urban roadway capacity expansion tends to have high unit costs (Litman, 2006a).
- Many cities are growing to a size and density that justifies more reliance on transit, including some areas classified as *suburban* that are becoming more urbanized.
- There is growing appreciation of more integrated transport and land use planning. For example, the Institute of Transportation Engineers (ITE, 2003), the International City/County Management Association (ICCMA, 1998) and the American Governor's Association (Hirschhorn, 2001) all support smart growth and multi-modal planning.

Transit Is Not Cost Effective

Critics often argue that rail transit projects are not cost effective at addressing a particular problem (congestion, air pollution, energy conservation, mobility for non-drivers, etc.). This reflects *reductionist* analysis, which only considers a single objective. But cost effectiveness should reflect total impacts. High quality transit that attracts discretionary riders (people who would otherwise drive) provides multiple benefits (Table 2). Although rail is not necessarily the most cost effective way of solving any of these problems individually, it is often cost effective overall, when all benefits and costs are considered (Hass-Klau, 2004). Rail critics generally ignore many of these impacts (see "Common Errors Made When Comparing Transit and Automobile Transport," Litman, 2004a).

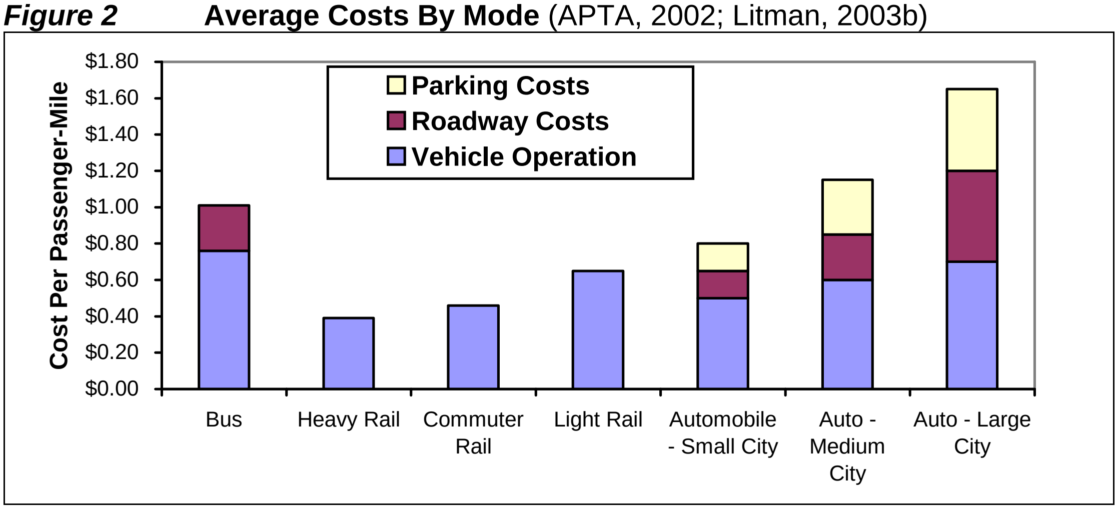
Table 2 **Planning Objectives That Transit Helps Achieve**

• Traffic congestion reduction	• Consumer cost savings
• Parking cost savings	• Land use planning objectives
• Roadway cost savings	• Excessive energy consumption
• Reduced traffic accidents	• Pollution emissions
• Improved mobility options	• Physical activity encouragement

Public transit can help achieve multiple planning objectives. Rail transit tends to be most effective on dense urban corridors where these problems are most intense.

Critics generally underestimate the full costs of accommodating additional automobile traffic and therefore the full savings provided by high quality transit that attracts discretionary travelers (Litman, 2006a). They usually overlook parking costs, and generally underestimate the real costs of expanding roadway capacity in the dense urban areas where rail transit is implemented (Figure 2). Critics often overlook the costs to consumers of owning and operating an automobile, and therefore the savings that result if quality transit allows households to reduce vehicle costs. Such savings will become increasingly important if fuel prices increases in the future, as many experts predict.

Figure 2 **Average Costs By Mode** (APTA, 2002; Litman, 2003b)



This figure compares vehicle and facility costs per passenger-mile of various modes. Rail transit costs are usually less than automobile costs, particularly in growing urban areas.

Critics often base their analysis on *average* costs, rather than the higher marginal costs of accommodating additional peak-period travel in the urban corridors where most rail transit projects are implemented. For example, although highway construction costs average just $5-10 million per lane mile, total urban project costs (including planning, land acquisition, intersections, etc.) are often several times greater (WSDOT, 2004). Parking and vehicle operating costs are also much higher under urban-peak conditions.

Rail transit projects have very large initial capital costs and take many years to build ridership and affect land use patterns, so unit costs (such as costs per additional transit rider) may seem very high during the short and medium term (less than 10 years). However, unit costs decline over time as ridership increases and costs are averaged over the facility's operating life, and when additional benefits from transit-oriented development are realized. Rail transit therefore provides a long-term legacy of benefits.

Critics often claim that rail transit receives an excessive portion of transportation funding, based on specific examples of regional capital budgets. But this misrepresents the issues:

- Rail transit is generally constructed in the densest part of a city where any transportation project is costly, due to high land values, numerous design constraints, and many impacts.
- Rail transit is constructed where the transport problems are greatest. Although rail only carries a small portion of regional travel, these are the trips with the greatest problems.
- The costs of new transit projects may seem high during construction years, but are much smaller when averaged over facilities' operating life.
- Transit must overcome market distortions that favor automobile travel, such as unpriced parking and roads, and so must provide high quality service to attract discretionary riders out of cars. Where such distortions are corrected, transit demand increases, reducing costs.
- Rail transit projects often include special amenities such as community redevelopment and streetscape improvements that provide additional benefits, besides just mobility.
- Rail transit projects include tracks, trains, stations, and sometimes parking facilities. It is inappropriate to compare rail system costs with just the cost of adding roadway capacity; comparisons should also include vehicle and parking costs needed for automobile travel.

Rail transit actually represents a small portion of total transport expenditures. Total U.S. 2000 rail transit subsidies (expenditures minus fares) totaled $12.5 billion, compared with $103 billion spent on roads and an estimated $200 billion spent on non-residential parking (Litman, 2003a). Rail subsidies therefore represent less than 10% of roadway and transit expenditures, and less than 5% of road, transit and parking facility expenditures.

From a household's perspective, rail transit provides an attractive return on investment. Quality rail transit requires about $95 annually per capita in public subsidy, but provides direct transportation cost savings that average about $450 annually, indicating a 500% annual return on investment (Litman, 2004a). Rail transit also tends to increase regional employment, business activity and productivity by reducing fuel and vehicle import costs, and shifting consumer expenditures to more locally-produced goods ("Economic Development Impacts," VTPI, 2005).

Critics generally ignore the problems exacerbated by many of the solutions they propose. For example, if rail funding was used to expand urban highway as critics recommend, total vehicle traffic would increase, exacerbating surface street congestion, parking problems, vehicle pollution, and sprawl. Table 3 lists transit benefits, and compares this with roadway capacity expansion. Road expansion provides just one benefit, congestion reduction, and if it stimulates additional driving and urban expansion, it increases many transportation problems, such as parking congestion, accidents and energy consumption.

Table 3 **Transportation Improvement Benefits Compared** (Litman, 2005b)

Transport Planning Objectives	Transit Improvements	Roadway Expansion	CAFE Standards	Subsidized Cars
Reduce traffic congestion	+	+	-	-
Reduce parking problems	+	-	-	-
Reduce traffic accidents	+	-	-	-
Consumer savings	+	-	-	-
Improve mobility for non-drivers	+	-	-	+
Conserve energy	+	-	+	-
Reduce pollution emissions	+	-	-	-
More efficient land use	+	-	-	-

This table compares the benefits of transit improvements, roadway expansion and subsidized cars for poor people. Transit improvements support numerous planning objectives (+), while other strategies support just one or two objectives but contradict others (-).

Described differently, the major urban transportation problems facing cities are traffic and parking congestion, traffic accidents, vehicle pollution and inadequate mobility for non-drivers, exactly the problems that rail transit can help solve. Rail serves the most densely developed corridors, where the full costs of accommodating more vehicle traffic by building more road and parking capacity, and the social and environmental problems of increased vehicle traffic are greatest.

Economic analysis by Nelson, et al (2006) used a regional transport model to estimate transit service benefits users and the congestion-reduction benefits to motorists in Washington DC. They found that rail transit generates congestion-reduction benefits that exceed rail subsidies, the combined benefits of rail and bus transit significantly exceed local transit subsidies, and the lowest-income group receives a disproportionately low share of the transit benefits, both in absolute terms and as a share of total income. Their study overlooked some benefits, such as parking cost savings, crash and emission reduction benefits, and so understates total transit benefits.

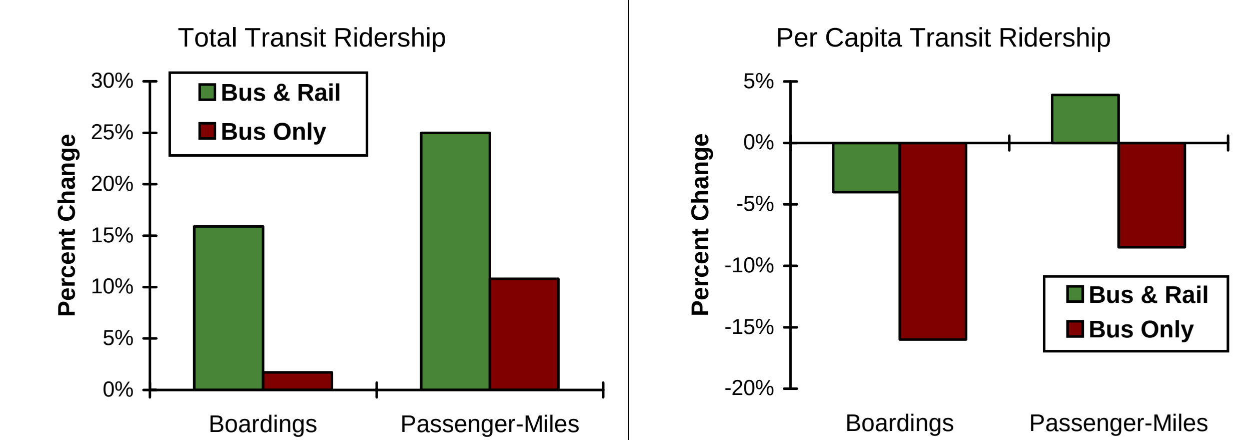
Rail Fails to Attract New Riders

Critics often argue that rail fails to attract new riders, pointing out that during much of the last half-century transit ridership declined in many cities that have rail transit. But such declines were much larger in areas that lack rail transit services.

Baum-Snow and Kahn (2005) found that, although transit mode share declined in most cities between 1970 and 1990, the decline what much smaller in cities with rail transit. They found that transit commute rates declined 23% (from 30% to 23%) in "old rail" cities (cities that have well-established rail transit systems in 1970), 20% (from 8% to 6%) in "new rail" cities (cities that build rail transit lines between 1970 and 1990), and 60% (5% to 2%) in cities without rail. At a census tract level they found higher rates of transit ridership in residential areas near both old and new rail transit lines, than in similar areas not served by transit. Transit use in all three samples remained relatively unchanged between 1990 and 2000, reflecting changing travel trends.

Henry and Litman (2006) compared public transport performance in U.S. urban areas that expanded rail transit with urban areas that expanded bus transit from the mid-1990s through 2003, using standard Federal Transit Administration data. Cities that expanded their rail systems significantly outperformed cities that only expanded bus systems in transit ridership, both absolutely and per capita (Figure 3).

Figure 3 **Changes in Transit Ridership – 1996 to 2003** (Henry and Litman, 2006)



Total transit use increased much faster in cities that have new or expanded rail service than in cities that only expanded bus service.

Per capita transit use declined less or increased in cities that expanded rail service compared with cities that only expanded bus service.

Schumann (2005) compared transit system performance in two similar cities. The city of Sacramento, California began building a Light Rail Transit system in 1985, while Columbus, Ohio failed in its efforts establish a similar system and so only offers bus transit. During the following 17 years, transit service and ridership increased significantly in Sacramento, but declined in Columbus, while operating costs per passenger-mile increased much more in Columbus than in Sacramento, as indicated in the table below.

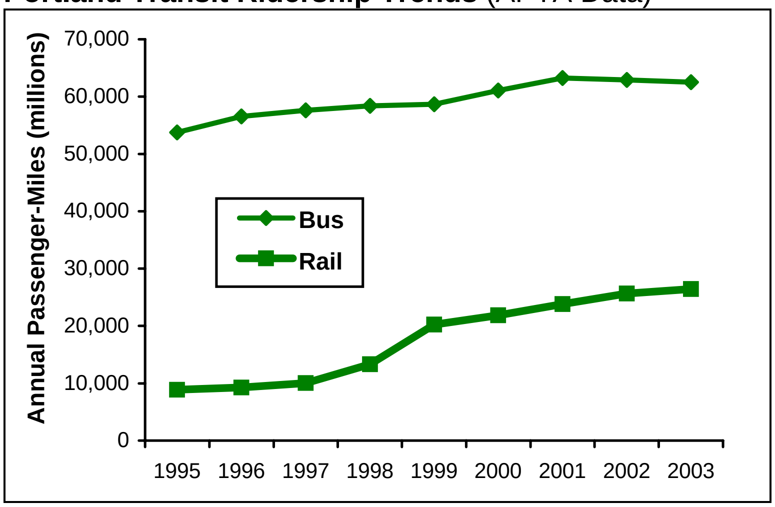
Table 4 **Columbus and Sacramento Transit Performance** (Schumann, 2005)

	Sacramento (rail transit)	Columbus (bus transit)
Transit trips per capita	15%	-47%
Transit passenger-miles per capita	-12%	-54%
Revenue vehicle miles	15%	-1%
Transit operating costs per passenger-mile	151%	205%

*Sacramento experienced far better transit performance after establishing a rail transit system than Columbus, a similar size city that only operated bus transit. For a more detailed summary see "Light Rail Transit," VTPI, 2006 (*www.vtpi.org/tdm/tdm121.htm*)*

Many cities that developed rail transit systems have experienced significant growth in total transit ridership (LRN, 2006). Those are generally cities that have implemented supportive transit-oriented land use policies (Demery and Setty, 2005). Figure 4 shows Portland's rail transit ridership is growing as the system expands. Most of the growth involves rail ridership growth.

Figure 4 **Portland Transit Ridership Trends** (APTA Data)



Portland transit ridership is growing as rail service expands. Most of this growth involves rail.

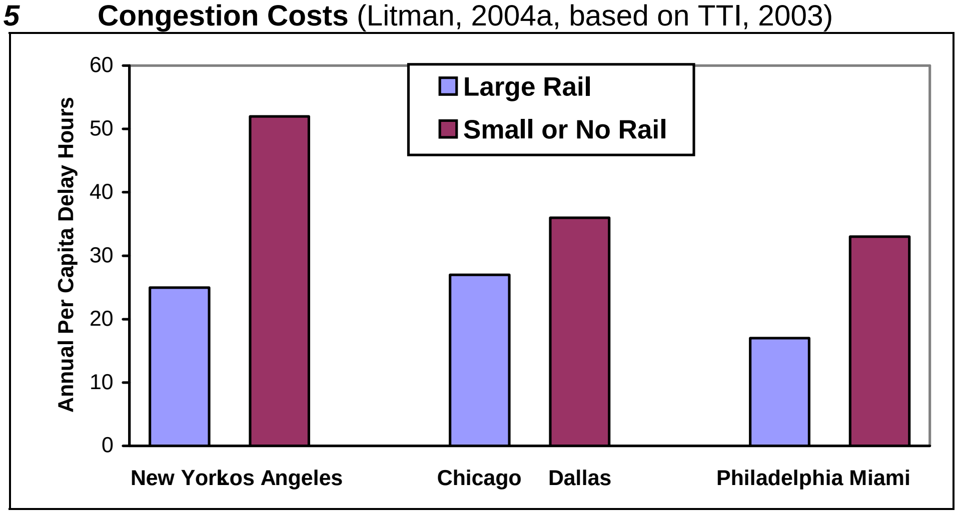
In addition, voters appear more willing to support dedicated funding for transit systems that include rail transit service. For example, in 1988, a year after the first rail line began operations, Sacramento country voters approved a referendum which provided sales tax funding to operate and expand the transit system, while in Columbus, which only has bus transit, only one out of four transit funding referenda passed between 1986 and 1995 (Schumann, 2005). As a result, the Columbus transit system was forced to raised fares and reduced service, which helps explain the decline in transit ridership. Had Columbus had a rail line in the 1980s there would likely have been more voter support for public transit funding, leading to a more attractive system and higher ridership now.

Fails To Reduce Traffic Congestion

Critics often argue that rail transit fails to reduce traffic congestion. Several recent studies indicate that taking into account factors such as city size, rail transit does reduce congestion (Lewis and Williams, 1999; Litman, 2004a; Litman, 2004b; Winston and Langer, 2004; Litman, 2006b). Winston and Langer (2004) found that both motorist and truck congestion costs decline in a city as rail transit mileage expands, but congestion costs increase as bus transit mileage expands. This appears to occur because buses attract fewer travelers from driving, contribute to traffic congestion themselves, and have less positive impact on land use accessibility. Garrett (2004) found that traffic congestion growth rates declined somewhat in some U.S. cities after light rail service began. In Baltimore the congestion index increased an average of 2.8% annually before light rail, but only 1.5% annually after. In Sacramento the index grew 4.5% annually before light rail, but only 2.2% after. In St. Louis the index grew an average of 0.89% before light rail, and 0.86% after. In Dallas, the growth rate did not change.

Critics often use inappropriate congestion indicators such as roadway *level of service* ratings and the Texas Transportation Institute's *Travel Time Index*, which only reflect delays to motorists, ignoring travel time savings to people who shift to transit. *Per capita congestion costs* are a more appropriate indicator of rail congestion reduction benefits. Baum-Snow and Kahn (2005) found significantly lower average commute travel times in areas near rail transit than in otherwise comparable locations that lack rail, due to the relatively high travel speeds of grade-separated transit compared with commuting by automobile or bus under the same conditions. Figure 5 shows matched-pair analysis that indicates the much lower congestion delays in cities with large rail transit systems.

Figure 5 **Congestion Costs** (Litman, 2004a, based on TTI, 2003)



Matched-pair analysis shows that cities with large rail transit systems have significant less per capita traffic congestion delay than similar size cities that have small or no rail transit. This suggests that rail transit significantly reduces congestion costs.

Bus Transit Is Cheaper Than Rail

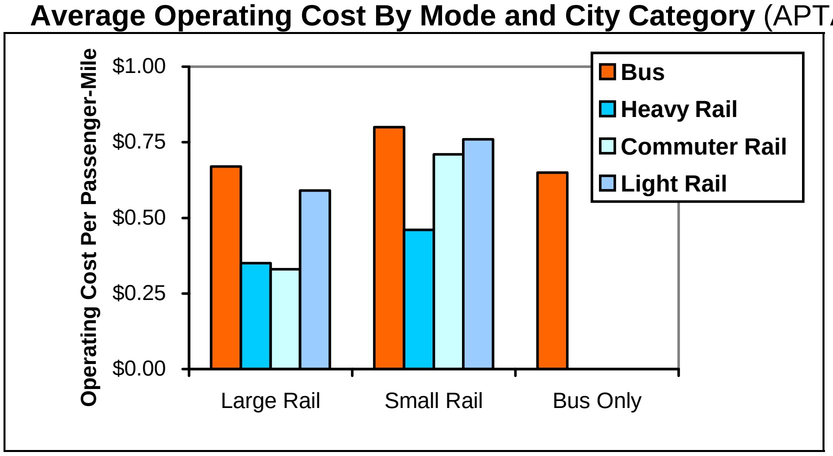
Critics often argue that bus transit could be provided at a lower cost than rail. Rail and bus each have advantages and disadvantages, and each is suitable for certain situations (Litman, 2004b). In general, rail tends to be most appropriate on very busy urban corridors with heavy ridership demand where communities want to encourage compact, walkable urban development. Bus is most appropriate serving lower-density area or where communities are unwilling to support transit-oriented land use.

Rail provides unique user attributes that many consumers value. Rail transit generally provides more comfortable vehicles, higher travel speeds, more frequent service, better stations, more care devoted to stations, and more prestige than buses. As a result, rail tends to attract more discretionary riders who would otherwise drive (Pushkarev and Zupan, 1977; Demery and Higgins, 2002; LRN, 2006). Rail is particularly advantageous in major centers to avoid the air and noise pollution of numerous buses. Bus rapid transit systems ("Bus Rapid Transit," VTPI, 2005) can provide some of the same amenities as rail by incorporating grade separation, stations, more comfortable vehicles and alternative fuel drive systems, but this increases their costs closer to that of rail.

Rail projects can serve as a catalyst for more accessible land use, which provides additional benefits as discussed in Litman, 2004a. People who live and work in such areas tend to own fewer vehicles, drive fewer annual miles, rely more on walking and transit for transportation, and as a result cause and experience less traffic congestion, fewer traffic accidents, reduced energy consumption and pollution emissions, improved fitness, and household travel cost savings. Busways do not usually have such effects.

Average operating costs per passenger-mile actually tend to be lower for rail than bus, as illustrated in Figure 6. In comparisons between rail and bus systems, Schumann (2005) and Henry and Litman (2006) find that operating costs are significantly lower of rail transit than for bus service. Although rail is costly per vehicle-mile it tends to have high load factors, while buses often maintain service in lower-density areas where demand is low in order to provide basic mobility. Unit costs for LRT systems tend to be high because these systems tend to be relatively short and new, and operate in congested areas.

Figure 6 **Average Operating Cost By Mode and City Category** (APTA, 2002)



Rail operating costs tend to be lower than for bus.

In a posting on his organization's website, O'Toole ("Does Light Rail Pay for Itself?" *Vanishing Automobile update #57*, http://ti.org/vaupdate57.html) claims to prove that rail generally has higher operating costs per passenger-mile than bus transit, but his analysis contains several critical errors. First, he bases his analysis on *average* bus operating costs, although rail transit is generally implemented in the most congested part of a city where congestion is greatest, stops most frequent, and operating speeds lowest, so bus operating costs per vehicle-mile on the same corridor are significantly higher than average. For example, if buses average 30 mph in a region overall but only 20 mph in the denser urban corridors where rail service is provided, their operating costs per passenger-mile on these corridors would be at least 33% higher than average.

Both traffic speeds and trip distances tend to be shorter in denser urban areas compared with more dispersed suburban areas, so costs per *passenger-mile* tend to be higher in urban areas although costs per *passenger-trip* may be lower due to shorter trip distances. Failing to take this factor into account when comparing costs biases the analysis in favor of suburban areas and bus transit, and undervalues the true transportation cost savings from more compact, accessible land use, and rail transit investments that help create this type of land use pattern (Litman, 2004a).

In addition, rail transit projects generally incorporate various amenities such as grade separation and transit stations that improve service quality, which attract more travelers who would otherwise drive and therefore provide various benefits such as reduced congestion, accident risk and pollution emissions. A fair comparison should therefore compare rail with a busway that includes a comparable amount of grade separation and transit stations, or account for the lower service quality and ridership of the cheaper bus option.

People Will Not Give Up Their Cars

Critics sometimes argue that rail transit requires residents to give up driving, which is futile because Americans (or the British, French, or any other group) "love to drive." This is wrong, both because rail system development doesn't require eliminating all automobile travel, and because there is plenty of evidence that many motorists would willingly shift a portion of their travel to transit, provided that it is convenient, comfortable, affordable and prestigious. In most cases a 5-20% mode shift on major corridors is sufficient to justify rail investments.

Transit Is Subsidized, Automobile Transport Is Not

Critics often argue that rail transit is inefficient and unfair because it is subsidized, while automobile transportation is not. However, this depends on which costs are considered. Public transit service is subsidized directly. Automobile travel is subsidized indirectly, through the provision of roads and parking, and through various uncompensated external costs such as accident risk and pollution emissions (Murphy and Delucchi, 1998; FHWA, 1997; Litman, 2003a). These external costs are particularly large under urban-peak conditions, while transit subsidies per passenger-trip and passenger-mile tend to be lowest under such conditions due to higher load factors.

In addition, public transit subsidies can be justified on the following grounds:

- *Equity.* Transit tends to provide basic mobility for non-drivers, many of whom are low income. Subsidies are therefore justified on vertical equity grounds. Automobile travel is subsidized through free roads and parking facilities, and uncompensated external costs imposed on other road users, so transit subsidies can also be justified on vertical equity grounds, to give non-drivers a fair share of resources. Since transit dependent people tend to travel much less than motorists per year, much higher subsidies per passenger-mile may be justified for transit users than for motorists, in order for each to receive an equal share of transportation subsidies per year.
- *As a second-best strategy to offset another market distortion.* Until automobile transportation is efficiently priced, with congestion fees, road tolls, parking fees, pay-as-you-drive vehicle insurance, and pollution emission fees, transit subsidies can be justified as a way to reduce excessive traffic congestion, roadway costs, parking costs, accident risk and environmental damages.
- *Due to economies of scale.* Rail transit provides economies of scale: unit costs tend to decline substantially with increased ridership. This price structure justifies subsidies.
- *To help achieve a strategic planning objective.* Rail transit can provide a catalyst for more efficient land use and economic development.

Under some circumstances rail transit subsidy costs are offset by increased land values and property tax revenues from adjacent properties (Smith and Gihring, 2004). Critics claim that these are shifts in property values rather than net gains, but there is theoretical and empirical evidence that by improving overall transportation system efficiency, rail transit increases regional productivity, and so does provide net revenue (Litman, 2004b).

Rail Transit Is Too Slow To Be Useful Or Attractive

Although average rail speeds are low compared with average automobile speeds, this is a false comparison (Litman, 2004a). On the congested urban corridors served by rail, automobile travel speeds tend to be much lower, so rail trips tend to be more competitive. In addition, many consumers tend to consider time spent traveling by quality transit (passengers have a seat, vehicles are comfortable, safe and quiet) to have less cost than the same amount of time spent driving in congested conditions (Litman, 2004b).

Rail Transit Systems Are Over Budget and Fail To Attract Predicted Ridership

Studies by Pickrell (1992) and Flyvbjerg (2005) suggested that many earlier rail transit projects exceeded projected costs and failed to achieve first-year ridership predictions. But much of what Pickrell classified as cost overruns where actually adjustments due to design changes, and first year ridership is a poor indicator of long-term effectiveness. Most recent rail transit projects have met or exceeded projections, as indicated in Table 5.

Table 5 **Light Rail Projects Completed Within Budget and Schedule** (LRN, 2001)

City & Year	Actual Completion and Ridership Compared With Projections
Calgary (1987)	Northwest line extension, opened in 1987, completed months ahead of schedule and $3 mn under budget at a cost of (1987 Canadian) $104 mn. [Source: TRB Special Report 221 (1989)]
Dallas (2001)	North Central and Northeast LRT extensions are on schedule and under budget. The total budget was reduced by $17 million due to excellent bid prices. [Source: DART, Oct. 2000] Ridership averages about 40,000 passengers a day, 10% higher than forecast. [Source: DART, 2000]
Denver (2000)	The nearly 9-mile-long Southwest light rail line to Littleton, which opened in July 2000, came in on target at a total cost of $177.7 million. Ridership averaged about 14,000 weekday passengers, 67% above original projections. [Source: Denver RTD; Denver Business Journal 26 Jan. 2001]
Edmonton (1978)	This project was completed on time and within its budget of (1978 Canadian) $65m. [Source: TRB Special Report 182 (1978)]
Houston (2004)	Houston's METRORail system was completed on time, within budget, and ridership has grown steadily since the system began operation. [Source: Houston Metro]
Memphis (2004)	The original budget for construction and procurement of five heritage streetcars was $75m, actual costs were approximately $55m. [Source: MATA website]
Minneapolis (2005)	Ridership on Minneapolis's new Hiawatha/Central LRT line was projected to carry 19,300 per weekday in 2005 and 24,600 per weekday by year 2020, but carried more than 25,000 passengers per weekday in August 2005. [Source: MetroTransit (www.metrotransit.org)].
Portland (1986, 1998)	Both the Eastside (1986, $214 m) and Westside (1998, $964 m) projects were completed within the FTA funding agreement budget [Source: Center for Transportation Excellence]. The Westside first year ridership exceeded forecasts by 22% [Source: Tri-Met, 2000], and in 2005 averaged more than 32,700 daily boardings, exceeding 2008 ridership targets [Source: Tri-Met, 2005].
Sacramento (1998, 2003)	Mather Field Road extension (2.5 mi), plus doubletracking of the starter line from Starfire to Butterfield and doubling of the Brighton Bridge were all completed on time and for about $37m, about 10% under total project estimate of $40 million. [Source: LTK Engineering (2000)] 2003 extension was completed on time and within budget.
Salt Lake City (1999)	According to Utah Transit Authority Grants Administrator's Office, the publicly budgeted amount for the TRAX LRT system was $312m when the project was funded. Actual payout was only $300m. By 2001, ridership averaged 20,000 weekday passengers, exceeding forecasts by 43% [Source: Utah Transit Authority, 2000; Denver Business Journal 2001/01/26].
San Diego (1981)	The first Trolley line was completed on time and within the budget of $86.5 mn (1981). [Source: APTA, North American Rail Transit (1991); J Schumann, LRT cost table (1996)]
St. Louis (1993, 2001)	The first MetroLink was completed on time and on budget for $355m. The second line opened ahead of schedule and under budget. First year ridership exceeded 20,000 daily passengers, 67% higher than projected. 2001 ridership reached 40,000 daily passengers, exceeding the 20-year projection of 37,000. [Source: Bi-State Dev. Agency, 2000; Citizens for Modern Transit, 2001]
Tacoma (2004)	The $80m Tacoma Link project, which included an array of urban enhancements in addition to the rail line itself, came in under budget and ahead of schedule. [Seattle Post-Intelligencer, 23 August 2003; Tacoma News Tribune, 22 August 2003] The 1.6-mile route carries about 2,320 weekday passengers, already exceeding 2010 projections. [Source: Sound Transit]

This table summarizes recent rail transit projects completed within budget and schedule.

Many highway projects also cost more than originally projected, or fail to reduce traffic congestion as expected. A General Accounting Office report (GAO, 2003) found that 23 of 30 major roadway projects had costs exceeding projections. Similarly, many toll roads have less than projected traffic and revenue (GAO, 2004). Muller (2001) found that of 16 recent U.S. toll road projects, demand and revenues averaged only 50-60% of forecasts. These examples show that highway projects are also vulnerable to inaccurate projections.

Rail Transit Harms Poor People

Critics make various claims that rail transit is inequitable. They argue that, since rail transit riders tend to be higher income than bus riders, devoting resources to rail reduces transit service quality for the poor. This is not always true. Many rail systems are heavily used by middle and lower-income travelers. This criticism assumes that money spent on rail would otherwise be spent on bus transit, but rail expenditures often substitute for highway expenditures. Many middle- and higher-income citizens are willing to support additional taxes to fund rail transit improvements, but are less willing to support such funding for bus projects. Once the rail system is built more citizens are willing to support bus expansion. By creating more accessible, multi-modal communities, rail transit tends to reduce consumer transportation costs and improve accessibility for non-drivers and low-income travelers (Litman, 2004a).

Rail transit critic Randal O'Toole claims that transit-oriented transportation systems harm the poor by reducing their employment options, citing research by Sullivan (2003) and Raphael and Stoll (2000) which indicate that having a personal automobile for commuting increases employment rates and incomes among lower-income and minority workers. O'Toole claims this proves that car ownership increases household income by an average of $1,100 per month, and so, conversely, transit-oriented transportation systems cause poverty. This misrepresents the issues. Both studies acknowledge that their results may reflect colinearity (higher income workers are more likely to afford a car) and other confounding effects, and that other types of transportation improvements may be more appropriate and cost effective overall for improving job access.

It would be more accurate to say that *accessibility* improves low-income workers' employment rates and incomes and that in automobile-dependent locations this requires automobile transportation. However, this does not prove that giving low-income households automobiles always increases their incomes, or that transit improvements cannot also improve employment access. Since even lower-cost motor vehicles typically cost owners $4,000 or more annually, compared with less than $1,000 for a public transit pass and occasional taxi fares, low-income workers would need to earn at more than $250 more per month before they are financially better-off overall. For this reason, a lower-income workers can be even better-off if transit improvements provide access to jobs without increasing their household costs.

Rail Requires High Densities

Critics sometimes claim that rail transit requires far higher densities (often reported at 50,000 residents per square mile) than found in most cities, and imply that rail requires all residents to live in multi-family housing. But regional population densities are not important. Rather, rail requires a sufficient number of people and jobs on a particular corridor. Light rail requires at least 9 residential units per acre, which can be achieved with a combination of single-family housing and low-rise apartments (Pushkarev and Zupan, 1977). Even lower densities may be sufficient if some rail trips are by park-and-ride, or if transit is supported by incentives such as discounted passes and parking cash out, to increase per capita transit trip rates (VTPI, 2005).

Rail Only Serves Downtown

Some critics claim that rail transit is not very useful because it only serves old central business districts, which contain a declining share of regional employment. But this is not quite true, rail transit connects commercial centers (business districts, malls, campuses and airports), including some in suburbs. As a result, in cities with major urban rail systems, a major portion of jobs, particularly higher-order jobs that involve longer commutes, are generally located near rail transit stations. In addition, rail transit encourages more businesses to locate in transit-oriented areas, and so can help reverse trends to more dispersed, automobile-dependent development patterns.

Rail Carries Too Few Travelers To Solve Transportation Problems

Critics often argue that a particular rail transit project's impacts are too small to solve regional transportation problems. But this criticism could also be made about most individual highway projects. Although rail transit carries just a small portion of total regional travel in most cities, it serves the most congested routes and destinations where even a small reduction in traffic volumes can provide significant benefits from reductions in congestion, road and parking costs, vehicle costs and traveler stress. On such corridors, rail transit is often more cost effective than accommodating additional trips by automobile, when all costs are considered.

Light Rail Operates Half Empty

Critics sometimes complain that "rail vehicles operate half empty." This may be true, but it is not a sign of inefficiency. Any distribution system must be sized for peak demand, including utility networks, road systems and transit vehicles. Rail vehicles are sized to carry peak loads, and so during off-peaks and at the ends of lines, they have extra capacity. Overall, rail systems tend to have higher load factors than bus systems, and utilize resources far more efficiently than automobile travel, which requires vehicles, roads and parking facilities sized to accommodate peak load requirements. For example, the average automobile has a capacity of 5 passengers but only carries about 1.6 on average, and so drives around *two-thirds* empty. And since the average automobile is only driven about one hour a day, its *overall* load factor is only about 1.3%, while transit vehicles are generally driven more than 12 hours a day. In addition, there are an estimated 4 parking spaces and 265 lane-feet of roadway per motor vehicle, which are only occupied about 23% and 1% of the time respectively.[1]

Critiquing Rail Transit Critics

This section examines specific rail transit criticisms. Also see CFTE (2005).

Great Rail Disasters

Randal O'Toole published *Great Rail Disasters* in 2004 to support his criticism of rail transit investments and smart growth policies.[2] The report applies the author's thirteen component index of transit impacts. But this index fails to reflect best practices for transit evaluation.[3] It makes a fundamental error by grouping together all cities with rail transit service, regardless of size. For example, it criticizes the New Orleans rail system for failing to solve the city's transport problems, although it is only a single rail line that serves a tiny portion of total regional transit trips. Accurate analysis must take into account the relative magnitude of rail systems.

O'Toole claims that rail fails to increase transit ridership, based on ridership trends between 1970 and 2000. But this indicates nothing about rail transit's effects since it includes no comparisons between cities or corridors with and without rail, or between rail cities and national trends. The only relevant evidence is a statement (which turns out to be false and has yet to be corrected),[4] "The twenty-three urban areas with rail transit collectively lost more than 33,000 transit commuters during the 1990s, while the twenty-five largest urban areas without rail transit collectively gained more than 27,000 transit commuters." These changes may reflect other factors unrelated to transit mode, such as the city's population and employment trends. Transit ridership grew in 18 of the 23 cities O'Toole analyzes, particularly those with expanding rail systems such as Denver (40%), Los Angeles (14%), Portland (59%), Sacramento (48%), San Jose (23%) and St. Louis (22%), indicating that rail transit investments often do increase ridership.[5]

Several demographic and economic trends increased automobile travel and reduced transit ridership during the 1970 to 2000 period, including growing vehicle ownership, baby boomers reaching peak driving age, more women in the workforce, and declining transit service. But many of these trends have peaked (Litman, 2005a), resulting in transit ridership growth most years since the mid-1990s. As described earlier, research by Baum-Snow and Kahn (2005) indicates that cities with rail systems experienced far smaller ridership losses than those that rely on bus transit.

O'Toole claims that rail is more costly than automobile or bus transportation, but his analysis contains several errors. He only considers a small portion of automobile costs and transit benefits when comparing modes: he overlooks vehicle costs, parking costs, accident damages and pollution emissions. O'Toole states incorrectly and without citation that regions with rail system devote 30-80% of their total transportation capital budgets to transit. When a major rail transit project is under construction most of the cost is included in a particular agency's capital budget, so for a few years it appears relatively large, but when averaged over a larger period (rail capital investments typically have 50+ year operating lives) these projects represent a relatively small portion of total transportation expenditures. O'Toole overlooks many benefits of rail, including improved mobility for non-drivers and urban redevelopment.

O'Toole significantly underestimates urban roadway expansion costs because he uses average costs rather than the much higher costs of roadway projects in congested urban corridors where most rail transit systems are built, and ignores costs for planning, land acquisition and intersections. Current large city highway expansion projects are typically two to four times higher than O'Toole's estimates.[6] He is also wrong to compare road and rail based on *total daily* rather than *peak period* travel, since most urban roadways can handle travel demand except during peak periods. Accordingly, roadway capacity expansion costs should be assigned only to peak-period travelers (Litman, 2004b).

O'Toole claims that rail increases traffic congestion, based on changes in the Texas Transportation Institute (TTI) *Travel Time Index* in cities with rail transit systems. But this indicates nothing about the effect of rail on congestion. Traffic congestion tends to increase with city size. Rail transit systems are generally developed as cities grow large enough to experience congestion problems, so cities with rail transit tend to have worse congestion than those without, but this does not mean that rail transit *causes* congestion or fails to reduce congestion compared with what would occur without rail. O'Toole's methodology only considers congestion experienced by motorists, ignoring benefits to travelers who shift from driving to grade-separated transit, and when rail transit projects provide a catalyst for more accessible land use development which reduces total travel distances.[7] The TTI study provides seven congestion indicators, some of which are more appropriate for evaluating transit impacts. *Per-capita Congestion Cost* accounts for time savings that result from shifts to alternative modes and more accessible land use patterns (Litman, 2004b). Measured in this way, congestion is found to decline substantially in cities with large rail transit systems, as illustrated earlier.

O'Toole argues that rail transit is dangerous based on relatively high crash rates per passenger-mile. Most of this risk is to other road users (pedestrians, cyclists and motorists), and it declines as load factors (transit passengers per vehicle) increase. Light rail crash rates per passenger-mile are far lower in other countries due to higher load factors and better integration of transit into urban design (Litman, 2004a). As with congestion, traffic accident risk is best measured *per capita* rather than per *passenger-mile*, since rail transit tends reduce total per capita vehicle travel.[8] Various studies indicate that per capita traffic fatality rates decline with increased per capita transit ridership (Litman, 2004b). U.S. cities with large rail systems average 7.5 traffic fatalities per 100,000 population (7.9 excluding New York), while cities with smaller rail systems average 9.9, and cities that lack rail average 11.7, a 40% higher rate (Litman, 2004a).

O'Toole argues that rail transit reduces transit service quality and so harms transit-dependent residents by absorbing an excessive portion of transit funding. However, per capita funding for both rail and bus transit tends to increase, and transit ridership grows, as rail transit systems expand, indicating that rail and bus transit are complements, not substitutes (Litman, 2004a). This occurs because rail transit tends to attract support from middle-class citizens, and so tends to increase total transit funding. In addition, transit-oriented development provides other benefits to non-drivers, including improved walking conditions and less-dispersed destinations that are easier to access without a car.

O'Toole claims that rail transit projects are consistently over-budget and have lower ridership than projected, based primarily on a study performed in the late 1980s that used five to ten year old examples (Pickrell, 1989 and 1992).[9] Although many of the examples are two decades old, O'Toole uses the present tense when describing them (e.g., "Pickrell reports that it went 61 percent over budget and carries less than a third of the anticipated riders"). Even when it was first published Pickrell's report was considered dated, since planning reforms had already corrected many of the problems identified (APTA, 1990). Similarly, O'Toole reports fourteen-year-old data on airport rail transit use by air travelers, and only when this number is low. O'Toole provides estimates of cost overruns and rider shortfalls for various rail projects but includes no details. Researchers normally provide specific references and analysis in a report to allow independent verification. O'Toole's failure to provide this information indicates either carelessness or that he has something to hide.[10] O'Toole ignores examples of more recent transit projects that have been on-time, on-budget and exceeded their ridership projections, as described earlier.

O'Toole claims that rail transit uses more energy than automobile travel, and is not cost-effective for reducing pollution emissions. However, he compares transit energy consumption with *cars* (3,500 BTUs per passenger-mile) rather than the *automobile fleet average* (6,348 BTUs per passenger-mile, including light trucks, SUVs and vans) which is either an error or an intentional attempt to deceive. He fails to account for rail's ability to reduce total per capita vehicle travel and therefore emissions (Litman, 2004a and 2004b). Although rail investments may not be justified on energy conservation and emission reductions alone, these can be considered valuable co-benefits. For example, if a community is choosing between expanding roadways or building rail in order to reduce traffic congestion, it makes sense to favor the rail option because it also reduces energy consumption and pollution emissions.

O'Toole claims that transit-oriented development reduces housing affordability, but this depends on how affordability is measured (Arigoni, 2001; Nelson, et al, 2002; "Affordability," VTPI, 2005). Rail transit projects are generally implemented in rapidly growing cities where property values are rising. There is no evidence that rail transit actually reduces housing affordability compared with what would otherwise occur. O'Toole also argues that zoning and other land use controls reduce housing affordability. This may be true, but the worst of these costs are minimum parking requirements and density restrictions to support automobile travel. Shoup (1999) found that parking costs average 4.4 times all other development charges combined, including fees for roads, schools, parks, water, sewage and flood control. Reduced parking requirements, increased housing diversity (allowing more multi-family developments and secondary suites), and location-efficient development (which reduces household transport costs) are smart growth ways to increase household affordability (Jia and Wachs, 1998; McCann, 2000; "Location Efficient Development," VTPI, 2005).

O'Toole' bias is revealed in its analysis of Portland, Oregon. According to his own indicators Portland's rail system is successful, with increasing transit ridership. Still, O'Toole arbitrarily concludes that Portland's rail system is a failure.

Summary: The Data Say Ouch!

Any evaluation involves numerous decisions as to which data to use, how to structure analysis, which results to provide, and how to present them. Statisticians joke that a researcher who manipulates analysis to reach a preferred conclusion "tortures the data."

For example, consider congestion impact analysis. The Texas Transportation Institute's *Urban Mobility Study* has nine congestion indicators. Of these, the Travel Time Index is the least appropriate for evaluating rail transit benefits since it only considers delays to road vehicles. *Per capita* congestion costs takes into account the reduction in congestion delays to people who shift to transit or who travel shorter distances due to more compact development. In addition, the data can be evaluated in various ways. Should analysis consider a single point in time or trends over time, and if so, which time periods? Which cities are compared? Should individual cities be compared with national trends? Should results be presented in total or per capita? A clever analyst can usually find a combination of data and evaluation techniques that reflect the conclusion they want. The results are true but biased.

Several features of *Great Rail Disasters* analysis violate standard economic evaluation practices, indicating that the data were selected and analysis manipulated to support the author's desired conclusions.[11] These include:

- Lack of with-and-without analysis. There are virtually no comparisons between cities that have rail and those that do not. It is therefore impossible to identify rail transit impacts.
- Failing to differentiate between cities with relatively large, well-established rail systems and those with smaller and newer rail systems that carry a relatively small portion of regional transit ridership.
- Failing to compare individual city's trends with national trends.
- Failing to account for additional factors that affect transportation and urban development conditions, such as city size, changes in population and employment.
- Failing to apply marginal analysis. The report makes no effort to determine the incremental cost of accommodating additional peak-period travel by each mode.
- Ignoring many types of automobile costs. For example, vehicle expenses are included when calculating transit costs, but vehicle and parking expenses are ignored when calculating automobile costs.
- Exaggerating transit development costs. Claims, such as "Regions that emphasize rail transit typically spend 30 to 80 percent of their transportation capital budgets on transit" are unverified and generally only true for certain regions and years, not when costs are averaged over larger areas and times.
- Presenting outdated data as current, including examples from the 1960s through early 80's, and airport ridership data from 1990.
- Ignoring other benefits of rail transit such as parking cost savings, consumer cost savings and increased property values in areas with rail transit systems.
- Failing to apply current best practices in transit evaluation (as described in ECONorthwest and PBQD, 2002, and Litman, 2004).

Evaluating the Index

The Rail Transit Performance Index used in *Great Rail Disasters* is biased and ineffective. The table below describes changes that would be needed to make it more accurate.

Table 6 **Rail Transit Performance Index**

“Great Rail Disaster” Indicators	Required For Accurate Analysis
1. Change in transit ridership from 1990 to 2000.	Rail systems should be categorized by their size relative to total transit ridership. Analysis should focus on the corridors served by rail, not total regional transit ridership. Should compare with national ridership trends. Continue to use most recent available data, such as 2002.
2. Change in transit share of motorized passenger travel from 1990 to 2000.	"
3. Change in transit commuting in the 1990s.	"
4. Change in transit’s share of commuting in the 1990s.	"
5. Reliability of construction cost forecasts.	Categorize by year (e.g., pre-1990, 1990-1999 and 2000+) to see if predictions improved over time. Provide specific citations to allow independent verification.
6. Reliability of ridership forecasts.	"
7. Changes in congestion from 1982 to 2001.	Categorize rail systems by relative size. Use per capita congestion costs rather than a congestion index (which treats increased driving as a congestion-reduction strategy). Analyze individual rail corridors rather than total regional congestion.
8. Changes in per capita driving from 1982 to 2001.	Categorize rail systems by relative size. Analyze corridors served by rail. Compare with national trends. Continue to use most recent data, such as 2002.
9. Cost-effectiveness of rail transit relative to freeways.	Categorize rail systems by relative size. Analyze marginal rather than average costs, taking into account facility, parking and vehicle costs.
10. Cost-effectiveness of rail transit relative to buses.	Categorize rail systems by relative size. Compare marginal rather than average costs.
11. Safety of rail relative to autos and buses between 1992 and 2001.	Categorize rail systems by relative size. Compare *per-capita* traffic fatalities, to account for the leverage effect rail can have on per capita vehicle travel.
12. Energy efficiency of rail relative to passenger cars in 2002.	Categorize rail systems by relative size. Compare *per capita* transport energy use, to account for the leverage effect that rail can have on per capita vehicle travel.
13. Effects of rail transit on land-use regulation and property rights.	Recognize that many householders prefer to live in more multi-modal neighborhoods, and that TOD reduces many land use regulations, such as parking requirements, setbacks and density limits.

This table recommends more appropriate indicators of transit system performance.

Point and Counter-Point With O'Toole

The week after the first version of this report was released, Randal O'Toole sent me the following comments. Below are my responses, in italics.

1. NEW YORK DISTORTS DATA
O'Toole: I like to say that the U.S. has two kinds of urban areas: New York and everywhere else. Nowhere else has a Manhattan with 52,000 people per square mile and (more important) 80,000 jobs per square mile. New York transit has more than twice the market share of the next leading region. Lumping New York in the transit data for any other group of urban areas (as you do in your discussion of "Large Rail cities" and elsewhere in your report) produces distorted results that are not reflective of other regions. Because New York is so large and because it produces more than 5 times as many transit rides as the next-highest urban area (and 38 percent of all transit rides in the U.S.), the averages you get from lumping it with other regions will be unrealistically high for any other region.

Litman: I recalculated the data (www.vtpi.org/rail.xls) to exclude New York. Below are examples to illustrate the point. In each case, excluding New York reduces the advantage of Large Rail cities by a modest amount, indicating that other Large Rail cities also enjoy significant benefits.

Annual Per Capita Transit Passenger-Miles	*Large Rail*	*Small Rail*	*Bus Only*
50 largest U.S. Cities With New York	*589*	*176*	*118*
50 largest U.S. Cities W/O New York	*520*	*176*	*118*

Annual Traffic Fatalities Per 100,000 Pop.	*Large Rail*	*Small Rail*	*Bus Only*
50 largest U.S. Cities With New York	*7.46*	*9.99*	*11.72*
50 largest U.S. Cities W/O New York	*7.90*	*9.99*	*11.72*

Per Capita Annual Congestion Costs	*Large Rail*	*Small Rail*	*Bus Only*
50 largest U.S. Cities With New York	*$551*	*$466*	*$397*
50 largest U.S. Cities W/O New York	*$561*	*$466*	*$397*

Percent Income On Household Expenditures	*Large Rail*	*Small Rail*	*Bus Only*
50 largest U.S. Cities With New York	*12.04%*	*15.81%*	*14.89%*
50 largest U.S. Cities W/O New York	*12.02%*	*15.81%*	*14.89%*

Similarly, the other six "Large Rail cities" are all older cities with high-density cores that have not been built elsewhere in the last century. While it is amazing that these regions have such low transit ridership compared with New York, any results for these six regions cannot be applied to newer regions such as Atlanta, Phoenix, and San Jose. These newer regions are just never going to look like Chicago or San Francisco. This is why I compared each region individually and didn't try to lump them together.

Litman: That is a key issue discussed in my paper, that is, whether new rail systems can achieve the land use impacts of older rail systems (see "Counter Arguments"). The evidence indicates it can, provided it is supported with appropriate transport and land use policies. The question is not whether Atlanta can become Chicago, but whether some Atlanta neighborhoods can become like some Chicago neighborhoods, and whether rail projects that leverage such land use patterns provide more benefits than alternative transport improvements on that corridor.

Litman: O'Toole misrepresents his paper when he says it does not try to lump cities with rail transit together. His report claims that, "The twenty-three urban areas with rail transit collectively lost more than 33,000 transit commuters during the 1990s, while the twenty-five largest urban areas without rail transit collectively gained more than 27,000 transit commuters." *Not only is this an example of a broad statement comparing rail and non-rail cities, but he admitted to me more than a month ago that the numbers are incorrect (it should be a 14,097 loss in rail cities and a 1,388 gain in bus cities), yet he has not changed the wording of the reports posted on his website.*

2. PER CAPITA TRANSIT RIDERSHIP IS NOT AN INDICATOR OF LIVABILITY
O'Toole: Much of your report focuses on the allegedly high per capita transit ridership in rail regions. But why is this important? Even the fastest transit tends to be slower and (because it is not door-to-door) less convenient than the automobile. High levels of per capita ridership thus suggest lower levels of mobility. Perhaps this is because the city is so well designed that people don't need that mobility -- the Robert Cervero argument for accessibility rather than mobility. In fact, no urban area, with the possible exception of New York (really, only parts of New York) is designed to give people accessibility through transit. This means that high levels of per capita transit ridership probably mean lower levels of mobility, which in turn means higher housing costs, consumer costs, and other costs.

Litman: I agree that transit ridership is an objective, not a goal. The goal is to improve transport system performance and provide consumer benefits. Most urban mobility is a derived demand, to provide access to goods, services and activities. Few people drive across town during rush hour just for the fun of it. Relative speed is just one aspect of access, some people prefer commuting by transit, particularly rail, because it is less stressful than driving, even if it takes more time. O'Toole evaluates transport system performance only in terms of mobility, not accessibility, and therefore ignores benefits that result when transit provides a catalyst for more accessible land use patterns. For more information see "Measuring Transportation: Traffic, Mobility and Accessibility", published last year in the ITE Journal (www.vtpi.org/measure.pdf), which discusses differences between mobility and accessibility.

I don't claim that every rail project significantly increases land use accessibility or that only rail transit investments can achieve these changes, but the study suggests that when such changes occur they can provide large benefits, including benefits to people who do not currently ride transit. Even relatively modest increases in transit mode split can cause relatively large per capita transport cost savings, congestion reductions and traffic death reductions. I think this occurs because the regional data hide larger local impacts, and shifts from automobile to transit tend to occur where it provides the greatest benefit (i.e., peak-period travel to major centers).

O'Toole is wrong to claim that transit oriented development and smart growth reduce housing affordability (See Arigoni, 2001; Nelson, et al., 2002; Carman, Bluestone and White, 2003). In some ways they reduce it (reduced per capita land supply) and in other ways they increase housing affordability (increased density allowances, more diverse housing options, reduced building setback requirements, reduced per capita parking costs, transportation costs, infrastructure cost savings that reduce taxes and business costs, etc.). This study indicates that residents of cities with large, well-established rail systems spend significantly less on transportation than residents of other types of cities, providing significant additional cost savings to smart growth community residents. These values change little when New York is excluded.

3. THE REPORT EMPHASIZES POINTS IN TIME WITHOUT SCRUTINIZING TRENDS
O'Toole: Most of the indicators in Great Rail Disasters were trends: typically 1990 to 2000. Most of the indicators in your report represent single points in time. Rail regions, for example, may have high per capita transit ridership, but if transit commuting is declining while it is increasing in bus regions, then that high ridership is pretty meaningless. Rail cities may have slightly lower per capita driving, but if per capita driving is increasing faster in those cities, it will not do them much good. Of your "large rail cities," Boston is the only one that is showing much transit growth. Of your "small rail cities," Portland and, to a lesser degree, San Diego are the only ones showing much transit growth. That is hardly indicative of rail's great success.

Litman: Simply tracking ridership trends indicates little about the effects of rail, since there is nothing to show how trends would differ without rail. Comparisons between cities with and without rail, or between rail cities and national trends, provide more useful information. I agree that low transit ridership is a reason for concern, but I don't think it proves that rail is necessarily a failure or a bad investment. Various cost-effective strategies described in my report can increase transit ridership and attract discretionary riders. The question therefore shifts from whether transit is good or bad, to how to optimize transit benefits. The concerns O'Toole raises can therefore justify MORE rather than LESS support for rail, provided they are cost effective.

4. RAIL COST EFFECTIVENESS IS GREATLY OVERESTIMATED
O'Toole: The report says that "rail transit is generally constructed in the densest part of a city where capacity expansion is most costly." It is equally true that rail transit is generally constructed in the slowest growing part of a city where capacity expansion is least needed. In any case, we have several examples of parallel rail and highway construction where the rail cost per passenger mile was far greater than the highway cost. Table 4 of your analysis compares user costs without mentioning the huge subsidies for rail transit. Through gas taxes, U.S. highways pay for themselves. Total subsidies to auto users are little more than 0.3¢ per passenger mile. Subsidies to the average transit rider are around 60¢ per passenger mile, and subsidies to rail riders are greater. Your analysis also compares operating costs, when in fact capital costs (when annualized using a standard amortization formula as required by the FTA) greatly outweigh operating costs for rail transit. That is like comparing the costs of housing but leaving out the costs of the walls and roof!

Litman: My goal is to create a comprehensive and accurate evaluation framework (see Litman, 2004a). Rail project budgets incorporate all associated costs. Buses require highways; and automobile travel requires vehicles, highways and parking facilities. It is inappropriate to compare rail capital costs with bus or highway costs without considering all vehicle, roadway and parking costs. I will incorporate capital costs in future analysis.

5. HOUSING AFFORDABILITY DISCUSSION WRONG
The report says that "rail transit projects and smart growth policies are generally implemented in rapidly growing cities where property values are rising due to increasing demand." That is not necessarily true. The fastest growing cities in the U.S. have no rail transit and little smart-growth planning and their housing remains very affordable. It is only in cities such as San Jose and Portland, where planners have attempted to create a transit utopia by increasing population densities that housing prices have become dramatically unaffordable.

Litman: As described above, smart growth and transit-oriented development can increase overall housing and transportation affordability by reducing various costs.

6. SAFETY DISCUSSION USES WRONG MEASURE

O'Toole: I compared the safety of various forms of transport in terms of fatalities per passenger mile. You compare it in terms of fatalities per capita. If it is true that smaller cities have higher per capita driving, then they can have lower fatalities per passenger mile yet higher fatalities per capita. Which is the right measure? If you value mobility, as I do, then fatalities per passenger mile is the correct measure. Though regrettable, fatalities result from almost anything we do. The question is whether what we do is worth the risk. Is getting to work on time worth the tiny and declining risk of getting killed in traffic? Apparently it is because most people drive. If you don't value mobility, then fatalities per capita may be adequate. But then you have to ask what the people in your smaller rail and bus cities are getting for their mobility. I suspect they are getting lower housing prices and other consumer costs, a wider range of job opportunities, access to more recreation, etc.

Litman: As mentioned above, most urban mobility is a derived demand, not an end in itself. Few people want to live in a community that requires more driving, requires more vehicle cost and causes more traffic deaths if they can enjoy a similar level of accessibility without these problems. Large Rail cities tend to have higher average incomes, suggesting more rather than less access to employment options and higher levels of productivity.

7. THE COST OF SPRAWL IS EXAGGERATED

O'Toole: Your report says that I "favor automobile-oriented sprawl." Nothing could be further from the truth. I favor freedom of choice and I oppose government manipulation of people to get some predefined (and ineptly designed) goal.

Litman: Minimum parking requirements, single-use zoning, restrictions on density and multi-family housing, building setbacks, generous road standards and many other current policies support sprawl and automobile dependency, yet O'Toole only opposes regulations that support transit. Analysis by Shoup described earlier indicates that parking costs are 4.4 times higher than other development fees.

O'Toole: Cities without zoning (e.g. Houston) have demonstrated that, in the absence of regulation, people prefer to drive and to live in low-density, single-use developments. Cities with high degrees of regulation and restrictions on driving and low-density development (e.g., Paris, Amsterdam, and almost any other major European city) show that people still prefer to live in low densities and to drive, as driving is rapidly increasing and densities declining in almost all European cities.

Litman: The evidence is quite mixed, and it misrepresents the issue to claim that it proves any single thing. People are diverse and at least some prefer urban living. Many cities are now experiencing population growth. Residents of Houston now support development of alternative travel options, including HOV lanes, bus transit, and recently rail transit systems, because they know from experience the problems that result from excessive dependency on automobiles, and therefore the benefits from a more diverse transportation system. This is not a question of urban versus suburban growth, rather, it is the nature of the growth that occurs since suburbs can be transit oriented.[12] Studies described in my paper indicate that many households are willing to pay a premium for New Urbanist housing and proximity to rail transit. Whether this market segment is a minority or a majority of consumers is irrelevant, as long as there is a sufficient demand (15-25% of urban households), it is large enough to support transit-oriented development.

O'Toole: What is wrong with what you call "sprawl"? The Russians say that "Americans don't have real problems, so they make them up." Sprawl is one of those made-up problems. Pollution from auto driving is rapidly declining even though we drive more every year. Auto fatalities are also declining. Lower densities translate to lower housing and consumer costs, lower taxes, and less congestion. If people decide to move to higher densities, that is up to them. I only oppose subsidies and regulation designed to promote higher densities and discourage lower densities.

Litman: There is considerable literature on the costs of sprawl and benefits of smart growth (Litman, 2003b). Smart growth is supported by many mainstream organizations including the Institute of Transportation Engineers (ITE, 2003), the International City/County Management Association (ICCMA, 1998) and the American Governor's Association (Hirschhorn, 2001), because of cost savings and other benefits. As a person of Russian descent I recommend against making general statements about what Russians say: two Russians, three opinions. None of O'Toole's claims are completely true. Some U.S. cities are experiencing increasing air pollution problems as vehicle mileage growth offsets vehicle-mile emission reductions. Per capita traffic fatalities are much higher in sprawled communities. Lower density housing often increases housing and transportation costs. As mentioned above, O'Toole indicates his bias by showing no concern about large subsidies and regulations favoring automobile dependency and sprawl.

9. LACK OF REFERENCES A VALID CRITICISM

O'Toole: You accurately point out that I failed to provide adequate references to some of my statements. I still stand behind those statements. In one case, I said that most rail cities are spending over half their transportation capital funds on transit. You can find the references at http://ti.org/vaupdate24.html. I will send you the list of EISs that I used to review rail costs and ridership soon.

Litman: That is helpful. However, the evidence presented misrepresents the issue. Rail transit projects show up in regional capital budgets, so they may appear proportionately large, but regional capital budgets are only a small portion of total transport expenditures. Analysis should consider total local, regional and state capital and operating expenditures, plus expenditures by businesses on parking, and by consumers on vehicles and residential parking. Evaluation should reflect marginal analysis, not regional mode share. The major urban transport problems are traffic and parking congestion on major corridors, and inadequate mobility for non-drivers. Transit improvements can address these, and help achieve other objectives, including consumer cost savings, parking cost savings, reduced accidents and pollution emissions. As a result, transit investments that improve service quality and attract discretionary travelers are often the most cost effective transport improvement, even if they provide a small portion of total regional travel.

10. LAND USE IMPACTS

O'Toole: You claim that "increased density and clustering tends to reduce per capita automobile ownership and use." There is little if any evidence of that. It would be more accurate to say that "increased density and clustering tends to be correlated with lower per capita automobile ownership and use," and that is accurate only at the neighborhood level. All of the papers you cite focus on neighborhoods. The problem is self selection: people who want to use transit tend to live in transit-friendly neighborhoods. But increasing the density of neighborhoods occupied by people who want to drive is not going to significantly reduce their driving.

Litman: Many studies indicate that transit-oriented development can reduce per capita vehicle ownership and use ("Land Use Impacts on Transportation," VTPI, 2005). For example, a survey of Portland TOD residents found that 22% commute by transit, far higher than the 5% regional average, and 69% use public transit more often than in their previous community (Podobnik, 2002). This study shows that having numerous TODs in a city can significantly reduce regional per capita vehicle ownership and mileage rates.

In another exchange, O'Toole claims that "Portland voters turned down light rail funding three times" (implying that citizens of cities with rail transit systems don't support them). Although this claim may be technically correct, it distorts the history of Portland's votes:

- 1994 - Original regional vote to fund South/North line passed by 2/3 margin.
- February 1995 - Clark County voters defeated a measure to fund a Washington LRT line.
- August 1995 - Oregon Legislature approved state funding for the South/North project.
- November, 1996 - State Measure 32, which included $375 million for LRT and $375 million for roads, failed statewide 47/53% but passed in the Portland region.
- November, 1998 - Regional vote on Measure 26-74 to fund rail failed 48-52%, but passed in Multnomah County, site of the proposed line. All precincts along the proposed line approved it.
- Subsequently, a new proposal was developed which better addressed concerns of displaced homes and businesses, increase in property taxes, alignment, and costs. Community support moved Interstate MAX forward. One year later, communities that had voted against the project asked to have it reconsidered, resulting in the current plan to have two rail lines.
- Although it is correct to say that votes to fund LRT in Portland failed three times, it is also correct to say that city of Portland voters supported all four light rail referenda, and in the TriMet service area, three of four passed. There is no indication that support for rail has declined since the LRT system was completed. By virtually any measure (increased transit ridership, increased downtown residential and commercial development, and support by residents and businesses to extend rail lines to additional areas), public support has increased.

After hurricane Katrina stuck in August 2005, O'Toole recommended improving emergency response by reducing funding for public transit and using the money saved to subsidize automobile ownership for lower-income households, and expand highways to accommodate larger traffic volumes. He argues that high rates of transit use and low vehicle ownership rates in cities such as New Orleans cause poverty, while increased automobile ownership reduces poverty, rather than concluding that poverty my reduce vehicle ownership rates and lower-income people may tend to choose homes in areas well served by transit (see earlier discussion "Rail Transit Harms Poor People").

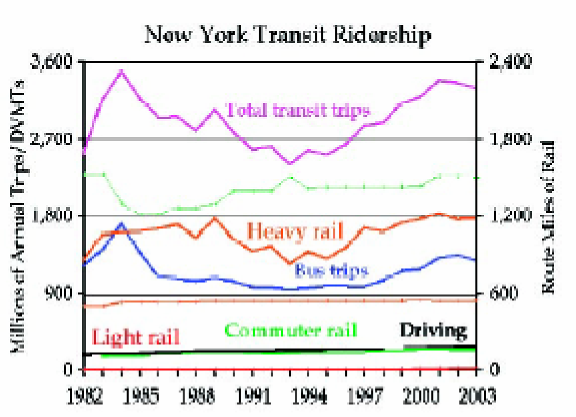
An alternative approach based on experience from both hurricanes Katrina and Rita suggests that the most equitable and efficient way of evacuating large numbers of people from an urban area is to give public transit vehicles (and perhaps other high occupancy vehicles) priority in traffic and fueling, in order to insure that the most vulnerable residents are well served and to efficiently manage available resources (Litman, 2005c). O'Toole criticizes this on the grounds that most evacuees would be unwilling to ride transit, and evacuation by automobile is overall most convenient and efficient.

Rail Disasters 2005: The Impact of Rail Transit on Transit Ridership

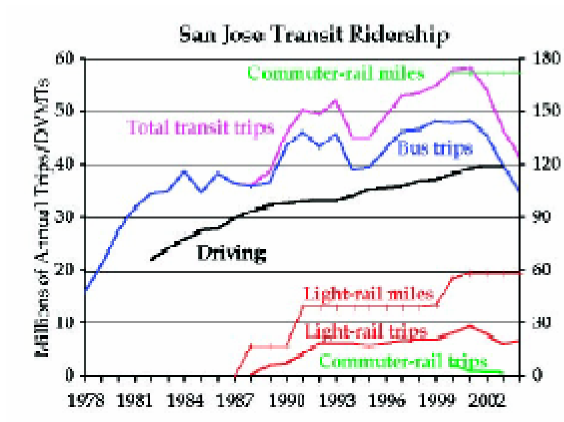
In 2005, Randal O'Toole published an update of *Great Rail Disasters*, which evaluates the effectiveness of rail transit in terms of its ability to increase regional public transit ridership. This narrow focus on ridership appears to be in response to *Rail Transit In America* (Litman, 2004a), and the previous edition of this report, which showed that much of O'Toole's previous criticism of rail transit was inaccurate and misdirected.[13]

O'Toole's 2005 report rates various U.S. cities on a scale from A to F based on their transit ridership trends during the last two decades. This rating system is arbitrary and biased. It assigns an "F" rating to most rail cities, including many where total transit ridership is growing. It ignores positive ridership trends during the last decade (starting in the early 1990s) in cities such as Cleveland, San Francisco, St. Louis, New York and Atlanta. It claims that transit ridership is flat or declining in San Jose, California, although it more than doubled between 1980 and 2000.

Figure 7 **O'Toole's Ridership Graphs**



O'Toole assigns New York an "F," claiming that transit ridership is flat. Yet ridership grew significantly between 1993 and 2001, and was projected to set new records until the 2001 terrorist attacks reduced regional travel activity.



O'Toole assigns San Jose's rail system an "F," claiming that long-term transit ridership is flat or declining. Yet ridership increased steadily from 1978 until 2000, when a recession reduced regional commute activity.

As in his 2004 report, O'Toole's ratings do not take into account rail system's relative size. For example, it criticizes New Orleans and Seattle rail systems, single rail lines that carry a small portion of regional transit trips, for failing to increase total transit ridership. To evaluate rail impacts it is necessary to compare transit ridership between otherwise similar cities or corridors with and without rail, or rail cities with national averages. O'Toole ignores external factors that affect ridership. The eight "Old Rail" cities he criticizes for declining transit ridership are older industrial regions that lost population and employment during much of the analysis period (although many are now growing). The report ignores the effects of the 2001 terrorist attacks and resulting economic recession on commute travel, blaming all transit ridership declines on rail transit.

O'Toole compares rail regions with eight selected "Bus-Only" regions. The report does not explain why these particular cities were chosen, but they are all rapidly growing urban areas with high transit ridership growth. Many other "Bus-Only" regions lost transit ridership during this period. Matched pair analysis in Litman, 2004a indicates that regions with large rail transit systems have much higher per capita transit ridership than similar size cities with smaller rail or bus-only transit systems.

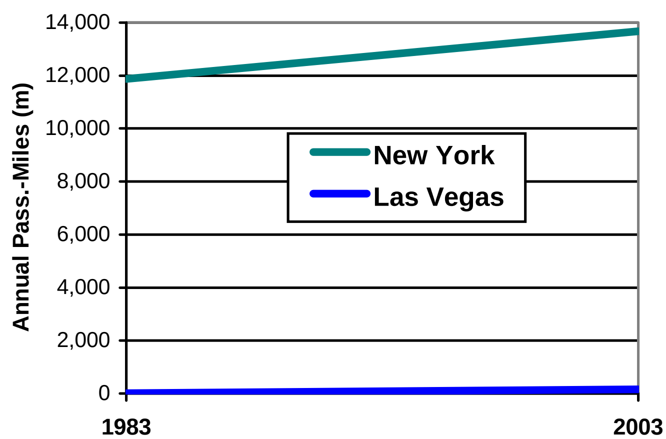
Table 7 **Change In Transit Ridership** (APTA Data)

	1983	2003	Total Change	Percent Change
1,000 Passenger-miles				
New York	11,879,309	13,673,085	1,793,776	15.1%
Las Vegas	15,665	158,205	142,540	910%
Population				
New York	7,071,639	8,008,278	936,639	13.2%
Las Vegas	164,674	478,434	313,760	191%
Passenger-miles Per Capita				
New York	1,680	1,707	28	1.6%
Las Vegas	95	331	236	248%

Although Las Vegas transit ridership growth significantly, this is because it started at a very low level and grew to a moderate level. It is still small compared with per capita transit ridership in large cities such as New York.

For example, during the two-decade period transit ridership in Las Vegas (the selected city with the largest percentage ridership increase) grew ten fold, but population tripled, business boomed, and the city expanded to a size in which transit becomes increasingly important (Table 7). During the same period New York City transit ridership increased 15%, proportionately smaller but much larger than Las Vegas in absolute terms (Figure 8). Although Las Vegas annual ridership increased from 95 to 331 per capita passenger-miles, this is still small compared with New York's 1,707 passenger-miles. At this rate it will take a century for Las Vegas residents to reach New York's current transit ridership.

Figure 8 **Total Transit Ridership Growth**

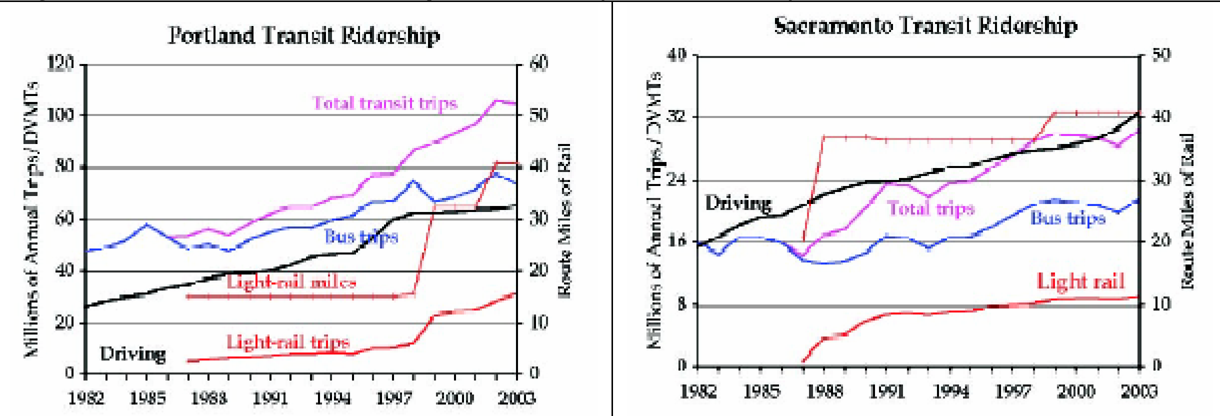


Transit ridership in Las Vegas (rated A) is small overall compared with New York (rated F).

O'Toole criticizes rail when bus ridership grows faster than rail ridership (on grounds that rail is ineffective), and when rail ridership grows faster than bus ridership (on grounds that bus ridership declined because resources were shifted to rail). He criticizes new rail transit lines for failing to immediately increase transit ridership, without taking into account the fact that it often takes many years for rail transit to achieve their full effects on land use and travel patterns, and therefore to achieve their full benefits.

O'Toole argues that buses are more cost-effective than rail at increasing transit ridership. As discussed earlier, this is not necessarily true, particularly if rail is implemented with supportive land use policies. Total transit ridership (rail and bus) tends to increase in cities that have implemented new rail systems, as illustrated in Figure 9, particularly if accompanied by supportive land use policies.

Figure 9 **Transit Ridership Increases** (O'Toole, 2005)



Total transit ridership more than doubled in Portland between 1987, when their light rail system was established, and 2002.

Total transit ridership nearly doubled in Sacramento between 1987, when their light rail system was established, and 2002.

O'Toole ignores the ability of rail to help achieve strategic planning objectives, such as encouraging urban redevelopment and compact, mixed-use neighborhoods, the reductions in per capita automobile ownership and use that result, and the economic, social and environmental benefits that this provides (Litman, 2004a and 2004b). It treats all transit passenger-miles equally, ignoring the fact that rail tends to operate in the densest corridors, where congestion, roadway and parking costs and pollution impacts are highest, and so the benefits of reduced car travel are greatest.

O'Toole assumes that each region has a fixed transit budget, so money spent on rail transit reduces bus transit funding. This may be true under some circumstances in the short-term (such as the examples O'Toole describes), but in many situations rail funds would otherwise be spent on highways, and total per capita public transit funding tends to be higher in communities with rail transit systems (Litman, 2004a), indicating that rail and bus are complements rather than substitutes. This occurs because rail tends to generate public support for transit and provides a catalyst for more multi-modal travel, increasing use all types of transit. Over time, many regions with growing rail transit service also expand their bus services in response to growing demand.

O'Toole claims that transit is more dangerous than automobile travel, based on a comparison of fatality rates per passenger-mile and a few examples of new rail lines with high crash rates, such as Houston.[14] However, because rail transit tends to leverage overall reductions in per capita vehicle travel, per capita traffic fatalities and congestion costs tend to decline with increased rail transit service (Litman, 2004a and 2004b).

O'Toole argues that rail transit systems are inequitable, because they tend to serve higher-income commuters at the expense of lower-income, transit-dependent bus riders. This is not always true. Many rail systems are heavily used by middle and lower-income travelers. This criticism assumes that money spent on rail would otherwise be spent on bus transit, but as discussed earlier, rail expenditures often substitute for highway expenditures. By creating more accessible, multi-modal communities, rail transit tends to reduce consumer transportation costs, and improve accessibility for non-drivers and low-income travelers (Litman, 2004a).

O'Toole argues that transit in general, and rail transit in particular, are subsidized more than automobile travel, based on comparisons of federal transit and highway expenditures. But this ignores additional subsidies and external costs of automobile travel, including local roadway expenditures, parking facility costs, congestion and accident risks imposed on other road users, and environmental impacts. It also ignores the fact that rail transit operates in the most congested urban conditions, where the costs of accommodating additional automobile trips are greatest. When all costs are considered, transit improvements are often more cost effective than highway capacity expansion (see discussion in Litman, 2004b).

O'Toole argues that new rail transit projects resulted from biased federal policies which reward inefficiency. But most new rail projects result from regional planning and referenda, reflecting citizen preferences for rail rather than bus systems. Just as many consumers choose to spend extra for a luxury automobile, many citizens appear to be willing to vote for extra public expenditures for higher quality transit service.

The report argues that demand is equal for rail and bus transit, citing a study in one U.S. city which found that bus systems will attract as many passengers as rail systems if they have comparable speed, frequency, comfort. But other studies indicate that rail tends to attract more discretionary riders, and therefore provides greater total benefits (see discussion in Litman, 2004b).

In summary, O'Toole is wrong to claim that rail is ineffective at increasing transit ridership. His own data show that total transit ridership tends to increase as cities expanded their rail systems. His analysis justifies more rather than less support for rail.

A Desire Named Streetcar

This paper (O'Toole, 2006) argues that federal transportation funding practices and political bias encourage local officials to invest in wasteful rail transit systems rather than more cost effective urban highways and bus systems. It is largely based on O'Toole's previous analysis (2004) which argued that rail transit is ineffective at attracting riders, has excessive costs, and few benefits. It assumes that the future consists of ever-growing automobile travel and suburban sprawl, based on extrapolation of past trends, ignoring demographic and market shifts that support multi-modal transportation and transit oriented development, such growing transit demand, consumer preferences for rail transit, the increasing costs and declining benefits of urban highway capacity expansion, and the multiple objectives that must be balanced in urban transport planning.

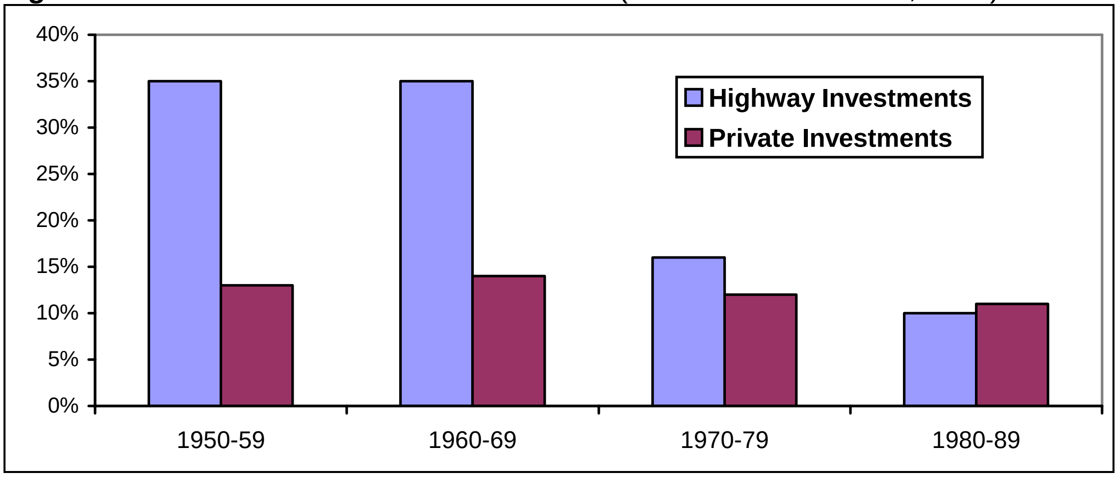
As described earlier, much of O'Toole's evidence that rail transit fails to attract riders is based on inaccurate and biased analysis, such as comparing rapidly-growing bus transit cities with rail cities that experienced little growth or negative population growth during the time period evaluated. He also ignores many benefits of rail transit, such as parking cost savings, consumer cost savings and positive land use impacts. Analysis by Litman (2004) and Lewis and Williams (1999) show that, when all impacts are considered, rail transit benefits can exceed their incremental costs, indicating that rail transit investments can be cost effective overall. O'Toole does not discuss these issues; he assumes without question that rail transit investments are wasteful and irrational. This basic premise is wrong, reflecting O'Tooles narrow analysis.

O'Toole claims that federal matching funds encourage wasteful rail transit investments. But the federal government provides much higher funding match for highways (usually 90%) than for urban transit systems (usually about 60%), requires less rigorous economic evaluation for highway projects than rail transit, and must compete for a much smaller portion of total transportation funding (Beimborn and Puentes, 2003). Because most transport funds are dedicated to highways, most highway projects are funded through existing revenues, while transit projects often require voters to approve special new taxes. All of these create a much higher barrier for transit than highway projects.

O'Toole claims that "special interests" and politician's desire to have a rail station with their name leads to excessive rail transit investments. However, there are more special interests supporting highway projects (the "road lobby") and equal vanity gained by freeway and airport naming. For example, O'Toole claimed incorrectly that there is a rail transit station named after U.S. Transportation Secretary Norman Mineta in San Jose, California. There is none. Rather, there is a Norman Y. Mineta airport in San Jose.

O'Toole assumes that it would be more efficient and fair to invest in urban freeways than in rail transit. The economic return from highway expenditures has declined over time (Figure 10). Although highways showed high annual return on investment during the 1960s when the Interstate Highway System was developed, this has since declined significantly, and this decline is likely to continue since the most cost effective projects have been implemented. It therefore makes sense to invest less in roadways and more in public transit to maximize economic returns.

Figure 10 **Annual Return On Investment** (Nadri and Mamuneas, 1996)



Highway investments provided a high economic return when the Interstate system was first being developed, but these returns have declined and are now below the return on private investments, indicating that highway investments are not cost effective.

O'Toole criticizes flexible funding, which allows communities to choose the best transportation investments for their needs. This leads to more cost effective investments, and is particularly important to accommodate changing transport needs.

O'Toole uses biased accounting to claim that transit receives more subsidy than automobile travel. He only includes general taxes used to fund highways, ignoring other subsidies to automobile travel such as free parking mandated by zoning codes. When these additional subsidies are considered, and taking into account the facts that about half of all transit subsidies are justified to provide basic mobility for non-drivers, that rail transit services are concentrated in major urban areas where road and parking costs are much higher than average, and that transit users tend to travel fewer annual miles than motorists, transit tends to receive about the same level of subsidy as automobile travel per passenger mile and far less per transit user. Significant transit subsidies are justified so that non-drivers and urban residents receive their fair share of transport funding.

O'Toole argues that the planning process has been hijacked by the "anti-highway lobby." But what he describes as a special interest group is really a mainstream movement to correct decades of transportation and land use planning practices biased in favor of automobile transport. Policies that O'Toole considers anti-highway, such as investments in walking, cycling and public transit, and smart growth development policies, have been widely embraced by the general public and professional organizations such as the Institute of Transportation Engineers, American Planning Association, the National Governors Association, and even many business organizations.

Light Rail Boon or Boondoggle

The article *Light Rail: Boon or Boondoggle* by Molly D. Castelazo and Thomas A. Garrett (2004) and a related report Garrett (2004) argue that light rail transit investments are inefficient compared with automobile investments. However, their arguments reflect a number of omissions, errors and misrepresentations (CMT, 2004; Litman, 2004d).

Castelazo and Garrett argue that transport decisions should be tested based on consumer willingness-to-pay and claim that rail transit fails to meet this test because rider fares only cover a portion of total costs. However, they ignore the underpricing of urban automobile travel, including the costs of roads, parking, congestion, accidents and environmental damages not borne directly by users (Murphy and Delucchi, 1998; FHWA, 1997; Litman, 2003a). This underpricing is particularly large under urban-peak conditions, while transit subsidies tend to be lowest under such conditions due to higher load factors. As discussed earlier, transit subsidies may be partly justified on basic mobility, strategic land use planning objectives, and economic development grounds.

Castelazo and Garrett claim that light rail can only provide short-term congestion and pollution reduction benefits. This is untrue and indicates that they are unfamiliar with the issues. As described earlier, there is both theoretical and empirical evidence that high-quality rail transit can provide significant, long-term reductions in per capita traffic congestion (Litman, 2004a and 2004b). It does this by attracting discretionary riders (people who have the option of driving for a particular trip), and providing a catalyst for more accessible land use patterns and more diverse transportation systems, which result in overall reductions in per capita vehicle travel.

This is not to suggest that the pricing reforms Castelazo and Garrett recommend are unjustified. Like most economists, I agree that more efficient transportation pricing can help solve many problems. With such a system, motorists would pay directly for using roads and parking facilities and for imposing external costs such as congestion, accident risk and pollution damages on other people. These price reforms increase the cost of driving (or put more positively, reward consumers for using efficient travel alternatives), particularly under urban-peak conditions, causing a significant portion of urban-peak automobile travel to shift to transit (Litman, 2002; VTPI, 2005). Since rail transit experiences significant economies of scale, more optimal pricing should increase the cost-effectiveness of rail transit service. Conversely, efficient pricing of road use is likely to be more politically acceptable and effective if implemented in conjunction with transit service improvements. The better the travel alternatives available, the smaller the price needed to reduce vehicle use to an economically optimal level (i.e., the greater the elasticity of automobile travel to pricing), and so the smaller the cost imposed on both those who reduce their automobile travel and those who continue to drive. In other words, pricing and transit investments are complements, not substitutes.

Comparing Transit and Automobile Costs

Castelazo and Garrett argue that rail transit is *cost ineffective*, but they make a number of analysis errors discussed earlier in this report. They ignore many costs of automobile transportation and benefits of transit. They use *average* cost values that are not representative of the actual costs of accommodating additional urban vehicle traffic.

Castelazo and Garrett claim incorrectly that rail is more costly than bus transit. Under some circumstances rail has higher costs per passenger-mile, and under other circumstances rail has lower costs (Litman, 2004a). They claim that light rail operating costs average 54.4¢ per passenger-mile, reflecting national cost values, but this includes many new light rail systems that are still building ridership and so have relatively high costs per passenger-mile. In St. Louis light rail costs actually average 27¢ per passenger-mile, less than a third of the 82¢ per passenger-mile for bus transit services ("Bi-State Development Agency," *National Transit Database*, APTA, 2002). There are various reasons that buses have higher cost per passenger-mile: buses serve lower-density areas where ridership is low, and buses can carry far fewer passengers per driver. However, it is wrong to claim that light rail is more costly than either automobile or bus transport in the dense urban corridors where rail is actually implemented.

On congested urban corridors automobile travel often costs two or three times more than the 41.4¢ per passenger-mile Castelazo and Garrett assume. As described earlier, the cost of an automobile trip includes vehicle expenses, 10-50¢ per vehicle-mile for urban road capacity and congestion impacts, $5-15 per day for downtown parking (averaging 25-75¢ per vehicle-mile for a 20-mile round trip commute), plus 1-10¢ per vehicle-mile for pollution emissions (Murphy and Delucchi, 1998; FHWA, 1997; Litman, 2004a; "Costs of Driving," VTPI, 2005). This indicates that automobile travel on these corridors costs $0.77 to $1.76 per mile, far higher than light rail transit costs on the same corridor.

Transit services, particularly rail transit, tend to experience economies of scale. If some level of transit service is needed to provide basic mobility to non-drivers, the marginal cost of accommodating additional riders is often small, particularly if the system has additional peak-period capacity. For this reason, if rail transit really does have excessive costs per passenger-mile, the appropriate response may be to increase support for rail, through incentives such as road and parking pricing, commute trip reduction programs, fare subsidies, and other strategies that increase ridership and therefore reduce unit costs.

Castelazo and Garrett's research shows that rail transit projects can significantly increase property values. They find that average home values increase $140 for every 10 feet closer they are to a MetroLink station, beginning at 1,460 feet. A home located 100 feet from the station has a price premium of $19,029 compared with the same house located 1,460 feet away. Their analysis did not investigate property value impacts on commercial properties, which probably also increase with proximity to stations. This increase in property values, increased tax revenue, and the implied additional value to consumers, offsets a significant portion of MetroLink costs.

Providing Mobility for Non-drivers

Castelazo and Garrett argue that it would be cheaper to provide low-income motorists with a car than light rail transit service. This overlooks several important points.

First, transit is subsidized for several reasons besides providing mobility to lower-income travelers, including congestion reduction, road and parking facility cost savings, consumer cost savings, increased safety, pollution reduction and support for strategic development objectives. Only a small portion of transit subsidies could efficiently or equitably be shifted to any one of these objectives. If transit subsidies were eliminated and the money used to purchase cars for the 14% of transit riders Castelazo and Garrett consider low-income, other transport problems would increase, and the 86% of current transit riders who do not qualify would be worse off.

The table below evaluates the impacts of subsidizing cars for low-income drivers who would use rail transit, and therefore travel regularly on congested urban corridors. Although this benefits a certain group (low-income urban commuters on a particular corridor), it exacerbates other problems including congestion, road and parking facility costs, traffic accidents, energy consumption and pollution emissions.

Table 8 **Impacts of Subsidizing Commuter Cars**

Transit Objectives	Effect of Subsidizing Cars
Basic mobility for low income drivers.	Helps
Basic mobility for non-drivers.	No effect or harmful if it reduces total transit service.
Congestion reduction.	Harmful.
Road and parking facility cost savings.	Harmful.
Consumer cost savings.	Helps those who receive the subsidy.
Reduce traffic accidents.	Harmful.
Energy conservation	Harmful.
Emission reductions.	Harmful.
Economic development.	Harmful if it increases congestion and parking costs and expenditures on imported fuel and vehicles.

Second, many transit riders cannot or should not drive. They are too young, disabled, or prohibited from driving. Subsidizing cars instead of transit service would not solve their mobility problems and would tend to increase higher-risk driving. It is easier to reduce driving by high-risk motorists in communities with good transit systems, for example, by delaying teenage vehicle ownership, revoking driving privileges for dangerous drivers, and reducing vehicle use by elderly residents, which helps explain the much lower per capita traffic fatality rates in areas with good transit service.

Third, substituting car ownership for transit service is probably far more expensive than they claim. Eliminating scheduled transit service would force riders who cannot drive to use demand-response or taxi services, which have far higher costs.

Fourth, increased vehicle traffic on busy urban corridors would significantly increase traffic congestion, road and parking costs, accidents, pollution and other external costs. Castelazo and Garrett misinterpret and underestimate congestion costs. In footnote 3 they calculate that giving 7,700 vehicles to current rail users would increase regional vehicle ownership by 0.5%, which they assume would only increase congestion by 0.5%. But rail users are commuting on the city's most congested corridors, so congestion impacts will be proportionately large. Congestion is a non-linear function: once a roadway reaches capacity even a small volume increase adds significant delays. For example, on an uncongested road, 100 additional vehicles per hour may cause little delay, but adding the same number of vehicles on a road at 90% capacity can increase delays by 20% or more.

Shifting 7,700 current St. Louis rail transit riders to automobile commuting is likely to increase regional traffic congestion costs by far more than 0.5%. The Texas Transportation Institute calculates that St. Louis traffic congestion costs totaled $738 million in 2001. If 7,700 additional downtown automobile commuters would increase regional traffic congestion costs 2.5% to 5.0%, this represents $18 to $37 million in additional annual congestion costs.

Fifth, there are substantial practical problems to subsidizing cars or carsharing instead of transit services. Castelazo and Garrett apparently assume that the 7,700 rail transit riders they identify as being unable to afford a car are a distinct, identifiable group. In fact, they consist of a much larger group, many of whom use transit part-time, or who sometimes do not own an automobile. For example, non-car owning riders may consist of 3,000 daily transit users, 4,000 who use it half-time, 10,000 who use it an average of once a week, and 700 out of town visitors. Similarly, some people who do not own a vehicle this month will next month, and vise versa. As a result, rather than giving 7,700 households a car, it would be necessary to offer a much larger number of households a part-time car, with provisions that account for constant changes in vehicle ownership and travel status, and for the increased travel that occurs when non-drivers gain access to an automobile. Like any subsidy program, it would face substantial administrative costs and require complex rules to determine who receives a subsidy, and how much they receive, in a way that seems fair and effective at achieving its objectives. It would create perverse incentives, rewarding poverty and automobile dependency.

Finally, as described earlier, rail transit can provide a catalyst for mixed-use, walkable urban villages and residential neighborhoods where it is possible to live and participate in normal activities without needing a car, which is particularly beneficial to non-drivers.

Although it is desirable to provide affordable mobility to lower-income people ("Affordability," VTPI, 2005), it is important to avoid oversimplifying this issue or ignoring the important role transit service play in meeting this need.

Urban Rail: Uses and Misuses

Wendell Cox is a frequent critic of rail transit. For example, in a policy statement titled "Urban Rail: Uses and Misuses" (Cox, 2000) *he criticizes rail investments. Below are his arguments and my responses.*

Virtually no traffic congestion reduction has occurred as a result of building new urban rail systems.

While city-wide congestion measured as roadway level of service or travel time index does not usually decline after light-rail systems are built, this is not surprising because light rail is developed where travel demand is growing, and light rail represents a small portion of total regional travel. Rail transit clearly does reduce congestion compared with what would have occurred otherwise, and when evaluated at the corridor level. As described earlier in this report, and in Litman (2004a and 2004b):

- Large cities with rail transit systems have about half the per capita traffic congestion costs as similar size cities that lack rail transit. The more rail transit service provided, the more rail ridership and the more congestion is reduced.
- Traffic congestion tends to decline on a road if there is fast and comfortable rail transit service on the same corridor, since some travelers will shift to transit when it is faster than driving, reducing the point of congestion equilibrium.
- Residents of urban neighborhoods served by new or expanding rail transit systems tend to reduce their vehicle ownership and increase their use of transit, reducing per capita automobile trips (see box).
- On major urban corridors, rail transit improvements are often more cost effective than roadway capacity expansion, when all costs are considered.
- Traffic congestion growth rates declined after light rail systems were built in several cities. Garrett (2004) found that traffic congestion growth rates declined somewhat in some U.S. cities after light rail service began. In Baltimore the congestion index increased an average of 2.8% annually before light rail, but only 1.5% annually after. In Sacramento the index grew 4.5% annually before light rail, but only 2.2% after. In St. Louis the index grew an average of 0.89% before light rail, and 0.86% after. In Dallas, the growth rate did not change.

Transit Improvements Help Reduce Vehicle Ownership and Use (www.translink.bc.ca)
In 2004 the city of Vancouver recorded a small decline in the number of automobiles registered in the city, and a reduction in downtown automobile trips, reversing a growth trend between 1994 and 2003. Small decreases were also recorded in some nearby suburbs, and others saw a reduction in the growth rate. Experts conclude that this results from increased transit services and a growing preference for urban lifestyle. "There are some fundamental changes going on," says David Baxter of the research firm Urban Futures. "It's increasingly possible to live in Vancouver without a motor vehicle."

Commuters are increasingly using alternative modes. Transit ridership rose by 9.5% in the first half of this year compared to the same period last year, and was 24.6% higher than 2002. Bus trips increased by 11.1%, and rail trips increased by 5.4%. A customer survey found that that 42% of riders on the SkyTrain, 49% on the West Coast Express, 35% on the 99B bus route and 25% on the 98B route switched from commuting by car. "The numbers show that demand for public transit continues to grow in response to the significant expansion of services."

Virtually any public benefit that has been achieved through urban rail could have been achieved for considerably less by other strategies.
Rail transit provides unique benefits. Cities with large rail transit systems have substantially higher per capita transit ridership, lower per capita congestion delays, lower per capita traffic fatalities, lower consumer transportation costs, lower transit operating costs, higher transit service cost recovery, and other positive attributes, compared with otherwise similar cities (Litman, 2004a). This occurs because rail tends to attract far more discretionary riders than bus, does not require the ability to drive like a private automobile, avoids congestion delays if grade separated, and it can have a leverage effect on land use which greatly expands total benefits.

Where the automobile has become the dominant form of transport, and where urban areas have become decentralized and highly suburbanized, there are simply not a sufficient number of people going to the same place at the same time to justify urban rail. As a result, it is typically less expensive to provide a new car for each new rider than to build an urban rail system.
Many cities are redeveloping, with increased population and business activity. At the same time, many suburbs are becoming more urbanized. If a travel corridor has enough travel demand to create significant congestion, there is often enough demand to justify some form of grade-separated transit.

Claims that it is cheaper to provide a new car rather than build an urban rail system usually overlook some significant costs, including the costs of vehicles, roads and parking facilities at destinations (as discussed earlier and in Litman, 2004d). Increased car ownership exacerbates other transportation problems, including traffic congestion, road and parking facility costs, traffic accidents and pollution emissions, and does not address the mobility needs of non-drivers. Expanding urban road and parking capacity is costly, and provides only modest congestion reduction due to latent demand.

Cox (2004) also argues that it would be cheaper to subsidize carsharing (vehicle rental services designed to substitute for private vehicle ownership), which he assumes could be accommodated by doubling demand-response funding, but since demand response services only provide 1.4% of total transit passenger-miles, doubling its funding could not compensate for reducing the other 98.6% of services. Current carshare services are relatively cheap because they are located in a few suitable urban areas. To provide carsharing in all areas currently served by transit, with enough vehicles to accommodate all peak-period users, could increase unit costs. People tend to significantly increase their travel when they shift from transit to having an automobile, so even if per-mile costs decline, per-user costs would likely increase.

Cox (2003) argues that virtually all current trends favor automobile transportation over transit, that extreme densities are needed for rail transit to be effective, that an excessive portion of urban transportation funding is devoted to public transit, and that investments in highway capacity expansion are a more cost effective way to improve urban transportation. His analysis makes many of the errors discussed earlier in this paper.

1. Many current demographic and geographic trends actually favor increased use of alternative modes, including an aging population, increased urbanization (many cities are experiencing population growth, and many suburbs are developing into cities), physical constraints to expansion in many growing urban areas (for example, Las Vegas is limited by water supply and Seattle is limited by geography), and higher future oil prices.

2. The analysis and arguments are based on the assumption that vehicle traffic congestion is the only significant transportation problem facing cities, and therefore reducing roadway congestion is the only planning objective. Other transportation problems, such as mobility for non-drivers, parking problems, consumer and government affordability, traffic safety, urban environmental quality, and energy conservation and pollution emission reductions are unimportant and not incorporated in his performance evaluation.

3. He significantly underestimates the full costs of increasing urban traffic capacity enough to reduce congestion. Cox dismisses the effects of generated traffic, although it is accepted by nearly all serious traffic modelers (see Litman, 2001), including the fact that it reduces the congestion reduction benefits of increasing roadway capacity, and the additional impacts of the added vehicle traffic.

4. Estimates of the portion of total transportation expenditures devoted to transit are not clearly referenced, and even if accurate are greatly exaggerated, since they do not account for all local, state and federal expenditures, or indirect costs, such as expenditures on parking facilities.

5. Cox dismisses the potential role of public transit, on the grounds that transit only carries 1% of total projected traffic growth. But on congested urban corridors transit can carry a much larger portion of traffic, and make a much larger contribution toward congestion reduction. If a travel corridor has enough travel demand to create significant congestion, there is often enough demand to justify some form of grade-separated transit.

6. Cox assumes the only way to increase transit ridership and transit system performance is to greatly increase regional land use densities. But there are many other options which are justified on economic efficiency grounds, including road and parking pricing reforms, transit oriented development (which clusters development around transit stations, but does not necessarily increase regional densities), transit priority strategies, commute trip reduction programs, transit service improvements and targeted transit fare discounts.

7. Cox's analysis includes various unexplained assumptions and data sources, such as the claim that urban traffic congestion could be significantly reduced with a $39 billion highway program, or that this provides a 6:1 benefit/cost ratio. Many of his arguments, such as the claims that highway widening causes no induced vehicle travel, or that smart growth and increased transportation system diversity are politically unacceptable, are based on nothing more than selective anecdotal evidence. In fact, there is plenty of evidence showing the opposite (Litman, 2001; Litman, 2003a).

Commuter Rail's False Promise

Writer Tom Keane (2006) argues that rail transit is a poor investment because it fails to increase development or transit ridership in modern cities. Citing a study by Eric Beaton (2006), he state, “One would think, for instance, that new commuter-rail stations might encourage development nearby. It turns out they don’t. Areas around train stations are only modestly more developed than anywhere else. One would also think that new stations might encourage more use of public transit. That is also untrue. The number of people using transit to get to work is largely unchanged by the addition of new stations.” He explains this as proof of declining demand for commuter rail since automobile transportation became dominant in the 1960s.

This misrepresents the analysis. In fact, Beaton found that in the Boston region, rail transit zones (areas within a 10-minute drive of commuter rail stations) had higher land use density, lower commercial property vacancy rates, and higher transit ridership than other areas. Regional transit ridership declined during the 1970s and 80s (it has rebounded since 1900), but declined significantly less in rail zones, indicating that TOD increases ridership compared with what would otherwise occur. In 2000, transit mode split averaged 11-21% for rail zone residents, compared with 8% for the region overall. Areas where commuter rail stations closed during the 1970s retained relatively high transit ridership rates, indicating that the compact, mixed land use patterns that developed near these stations has a lasting legacy.

Although Beaton found that land use density did not increase near stations built between 1970 and 1990, they did increase near stations build after 1990. This can be explained by the fact that the value of smart growth development (using land use policies to create more compact, mixed, multi-modal land use) only became widely recognized in the 1990s, and much of the research and literature on transit oriented development is even more recent.

Similarly, detailed analysis by Badoe and Miller (2000) conclude that transit service can facilitate land use development patterns, but is only one of many factors, and will not cause significant land use or travel behavior change by itself. They found that if an area is ready for development, improved transit service (such as a rail station) can provide a catalyst for higher density development and increase property values, but it will not by itself stop urban decline or change the character of a neighborhood.

Keane is wrong to conclude that rail transit investments cannot affect travel or land use. Virtually all research indicates that rail transit improvements can increase ridership and create more compact, mixed, multi-modal communities, provided they are implemented with supportive transportation and land use policies. When this is done the research shows that rail transit zones have significantly higher property values and transit ridership than would otherwise occur (Cervero, et al, 2004; Litman, 2005).

The Social Desirability Of Urban Rail Transit Systems

A study by Clifford Winston and Vikram Maheshri (2006) titled *The Social Desirability Of Urban Rail Transit Systems* estimates the social benefits of 25 U.S. rail transit systems based on consumer demand (users' willingness to pay for rail transit services) and congestion reduction benefits. They conclude that only one system (BART) is cost effective. They argue that rail transit investments result from misguided political support rather than rational analysis.

But this analysis overlooks many rail transit benefits, including reductions in external costs (road and parking costs, traffic accidents and pollution emissions). It also ignores positive land use impacts, such as efficiencies of agglomeration and rail transit's ability to create more compact, multi-modal land use development that reduces per capita vehicle ownership and use. By ignoring these effects it assumes that one passenger-mile of rail substitutes for one vehicle-mile of driving, and so undervalues benefits associated with reductions in per capita vehicle travel. The evidence provided in the paper to justify these exclusions is one-sided and anecdotal.

Winston and Maheshri argue that rail transit plays a declining role in the U.S. transport system, but much of their evidence is outdated, reflecting trends such as housing and employment dispersion, which appear to be reversing in some major cities. They ignore projections that an increasing portion of U.S. households may value living in transit oriented neighborhoods (Reconnecting America, 2004). They argue that rail transit's role is declining because it only serves old central business districts, which they estimate contain only 10% of regional employment. But this misrepresents the role of rail, which connects commercial centers (business districts, malls, campuses and airports), including some in suburbs, and helps attract more businesses to central locations. As a result, in cities with major urban rail systems, a major portion of jobs, particularly higher-order jobs that involve longer commutes, are generally located near rail transit stations.

Winston and Maheshri argue that rail transit is inefficiently subsidized, but ignore automobile transportation subsidies such as roadway costs not borne through user fees, subsidized parking, and external congestion, accident and pollution emissions. Although they analyze how various transit pricing and operational changes would affect rail service cost efficiency, they do not test the effects of efficiency-justified market reforms, such as congestion pricing, parking pricing, parking cash-out and pay-as-you-drive vehicle insurance, which tend to increase transit ridership, and therefore rail transit benefits. In other words, existing market distortions that favor automobile over transit travel (subsidized parking, unpriced road space, fixed vehicle insurance) reduce transit demand below what is optimal, thereby reducing transit efficiencies and measured benefits.

Careless Omissions Or Intentional Bias?

Good research provides comprehensive information so readers can make a fair judgment about an issue. Good research follows principles and practices to insure that information is accurate and balanced, as listed below. Critics generally fail to follow these practices.

Good Research Practices (Litman, 2004c)

- Attempts to fairly present all perspectives of an issue.
- Provides context information by summarizing issues and by referencing relevant documents.
- Carefully defines research questions which link specific research to broader issues.
- Provides accurate data and appropriate analysis in a format that can be accessed and replicated by others.
- Discusses critical assumptions made in the analysis such as why a particular data set or analysis method is used.
- Presents results in ways that highlight critical findings.
- Discusses conclusions and their implications. Discusses alternative explanations and interpretations, including those with which the researcher disagrees.
- Describes analysis limitations and cautions. Does not exaggerate implications.
- Is respectful to people with other perspectives.
- Provides adequate references.
- Indicates funding sources, particularly any that may benefit from research results.

These critics fail to discuss key decisions concerning the selection of data sources and analysis methods. For example, O'Toole does not discuss the various congestion indicators available for comparing cities, and why he selected the Travel Time Index. This index undervalues the congestion reduction impacts of grade-separated transit, because it only measures the intensity of delay experienced by road vehicle occupants, and overlooks the congestion reduction benefits that result when people shift to alternative modes, and from more compact land use that reduces travel distances. Similarly, O'Toole does not explain why he compares transit energy consumption rates with those of passenger cars rather than the higher weighted fleet average rate. Similarly, Castelazo and Garrett do not discuss why they use national cost values (54.4¢ per passenger-mile) rather than local values (27¢ per passenger-mile) when assessing rail costs transit. Cox makes general statements without evidence, many of which are contradicted by current research.

In virtually every situation, these critics choose the data and analysis option that presents rail transit most negatively. It is possible that they have valid reasons for making these choices, but they do not describe them as required for good research practices. This suggests that the various omissions and distortions in these reports are intentional, designed to present rail transit in a negative light, rather than to provide fair and comprehensive information on benefits and costs.

Points of Agreement

Transit critics raise some important issues. I agree that the relatively low portion of total trips made by public transit, and the declining transit mode share, are concerns. However, I believe that this reflects the need to correct existing market distortions that favor automobile travel over transit. Simple market reforms that are justified on both efficiency and equity grounds, such as parking cash-out, distance-based vehicle registration and insurance pricing, and least-cost planning, can substantially increase transit ridership by creating a more level playing field ("Transit Encouragement," VTPI, 2003). Various cost effective strategies for improving transit service and increasing ridership are described in the next section.

It is also reasonable to argue that rail transit investments should not be made at the expense of bus service. In many situations, incremental bus service improvements may provide faster, more equitable and greater total benefits than rail transit improvements. However, bus systems do not seem to have the positive effect that rail has on land use accessibility, has less ability to attract discretionary riders, and has some disadvantages compared with rail on high demand corridors.

The relatively high traffic accident rate of rail transit is also a concern, and efforts should be made to reduce this through education and traffic management. Recent experience in Salt Lake City and Houston indicate that crash rates are high when light-rail systems are first introduced in a city, but decline as drivers become familiar with new traffic operations. However, these high crash rates per passenger-mile are offset many times over by reductions in per-capita crash fatalities, and are probably further offset by additional health benefits from reductions in urban air pollution exposure, and increased walking by commuters who shift from driving to transit.

My criticism of omissions and errors by critics must be tempered by the fact that the data needed for some analyses are unavailable. In particular, it is difficult to obtain accurate data on the marginal cost of expanding roadway, bus and rail systems, and so it is often necessary to use average-cost data. But a rough estimate of marginal costs is more accurate than precise average-cost data, and when average values are used, it is important to identify the direction of error: it is clear that marginal roadway and parking facility capacity expansion costs tend to be higher in dense urban centers and that transit demand is particularly high in such corridors, which can result in low unit costs.

I also am concerned about housing affordability and the impacts of planning decisions on low-income households. However, research by myself and others indicates that more accessible community design, more diverse transportation systems, and more flexible residential development standards are the best ways to improve overall affordability and increase economic opportunity, because they can reduce both housing and transport costs, and provide other benefits to lower-income people, such as improved accessibility for non-drivers ("Location Efficiency Development," VTPI, 2003).

Conclusions

If implemented in growing urban areas with supportive transportation and land use policies, rail transit can provide significant benefits to users and society. But there has been considerable debate over the merits of rail transit. Critics argue that rail transit is outdated, ineffective at solving transportation problems, and wasteful, but their analysis is based on various omissions, errors and misrepresentations. Critics argue that transit is becoming unimportant, based on past demographic and economic trends that favored automobile travel, but many of these trends are leveling-off or reversing. As the baby boom ages and fuel prices rise, the value to consumers of high-quality transit increases.

Critics ignore or understate many benefits of transit, and they underestimate the full costs of accommodating additional automobile traffic on congested urban corridors. They fail to account for multiple benefits and so they undervalue transit. Critics may be correct that rail transit is not the most cost-effective solution to individual problems such as traffic congestion or air pollution, but it can help achieve multiple planning objectives, while automobile-oriented solutions often exacerbate other problems.

Rail transit can improve mobility for non-drivers, reduce automobile travel and associated costs, and support more efficient land use patterns. As a result, communities with major rail transit systems tend to have less per capita traffic congestion, lower per capita traffic fatalities, lower road and parking facility costs, and consumer cost savings. These benefits often exceed rail transit costs.

Critics are wrong when they claim that rail transit does not reduce traffic congestion. There is strong evidence that per capita congestion delays are lower on corridors with high-quality rail transit, because a portion of motorists shift to transit whenever it is faster than driving. Critics are either unfamiliar with current research – measuring congestion impacts in ways that undervalue transit impacts – or intentionally misrepresent this issue.

Critics claim that rail transit is excessively subsidized, but rail transit subsidies are often lower than subsidies for bus transport and far lower than the total costs of automobile transport under urban travel conditions. Transit subsidies are also justified for the sake of equity, to offset various market distortions, to take advantage of economies of scale, and to help achieve a strategic planning objective, factors that critics generally ignore.

Although few motorists want to give up driving completely, at the margin (compared with their current travel patterns) many would prefer to drive less and use alternatives more, provided they are convenient, comfortable and affordable. This does not mean that rail transit should be provided everywhere, that every automobile trip should shift to transit, or that transit can solve every urban problem. But when all impacts are considered rail transit is often the most cost effective way to improve transportation on major urban travel corridors.

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Endnotes

[1] Parking supply estimate for Shoup, 2005 and "Parking Costs," Litman, 2003. Road lane estimate based on BTS (2004) data showing 3,974,107 miles of roadway and 236 million motor vehicles in the U.S. in 2003, assuming roads average three traffic lanes.

[2] Subsequent rail critics such as Balaker (2004) rely heavily on O'Toole, citing him and his sources, and also fail to use best current practices in evaluating transit benefits or provide information that does not support his conclusions.

[3] For information on transit evaluation best practices see Cambridge Systematics, 1998; FTA, 1998: Lewis and Williams, 1999; Phillips, Karachepone and Landis, 2001; HLB, 2002; Kittleson & Associates, 2003; MKI, 2003 and Litman, 2004b.

[4] Randal O'Toole, the author of *Great Rail Disasters* was kind enough to send me his analysis spreadsheet for review. I found several substantial errors and reported them to him at the end of February 2004. He recalculated the data and adjusted the results downward, from a 33,000 commuter loss in rail cities and a 27,000 gain in bus cities, to a 14,097 loss in rail cities and a 1,388 gain in bus cities. Other values in the

report will also need correction. Mr. O'Toole promised to correct these errors March 2004, but the reports posted on the Center for The American Dream website in 2005 still contain the false data.

[5] Winston and Langer (2004) found a strong positive relationship between rail transit system mileage and transit ridership.

[6] For example, a $376 million project started in 2004 to add carpool lanes along six miles of Interstate 215 in Southern California averages about $31 million per land-mile, and Boston's Big Dig project cost hundreds of millions of dollars per added lane-mile. Of course, these are particularly costly projects because they occur in major cities, exactly where rail transit projects are implemented.

[7] Analysis of delay reduction benefits to people who shift from driving to high quality public transit is difficult, in part because some of the benefit is results from reduced stress and greater comfort to transit passengers compared with motorists driving in congested conditions, rather than time savings measured by a clock. See discussion in the "Travel Time Costs" chapter of Litman (2003a) and Litman (2004b).

[8] Measuring risk per passenger-mile assumes that increased low-risk travel increases safety. For example, by this measurement, an increase in vehicle travel on grade-separated highways (which have a low crash rate per passenger-mile) increases overall traffic safety. Measuring crashes per capita allows traffic risk to be compared with other health risks.

[9] Flyvbjerg, Holm and Buhl (2002) conclude that transportation project cost projection accuracy did not measurably improve between 1990 and 1998, but Figure 3 of their report actually suggests that between 1985 and 1998 cost accuracy improved significantly. More detailed analysis is needed to determine whether rail transit cost and ridership projections have improved over time.

[10] In mid-March, 2004 Randal O'Toole agreed to my request to provide more specific information on his analysis of transit project cost overruns and ridership shortfalls for review, but despite repeated requests, as of Sept. 2005 he provided nothing. Without this information it is not possible to verify his claims.

[11] For more discussion of these issues see Todd Litman, *Evaluating Research Quality: Guidelines for Scholarship*, Victoria Transport Policy Institute (www.vtpi.org), 2004.

[12] Many suburban communities are developing into towns and cities. A good example is Silver Springs, Maryland, which until the 1990s was a typical, automobile-oriented suburb, but has recently become a multi-modal city, with medium- and high-density development clustered around a rail transit station. Although such areas are classified as suburban, they enjoy significant benefits from rail transit service as a catalyst for more efficient land use development patterns.

[13] O'Toole references *Rail Transit In America* (Litman, 2004a), acknowledging that my study indicates that regions with high quality rail transit have higher per capita transit ridership and lower per capita congestion costs, but claims that my analysis fails to account for ridership trends over time. It ignores other identified benefits such as reduced crashes, consumer cost savings and reduced operating costs per passenger-mile. It also misspells my name.

[14] O'Toole criticizes the Houston rail line for having 68 collisions with automobiles during its first year. However, the Main Street on which it operates averages about 2,000 annual vehicle collisions. Virtually all of these collisions result from motorist errors, and the high crash rate is declining as new safety features are implemented and drivers become more familiar with the rail system.