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Evaluating Transportation Economic Development Impacts

Understanding How Transport Policy and Planning Decisions Affect Employment, Incomes, Productivity, Competitiveness, Property Values and Tax Revenues

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Transportation planning decision affect economic development in many ways: by influencing the connections between resources, workers, businesses and customers; by influencing consumer expenditures; and by affecting land use development location and intensity.

Abstract

Economic development refers to progress toward a community's economic goals such as increased employment, incomes, productivity, property values, and tax revenues. This report examines how transportation policy and planning decisions affect economic development, methods for evaluating these impacts, and ways to maximize economic development benefits in transport decisions. Some of these impacts are often overlooked in conventional analysis.

Executive Summary

Transportation enables economic activity by connecting people, businesses and resources. Transport policy and planning decisions can have many economic impacts by affecting employment, productivity, property values, affordability and wealth accumulation. Some of these impacts are widely recognized and considered in conventional policy and planning analysis, but others are often overlooked or undervalued.

This report provides guidance on practical ways to incorporate comprehensive economic analysis into transport planning. It describes specific ways that transport policies affect economic development, methods for evaluating these impacts, and strategies for achieving economic development objectives.

Table ES-1 **Economic Development Impacts**

Factor	Description	Evaluation Methods	Development Strategies
Project expenditures	Jobs and business activity caused by project expenditures.	Regional economic models, input-output tables	Favor policies and projects with greater job creation.
Consumer expenditures	Impacts of future consumer transport expenditures.	Consumer expenditure surveys and regional economic models	Favor policies and projects that reduce future fuel and vehicle expenditures.
Transport project cost efficiency	Whether transport facility investments repay costs and optimize value.	Comprehensive benefit/cost models that account for all impacts.	Choose projects with high return on investment or benefit/cost ratios.
Transport system efficiency	Ratio of benefits to costs. Whether transport policies support economic objectives	Whether transport policies reflect efficient market principles.	Use efficient pricing and policies that favor higher value trips (such as freight) and efficient modes.
Basic access	Effects on basic mobility for non-drivers (access to shops, schooling and jobs)	Analysis of travel options between affordable housing, services and jobs	Support projects that improve commute options for disadvantaged workers.
Impacts on specific industries	Impacts on specific industries and businesses (e.g., vehicle and fuel producers, taxis, etc.)	Analysis of employment and productivity of specific industries and businesses	Identify potential negative impacts and arrange transition and compensation if needed
Property values and development	Whether policies and projects increase real estate values and development.	Property valuation studies. Surveys of real estate professionals.	Support projects that increase property values. Capture value for transport project funding.
Land use objectives	Support for more accessible, efficient land use development.	Land use development impact analysis.	Favor projects that support strategic land use objectives
Affordability	Impacts on transportation and housing affordability.	Transportation and housing affordability analysis.	Favor affordable modes and affordable-accessible housing
Wealth accumulation	Household wealth created by housing investments.	Expenditures on housing versus transportation.	Support location-efficient development.
Outcomes	Improved health, education, environmental quality, etc.	Sustainable development indicators.	Favor projects that help achieve desired outcomes.

This table categorizes transportation economic development impacts, evaluation methods, and strategies to achieve related economic development objectives.

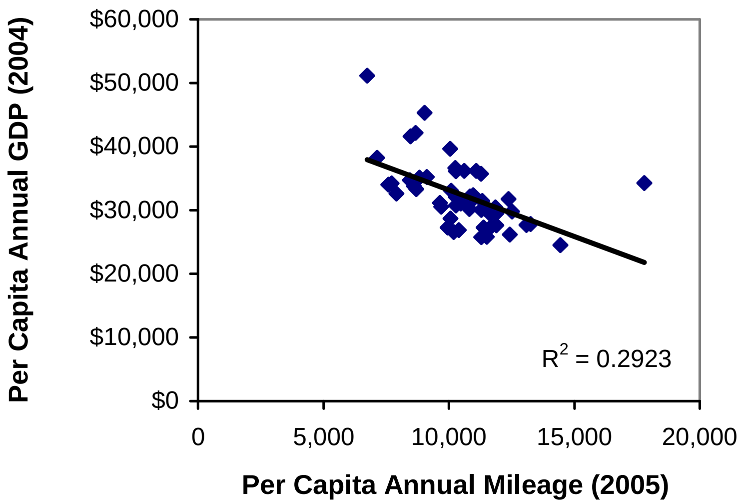
Conventional transport planning focuses on certain economic impacts (travel time, congestion delay, vehicle operation costs, and some accident costs), but tends to overlook and undervalue others (parking costs, vehicle ownership costs, and incremental costs of induced travel), although they are often significant. As a result of these omissions, what analysts report as *the* economic impacts (or net present value, or benefit/cost ratio) of a transport project are often just a subset of total economic effects. More comprehensive analysis considers a wider set of economic impacts. Even impacts unsuited for quantification and monetization can be identified and considered qualitatively.

During the last century transportation money and time costs declined substantially, increasing overall economic development. Although some transport productivity gains may occur in the future due to technological improvements, these are likely to be offset by rising congestion and energy costs. Larger economic benefits are likely to result from policies that reduce the need for physical travel through telecommunications and operational efficiencies then from policies that further increase per capita vehicle travel.

Transportation policy and planning decisions tend to support economic development to the degree they increase efficiency. Policies that reflect efficient market principles (suitable consumer options, cost-based pricing, efficient prioritization, and neutral public policies) tend to support economic development. However, strategies that shift transport costs to other economic sectors, such as financing roads and parking through general taxes or development fees, reduce efficiency and are ultimately economically harmful.

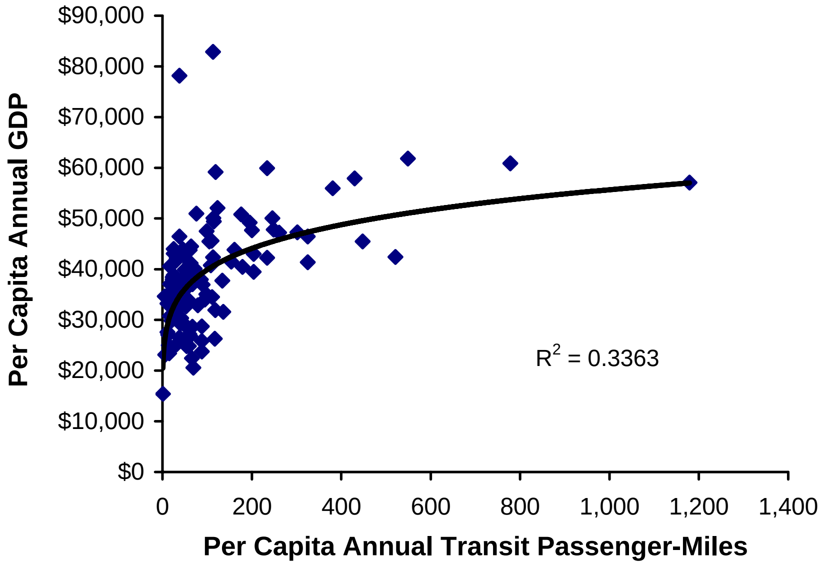
Some experts claim there is a direct relationship between mobility and economic productivity so policies that reduce vehicle travel are economically harmful. Research in this report suggests otherwise. It indicates that increasing from low to moderate mobility (less than 1,000 up to about 4,000 annual VMT per capita) tends to increase productivity but beyond that marginal economic benefits decline while costs increase. In industrialized countries, economic productivity tends to increase with *less* motor vehicle travel, *more* public transit travel, and *higher* fuel prices, as indicated in Figures ES-1, ES-2 and ES-3.

Figure ES-1 **Per Capita GDP and VMT For U.S. States**



Per capita economic productivity increases as vehicle travel declines. (Each dot is a U.S. state.)

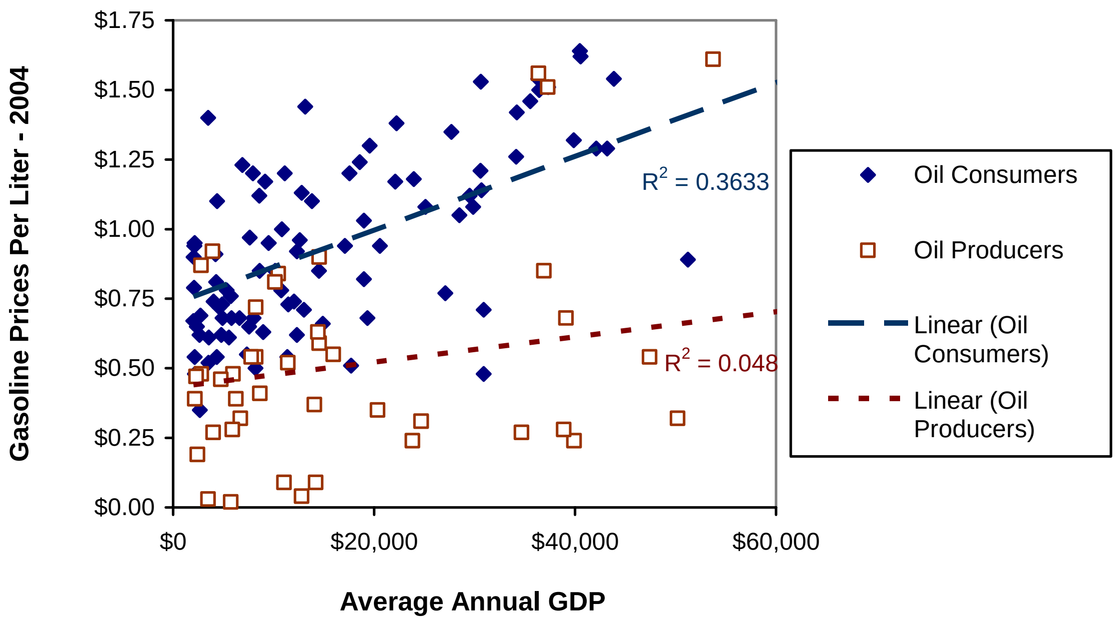
Figure ES-2 **Per Capita GDP and Transit Ridership**



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

This has important policy implications. It indicates that excessive automobile dependence can reduce economic productivity, and policy reforms that reduce per capita vehicle travel and increase transport system efficiency (called *mobility management* or *transportation demand management*) often support economic development.

Figure ES-3 **GDP Versus Fuel Prices, Countries**



Economic productivity tends to increase with fuel prices, particularly in oil consuming countries.

Conventional planning tends to evaluate the transportation system quality based on automobile travel conditions (roadway level-of-service, average traffic speeds, parking facility supply, vehicle operating costs), which tends favor automobile-oriented improvements, often to the detriment of other transportation improvement options. More comprehensive analysis evaluates the transport system based on overall *accessibility*, which considers additional factors such as the quality of alternative modes, land use patterns, and mobility substitutes such as telecommunications and delivery services.

Sustainable transportation planning requires balancing economic, social and environmental objectives. Analysis in this report can help identify true *win-win* transportation strategies, which support economic development in ways that also help achieve social and environmental objectives.

When evaluating the economic impacts of specific transportation policies and projects it is important to ask critical questions, such as:

- Are transportation improvements really the best way to support economic development?
- Does the proposal really increase overall productivity? Are some perceived benefits are really economic transfers? To what extent are benefits offset by increased indirect costs?
- Is the proposal really the best way to improve transportation and access? Could better management of existing facilities satisfy demands at lower costs?
- Are subsidies justified? Could costs be borne directly by users?

Applying this analysis framework to typical transport planning issues indicates that:

- Parking subsidies are an inefficient way to support downtown economic development. More efficient management is generally more cost effective and beneficial overall.
- High quality interregional highways support economic development, but once a basic highway system exists, expanding its capacity to reduce congestion has negative as well as positive impacts because it stimulates automobile dependency (fewer travel options) and sprawl, which tends to increase costs and reduce efficiency.
- Many mobility management strategies reflect basic market and planning principles. They reduce transportation costs and increase transport system efficiency, which increases economic productivity and development.
- High quality public transit provides many economic benefits and so can be cost effective provided there is sufficient consumer demand and supportive land use policies.

Contents

Introduction

Transportation enables economic activity by connecting people, businesses and resources. Transportation improvements are often advocated for economic development sake and there is often debate over which transport policies best support economic development. This report explores these issues and provides guidance on practical ways to incorporate economic development objectives into transport planning.

Economic development refers to progress toward a community's economic goals and objectives, such as those listed in Table 1.

Table 1 **Economic Development Objectives and Indicators**

Objectives	Performance Indicators
Income	Average or median wage rates and employee or household incomes.
Employment	Employment or unemployment rates, often measured as *full time equivalents* (FTEs)
Productivity	Production of goods and services as measured by Gross Domestic Product (GDP)
Competitiveness	Efficiency and productivity compared with competitors.
Business activity	Gross sales volumes.
Profitability	Business profits or return on investment.
Property values	Value of land and buildings, or changes in those values.
Investment	Value of capital investments
Tax revenues	Value of tax revenue
Affordability	Transport costs relative to income. Transport expenditures by income class.
Equity	Differences in wealth, poverty and outcomes (longevity, health, etc.) between groups.
Outcomes	Health, longevity, education, crime, environmental quality, life satisfaction, etc.

This table summarizes various economic development objectives and their indicators suitable for evaluating economic development impacts. Not all impacts need be considered in every evaluation.

Transport policy and planning decisions affect economic development in various ways:

- As an input to economic activities (shipping, business travel, the delivery of services), which affects production costs and productivity.
- Through productivity, employment and profits of transportation-related industries.
- On consumer expenditures and their economic impacts.
- On people's ability to access to economic activities (schooling, employment and shops) and therefore engage in economic opportunities.
- On the cost burdens imposed on different activities, groups and locations.
- Through impacts on location and land use development patterns.

Some of these impacts are widely recognized in transport planning but others are often overlooked or undervalued. Economic development is sometimes a primary planning objective but other times it is overlooked. Both extremes can lead to bad decisions: economic development strategies that contradict other planning objectives, or social and environmental strategies that contradict economic development. A better approach is to use comprehensive analysis that considers economic, social and environmental objectives together, to identify truly optimal policies. This is the basis of sustainable development.

Although mobility contributes to economic productivity, transport activity also imposes significant costs, so too much mobility is as economically harmful as too little. For example, it would be economically inefficient to walk for trips involving long distances and heavy loads, which are most efficiently performed by motor vehicle; but it is also economically inefficient for a healthy person to use a car or truck for short trips that could efficiently be performed by walking or bicycling. Efficient transport policies result in optimal mobility: not too little, not too much, and each mode is used for what it does best. This maximizes economic productivity and therefore economic development.

Evaluation of a proposed policy or project should consider questions such as:

- Are transportation improvements really the best way to support economic development? Could other policies or projects (utility improvements, better schools, lower taxes, etc.) be more cost effective overall?
- Does the proposal really increase overall productivity? Are some perceived benefits are really economic transfers? Are benefits to one business, district or industry offset by losses to others? To what extent are benefits offset by increased costs, including indirect and external costs?
- Is the proposal really the best way to improve transportation and access? Could better management of existing facilities satisfy demands at lower costs?
- Are subsidies justified? Would it be more efficient and equitable to recover costs directly from users?

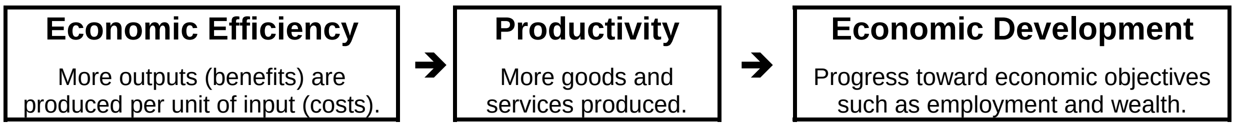
This report provides guidance for evaluating the economic development impacts of specific transportation policies and planning decisions. It defines economic development concepts, investigates the role that transportation plays in economic production, how transport improvements contribute to economic development, describes factors to consider when evaluating transportation economic impacts and methods for evaluating these impacts, and discusses transport policies that help achieve economic development objectives.

Economic Development Concepts

This section discusses various concepts related to transport economic analysis.

Economic Efficiency and Productivity

In general, increasing *economic efficiency* (the ratio of benefits to costs) increases *productivity* (the quantity of goods produced), which increases *economic development*, as illustrated below. *Logistics* is the discipline concerned with maximizing transport system efficiency.



Transportation efficiency gains filter through the economy in various ways. For example, more efficient parking management may reduce tax costs (if parking is supplied by governments), increase developer profits, reduce rents, improve building quality (money saved on parking is spent on building space), or a combination of these. Even small efficiency gains can provide large total benefits. For example, if two locations are otherwise comparable, the more accessible generally experiences more development. Similarly, a business with lower transport costs than competitors is more profitable. Even small savings can significantly increase profits and investments. For example, if a business has an 8% annual return on investment and transport represents 16% of its costs, a 10% transport cost reduction increases profits 20%.

Efficiency is a simple concept with many implications. Efficiency is sometimes measured in physical units, such as vehicle-miles-per-gallon, tonne-miles-per-dollar, or vehicles-per-lane-hour. Reducing unit costs (more miles per gallon or per dollar, or lower costs to accommodate more vehicle traffic per hour) increases *cost efficiency*.

Economic efficiency is a broader concept that refers to the *value* provided by a good or service, and so increases if unit costs decline *or* if higher value uses receive priority over lower value uses. For example, transport system economic efficiency increases if the total costs of travel are reduced (for example, if a roadway improvement increases traffic speeds) or if roadway management gives higher value trips (such as freight and service vehicles) priority over lower value trips (such as personal errand trips).

This concept has many implications for policy and planning analysis. Mobility provides many benefits, but it also incurs significant costs. Maximizing transport system benefits therefore requires achieving the optimal amount and mix of mobility. For example, to transport heavy loads a truck is generally more efficient than a horse. For long-distance trips, air travel is generally more efficient than driving, and for medium-distance trips, driving is generally more efficient than walking. On the other hand, since driving incurs significant economic costs for vehicles, fuel, roads, parking, accident risk and pollution damages, walking and bicycling are often more efficient than driving for short trips by healthy people that involve light loads.

As a result, either too little or too much vehicle travel can be economically inefficient. For example, a transport system may be economically inefficient if farmers, contractors and other businesses cannot use trucks when transporting heavy loads due to inadequate roadway infrastructure, since this reduces their productivity; but it can also be economically inefficient if residents cannot easily walk and bicycle when running local errands due to inadequate sidewalk and path infrastructure, since this forces them to drive even when making local trips, increasing traffic congestion, road and parking facility costs, vehicle and fuel costs, accident risk and pollution damages.

The following principles tend to maximize economic efficiency:

- *Consumer options* (also called *consumer choices* or *consumer sovereignty*). The more options available the easier it is for consumers to find the combination that maximizes their benefits.
- *Efficient pricing.* Cost-based pricing (what consumers pay for each good reflects its marginal production costs) insures that resources are used efficiently, so society avoids spending two dollars to produce goods consumers only consider worth one dollar.
- *Prioritization*. Higher value trips and more efficient modes get priority over lower value trips and less efficient modes, through regulations or pricing.
- *Economic neutrality.* This means that public policies should not arbitrarily favor one good over others, unless specifically justified. For example, it would be inefficient for transportation planning to arbitrarily automobile travel over other modes.

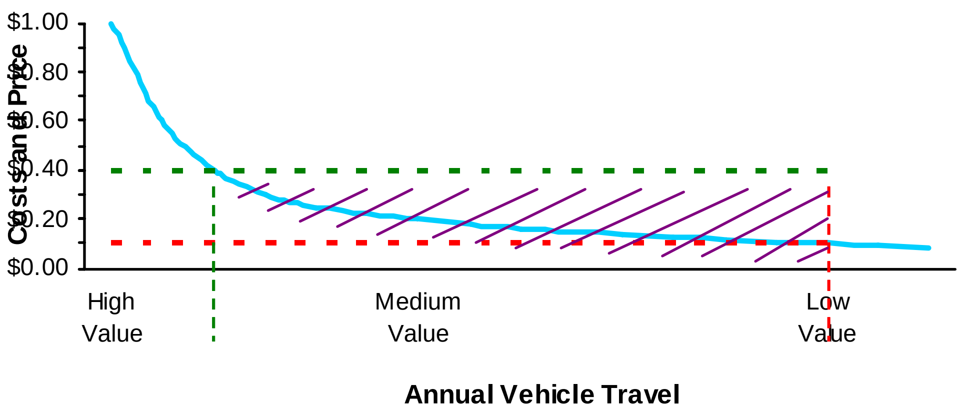
Transportation policies that reflect these principles tend to maximize transport system efficiency and therefore economic productivity. A diverse and efficiently priced transport system encourages consumers to choose the most efficient option for each trip which maximizes transport activity benefits. Current transportation markets often violate these principles (Clarke and Prentice 2009). Travelers often lack viable options, vehicle travel is underpriced (many costs are external), and some planning practices favor automobile travel over alternative modes. Motor vehicle travel that results from these market distortions is economically inefficient: vehicle travel for which marginal costs exceed marginal benefits. This tends to reduce economic productivity.

The external costs of transportation are well documented (Litman 2009a; Vermeulen, et al. 2004). They include congestion delays and accident risk imposed on other road users, facility and service costs not borne by users, pollution damages and habitat losses caused by an automobile-dependent transportation system. Pricing reforms that internalize these costs tend to increase efficiency and support economic development.

For economic analysis it is important to differentiate between *resource impacts* (change in valued resources such as money, time, land and clean air) and *economic transfers* (resources shifted from one person or group to another). Some policies that appear to reduce transport costs are really economic transfers that shift costs elsewhere in the economy. For example, roads financed through general taxes and parking costs borne as building expenses reduces the costs of driving but increases the costs of other goods, and so are economically inefficient overall. Many transport improvement benefits involve both resource benefits and economic transfers. For example, a new highway or transit line provides both resource cost savings (travel is cheaper) and economic transfers (it attracts development from other locations).

Demand for mobility is potentially unlimited (Figure 1). If costs decline, consumers can usually find reasons to travel more, even if marginal user benefits are small and the travel imposes external costs. For example, if offered cheap fuel and inexpensive suburban homes many consumers will accept long-distance commutes, and if cheap free air travel they would choose distant holiday destinations, even if shorter commutes and more local holidays are almost as nice and impose much lower total costs to society.

Figure 1 **Mobility Demand Curve**



The automobile travel demand curve (light blue line) has a "long tail" – as prices decline people tend to increase their annual mileage even if marginal benefits are small. If automobile travel has 40¢/mile total costs (green dashed line) but motorists only perceive 10¢ because many costs are external or fixed (orange dashed line), consumers will drive more than economically efficient. Purple hatched area indicates the area of inefficiency: benefits are smaller than total costs.

People seldom think about travel in this way. They generally consider all of their vehicle trips valuable and perceive few practical alternatives. Many of their decisions that increase vehicle travel long-term decisions by governments and households, such as how much to invest in various modes, the type of zoning codes to apply, where to locate public facilities (such as schools), where to live and work, and how many vehicles to own. After these decisions are made people become locked into a particular level and type of mobility, and the associated costs. For example, automobile-oriented transport and land use planning practices create communities in which many residents perceive no alternative to driving for most trips, and incurring high vehicle, fuel and accident costs. Market and planning reforms that correct these distortions tend to increase productivity and support economic development.

Economic impacts vary by travel purpose, as indicated in Table 2. In general, *producer* transportation efficiency (freight and service delivery, and business travel) tends to have the greatest effects on economic productivity. Improving commute travel efficiency can increase productivity if it improves education and employment opportunities, improving the match between workers and jobs. Increasing personal travel efficiency (for example, faster travel for errands, social and recreation) benefits users but does not generally increase economic productivity. Improving consumer access to regional shopping centers may allow retail agglomeration efficiencies (such as bulk discount stores), but this may be offset by declines in local shopping efficiency (residents have fewer local shopping options), and by any additional costs of owning and operating automobiles.

Table 2 **Economic Impacts by Trip Purpose**

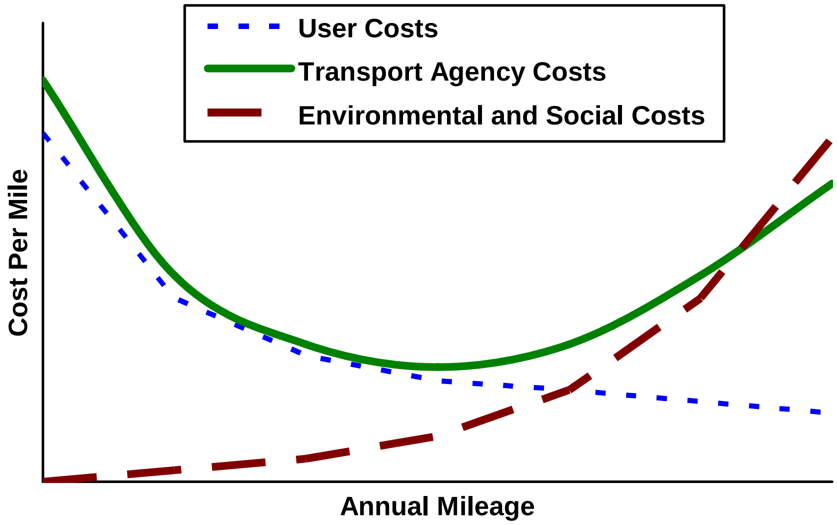
Type of Trip	Typical Portion of Total Travel	Economic Productivity Impacts
Freight, service and business travel	15%	Directly affects economic efficiency and productivity.
Commuting	20%	Can affect educational attainment, employment rates, and the match between employees and jobs.
Personal errands (e.g. shopping, trips to school and recreation.	30%	May affect where people shop, and may allow efficiencies of agglomeration (i.e., bulk retail stores, medical clinics, specialized services), but rarely affects total regional retail activity.
Social and recreation	25%	Affects user benefits, but little economic productivity impacts.
Holiday	10%	May affect the number of tourist who can visit an area, and the number of residents who can leave and spend money elsewhere.

This table illustrates the ways that different types of trips affect economic productivity. Freight, service and business travel represent a small portion of total travel.

People sometimes argue that transportation industries and activities provide benefits that offset external costs, justifying underpricing and subsidies, such as unpriced roads and parking facilities. However, the existence of benefits does not justify underpricing and subsidies. Only if vehicle travel provides significant *marginal external benefits* (you benefit if your neighbors increase their annual mileage) would subsidies be efficient. New transportation systems often have scale economies. For example, during the first few years of the automobile age people benefited as their neighbors purchased more vehicles and drove more annual miles because this reduced vehicle and road production costs, creating cheaper cars and better roads. This justified underpricing to stimulate consumption. Now these systems are mature and roads are increasing congested so there are no longer efficiency gains from underpricing automobile use.

Transportation market distortions create conflicts between individual consumers and society, as illustrated in Figure 2. Since automobiles have high fixed and low variable costs, motorists perceive a declining cost curve which encourages them to maximize driving, “to get their money’s worth.” Transportation agencies perceive a U-shaped cost curve, since they experience economies of scale when roadway systems are first developed, but eventually face congestion, at which point they perceive benefits from reducing traffic demand. External costs tend to have upward cost curves, as driving increases so does congestion, accident risk, pollution emissions and sprawl-related costs.

Figure 2 **Motor Vehicle Use Conflicting Cost Curves**



Since most motor vehicle costs are fixed, marginal costs decline with increased annual mileage, giving vehicle owners an incentive to maximize driving. Facility development has a downward sloping cost curve (economies of scale) when traffic is low, since increased driving allows costs to be divided among more miles of use, but once the system is congested average costs increase. External costs, such as congestion and pollution, are minimal when use is low, but slope upward.

Goals, Objectives and Performance Indicators

With both economic and transportation analysis it is important to clearly define *goals* (what we ultimately want), *objectives* (ways to achieve goals) and *performance indicators* (practical ways to measure progress toward goals). For example, the ultimate goals of economics are to increase *social welfare* (total benefits to society) and *equity* (the fairness with which impacts are distributed). *Productivity* (the production of goods and services) is an objective. Increasing *Gross Domestic Product* (GDP) and incomes are performance indicators, not ends in themselves. Some strategies to increase wealth can reduce social welfare, and so are not economically justified.

For example, some people may prefer part-time work or early retirement although it reduces productivity and incomes. If jobs are inflexible or living costs excessive, people may be forced to work more than they really want. Conventional economic indicators, such as GDP and average incomes, assume that increased economic activity is desirable, even if it results from people working harder than they want, from injuries and illnesses that increase healthcare expenses. Wealth can be defined as *incomes minus basic living costs* (the costs of adequate food, shelter, transport, health care, etc.), which recognizes that higher incomes may provide little benefit if living costs increase.

Similar issues apply to transportation analysis. The ultimate goal of most transport activity is *accessibility* (people's ability to reach desired goods and activities). *Mobility* (physical travel) is an objective that helps achieve accessibility. *Vehicle miles traveled* (VMT) and *vehicle operating costs* are commonly used transport system performance indicators. It is important to interpret them carefully. For example, an increase in VMT may result from an increased productivity and wealth or it could result from a reduction in overall accessibility due to reduced transport options (degraded walking and cycling conditions, inferior public transit service) and more dispersed destinations which increase the amount of vehicle travel required to maintain a given level of accessibility. When this occurs, increased VMT may reflect reduced economic efficiency and social welfare.

Described differently, conventional evaluation tends to measure the *quantity* of economic activity, although once people's basic material needs are met the *quality* of goods and activities becomes more important. For example, once people can purchase an adequate quantify of food they generally want better quality. Similarly, motorists do not necessarily want to drive more annual vehicle-miles than they do now; many would prefer to drive less, provided they have better alternatives: good walking, cycling and public transit service, and better housing options in accessible, walkable neighborhoods.

Conventional economic does a poor job of reflecting consumer demand for qualitative values as safety and health, equity, and ecological integrity. Similarly, conventional transport economics does a poor job of reflecting consumer demand for alternative modes, and improved comfort. More comprehensive analysis, often called *sustainable economics*, considers more indirect and non-market impacts in order to help balance economic, social and environmental objectives. *Sutainable transportation planning* provides more comprehensive analysis of objectives, options and impacts (ADB 2009).

Efficient Transportation Pricing

Efficient pricing means that the price consumers pay for a good reflects the total marginal costs of producing that good, unless a subsidy is specifically justified. For example, the efficient price of a vehicle trip should include vehicle costs, road and parking facility costs, plus charges for any congestion, accident risk and pollution costs. There is some debate concerning exactly what constitutes the efficient price for road and parking facility use; at a minimum it includes short-term wear-and-tear costs, but some economists recommend that road users should also pay a share of construction and land value costs, since that reflects long-term costs and is the price structure for most other goods.

Table 3 compares the efficiency of various transportation pricing options. The best are variable fees that reflect vehicle type, time and location, with higher charges when a vehicle imposes higher costs. Flat mileage fees and fuel taxes are less efficient (although much easier and cheaper to implement), while fixed vehicle fees and external costs (such as transportation facilities financed indirectly) are least efficient.

Table 3 **How Well Different Fees Represent Marginal Vehicle Costs**

Rank	General Category	Examples
Best	Time- and location-specific road and parking pricing	Variable road pricing, location-specific parking management, location-specific emission charges.
Second Best	Mileage-pricing	Weight-distance charges, mileage-based vehicle insurance, prorated MVET, mileage based emission charges.
Third Best	Fuel charges	Increase fuel tax, carbon tax, apply general sales tax to fuel, pay-at-the-pump insurance.
Bad	Fixed vehicle charges	Current MVET, vehicle purchase and ownership fees.
Worst	External costs (not charged to motorists)	General taxes paying for roads and traffic services, parking subsidies, uncompensated external costs.

This table compares how different types of pricing reflect marginal costs.

If efficient market principles are not fully applied, other policy interventions may be appropriate. Subsidies and underpricing may be justified for the following reasons:

- *Equity and basic mobility objectives.* Subsidies may be justified to provide basic mobility of savings to physically, economically and socially disadvantaged people. This includes universal design, special mobility services, and targeted discounts.
- *Scale efficiencies.* Many transport services experience efficiencies of scale and scope: they become more efficient as they expand. For example, expanding pedestrian, cycling and public transit networks tends to reduce unit costs per person-mile.
- *For strategic planning objectives.* Subsidies may be justified to support strategic planning objectives, such as development of a particular region or industry. For example, governments may subsidize a new rail line, highway or airport to improve access to an area with development potential.
- *As a second best solution to other distortions.* Subsidies may be justified to help correct problems create by other market distortions. For example, if road and parking facility underpricing leads to economically excessive automobile traffic, subsidies for alternative modes may be justified to reduce external costs such as congestion and pollution.

Equity Analysis

Equity relates to the distribution of impacts and the degree this is considered fair. Conventional transportation planning often considers a limited set of equity impacts and treats them as special issues to be addressed with special programs, but equity analysis can be incorporated comprehensively so all policies and programs are designed to help achieve equity objectives. For example, rather than just providing special bus services for wheelchair users, a broader effort can be made to insure that all transportation facilities and services accommodate people with disabilities, improve overall public transit service quality, and locate affordable homes in accessible locations, for equity sake.

Improving accessibility for disadvantaged groups provides both efficiency and equity and benefits. For example, improving affordable, accessibility options directly benefits disadvantaged people, improves their access to education and employment, and therefore their productivity (for example, businesses benefit if better mobility and accessibility expand their pool of lower-wage workers), and improves their ability to access medical services and healthy food, which reduces healthcare costs.

There are several types of transport equity objectives:

1. *Horizontal Equity (also called "fairness")*. This is concerned with the fairness of impact allocation between individuals and groups considered comparable in ability and need. Horizontal equity implies that consumers should "get what they pay for and pay for what they get," unless a subsidy is specifically justified.
2. *Vertical Equity With Regard to Income*. According to this definition, transport is most equitable if it provides the greatest benefits and least costs to lower-income people. Policies that provide relatively large benefits to lower-income groups are called *progressive* and those that burden lower-income people are called regressive.
3. *Vertical Equity With Regard to Mobility Need and Ability*. This assumes that everyone should enjoy at least a basic level of access, including people with special needs and constrains, which may require extra resources and subsidies, such as extra expenditures to accommodate people with disabilities or targeted subsidies.

Table 4 identifies transport equity indictors that can be used to evaluate specific policies and programs.

Table 4 **Transportation Equity Indicators** (Litman 2002)

Equity Objectives	Indicators
Horizontal equity	Whether similar groups and individually are treated equally.
Individuals bear the costs they impose	Whether individual consumers bear the costs they impose, and subsidies minimized unless specifically justified.
Progressive with respect to income.	Whether lower-income people save and benefit overall.
Benefits transport disadvantaged.	Whether people with mobility constrains (such as physical disabilities) benefit overall.
Improves basic mobility and accessibility.	Whether more socially valuable trips (emergencies, medical access, commuting, basic shopping) are favoured.

This table indicates examples of transportation equity indicators.

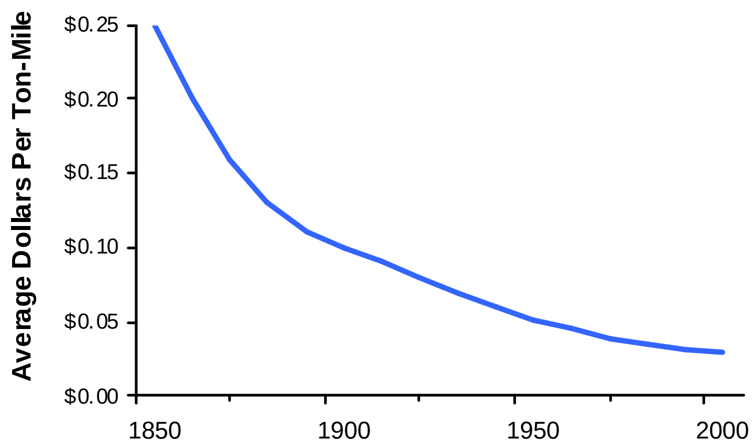
Transportation Productivity Trends

This section considers how transportation productivity (the mobility provided per dollar or hour of travel) changed in the last century and is likely to change in the future.

Freight Transport

Figure 3 shows how rail shipping costs declined over a 150 year period due to technological improvements such as larger, faster and more efficient vehicles, and more efficient loading and operations (such as containerization and automated dispatching).

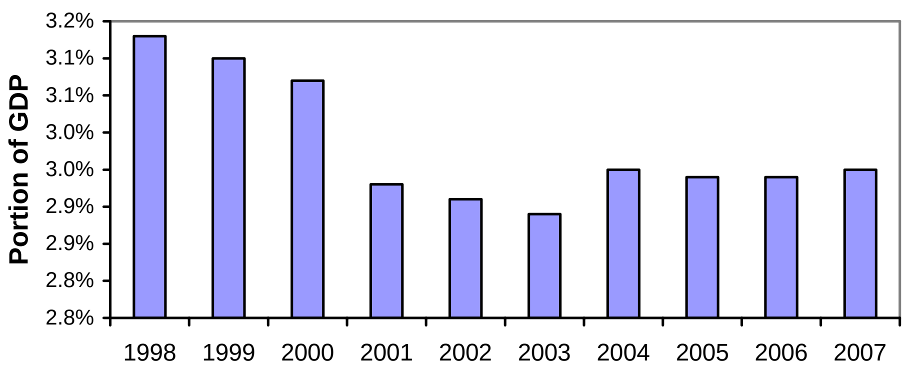
Figure 3 **Railroad Freight Costs** (Garrison and Levinson 2006 p. 290)



Shipping costs per ton-mile declined significantly during the last 150 years.

Despite growing freight volumes, the portion of U.S. employment devoted to transportation services declined during the last decade, as illustrated in Figure 4. This all indicates large increases in fright transport productivity. It is unlikely that productivity will continue to increase at this rate in the future, since costs are already low, many major efficiency improvements have been fully implemented, and rising fuel prices may offset some future efficiency gains.

Figure 4 **Transportation and Warehousing Services** (BLS 2008, Table 3-4a)

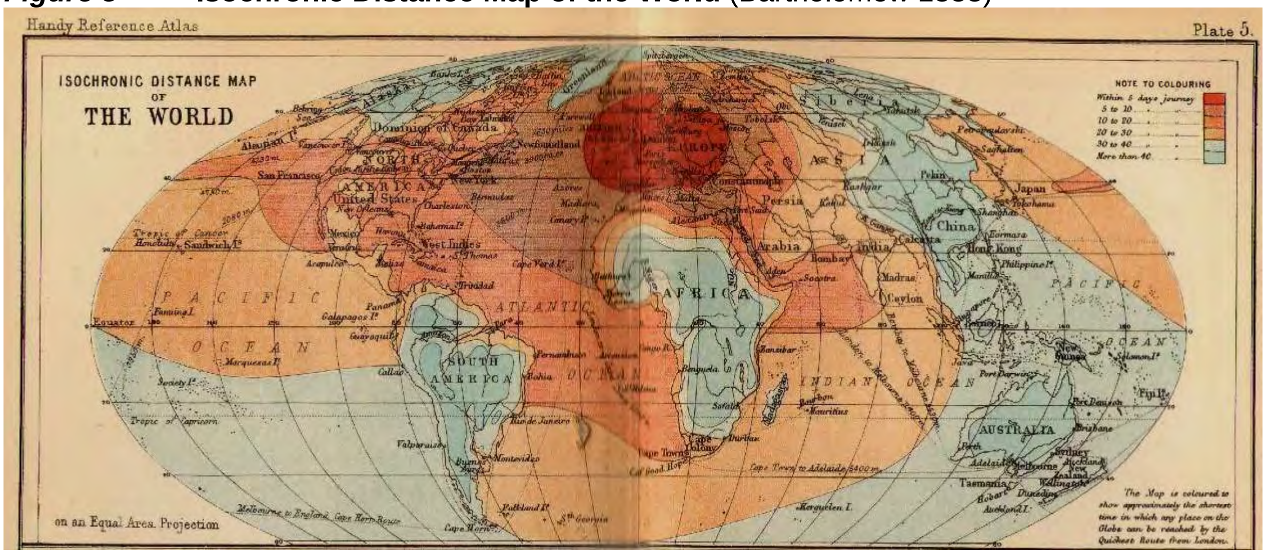


Transportation services declined as a portion of the U.S. economy during the last decade.

Personal Transport

Personal travel also experienced large productivity gains during the last century. Figure 5 is an 1888 map showing travel times from London, England to other parts of the world. It indicates that travel to New York required 5-10 days, travel to San Francisco required 10-20 days, and travel to more isolated locations (central South America and Africa, most of China and all of Australia) required 40 days or more. This map is now quite accurate if measured in *hours* rather than *days*, indicating that during the last century long-distance travel speeds increased about 24 fold.

Figure 5 **Isochronic Distance Map of the World** (Bartholomew 1888)



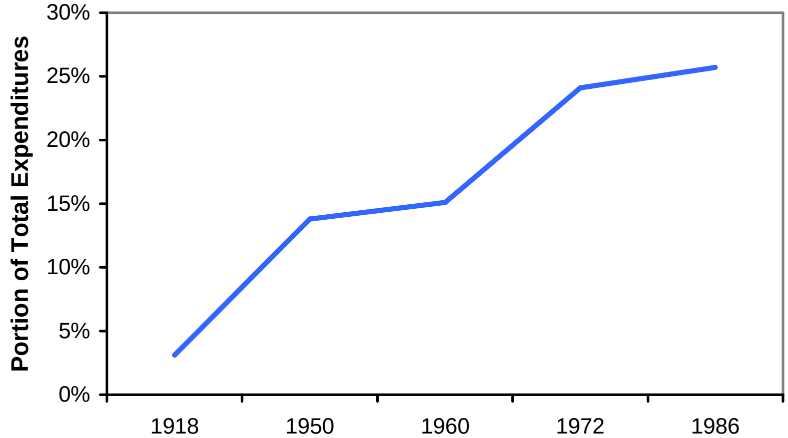
This 1888 map shows days of travel time from London to other world locations. It is now approximately accurate if measured in hours, indicating average travel speeds increased more than an order of magnitude during the last century.

Passenger fares have also declined significantly. In the 1880s, transatlantic steamship fares cost $35 to $100 (about $1,000 to $3,000 in current dollars), and transcontinental rail fares $100 to $200 ($3,000 to $6,000 in current dollars). By the 1940s, transcontinental rail fares were $70 to $100 ($250 to $350 in current dollars), and typical transcontinental airline fares were $300 ($3,600 in current dollars), this declined to about $150 ($1,200 in current dollars) by the 1960s, and now, one-way transcontinental economy class airfares are now typically about $600.

These represent huge increases in interregional transport productivity. A typical long-distance trip costs just 1% to 10% of time and money required a century ago, currier services can ship small packages to almost any city in the world within a day or two, and electronic communication allows nearly instantaneous transmission of information. These greatly increased economic productivity. Although some transport productivity gains are likely to occur in the future, primarily due to improved operations, they are likely to be smaller than what occurred during the last century and partly offset by rising fuel costs and congestion. For example, it is unlikely that travel from London to New York will become significantly faster or cheaper than it is now.

Automobile transport has a different efficiency profile. During the Twentieth Century vehicle and roadway improvements increased travel speed, comfort, fuel efficiency and reliability, but this imposed significant financial costs on households, as illustrated in Figure 6, and increasing indirect costs such as congestion, parking subsidies, accidents and pollution damages, and more dispersed land use development patterns (sprawl) which reduced accessibility. Although mobility increased significantly the benefits were partly offset by the high costs of owning and operating vehicles.

Figure 6 **Household Transportation Expenditures** (Johnson, Rogers and Tan 2001)



The portion of household budgets devoted to transport significantly increased during the last century.

Table 5 summarizes automobile transportation performance (operating costs, speed and other costs) changes during the last century. Productivity (vehicle miles per dollar and minute) appears to have peaked around 1980. Automobile travel is not significantly cheaper or faster in 2009 than it was in 1999 or 1989, while congestion and fuel costs increased. Vehicle reliability improved but repair costs increased as parts and servicing became more specialized. Seatbelts and roadway improvements reduced crash injuries but more recent safety features such as air bags and anti-lock brakes have higher costs and smaller benefits. Some externalities (pollution and crashes) declined when measured per vehicle-mile but these benefits were offset by increased vehicle travel and congestion. Most recent improvements (electric door locks, automatic seat adjusters, cup holders, sound systems, etc.) increase user convenience and comfort, but not productivity.

Described differently, although average *vehicle speeds* increased during much of the Twentieth Century, in recent decades there has been little increase in *effective speed* (total time devoted to travel, including time spent earning money to pay transport expenses). Effective speed is unlikely to increase significantly in the foreseeable future.

Table 5 **Changes In Vehicle Transport Productivity** (cost per vehicle-mile)[1]

Year	Typical Vehicles	Vehicle Operation Costs	Travel Time Costs	Other Costs	Vehicle Mileage
1900	Horse-drawn wagon	High. Short operating life, high fuel costs (for feed)	Very high. 5-10 miles per hour (MPH)	Requires lots of road and parking space. Air and noise pollution.	Low. Few people used personal vehicles daily.
1920	Ford Model T	Moderate. 1915 $440 purchase price is about equivalent to $10,000 current. About 15 miles per gallon (MPG).	High. Although faster than a horse, top speed was 40 MPH and few roads were paved.	Moderate. High air and noise pollution. High risk.	Low. Probably 2,000-6,000 annual miles per vehicle.
1940	Ford Model A	Low. The 1930s $385-$570 price equals about $5,000-7,500. About 15 MPG.	Moderate. Top speed was 60 MPH and many roads paved.	Moderate. Relatively small size. High air and noise pollution.	Averaged about 9,000 annual miles per vehicle.
1960	Large sedans and station wagons	Moderate purchase price. Averaged about 14 MPG.	Low. Virtually all automobiles can reach 65 MPH and most roads paved.	High. Relatively large size. High air pollution.	Averaged about 9,500 annual miles per vehicle.
1980	Ford Taurus and Honda Accord	Purchase prices moderate to high. Averaged about 16 MPG.	Low. Most vehicles can reach 75 MPH. Interstate Highway System completed.	Moderate. Low air and noise pollution.	Averaged about 9,000 annual miles per vehicle.
2000	SUVs and vans	Purchase prices moderate to high. Averaged about 21 MPG.	Moderate. Roads increasingly congested. Improved comfort.	Moderate. Larger vehicles increased some externalities.	Averaged about 12,000 annual miles per vehicle.
2020	Fuel efficient vehicles	Purchase prices moderate to high. Fuel economy and fuel prices increasing.	Moderate. Roads increasingly congested. Improved electronics.	Moderate. Increased congestion. Low air and noise pollution.	Likely to decline slightly.

This table indicates that vehicle and roadway improvements increased travel productivity (vehicle-miles per dollar and hour) significantly between 1900 and 1980 but further increases are unlikely.

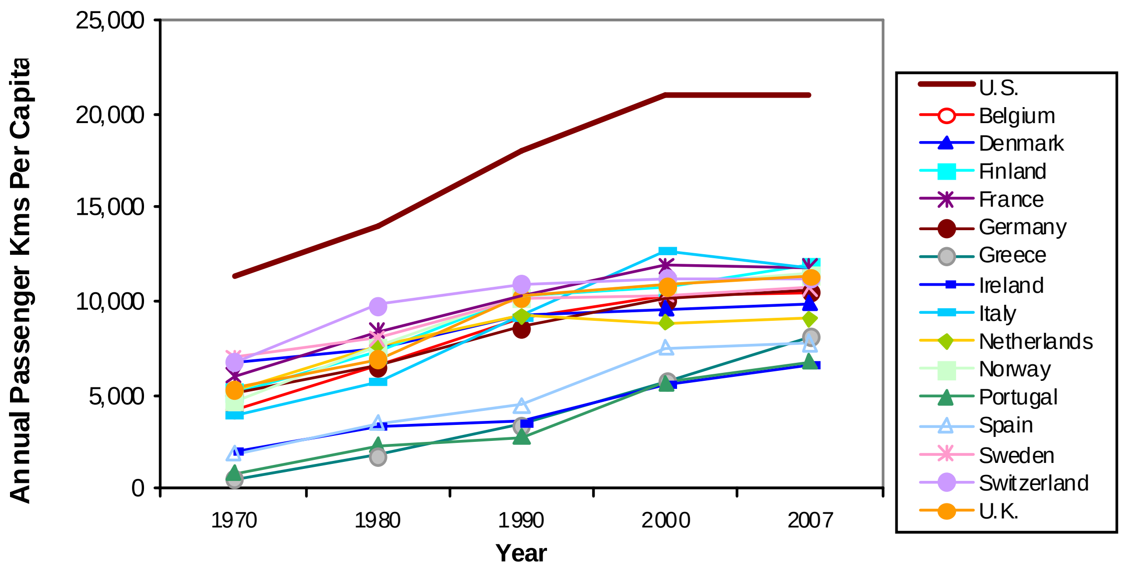
Rising incomes and increased vehicle productivity stimulated automobile ownership and use, but in recent years marginal productivity gains appear to have peaked and probably declined somewhat due to rising congestion and fuel prices, causing per capita vehicle travel to decline. This is happening in most economically developed countries.

Figure 7 illustrates vehicle travel trends in various industrialized countries. It indicates that per capita vehicle travel grew steadily during the Twentieth Century but peaking in most countries about the year 2000 and has declined slightly since due to demographic

[1] Sources: *Annual Vehicle Distance Traveled In Miles And Related Data, 1936 – 1995*, Table VM-201A, FHWA (www.fhwa.dot.gov/ohim/summary95/vm201a.pdf); Model T (http://en.wikipedia.org/wiki/Ford_Model_T); Model A (www.conceptcarz.com/vehicle/z7025/Ford-Model-A.aspx); *The Future Isn't What It Used To Be* (www.vtpi.org/future.pdf).

and economic trends (aging population, increased urbanization, rising fuel costs, etc.). The level at which per capita vehicle travel peaks varies from one country to another, due in part to differences in transport and land use policies (fuel taxes, infrastructure investments, land use development patterns, etc.), and is about twice as high in North America as in other industrialized countries.

Figure 7 **International Vehicle Travel Trends** (EC 2007; FHWA, Various Years)



Per capita vehicle travel grew rapidly between 1970 and 1990, but has since leveled off and is much lower in European countries than in the U.S.

Demographic and economic trends are reducing per capita vehicle travel demand in wealthy countries. Per capita vehicle travel is likely to increase in developing countries, such as India and China. In developed countries total vehicle travel may continue to increase somewhat with population growth, but such increases are likely to be small compared with what occurred during the last century.

Many countries are now implementing mobility management strategies reduce problems such as congestion, road and parking facility costs, and to help achieve health and environmental objectives. As described later in this report, many of these strategies are market and planning reforms that increase economic efficiency. If properly implemented these policies can significantly increase transport system productivity (the amount of accessibility provided per dollar of expenditures, hour of time and acre of land).

This indicates that, although increased automobile travel and speed made major contributions to overall economic development during the Twentieth Century, this is unlikely to continue in the future. In the future, other types of transport efficiency improvements such as increased fuel efficiency, improvements to alternative modes, better telecommunications and delivery services are likely to contribute more to economic development.

Mobility, Vehicle Travel and Economic Development

This section discusses the relationships between motor vehicle travel and economic development.

There is no doubt that mobility (physical travel, typically measured as vehicle-miles-traveled or VMT) contributes to economic productivity: it allows resources to be shipped, employees to commute, business meetings to occur, and products to be distributed. As discussed in a previous section, transportation efficiency improvements contributed significantly to economic productivity gains during the last century. Measured in some ways, VMT and GDP increase together, in part because improved mobility contributes to productivity, and in part because increased productivity increases wealth which allows consumers to purchase more mobility.

But mobility tends to experience declining marginal benefits. As per capita mobility increases a declining portion serves productive travel (freight and service delivery, business travel, emergency transport), and an increasing portion of vehicle-miles consist of low-value trips that consumers would forego if prices were somewhat higher. High levels of VMT may partly result from reduced accessibility (more money, time and land needed to reach services and activities such as shops, schools and jobs), which reflects a reduction in transportation system efficiency. As a result, in automobile-dependent regions there may be a negative relationship between mobility and productivity: cities and neighborhoods with less per capita VMT due to their more efficient transport systems are more economically productive.

The next three sections explore these issues. The first examines data showing both positive and negative relationships between mobility and economic productivity. Positive relationships are evident when comparing regions at very different levels of development (low, middle, and high income countries). Negative relationships are evident when comparing different regions within a wealthy country.

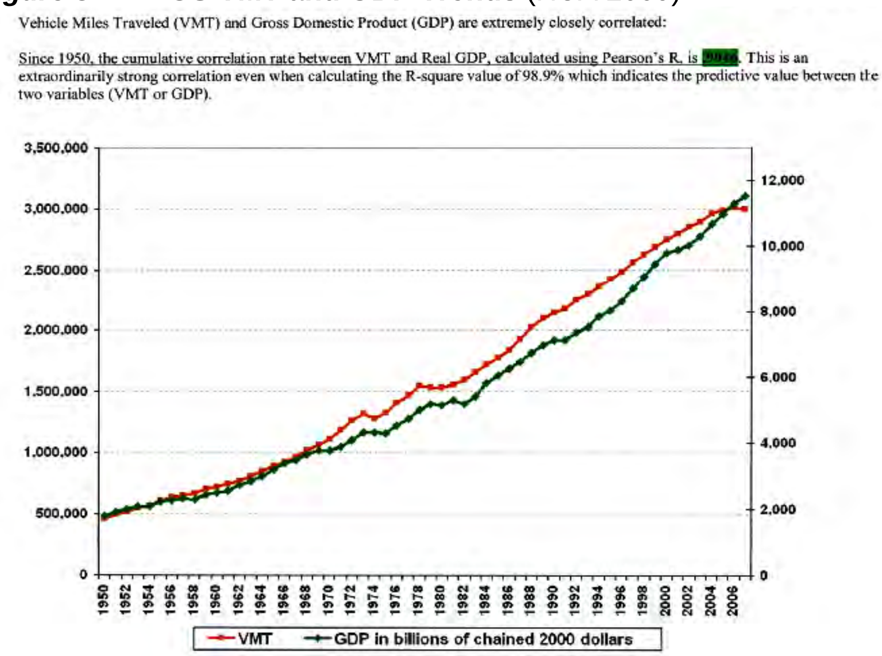
The second section examines in more detail the relationships between automobile transportation and productivity. It discusses ways that automobile transport can increase and reduce productivity, and how these impacts are perceived by different perspectives and measurement units.

The third section examines the economic productivity impacts of various *mobility management* strategies (policy and planning reforms intended to change travel behavior in order to increase transport system efficiency, also called *transportation demand management*). Many of these strategies reflect economic efficiency principles, and so tend to increase economic productivity. Described differently, many planning reforms advocated by economists to increase efficiency, such as cost-based road and parking pricing, neutral (least cost) planning and funding, and more accessible land use development, are classified as mobility management strategies by transportation professionals. These strategies tend to help support economic development.

How Vehicle Travel Affects Economic Productivity

Some people claim that there is a direct relationship between motor vehicle travel and productivity, so increased motor vehicle travel supports economic development and mobility management strategies that reduce vehicle travel are economically harmful. For example, the Highway Users Alliance (HUA 2009) claims that the graph below proves that, because VMT and GDP are correlated, efforts to reduce vehicle travel must reduce economic productivity.

Figure 8 **US VMT and GDP Trends** (HUA 2009)

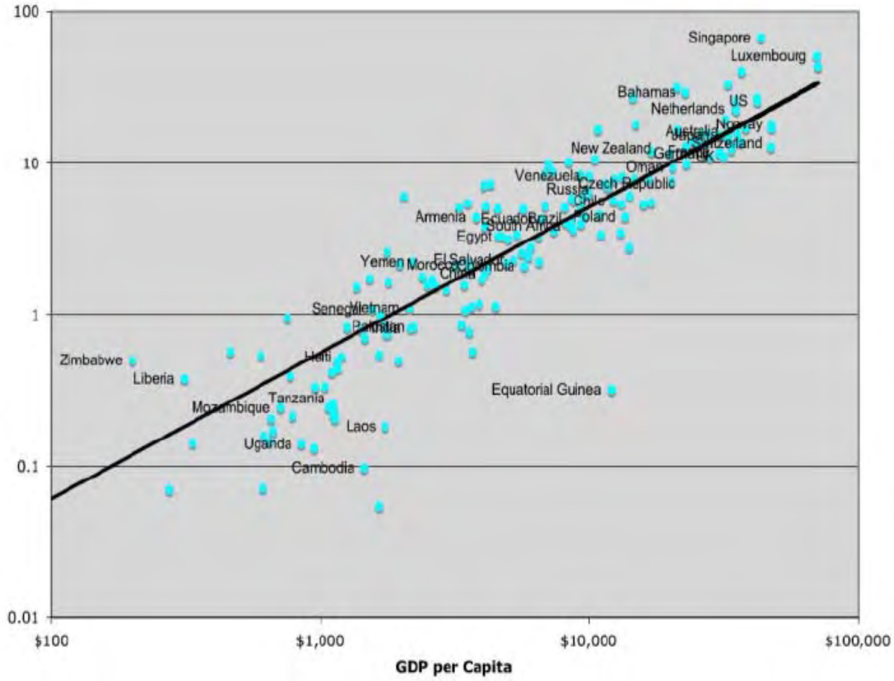


The Highway Users Alliance claims that this graph proves that a reduction in vehicle travel will reduce economic productivity, but correlation does not prove causation.

Similarly, economist Randall Pozdena claims that Figure 9, and case studies showing that oil price spikes reduce economic productivity in oil consuming countries, prove that policies which increase vehicle operating costs or reduce vehicle travel reduce economic development. He concludes that, “a one percent change in VMT/capita causes a 0.9 percent change in GDP in the short run (2 years) and a 0.46 percent in the long run (20 years).” This analysis misrepresents these issues in important ways.

The log-log format in Figure 9 exaggerates the relationships between energy and economic development. For example, although the U.S. and Norway are located close together, Norwegians actually consume about half as much fuel per capita as U.S. residents. The graph includes countries with very different levels of industrialization. An increase in per capita vehicle travel in very poor countries such as Zimbabwe and Liberia has a very different productivity impacts than in wealthy, industrialized countries. Similarly, although oil price spikes harm oil consumers, gradual and predictable fuel tax increases can be economically beneficial by encouraging energy conservation and reducing the wealth transferred to oil producers.

Figure 9 **Per Capita GDP Versus Barrels of Oil** (QuantEcon 2009)



Pozdena claims this graph proves that increased energy consumption increases economic productivity. A log-log graph such as this exaggerates such relationships.

Certainly energy use, vehicle travel and GDP tend to increase together, as figures 8 and 9 indicate, but this reflects several different factors:

1. Motor vehicle increases economic productivity when it supports productive activities such as freight and service delivery. HUA and Pozdena emphasize this factor.
2. Increased wealth tends to increase vehicle ownership and use, although at higher income levels, additional income causes smaller increases in mileage, as illustrated in Table 6.

Table 6 **Annual Per Capita Vehicle Mileage By Income Quintile** (BLS 2007)

Income Quintile:	1	2	3	4	5
Income before taxes	$6,195	$12,579	$18,485	$24,986	$49,496
Annual mileage	4,733	6,182	7,440	7,926	8,885
Mileage increase per $1,000 additional income	*764*	*227*	*213*	*75*	*39*

Increased wealth causes declining marginal mileage increases.

3. Increased wealth allows some wealthy households to choose more accessible locations, allowing them to reduce their vehicle travel.
4. Automobile-oriented transport planning and land use development increase the amount of travel needed for a given level of accessibility. This increases vehicle travel and associated expenses, but reduces true economic productivity (people must spend more to meet their needs and maintain a given level of social welfare).
5. Vehicle travel imposes external costs (congestion, accident and pollution damages, oil import costs), which may increase some economic activity (increased expenditures on vehicle repairs and medical services) although it reduces actual productivity.

Factor 1 *causes* wealth to increase, while factors 2-5 *result from* increased wealth. Factors 1 and 2 cause *positive* relationships between VMT and GDP, while factors 3, 4 and 5 cause negative relationships. Factors 4 and 5 partly reflect the increased economic activity that results if more automobile travel is required to maintain a given level of accessibility, which increases various economic costs. This increases GDP but is a misguided indicator of true economic development, since it actually reflects increased costs and harms to society.

It is therefore unsurprising that VMT and GDP correlate, since vehicle expenditures account for 10-20% of personal consumption and a significant portion of government and business consumption, so all else being equal, doubling VMT increases GDP by about 10%. However, this does not necessarily reflect true economic development that increases social welfare. For example, policies that stimulate sprawl will increase both VMT and GDP, since residents must drive more annual miles, spend more on vehicles and fuel, although consumers and society could be worse off overall. In such situations, VMT reductions can support economic development.

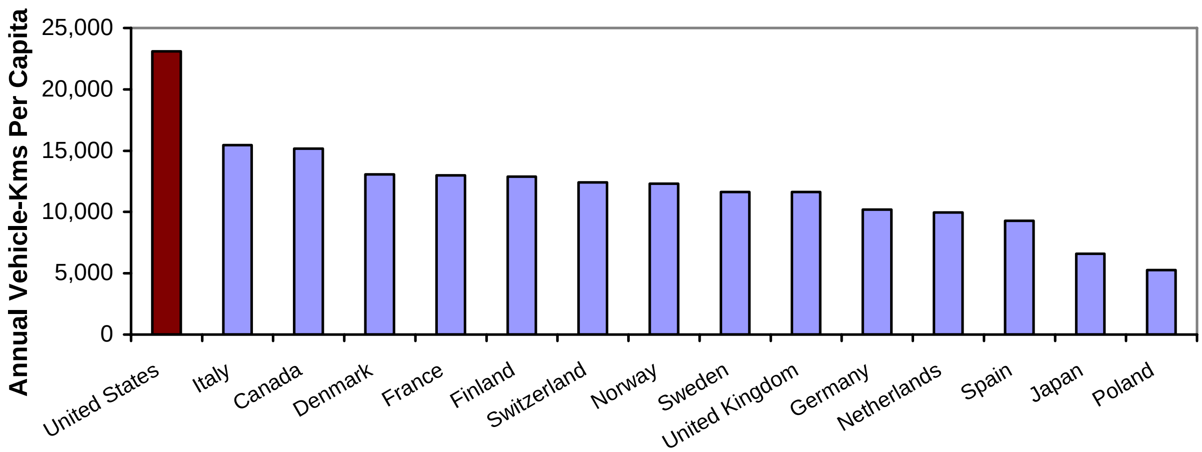
The relationship between personal vehicle travel and economic development is actually weak (Baird 2005; O'Fallon 2003). Although personal mobility tends to increase as people shift from low to medium incomes, among high income countries per capita annual passenger-kilometers vary significantly depending on transportation and land use policies. Empirical evidence suggests that a certain amount of motor vehicle travel, used for high-value trips, increases productivity and supports economic development, but beyond that level the relationship between personal vehicle travel and economic development weakens and eventually becomes negative.

Empirical evidence suggests that increasing from very low to moderate levels of mobility increases productivity since motor vehicles are used for high-value trips, but at higher levels of per capita VMT, marginal benefits decline and eventually becomes negative as external costs and inefficiencies increase. An international study found that per capita vehicle ownership peaks at about $21,000 (1997 U.S. dollars) annual income (Talukadar 1997). Similarly, a World Bank study found that beyond an optimal level (about 7,500 kilometers annual motor vehicle travel per capita, with considerable variance due to geographic and economic factors), vehicle travel marginal costs outweigh marginal benefits (Kenworthy, et al. 1997). The researchers conclude that, "*there are no obvious gains in economic efficiency from developing car dependence in cities*," and, "*There are on the other hand significant losses in external costs due to car dependence*."

Among wealthy countries there is considerable variation in per capita vehicle ownership and use. Although per capita VMT grew during most of the last century, it has saturated in most wealthy countries and the level of saturation varies. The U.S. averages more than twice the per capita vehicle travel (about 20,000 average annual vehicle-kilometers) as most other OECD countries (5,000 to 10,000 average annual vehicle kms.), and there are similar variations between U.S. cities, due in part to policies such as road, parking and fuel prices; transport investment and planning practices; and land use regulations.

Figure 10 shows the variation in vehicle travel among peer countries. Economically successful countries such as Norway and Germany have half the average VMT per capita as in the U.S.

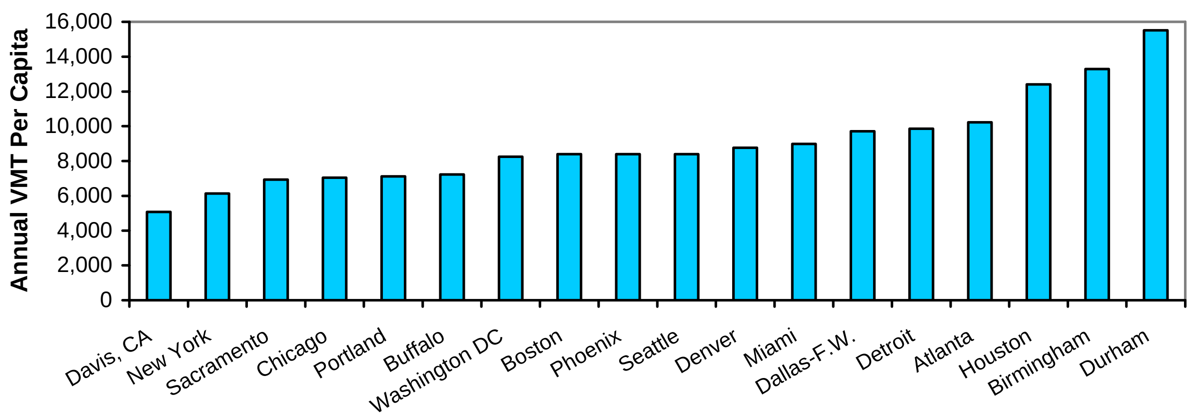
Figure 10 **Per Capita Annual Vehicle Travel By Country** (OECD 2009)



Per capita vehicle mileage is significantly higher in the U.S. than in other industrialized countries. Residents of wealthy countries such as Switzerland, Norway and Sweden drive about half as much as in the U.S. due to policies and planning practices that increase transport system efficiency.

Similarly, annual per capita vehicle mileage varies significantly among U.S. cities, from fewer than 5,000 to more than 15,000 average annual vehicle-miles per capita. These differences result, in part from transport and land use policies that affect the travel options available, travel incentives, and land use development patterns. There is no evidence that lower VMT cities, such as New York, Sacramento and Chicago are less economically successful than high VMT cities such as Atlanta, Birmingham or Durham; in fact, cities with lower per capita VMT tend to have higher per capita GDP.

Figure 11 **Per Capita Annual Vehicle Travel Selected U.S. Cities** (FHWA 2007)

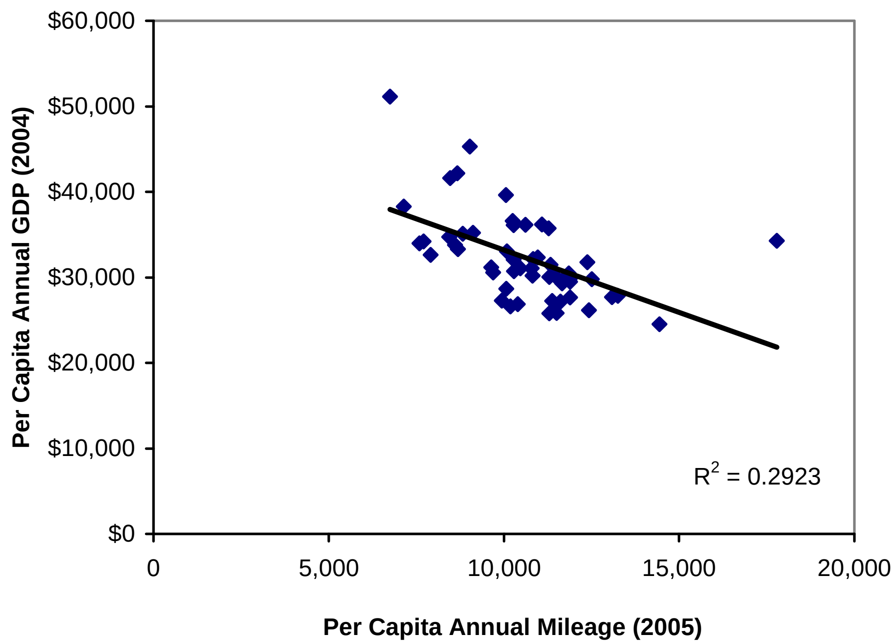


Per capita vehicle travel varies from fewer than 5,000 to more than 15,000 average annual miles among U.S. cities. This variation results, in part, from different transport and land use policies.

Although the data presented by the Highway Users Federation and Pozdena indicate a positive relationship between VMT and GDP, it includes countries at very different levels of industrialization. In undeveloped countries, increased vehicle travel tends to increase productivity, for example, if motor vehicles replace headloading, pushcarts and animal wagons for important trips such as freight and service distribution, business travel and emergency transport. During this phase it is likely that increased motor vehicle travel contributes to economic productivity. But as vehicle increases the marginal benefits decline while economic costs such as traffic congestion, infrastructure costs, accident and pollution damages increase, and land use becomes more dispersed, reducing accessibility.

Within developed countries there is a negative relationship between vehicle travel and productivity: *per capita GDP is higher in jurisdictions with lower VMT*, as illustrated in Figure 13, which indicates this relationship for U.S. states.

Figure 13 **Per Capita GDP and VMT For U.S. States** (VTPI 2009)[2]

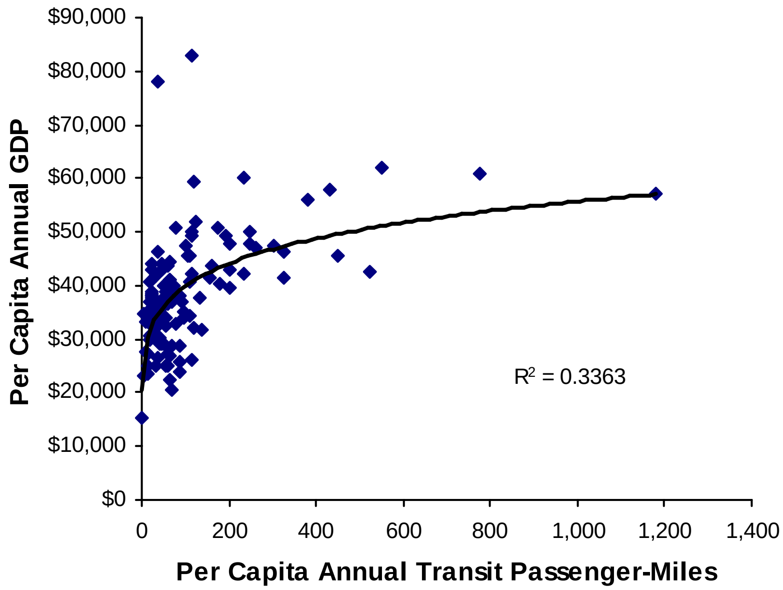


Per capita economic productivity increases as vehicle travel declines. (Each dot is a U.S. state.)

Similarly, data from U.S. metropolitan regions indicates that per capita GDP tends to increase with per capita public transit travel, as illustrated in Figure 14.

[2] Information in this and subsequent graphs is contained in the *2009 Urban Transportation Performance Spreadsheet* (www.vtpi.org/Transit2009.xls), based on data from the FHWA's *Highway Statistics* (www.fhwa.dot.gov/policyinformation/statistics/2007/hm72.cfm), the TTI's *Urban Mobility Report* (http://mobility.tamu.edu/ums/congestion_data/tables/complete_data.xls), and the Bureau of Economic Account's *Gross Domestic Product By Metropolitan Area* (www.bea.gov/regional/gdpmetro).

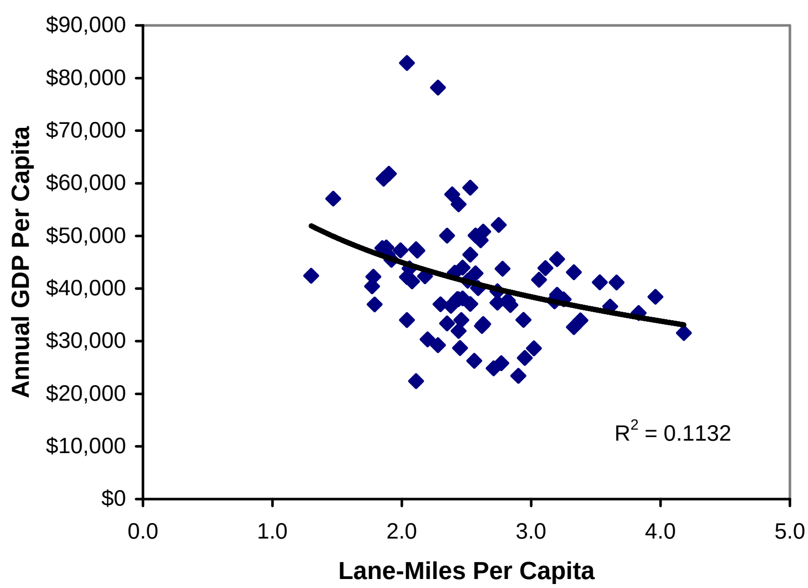
Figure 14 **Per Capita GDP and Transit Ridership** (VTPI 2009)



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

Per capita GDP tends to decline with roadway lane miles, as illustrated in Figure 15.

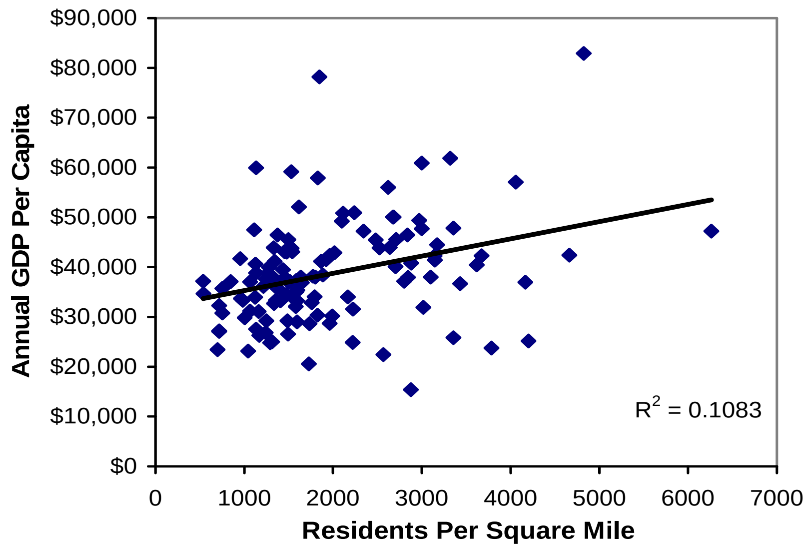
Figure 15 **Per Capita GDP and Road Lane Miles** (VTPI 2009)



Economic productivity declines with more roadway supply, an indicator of automobile-oriented transport and land use patterns. (Each dot is a U.S. urban region.)

Per capita GDP tends to increase with population density, as illustrated in Figure 16. This probably reflects the positive effects of improved land use accessibility, increased transport diversity and agglomeration efficiencies.

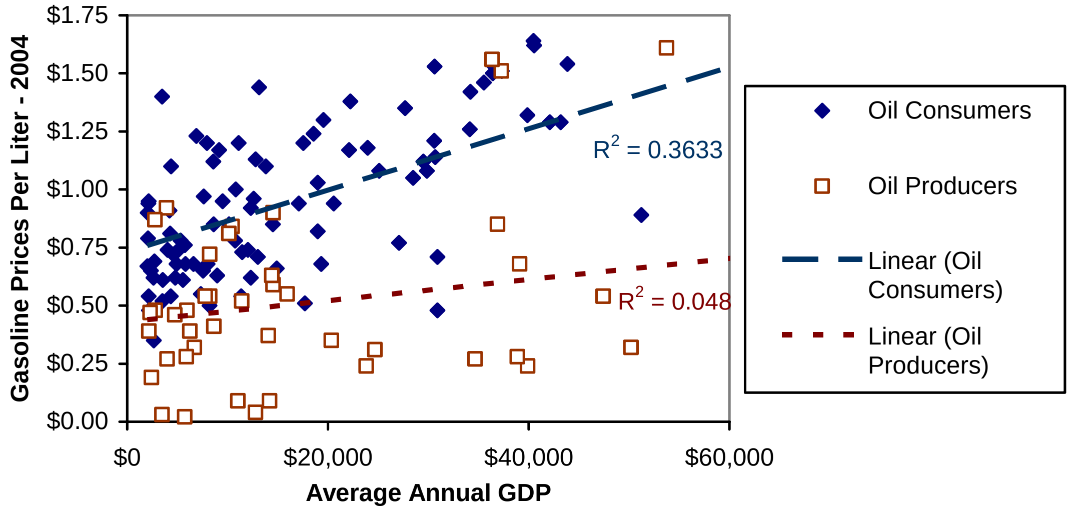
Figure 16 **Per Capita GDP and Urban Density** (BTS 2006 and BEA 2006)



Productivity tends to increase with population density. (Each dot is a U.S. urban region.)

Figure 17 shows that per capita GDP increases with fuel prices, particularly among countries that oil consuming countries (countries that produce no petroleum).

Figure 17 **GDP Versus Fuel Prices, Countries** (Metschies 2005)[3]



Economic productivity tends to increase with higher fuel prices, indicating that high vehicle fees do not reduce overall economic productivity.

[3] Fuel price (www.internationalfuelprices.com), GDP (http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita), petroleum production (http://en.wikipedia.org/wiki/Petroleum); excluding countries with average annual GDP under $2,000.

These fuel prices range from about 2¢ up to about 15¢ per vehicle-mile for typical fuel efficiencies. Since motor vehicle external costs (congestion, road and parking facility costs, accidents and pollution impacts) are typically estimated to total 10-30¢ per vehicle-mile), the higher-range fuel prices tend to increase economic efficiency by internalizing a significant portion of these costs (Litman 2009a; Vermeulen, et al. 2004). Although fuel taxes are an imperfect vehicle user fee (fees that vary by time, location and vehicle type can be more efficient), they are generally more efficient than underpriced driving.

Several factors probably contribute to this positive relationship between fuel prices and GDP. Higher fuel prices encourage more efficient transportation and fuel conservation. Doubling fuel prices typically reduces vehicle travel by 20-30% and fuel consumption by 50-70% over the long run ("Transportation Elasticities," VTPI 2008). For oil consuming nations, reduced fuel consumption reduces the economic costs of importing petroleum. For oil producing countries it leaves more product to export, increasing revenues and income. For all countries, reducing VMT reduces costs such as traffic congestion, road and parking facility costs, accident and pollution costs, helps maintain a diverse transportation system (walking, cycling and public transport), and reduces sprawl.

In a detailed study of international fuel prices, Metschies (2005) finds that many countries, particularly lower-income oil producers, have inefficiently low fuel prices. Development economists frequently find that regions with abundant natural resources, such as oil, have low rates of economic development, which they refer to as *the resource curse* or *the paradox of plenty*.[4] This results, in part, from policies such as inefficiently low fuel prices which stimulates wasteful resource use.

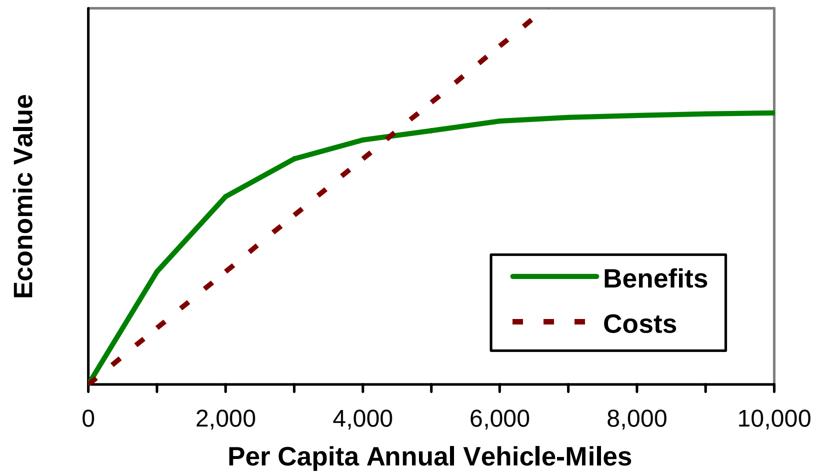
This suggests that high fuel prices (and therefore, high vehicle operating costs) do not generally constrain economic activity and competitiveness, on the contrary, they tend to increase productivity and economic development by increasing transport system efficiency and reducing the domestic wealth that must be devoted to importing fuel.

Described differently, transportation market distortions, such as underpricing of automobile travel, encourage economically inefficient vehicle travel, in which marginal costs exceed marginal benefits. More efficient pricing and planning practices encourage efficiency, and so tend to increase economic development. Two factors help explain why GDP tends to decline at high levels of VMT:

1. Marginal productivity benefits decline as a declining portion of travel is for productive uses, such as freight and service delivery, and business travel.
2. The additional VMT imposes increasing economic costs (vehicle expenses, road and parking facility costs, traffic service costs, accident and pollution damages, etc.).

[4] See http://en.wikipedia.org/wiki/Resource_curse.

Figure 18 **Vehicle Travel Economic Benefits and Costs**



As per capita vehicle travel increases, marginal economic benefits decline while costs increase linearly. As a result, beyond about 4,000 annual vehicle miles per capita overall, total costs exceed total benefits. More efficient pricing and better planning encourage consumers to rationally choose economic efficiency transportation options, increasing economic productivity.

This analysis suggests that there are three levels of per capita motor vehicle travel:

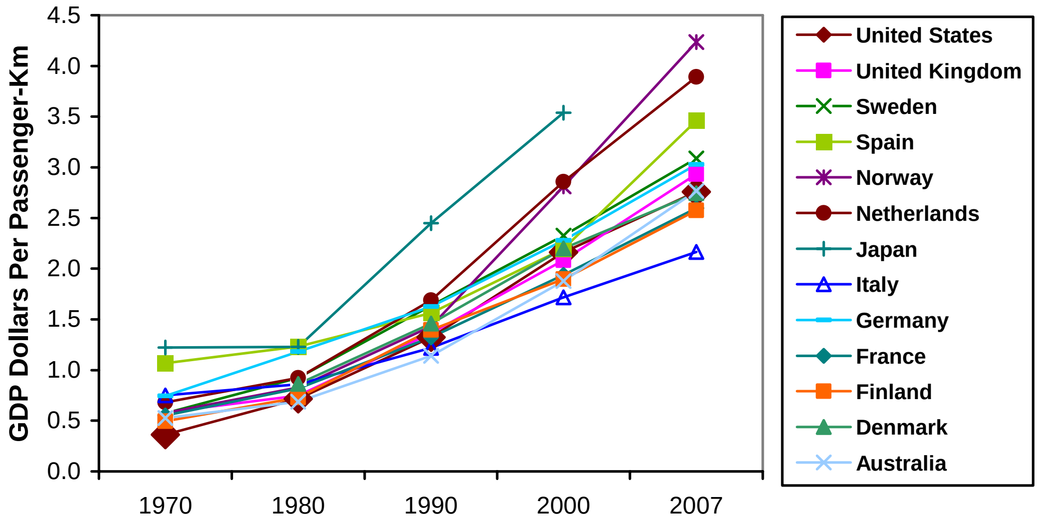
1. *Inadequate* (typically less than 2,000 annual VMT per capita). Producers (businesses) lack efficient freight and service delivery, potential workers are unable to access jobs, and consumers have difficulty accessing basic services and competitive markets.
2. *Optimal* (typically 2,000-5,000 annual VMT per capita). Freight and public transport systems are efficient, and personal vehicles are used efficiently.
3. *Excessive* (typically more than 5,000 annual VMT per capita). High levels of vehicle traffic cause traffic congestion, require large investments in roads and parking facilities, and cause high traffic accident costs. Reduced quality of alternative modes and sprawled land use increase the amount of travel required to maintain a given level of accessibility.

For individuals, optimal VMT will generally seem to be much greater than the social optimal because many costs are external. For example, lower-mileage community where most commuters use alternative modes, an individual commuter gains speed, comfort and status by driving instead. However, if most commuters shift to driving, the advantages disappear as congestion, parking problems and accident costs increase.

The data presented by HUA and Pozdena do not really prove that increased energy consumption and vehicle travel increases productivity and wealth generation in industrialized countries where basic energy and mobility needs are already satisfied. For example, although increasing annual per capita VMT from 1,000 to 2,000 in an undeveloped country can significantly increase economic productivity, it is wrong to assume that policies that reduce annual per capita VMT from 16,000 to 15,000 in a wealthy country significantly reduce VMT, although this is what Pozdena implies. Many wealthy countries have far less per capita annual vehicle travel due to policies and planning practices that increase transport system efficiency by improving travel options, efficient pricing, and more accessible and multi-modal land use development. This reduces total transportation costs and increases economic competitiveness.

Described differently, the amount of energy and vehicle travel required per unit of GDP varies widely. Virtually all developed countries are increasing energy efficiency (GDP per unit of energy) and some do far better than others, as illustrated in Figure 19. All else being equal, policies that increase transport system efficiency (both energy and economic efficiency) increase productivity and competitiveness, and this is likely to become increasingly important as international fuel prices rise. Economic growth with increased resource efficiency is sometimes called *decoupling*.

Figure 19 **GDP per Passenger-Kilometer for Various Countries** (OECD 2009)



Most countries are increasing GDP per passenger-mile, some much more than the U.S. This reflects an increase in transportation system economic efficiency.

A rigid relationship between mobility and economic productivity implies that economies are inflexible: there is only one efficient way to produce goods, and that economic development requires ever more energy and movement. A flexible relationship between mobility and economic productivity implies that economies are responsive and creative: if energy and mobility are cheap, businesses and consumer use a lot, but if prices increase or other policies encourage conservation, the economy becomes more efficient.

Automobile Transportation Productivity

The previous section indicates that beyond an optimal level, additional vehicle travel reduces productivity. The additional mobility may provide consumer benefits, such as more convenience, comfort and status for motorists, but does not increase productivity, employment or tax revenue; on the contrary, high levels of per capita vehicle travel tend to be economically harmful.

This is a controversial conclusion, particularly in automobile-dependent communities where people directly experience the productivity benefits of automobile transportation. In such areas, automobile transport is generally much faster and more cost effective than other travel modes. To individual motorists, automobile transport saves time and increases productivity, allowing people to squeeze several activities into a day (multiple jobs and meetings, evening classes, family responsibilities, and social activities) which would be impossible by alternative modes. As a result, many people are skeptical that automobile transportation reduces economic productivity.

However, the increased productivity of automobile transport is offset in various ways:

- Owning and operating a vehicle is costly. A typical motorist spends about 10 hours per week driving and another 10 hours per week working to pay vehicle expenses, and drives about 200 mile, so the average *effective speed* (distance divided by total time, including time spent traveling, devoted to vehicle maintenance, and working to pay transport expenses) is only about 10 miles-per-hour.
- The relative speed advantage of driving compared with other modes in automobile-oriented communities results, in part, from dispersed land use patterns and reductions in alternative modes which increase the distance that people must travel reach destinations and reduces the efficiency of alternatives, reducing overall accessibility.
- Automobile dependency imposes a variety of indirect costs. It forces motorists to chauffeur non-drivers, which would not be required in more multi-modal communities. Reduced walking and cycling force residents to devote special time to exercise or suffer health problems. It increases traffic congestion delays, road and parking facility costs, accident and pollution damages.

Table 7 summarizes automobile transport productivity impacts. Even people who rely entirely on driving can be more productive in an accessible, multi-modal community, which reduces the traffic congestion they face, the distances they must travel, their need to chauffeur non-driving friends and family members, and their cost burdens for roads, parking, accident risk and pollution damages (for example, business owners save money if customers and employees use alternative modes so fewer parking spaces are needed).

This evidence indicates that, although some motor vehicle travel supports economic productivity, beyond an optimal level marginal benefits tend to decline. Among developed countries, those with more efficient transport systems and more accessible land use systems tend to be more economically successful.

Table 7 **Automobile Transport Productivity Impacts**

Increases Productivity	Reduces Productivity
• Increases efficiency of business, delivery and service trips. • Expands pool of potential employees. • More employees can be available on-call. • Employee automobiles allow businesses the cost burden of maintaining fleets. • Allows more people to attend school (such as college or professional development courses) while working. • Allows retail efficiencies of regional shopping centers.	• Increases traffic and parking congestion. • Incurs costs to consumers of owning and operating vehicles. • Increases external costs, such as road and parking subsidies, crashes and pollution damages. • Stimulates sprawled (dispersed) land use patterns, which increases the mobility required to maintain a given level of accessibility. • Reduces travel options (walking, cycling, public transport tend to decline), since alternative modes tend to experience economies of scale.

Automobile transportation increases economic productivity in some ways but reduces it in others. Productivity is maximized if public policies limit automobile travel to efficient levels.

The study, *Socially Optimal Transport Prices and Markets* (Litman 2007b) investigates the amount of vehicle travel that is economically optimal. It defines efficient market principles (consumer sovereignty, cost based pricing, economic neutrality), investigates transport market distortions and reforms, estimates these reforms' travel impacts, and investigates resulting economic impacts. This analysis indicates that efficient pricing would approximately triple vehicle operating costs, mainly due to direct parking fees and distance-based insurance and registration fees, as indicated in Table 8.

Table 8 **Optimal Pricing Summary – Middle-Range Values** (Litman 2007b)

Cost Category	Per Vehicle-Mile
Vehicle congestion – delays a vehicle imposes on other vehicles	$0.010
Nonmotorized delays – delays a vehicle imposes on walkers and cyclists	$0.005
Roadway facilities – costs of building and maintaining roads	$0.030
Registration & licensing – existing fees made distance-based	$0.020
Roadway land value – rent paid for road rights-of-way land	$0.040
Traffic services – costs of services such as policing and emergency response	$0.010
Land use impact costs – external costs of sprawl	$0.010
Accidents – cost of traffic accident damages	$0.100
Air pollution – costs of vehicle air pollution	$0.040
Noise pollution – costs of vehicle air pollution	$0.005
Water pollution – costs of vehicle air pollution	$0.005
Parking facilities – costs of parking facilities used by a vehicle	$0.120
Fuel externalities – economic costs of importing and using vehicle fuel	$0.014
General Taxes – average sales taxes, if applied to vehicle fuel	$0.006
Total	$0.415

This table summarizes efficient road, parking, insurance and fuel charges averaged per vehicle-mile. This indicates that optimal pricing is about three times higher than current vehicle operating costs.

In addition, more neutral planning, which applied multi-modal analysis and least-cost principles (so alternative modes and mobility management strategies are implemented whenever cost effective), would tend to improve accessibility options (walking, cycling, ridesharing, public transit, carsharing, telework, delivery services, and more housing options in accessible locations), and support other mobility management programs.

This analysis indicates that in a more optimal market U.S. consumers would drive less, use alternative modes more, choose more accessible locations, and be better off overall as a result. Vehicle travel reductions would probably average 30-50%, depending on individual needs and preferences.

The additional automobile travel that results from market distortions is economically inefficient: it is vehicle travel that consumers would forego if they had better travel options and more efficient prices. The additional external costs that result from this travel (congestion, facility costs, accidents and pollution damages) burden the economy, reducing productivity. Transportation market reforms that correct these distortions tend to support economic development.

Mobility Management Economic Impacts

Mobility Management (also called *Transportation Demand Management* or *TDM*) refers to policies and programs that change travel behavior to increase transport system efficiency (Concas and Winters 2007; VTPI 2008). Table 9 lists various mobility management strategies. These strategies cause various types of travel changes including shifts in *mode* (from driving to walking, cycling, ridesharing, public transit, etc.), *destination* (closer rather than more distant services), *time* (from peak to off-peak), and *frequency* (consolidating trips and substituting telework for physical travel). Some increase land use *accessibility* (such as locating services closer to residential areas).

Table 9 **Mobility Management Strategies** (VTPI 2008)

Improves Transport Options	Incentives	Land Use Management	Implementation Programs
Transit improvements Walking & cycling improvements Rideshare programs HOV priority Flextime Carsharing Telework Taxi service improvements Guaranteed ride home	Congestion pricing Distance-based insurance and registration fees Commuter financial incentives Parking pricing (including cash out and unbundling) Parking regulations Fuel tax increases Transit encouragement	Smart growth policies Transit oriented development Location-efficient development Parking management Carfree planning Traffic calming Streetscaping	Commute trip reduction programs School and campus transport management Freight transport management Tourist transport management Transport planning reforms

This table lists various mobility management strategies. Many include subcategories.

Many of these strategies tend to increase economic efficiency, as indicated in Table 10. Described differently, many transport market and planning reforms that economics support are classified as mobility management strategies by transportation professionals.

Table 10 **Efficient Transportation Reforms** (Litman 2009)

Strategy	Description
Road user fees	Fuel taxes and road tolls that finance roadway construction and operating costs.
Congestion pricing	Road tolls that increase during peak periods to reduce traffic to optimal volumes.
Parking pricing	Parking fees that finance parking facilities. Also parking cash out and unbundled.
Distance-based fees	Vehicle insurance and registration fees are prorated by mileage, so a \$500 annual fee becomes 4¢ per vehicle-mile and a \$1,000 annual fee becomes 8¢ per vehicle-mile.
Energy and emission fees	Special fuel taxes and vehicle fees based on external energy and pollution costs.
Comprehensive planning	Transport planning that considers all options and impacts.
Neutral funding and pricing	Lease-cost funding so alternative modes and mobility management strategies are implemented whenever they are most cost-effective overall.

This table indicates transport policy reforms that tend to increase economic efficiency.

Critics sometime claim that mobility management consists of arbitrary and inefficient restrictions on vehicle travel, but most strategies reflect market principles and provide equity and consumer benefits, as indicated in Table 11.

Table 11 **Impacts of Mobility Management Strategies**

Strategy	Efficiency	Consumer (Users)	Equity
Incentives to Choose Efficient Modes			
Congestion pricing	Positive. Reflects efficient pricing.	Mixed. Increases motorists' costs but reduces congestion.	Mixed. Benefits some people but burdens others.
Cost-recovery road tolls	Positive. Reflects efficient pricing.	Mixed. Increases motorists' costs but provides revenues.	Positive. More equitable than most other funding.
Distance-based registration fees	Positive. Reflects efficient pricing.	Positive. Gives motorists a new way to save money.	Positive. Charges users for the costs they impose.
Cost-recovery parking fees	Positive. Reflects efficient pricing.	Mixed. Increases motorists' costs but provides revenues.	Positive. Charges users for the costs they impose.
Fuel tax increases	Positive if raised gradually and predictably.	Mixed. Increases motorist costs but provides revenues.	Positive if taxes internalize costs.
TDM marketing (information and encouragement campaigns)	Generally positive, since improved user information tends to increase efficiency.	Generally positive, although overly aggressive campaigns can be annoying.	Generally positive.
No-drive days	Generally negative.	Generally negative.	Mixed. Sometimes considered more equitable than pricing.
Improved Options			
Transit improvements	Mixed. Is cost effective on major urban corridors.	Generally positive, provided it meets consumer demands.	Generally positive. Provides basic mobility.
Walking and cycling improvements	Improvements justified to meet growing demand.	Generally very positive.	Generally positive. Provides basic mobility.
Rideshare programs	Mixed. Is cost effective on major urban corridors.	Generally positive, provided it meets consumer demands.	Generally positive.
Telework and flextime	Generally cost effective and beneficial.	Generally very positive as a user option.	Generally positive.
Carsharing	Generally cost effective and beneficial.	Generally very positive as a user option.	Generally positive.
Land use Policies			
More flexible zoning (more density, mix, housing types, etc.)	Generally reflects market principles and increases efficiency.	Mixed. Benefits some consumers but disadvantages others.	Generally achieves equity objectives
Location-efficient development.	Generally reflects market principles and reduces public service costs.	Mixed. Benefits some consumers but disadvantages others.	Generally achieves equity objectives.
Urban growth boundaries.	Mixed. Restricts development but increases public service efficiency.	Mixed. Benefits some consumers but disadvantages others.	Mixed.

This table summarizes efficiency, consumer and equity impacts of various mobility management strategies.

Mobility management strategies tend to provide a variety of economic benefits, including congestion reductions, road and parking facility cost savings, consumer savings, accident reductions, improved mobility options for non-drivers, energy conservation, emission reductions and more accessible land use development. Conventional analysis tends to overlook many of these benefits and so tends to undervalue mobility management relative to strategies such as highway widening to reduce congestion and shifts to more efficient vehicles to conserve energy and reduce pollution emissions.

Table 12 **Comparing Strategies** (Litman 2005)

Planning Objective	Roadway Expansion	Fuel Efficient Vehicles	Mobility Management
Motor Vehicle Travel Impacts		*Increased*	*Reduced*
Congestion reduction	✓		✓
Road and parking cost savings			✓
Consumer cost savings			✓
Reduced traffic accidents			✓
Improved mobility options			✓
Energy conservation		✓	✓
Pollution reduction		✓	✓
Physical fitness & health			✓
Land use objectives			✓

Because Win-Win Solutions improve travel options, encourage use of alternative modes, and reduce total vehicle travel, they support many planning objectives. Increasing vehicle fuel efficiency and roadway expansion provide fewer benefits. Those strategies tend to increase total vehicle travel and so can exacerbate problems such as congestion, accidents and sprawl.

Mobility management tends to be most effective if implemented as an integrated program. For example, public transit improvements alone might reduce VMT by 5%, and parking cash out alone may reduce automobile travel 5%, but implemented together they reduce automobile travel 15% by giving travelers better options and incentives to use alternative modes when possible. Market reforms both support and are supported by investments in alternative modes. For example, road and parking pricing tend to be more effective at reducing traffic congestion if implemented with improvements in alternative modes so travelers can more easily reduce their peak-period vehicle trips.

Critics sometimes argue that increasing fuel prices is economically harmful because it increases business costs, but this is not necessarily true. High wholesale fuel prices are economically harmful, particularly in petroleum importing regions because wealth leaves the economy, but high fuel taxes tend to be economically beneficial by encouraging fuel efficiency which reduces petroleum import costs and retains more wealth within the regional economy (Clarke and Prentice 2009). For example, although Norway produces petroleum it maintains high fuel prices and has other strategies to encourage energy conservation, including support for alternative transport modes, which reduces domestic consumption, leaving more oil to export. As a result, Norway has one of the world's highest incomes, a competitive and expanding economy, a positive trade balance, and the world's largest legacy fund, , as indicated in Figure 20. Other oil producers, such as

Russia, Venezuela and Saudi Arabia, minimize fuel prices and so are less economically successful because their policies encourage inefficiency and so reduce national income.

Figure 20 **Trade Statistics** (*Economist Magazine,* 18 June 2009)

Trade, exchange rates, budget balances and interest rates

	Trade balance* latest 12 months, $bn	Current-account balance latest 12 months, $bn	Current-account balance % of GDP 2009†	Currency units, per $ Jun 17th	Currency units, per $ year ago	Budget balance % of GDP 2009†	Interest rates, % 3-month latest	Interest rates, % 10-year gov't bonds, latest
United States	−711.0 Apr	−628.3 Q1	−3.2	–	–	−13.2	0.36	3.64
Japan	+6.0 Apr	+111.1 Apr	+1.7	95.7	108	−6.8	0.44	1.46
China	+293.9 May	+426.1 Q4	+7.4	6.84	6.88	−3.8	1.23	3.36
Britain	−150.6 Apr	−44.6 Q4	−1.6	0.61	0.51	−13.8	1.20	3.78
Canada	+28.0 Apr	−3.9 Q1	−1.9	1.14	1.02	−2.3	0.23	3.52
Euro area	−54.7 Apr	−145.2 Mar	−1.0	0.72	0.64	−5.8	1.26	3.53
Austria	−4.2 Mar	+15.0 Q4	+1.7	0.72	0.64	−4.6	1.25	4.28
Belgium	+5.0 Feb	−12.1 Dec	−1.8	0.72	0.64	−4.8	1.27	4.07
France	−78.6 Apr	−63.5 Apr	−2.2	0.72	0.64	−6.6	1.25	3.83
Germany	+205.8 Apr	+178.3 Apr	+4.4	0.72	0.64	−4.6	1.25	3.48
Greece	−58.8 Mar	−46.7 Mar	−8.8	0.72	0.64	−6.0	1.25	5.25
Italy	−13.7 Apr	−70.6 Mar	−2.6	0.72	0.64	−5.2	1.25	4.58
Netherlands	+44.8 Apr	+65.3 Q4	+5.9	0.72	0.64	−4.1	1.25	3.91
Spain	−117.2 Mar	−135.9 Mar	−7.5	0.72	0.64	−9.6	1.25	4.21
Czech Republic	+4.1 Apr	−6.3 Apr	−2.0	19.2	15.5	−4.0	2.14	5.73
Denmark	+7.0 Mar	+7.5 Apr	+1.0	5.37	4.81	−2.5	2.40	3.94
Hungary	+0.6 Apr	−13.0 Q4	−2.9	203	157	−3.9	9.65	10.16
Norway	+65.1 May	+79.6 Q1	+12.5	6.43	5.18	7.2	2.15	4.25
Poland	−18.2 Apr	−19.3 Apr	−5.7	3.26	2.18	−4.0	4.62	6.35
Russia	+142.3 Apr	+75.4 Q1	−0.6	31.3	23.6	−8.4	11.50	10.57
Sweden	+13.1 Apr	+31.4 Q1	+7.3	7.92	6.05	−4.7	0.35	3.50
Switzerland	+18.0 Apr	+53.3 Q4	+7.6	1.09	1.04	−3.1	0.40	2.36
Turkey	−54.2 Apr	−26.7 Apr	−0.7	1.57	1.23	−5.6	10.91	6.65‡
Australia	+6.1 Apr	−29.8 Q1	−4.7	1.27	1.06	−4.2	3.26	5.48
Hong Kong	−23.8 Apr	+30.5 Q4	+7.7	7.75	7.81	−4.1	0.33	2.64
India	−104.9 Apr	−37.5 Q4	−3.0	48.1	42.9	−7.7	3.35	7.34
Indonesia	+10.4 Apr	−0.8 Q1	+0.5	10,215	9,285	−3.2	7.61	7.65‡
Malaysia	+41.7 Apr	+39.1 Q4	+12.3	3.53	3.26	−7.8	2.09	2.92‡
Pakistan	−17.0 May	−15.3 Q4	−1.2	81.0	67.0	−5.6	13.00	15.11‡
Singapore	+17.1 Apr	+23.1 Q1	+17.2	1.46	1.37	−4.1	0.48	2.47
South Korea	+7.5 May	+13.2 Apr	+2.9	1,260	1,029	−5.7	2.41	5.24
Taiwan	+12.3 May	+29.2 Q1	+9.6	32.9	30.3	−5.0	0.85	1.44
Thailand	+9.9 Apr	+7.9 Apr	+5.3	34.2	33.3	−4.7	1.35	3.39
Argentina	+14.4 Apr	+7.6 Q4	+2.0	3.77	3.02	−1.2	14.63	na
Brazil	+25.6 May	−19.8 Apr	−1.3	2.00	1.62	−2.0	9.16	6.16‡
Chile	+4.0 May	−4.3 Q1	−1.4	550	492	−3.3	1.32	3.02‡
Colombia	+0.1 Mar	−6.8 Q4	−3.9	2,084	1,651	−3.4	5.46	6.27‡
Mexico	−16.2 Apr	−14.2 Q1	−3.5	13.5	10.3	−5.3	5.01	8.19
Venezuela	+32.5 Q1	+26.2 Q1	nil	6.57	3.43§	−7.8	15.98	6.55‡
Egypt	−26.8 Q4	−1.3 Q4	−0.8	5.60	5.34	−7.0	10.29	3.21‡
Israel	−10.2 May	+4.1 Q1	+2.0	3.96	3.36	−5.8	0.37	4.27
Saudi Arabia	+197.4 2008	+124.0 2008	−8.4	3.75	3.75	−9.0	0.65	na
South Africa	−6.2 Apr	−21.0 Q4	−5.6	8.14	8.06	−4.0	7.38	8.80

Norway has accumulated huge wealth and a positive trade balance by maintaining high fuel taxes.

Evaluating Specific Economic Development Impacts

This section discusses specific ways transport planning decisions affect economic development.

Transportation Program Expenditures

Transportation policies and planning decisions affect the employment and business activity generated by project and program expenditures, such as the jobs and contractor profits from road project and public transit services. Some tend to create more or higher-paying jobs than others. These impacts can be quantified using *Input-Output Tables* (REMI 2005; Lindall and Olson 2005; BEA 2008), which are computer models that track how dollars flow through a regional or national economy.

Care is needed when interpreting this information since the data are aggregated and averaged and do not necessarily reflect a specific program or project. Actual economic impacts can vary significantly depending on the type of project and the geographic scale of analysis (local, regional or national). Because input-output modeling is costly to perform it is common to extrapolate available data to a particular situation. For example, the U.S. Federal Highway Administration estimates that, on average, each $1 billion of Federal highway spending supported 30,000 jobs in 2007 (FHWA 2008). This number has been widely applied, though recent analysis by Heintz, Pollin and Garrett-Peltier (2009) and EDRG (2009) suggest that actual impacts are somewhat lower.

In addition, such models often include some inaccurate or outdated assumptions. For example, the IMPLAN Model apparently assumes that all service station jobs result from fuel sales, although most sell other goods and fuel is a relatively unprofitable product (Chmelynski 2008). As a result, the number of regional and national jobs created per million dollars of fuel expenditures is probably far lower than this model indicates.

Input-output tables are generally static and backward looking in terms for factors such as domestic inputs and productivity, and so will exaggerate future job creation by industries such as petroleum and automobile production, which are increasingly automated and dependent on imported imports (such as domestic vehicles assembled with imported engines and electric systems. These models often assume the economy has excess capacity so public projects do not compete with other industries, that without government expenditures labor and equipment would be unused, which is often untrue. Without government projects contractors might accept lower-profit but productive projects.

Table 13 is an example of input-output table results, in this case for Washington State, showing various industries' direct regional economic impacts ranked from highest to lowest direct employment generation. Overall, construction expenditures rank about average, creating approximately 16 state jobs per million dollars spent, which is better than some industries but less than labor-intensive services such as nursing care (36.43), arts and recreation (30.87) and education (27.13). If economic stimulation is the only objective, more labor-intensive industries such as medical services, education and public transit operation are better investments. Transport facility investments are only justified if they support other strategic objectives.

Table 13 **Washington State Input-Output Multipliers** (OFM 2008)

Industry	Total Jobs Per $million Final Demand	Total Employment Per Direct Job	Total Output Per $ Final Demand	Total Labor Income Per $ Final Demand
Animal Production	37.19	1.593	2.41	0.77
Nursing and Residential Care	36.43	1.461	2.21	0.95
Administrative Support	33.11	1.534	2.17	0.98
Food and Drinking Services	32.12	1.451	2.13	0.71
Arts and Recreation	30.87	1.479	2.01	0.75
Educational Services	27.13	1.550	2.07	0.71
Legal /Accounting services	24.37	1.995	2.24	1.07
Other Transport/Postal Offices	23.04	2.031	2.26	0.94
Architectural and Engineering	22.96	2.234	2.26	1.10
Ambulatory Health Care	22.88	2.012	2.16	0.99
Crop Production	22.74	2.033	2.30	0.64
Waste Management	21.99	1.773	2.04	0.65
Retail	21.92	1.623	1.89	0.66
Truck Transportation	21.57	2.165	2.20	0.83
Transport/Warehousing/Storage	21.49	2.341	2.24	0.95
Hospitals	20.38	2.108	2.11	0.86
Ship and Boat Building	19.97	2.428	2.20	1.06
Mining	19.37	2.320	2.23	0.80
Furniture	18.90	2.005	2.05	0.68
Printing	18.22	2.061	2.02	0.73
Fishing, Hunting, and Trapping	17.99	2.085	2.05	0.78
Textiles and Apparel	17.53	1.782	1.82	0.60
Forestry and Logging	17.30	1.845	1.82	0.37
Construction	*15.95*	*2.344*	*1.97*	*0.64*
Fabricated Metals	15.01	2.101	1.85	0.61
Other Information	14.96	3.359	2.17	0.68
Wood Product Manufacturing	14.78	3.052	2.16	0.54
Real Estate, Rental and Leasing	14.65	1.765	1.70	0.43
Other Finance and Insurance	14.43	2.918	2.10	0.69
Other Manufacturing	14.28	2.034	1.81	0.57
Food, Beverage and Tobacco	14.18	4.001	2.17	0.51
Machinery Manufacturing	13.86	2.229	1.83	0.61
Wholesale	13.76	2.298	1.80	0.62
Nonmetallic Mineral Products	12.56	2.555	1.88	0.52
Primary Metals	12.34	2.782	1.90	0.57
Credit Intermediation	12.34	2.735	1.93	0.51
Computer and Electronics	11.42	2.762	1.79	0.58
Other Utilities	11.05	2.193	1.64	0.47
Internet Service Providers	10.76	5.887	1.89	0.67
Telecommunications	10.71	4.006	2.00	0.50
Water Transportation	10.60	3.682	1.80	0.48
Paper Manufacturing	10.54	4.053	1.99	0.51
Electrical Equipment	10.50	2.436	1.69	0.48
Other Transportation	9.93	3.727	1.82	0.45
Air Transportation	9.60	2.811	1.72	0.44
Chemical Manufacturing	7.96	6.408	1.78	0.50
Electric Utilities	5.84	4.221	1.73	0.30
Aircraft and Parts	5.63	2.814	1.38	0.32
Gas Utilities	5.57	5.382	1.48	0.26
Petroleum and Coal Products	3.23	9.555	1.35	0.15

This table indicates various industries' regional economic impacts. Construction rates average.

Table 14 indicates the national economic impacts of highway expenditure. These have declined during the last decade due to improved labor productivity and increased imports of inputs such as fuel, aggregate and steel. These are upper-bound estimates because they assume resources would otherwise be unused, actual impacts are generally smaller.

Table 14 **Million Dollar Highway Expenditure Impacts** (FHWA 2008)

	1997	2005	2007
Construction Oriented Employment Income	$589,363	$428,842	$394,814
Construction Oriented Employment Person-Years	15.6	10.0	9.5
Supporting Industries Employment Income	$222,577	$192,752	$175,068
Supporting Industries Employment Person-years	5.5	4.5	4.3
Induced Employment Income	$545,182,399	$548,154,399	$492,090,698
Induced Employment Person-years	17.0	14.7	14
Total Employment Income	$1,357,125	$1,169,751	$1,061,973
Total Person-years	*37.9*	*29.2*	*27.8*

This table indicates total estimated economic impacts from a million dollar highway expenditure.

Public transit investments tend to create relatively large numbers of jobs (GJF 2006). A billion dollars spent on transit operation typically creates about 41,000 jobs, and spent on transit capital projects about 24,000 jobs, or 36,108 averaged overall (EDRG 2009). This is about 9% higher than road maintenance, nearly 19% higher than new roadway projects (STPP 2004), and 17% more than average for federal spending overall (EDRG 2009). Transit vehicle purchases tend to have smaller economic impacts because they are mostly imported but this could change if domestic transit vehicle production improves.

Table 15 summarizes employment generation of various infrastructure investments. Transportation maintenance and repair projects are generally faster to implement (minimal delay for planning or land assembly), create more jobs per dollar (little money is required for land acquisition or expensive equipment), employ more local workers (fewer tasks require specialized labor), and are more geographically distributed than large highway capacity expansion projects (Troth 2009).

Table 15 **Employment Impacts Per Billion Dollar Infrastructure Expenditure** (Heintz, Pollin and Garrett-Peltier 2009, Tables 3.1 and 3.7)

Category	Direct and Indirect	Plus Induced	Domestic Content
Energy	11,705	16,763	89.4%
Transportation	13,829	18,930	96.8%
Average Roads and Bridges	13,714	18,894	96.8%
New Construction	12,638	17,472	96.7%
Repair Work	14,790	20,317	96.9%
Rail	9,932	14,747	96.9%
Mass Transit	17,784	22,849	96.7%
Aviation	14,002	19,266	96.9%
Inland Waterways / Levees	17,416	23,784	97.3%
School Buildings	14,029	19,262	96.9%
Water	14,342	19,769	96.9%

This table indicates the employment effects of various infrastructure investments.

Consumer Expenditures

Just as transportation program expenditures have economic impacts, so do consumer expenditures. Some transport activities generate more regional jobs and business activity per capita than others. Transportation policy and planning decisions affect how and how much people travel, and therefore household expenditures on vehicles, fuel and public transportation services, which can have significant economic impacts.

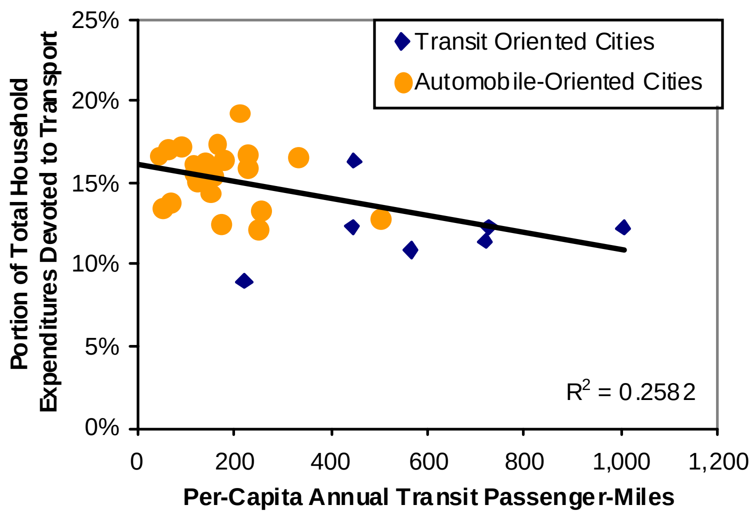
Table 16 **2007 Transportation Expenditures By Income** (BLS 2008)

Transport Expenditures	Overall	First	Second	Third	Fourth	Fifth
Average annual expenditures	$49,638	$20,471	$31,150	$42,447	$57,285	$96,752
Vehicle purchase and rentals	$3,722	$1,210	$2,162	$2,936	$5,014	$7,280
Vehicle finance charges	$305	$73	$164	$297	$442	$550
Gasoline and motor oil	$2,384	$1,046	$1,768	$2,418	$2,988	$3,696
Maintenance and repairs	$738	$271	$499	$693	$920	$1,304
Vehicle insurance	$1,071	$471	$882	$1,220	$1,189	$1,594
Other vehicle expenses	$2,592	$950	$1,762	$2,544	$3,105	$4,596
Total vehicle expenses	*$10,812*	*$4,021*	*$7,237*	*$10,108*	*$13,658*	*$19,020*
Public transport (transit, rail, air)	$538	$171	$242	$362	$506	$1,406
Total transportation	*$11,350*	*$4,192*	*$7,479*	*$10,470*	*$14,164*	*$20,426*
Transportation portion of total	*22.9%*	*20.5%*	*24.0%*	*24.7%*	*24.7%*	*21.1%*

Households spend approximately $10,000 on average in total vehicle expenditures, $2,000 of that for fuel.

Average U.S. households devote 14.3-19.3% of their budgets to transport (Table 16), and more including indirect costs such as residential parking and taxes spent on roads. This portion tends to increase with per capita automobile use. For example, residents of automobile-oriented cities spend an average of $3,332 (16% of total budgets) annually per capita on transport, compared with $2,808 (12.5% of budgets) in transit-oriented community, providing about $500 in direct annual savings per resident (Figure 21).

Figure 21 **Percent Transport Expenditures** (Litman 2004a)



The portion of total household budgets devoted to transport (automobiles and transit) tends to decline with transit ridership and is lower on average in transit oriented cities.

International studies show similar results (Newman and Kenworthy 1999, pp. 111-117). These studies reflect regional-scale analysis and so understate differences at a smaller geographic scale, such as between automobile-oriented and transit-oriented neighborhoods. McCann (2000) found that households in automobile-dependent communities spend more than $8,500 annually on transportation compared with less than $5,500 annually in multi-modal, smart growth communities, providing more than $1,000 annual savings per capita. Investments in alternative modes and smart growth policies reduced Portland, Oregon per capita vehicle travel about 20% compared with cities that expanded highways, providing consumer and business savings (Cortright 2007).

These savings tend to provide significant economic development benefits (Goldstein 2007). Table 17 summarizes IMPLAN input-output model analysis (Lindall and Olson 2005). One million dollars of fuel expenditures shifted to a typical bundle of consumer goods adds 4.5 jobs to the U.S. economy (17.3-12.8), and each million shifted from general vehicle expenditures (vehicles, servicing, insurance, etc.) adds about 3.6 jobs (17.3-13.7). Expenditures on public transit create a particularly large number of jobs. These impacts are likely to increase in the future as oil prices rise (Litman 2009b).

Table 17 **Economic Impacts per $1 Million Expenditures** (Chmelynski 2008)

Expense category	Value Added	Employment	Compensation
	2006 Dollars	FTEs*	2006 Dollars
Auto fuel	$1,139,110	12.8	$516,438
Other vehicle expenses	$1,088,845	13.7	$600,082
Household bundles			
Including auto expenses	$1,278,440	17.0	$625,533
Redistributed auto expenses	$1,292,362	17.3	$627,465
Public transit	$1,815,823	31.3	$1,591,993

(FTE = Full-Time Equivalent employees) A million dollars shifted from fuel expenditures to a typical consumer bundle of goods adds 4.5 jobs to the U.S. economy, and each million shifted from general motor vehicle expenditures adds about 3.6 jobs.*

Impacts are usually much greater when analyzed at a local or regional level. Table 18 breaks down fuel prices into its components. Modern gas stations are very efficient so only a small portion of fuel expenditures stay in local economies as wages and rents. Dollars spent on taxes, distribution and marketing, and refining tend to leave the region but stay in the national economy. Crude oil is largely imported. As a result, fuel expenditure provide little regional employment or business activity.

Table 18 **Gasoline Cost Components** (EIA 2008)

Component	Percent	Avg. Household Annual	Location
Taxes	13%	$262	All domestic
Distribution and marketing	25%	$503	Mostly domestic
Refining	3%	$60	Mostly domestic
Crude oil	59%	$1,188	Mostly imported
Totals	*100%*	*$2,013*	

Most of the money spent on vehicle fuel leaves the regional and national economies. As a result, purchasing fuel generates fewer local jobs and less economic activity than most goods.

Table 19 shows the regional economic activity and employment generated by expenditures on automobile use, transit use, and general consumer expenditures in Texas. Each 1% of regional travel shifted from automobile to public transit increases regional income about $2.9 million (5¢ per mile shifted), resulting in 226 additional regional jobs.

Table 19 **$1 Million Economic Impacts in Texas** (Miller, Robison and Lahr 1999)

Expenditure Category	Regional Income	Regional Jobs
Automobile Expenditures	$307,000	8.4
Non-automotive Consumer Expenditures	$526,000	17.0
Transit Expenditures	$1,200,000	62.2

This table shows economic impacts of consumer expenditures in Texas.

Petroleum imports are economically harmful (ASTRA 2000; "Resource Externalities," Litman 2008a). A US Department of Energy study estimated that dependence on imported petroleum cost the U.S. economy $150-$250 billion in 2005, when oil averaged $35-$45/bbl, so these costs probably increased significantly since (Greene and Ahmad 2005). Another study estimates the external costs of imported oil (described as "a measure of the quantifiable per-barrel economic costs that the U.S. could avoid by a small-to-moderate reduction in oil imports" but excluding military intervention costs) to be $13.60 per barrel, with a range of $6.70 to $23.25 (Leiby 2007). Including even a small portion of military expenses significantly increases these cost estimates. This indicates that policies which reduce vehicle and fuel consumption tend to increase employment and business activity, particularly in petroleum importing regions.

These impacts are particularly high in regions that import large amounts of petroleum and are likely to increase in the future as international oil prices rise. Although exact impacts are uncertain and impossible to predict with precision, between 2010 and 2020 a million dollars shifted from fuel to general consumer expenditures is likely to generate at least six jobs and after 2020 at least eight jobs in the U.S. overall, and much more at the regional level. As a result, current planning decisions can support future economic development by reducing automobile dependency and increasing fuel efficiency. For example, transport policies and investments that halve U.S. per capita fuel consumption would save consumers $300-500 billion annual dollars, provide comparable indirect economic benefits, and generate 3 to 5 million domestic jobs (Litman 2009b). Even large economic development benefits are likely to result from fuel conservation strategies in countries that rely even more on imported oil.

Transportation Project Cost Efficiency

Transportation infrastructure (paths, roads, parking facilities, railroads, ports, etc.) are costly assets, often among the largest investments made by many jurisdictions. Various methods can be used to calculate the economic value of such investments, including life-cycle costs and benefits; net present value; rate of return; benefit/cost ratio; and payback period (Litman 2001; Cambridge Systematics 2009).

Project evaluation models, such as MicroBenCost are used to evaluate the net economic value of specific transportation projects and programs (CalTrans 2006; Economic Development Research Group). These typically compare construction costs and any future operating subsidies with benefits such as travel time savings, fuel cost savings and crash reductions. Such models can indicate whether a particular project is cost effective (benefits exceed costs), evaluate different project options (different sizes, routes, and designs), and compare the cost-effectiveness of different approaches (such as highway expansion, public transit service improvements, and road pricing options for reducing traffic congestion on a particular roadway). The option with the greatest net benefits or benefit/cost ratio is considered most economically productive and therefore contributes most to economic development.

However, most of these models were originally developed to evaluate various highway improvement options, and so assume that factors such as vehicle ownership and total VMT are constant for each option. They are unsuited to comparing investments in alternative modes or mobility management strategies because they overlook significant economic impacts such as vehicle ownership costs, parking costs, and the additional accidents and emissions caused by highway expansion that would be avoided by alternative options. More comprehensive analysis can provide more accurate information about economic productivity (Litman 2008a).

Even small biases in transportation project evaluation can have large long-term economic effects. For example, if transport policy favors highway investments over alternative modes or mobility management (perhaps because some benefits of multi-modal transport system are overlooked or dedicated highway funding), a few million dollars spent on a highway improvement can leverage tens of millions of dollars on downstream roadway expenditures, which leverages hundreds of millions of dollars of development, which stimulates billions of additional consumer expenditures on vehicles and fuel over the projects' lifetime, costs that could have been shifted had more comprehensive analysis or more flexible funding been applied during the planning process.

Better evaluation tools are available ("Model Improvements," VTPI 2008). For example, the U.K. *Transport Analysis Guidance* (DfT 2006) provides guidance on:

- Modeling travel demand by various modes.
- Predicting the effects of public transit system changes on road traffic congestion.
- Comprehensive analysis of transport costs and benefits under various conditions.

Transport System Efficiency

As described earlier, overall transportation system efficiency (the ratio of benefits to costs) tends to increase if the system reflects market principles, which include consumer options, efficient pricing and neutral public policies. In general, an efficient transportation system reflects the following features:

- Well designed and maintained transportation facilities. This includes a network of roadways that accommodate walking, cycling, automobile and truck travel and public transit; a network of walking and cycling facilities; and an efficient network of railroads, ports and airports. These facilities should be efficiently sized. Not every community needs a major port or airport; excess capacity is costly to maintain and can dissipate demand so no facility operates efficiently.
- A multi-modal transportation transport system which offers travelers a diverse range of options, which typically includes walking, cycling, public transit, automobile, taxi services, and delivery services. Although the combination of options that are optimal vary from one area to another depending on demographic and geographic factors, in general, the more options available the easier it is for users to choose the most efficient options for each trip.
- Efficient pricing, including cost-based pricing of roads, parking, insurance and fuel.
- Pricing and policies that favors higher value trips over lower-value trips, and more efficient modes (such as those that require less road space per passenger-mile under congested conditions) over less efficient modes, including special traffic lanes and parking facilities for freight vehicles and High Occupancy Vehicles (HOVs) where sufficient demand exists.

Transportation improvements are generally incremental: a particular project is being considered to address a particular problem, such as a new or significantly improved roadway to improve access to a particular area, or an expanded roadway to reduce traffic congestion. However, individual projects can have many indirect and long-term impacts, so it is important that individual decisions support strategic planning objectives. For example, if improving transportation system diversity is a strategic objective, it may be efficient to invest in alternative modes (walking and cycling facilities, public transit service improvements) even if some individual projects would not be cost effective if evaluated alone.

In general, basic roadway improvements, such as paving a gravel road or increasing the load capacity of a bridge, support economic development by reducing transportation costs, provided that increased development in that area that is served is desirable. However, roadway expansion can have undesirable economic impacts: it can create barriers to walking and cycling, and stimulate additional automobile use and sprawl which reduces transportation system efficiency. Expanding existing roadways to reduce traffic congestion is not optimal if a combination of improvements to alternative modes, more efficient pricing, or other incentives to reduce peak-period vehicle travel can reduce congestion at a lower total cost.

To the degree that peak-period automobile travel is underpriced (and in most cases it is to a significant degree), expanding highways can have negative overall economic impacts because incremental costs resulting from in induced travel (downstream congestion, parking facility costs, accident damages, increased sprawl and associated costs, increased energy imports and pollution emissions) can exceed incremental congestion reduction benefits.

Transport system efficiency can be evaluated by considering the degree to which existing policies and planning practices reflect efficiency principles:

- Are all transportation options for which there is suitable demand being provided. For example, is there adequate support for walking, cycling, public transit, taxi, telework and delivery services.
- What portion of total transportation costs, including user costs such as insurance, and external costs such as congestion, road and parking facility costs, accident and pollution risk imposed on others.
- Are trips with high economic values (freight and service delivery vehicles, and business travel) given priority over lower value trips?
- Are space efficient modes (buses, vanpools and carpools) given priority under congested conditions?
- Are policies reviewed to minimize unintended biases favoring inefficient modes?
- What portion of vehicle travel would decline if transportation planning were more comprehensive and neutral, and transportation pricing were more efficient?

Roadway Improvements

Transportation infrastructure investments, particularly roadway improvements, are often justified to support economic development. Appropriate infrastructure investments do increase productivity. Bhatta and Drennan (2003) estimate the elasticity of production costs as a function of transportation infrastructure investments ranges from -0.05 to -0.21, meaning that a 1% increase in transportation infrastructure investments increases economic productivity 0.05% to 0.21%.

Roadways contribute significantly to economic productivity. Building the first highway to a region tends to significantly increase local economic productivity, but once a basic paved road system exists, expanding it provides declining marginal benefit (SACTRA 1999; Kopp 2006). Since traffic congestion imposes economic costs, highway expansion (more traffic lanes) is sometime promoted to increase productivity (Hartgen and Fields 2006; ATA 2008), but alternative congestion reduction strategies tend to be more cost effective and efficient overall (Hodge, Weisbrod and Hart 2003; Utt 2004; Litman 2007a). A significant portion of the perceived economic benefits of incremental highway improvements are economic transfers (some businesses and property owners gain at others' expense) rather than net increases in productivity (SACTRA 1999).

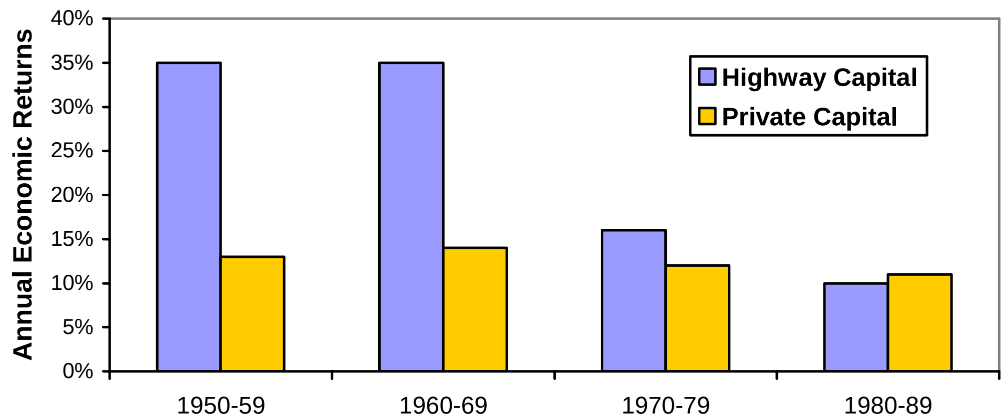
After analyzing Washington State highway investment economic impacts, Peterson and Jessup (2007) conclude that "*some* transportation infrastructure investments have *some* effect on *some* economic indicators in *some* locations" but dismiss the idea that such investments are always worthwhile. Weiss (1999) and Horst and Moore (2003) show that rural areas with good highway access experienced more employment growth, poverty alleviation and industrial diversity than areas that lack such access, but these are largely economic transfers from one location to another without overall gain in economic activity (Baird 2005; CBP 2002; Chalermpong 2004).

Shirley and Winston (2004) found that infrastructure spending increased productivity but returns declined from more than 15% annually in the 1970s to less than 5% in the 1980s and 1990s. They conclude, "During the past two decades, the primary objective of highway spending has shifted from expanding the nation's capital stock to maintaining it. Undoubtedly, the improvement in costs and service from such investments and the concomitant reduction in plants' inventories cannot compare with those produced by the construction of thousands of miles of new roads."

Smith, et al (2002) found that new highways significantly affected land development patterns in the Twin Cities region during the 1970s, but once the basic system was completed adding roadway capacity provides less additional residential, commercial or industrial development. Regions that invest heavily in road capacity expansion fared little better in reducing traffic congestion than those that invested much less (STPP 1998). Other transportation improvements, such as public transit investments and mobility management strategies such as congestion pricing and HOV facilities often provide greater economic benefits (Boarnet and Haughwout 2000; Cambridge Systematics 1999).

Although highways showed high economic returns during the 1950s and 60s, this declined significantly by the 1990s and has probably continued to decline since the most cost effective projects have already been implemented, as indicated in Figure 22.

Figure 22 **Annual Highway Rate of Return** (Nadri and Mamuneas 1996)



Highway investment economic returns were high during the 1950s and 60s when the U.S. Interstate was first developed, but have since declined, and are now probably below the returns on private capital, suggesting that highway expansion is generally a poor investment.

Jiwattanakulpaisarn, et al. (2009) analyzed the relationship between U.S. highway supply and employment using time-series cross-sectional data on roadway lane miles and private sector employment for the 48 contiguous states over the period 1984–1997. The analysis found that employment growth is temporally influenced by annual growth in major highways within the same state and all other states, but the existence and direction of these effects depends on highway type and time lags considered. Jiwattanakulpaisarn, Noland and Graham (2009) found similar results. Their analysis suggests that further highway improvements provide small economic returns: a dollar spent to increase interstate highway capacity could increases private sector output just $0.15 in the long run (more than a decade), with even smaller productivity gains from expansion of lower functional road categories. Hymel (2009) examined the impact of traffic congestion on employment growth in large U.S. metropolitan areas. The study found that congestion reduces employment growth, particularly over the long run in highly congested places. The analysis suggests that in a large congested city such as Los Angeles a 10% increase in congestion would reduce subsequent long-run employment growth by 4%.

Some studies suggest that highway investments that stimulate sprawl are economically harmful. In a study of 44 US metropolitan regions Nelson and Moody (2000) found that, controlling for other factors, per capita economic retail and service activity declined as the number of urban beltways increases. They concluded that beltways deconcentrate people and businesses to levels that reduce for industrial agglomeration efficiencies.

An expert review of economic impact research (SACTRA 1999) concludes:

- "The available evidence does not support arguments that new transport investment in general has a major impact on economic growth in a country with an already well-developed infrastructure. At the regional and local level, in particular, the issue of impact is made more complex by the possibility that changes in quality of access can either benefit or harm the area in question. We do not accept the results of macroeconomic studies which purport to identify very large returns from infrastructure investment."
- Transport investments may have broad economic impacts, but these can be either positive or negative. For example, road improvements can lead to residents traveling elsewhere for shopping and services, reducing business in that community.
- Traffic reduction strategies can provide economic benefits by encouraging more efficient use of existing capacity. Travel demand management (including road pricing or improvements in alternative travel modes) should be considered as alternatives to capacity expansion."

O'Fallon (2003) provides the following guidance for maximizing productivity gains from infrastructure investments:

- Improve the efficient use of existing infrastructure through demand management and efficient pricing. Additional infrastructure capacity may fail to increase productivity if existing infrastructure is ineffectively utilised. Efficient management has the possibility of greatly affecting economic productivity.
- Recognise that the *reliability* of infrastructure is particularly important vis-à-vis its impact on international trade and production costs for small enterprises. Poor quality or unreliable infrastructure service provision may mean that firms are reluctant to invest productive capital, or have to reduce such investment in favour of "complementary" capital to compensate for the lack of infrastructure
- Care should be taken not to get into a situation of oversupply of infrastructure, which can have a negative impact on the economy as it draws scarce resources away from maintenance and operation of existing stocks.
- Infrastructure investments should be carefully evaluated based on national benefits. This implies the use of benefit-cost analysis. Some authors have suggested trade-offs should include those between different kinds of infrastructure investment.
- Avoid making infrastructure decisions based on political influence (i.e. through pork barrelling or lobbying and coalition agreements) as such decisions may lead to distortion in infrastructure provision, particularly in the longer term.

This indicates that highway expansion tends to support economic development under certain circumstances: when economic development is constrained by inadequate access and highway improvements are cost effective or are subsidized by others. Alternative approaches, such as more efficient road pricing, may be most beneficial overall.

Alternative Modes

Improving alternative modes (walking, cycling, ridesharing, public transit, telework, etc.), and incentives that encourage their use (such as more efficient road, parking, insurance and fuel pricing) can provide various economic saving and benefits:

- Traffic congestion reductions.
- Road and parking facility cost savings.
- Accident reductions.
- Consumer cost savings.
- Energy conservation and pollution emission reductions.
- Improved access to education and employment by disadvantaged people.
- Support for more compact land use development and therefore increased accessibility.

These savings can be significant. Commuters that shift from driving to alternative modes, and households that reduce their vehicle ownership, typically save thousands of dollars annually, and provide hundreds of dollars worth of road and parking facility cost savings, plus reductions in accidents, energy consumption and pollution emissions. Conventional planning tends to overlook or undervalue many of these benefits, as indicated below.

Table 20 **Conventional Transport Planning Evaluation** (Litman 2008b)

Usually Considered	Often Overlooked
Financial costs to governments	Downstream congestion impacts
Travel speed (reduced congestion delays)	Parking costs
Vehicle operating costs (fuel, tolls, tire wear)	Vehicle ownership costs
Per-mile crash risk	Mobility for non-drivers
Project construction environmental impacts	Strategic land use objectives (community redevelopment, sprawl reduction)
	Energy use and pollution emissions
	Impacts on physical fitness and public health
	Travelers' preference for alternative modes

Conventional planning tends to overlook many impacts and so tends to undervalue alternative modes.

People sometimes assume that alternative modes are justified primarily for their social and environmental benefits (improved mobility for non-drivers and emission reductions), but they also provide substantial economic benefits. Their cost efficiency depends on whether there is sufficient demand to justify investments. For example, investments in sidewalks, paths and bike parking can be considered cost effective if their costs per trip is equal or below that of other modes. Alternative modes may provide other benefits, such as exercise and recreation, and basic mobility for non-drivers, so investments may sometimes be justified even if their unit costs are higher than roadway improvements.

The cost efficiency of alternative modes tends to increase if implemented as an integrated program that includes suitable incentives and land use development. For example, cycling facilities and public transit services will attract more users and provide more benefits if implemented with commute trip reduction programs, efficient road and parking pricing, and smart growth land use policies. An integrated program can result in substantial mode shifts, benefits and economic returns. Even people who never use these modes themselves can benefit from reduced automobile traffic problems.

Basic Mobility - Employment Access

Economic productivity may be constrained if people lack basic mobility, particularly if workers have difficulty accessing jobs. Transportation policies and programs that improve vulnerable workers' access to jobs can therefore increase productivity. In general, improving commute options for people with disabilities and low incomes tends to accomplish this objective, including better walking, cycling, ridesharing, public transit services, and more affordable housing in job rich areas. Special "welfare to work" programs are sometimes intended to improve job access, such as special reverse commuter transit service (vans and buses from urban neighborhoods to suburban employment centers), and vehicle purchase grants.

Research indicates that access to an automobile increases unemployed people's chance of obtaining a job and their average incomes (Blumenberg and Waller 2003), particularly for residents of automobile-dependent communities. However, automobile ownership also has significant costs; about half of the additional income provided by a car must be spent on vehicle expenses, and the older vehicles that lower-income commuters use tend to be unreliable. Lower-income workers tend to benefit most if they can minimize vehicle expenses by sharing vehicles and rides, and using alternative modes when possible.

High quality public transit can increase labor participation in U.S. cities, in addition to reducing transportation expenditures, suggesting that improving transport system diversity increases productivity and economic development overall (Sanchez, Shen and Peng 2004; Yi 2006).

Impacts on Specific Industries and Businesses

Transportation policies and projects often affect the employment, productivity and profits of specific industries and businesses, and communities in which they are located. For example, policies that improve transport options and discourage motor vehicle travel may reduce employment and profits in vehicle and fuel production industries, and therefore economic activity in areas where those industries are concentrated. Similarly, improving airport transit service may reduce taxi service demand. Advocates for the affected industries often lobby against such policies on grounds that jobs and economic activity will decline, but such impacts are generally economic transfers (one industry, business or area benefits at others expense). There is generally no overall public policy justification to favor older, established industries over newer, more efficient transport services, regardless of their size. Rather, it may be most efficient to help such industries contract.

Advocates of policies favoring automobile transportation sometimes make claims such as "Ten percent of all U.S. jobs are in the automobile industry" or "Automobile production is a particularly important economic sector." Such claims are generally outdated (the portion of the U.S. economy devoted to automobile production and distribution has declined significantly during the last half-century), and misguided since vehicle manufacturing tends to be overcapitalized and unprofitable compared with other industries, so the best strategic goal is generally to allow that sector to contract to a more efficient size and invest in more profitable industries.

Policies favoring motor vehicle travel may have been justified decades ago when the automobile industry was expanding, but it is now mature, with average wages, low profits and excess capacity. There is now no economic reason for transport policy to encourage automobile ownership and use. As discussed earlier, consumer expenditures on vehicles and fuel tend to provide relatively little domestic employment and productivity. Although a region benefits from exporting vehicles and fuel, there is generally no economic benefit from policies that stimulate demand for vehicles and fuel by local consumers. For example, the U.S. may benefit from exporting vehicles to other countries, or if more of the vehicles purchased by U.S. consumers are domestically produced, but there is no overall economic benefit if U.S. transport policies encourage domestic consumers to purchase more vehicles and fuel, since they would therefore have less money to spend on other goods and services which tend to generate more employment and productivity.

Similarly, improving airport public transit service provides increases productivity: total transport costs (for vehicles, roads and parking) are generally lower compared with employees driving their own automobiles and visitors using taxis. If travelers spend less money on taxis, some of the savings are likely to be spent on other local goods and services, and cheaper, more convenient local travel may make a city a more attractive destination (which is why many resorts offer special airport transportation services).

Transportation policies can also affect the competitiveness of local industries. Low transportation costs make locally produced goods less competitive compared with imports, harming local industries. For example, vegetables are cheaper to grow in California and Florida then in New York and Washington State, so low shipping costs leads to more imported vegetables and less local farm production. Underpricing freight transport, for example, if trucks pay less than their share of roadway costs or impose significant uncompensated accident and pollution costs, the result is both economically excessive truck travel and underdevelopment of farming in northern states.

The table below illustrates an example of how underpricing transportation disadvantages local producers and is economically inefficient overall. If a case of lettuce costs $10 to produce and $5 to ship from California, while local producers cost $15 to produce and $2 to ship, local shops will rely on imports. However, if shipping from California imposes $5 in external costs, but local shipping only imposes $1 in externalities, society is better off overall with the locally produced lettuce.

Table 21 Imported Versus Locally Produced Costs

	Imported	Locally Produced
Production costs	$10.00	$15.00
Transport costs	$5.00	$2.00
Price	*$15.00*	*$17.00*
External costs	$5.00	$1.00
Total costs	*$20.00*	*$18.00*

Underpriced transport encourages imported good consumption, reducing local productivity.

Similarly, reducing transportation costs reduces shipping costs to local businesses but also encourages local residents to shop at more central locations, reducing local economic activity and leading to reduced local shopping options (SACTRA 1999). In these ways, underpriced transport tends to harm local industries such as farms, processing facilities and retail businesses. This is not to suggest that transport costs should be kept artificially high to favor local industries, but it does point out that policies that underprice transport often have negative as well as positive economic impacts.

Impacts on specific industries and businesses should be identified and evaluated in terms of overall economic efficiency. Policies should generally not be designed to favor specific industries and businesses. Instead, it is generally best to develop transition or compensation programs to facilitate economic transitions. For example, it may be appropriate to develop a plan to contract oversized businesses and develop new products and industries. A region that is overly dependent on automobile or petroleum industries should strive to diversify so it is less exposed to market fluctuations and is not forced to support inefficient transport to protect existing jobs.

Property Values and Development

Transportation policy and planning decisions can affect property values, and the location and type of development that occurs. All else being equal, real estate values increase with improved access and reduced traffic impacts such noise. For example, a new highway or rail line that improves access to a particular area can stimulate more regional economic activity, such as farming and tourism in rural areas, commercial and residential development in urban areas. Similarly, pedestrian and cycling improvements, and traffic calming tend to increase local property values by improving local accessibility and reducing motor vehicle traffic impacts (Cortright 2009).

Certain types of transport improvements attract certain types of development. Where conditions are suitable, certain transport improvements can leverage large amounts of private investment and economic development. For example, a billion dollars invested in a new rail line can stimulate ten billion dollars in nearby property development. In competitive markets, small differences in accessibility and traffic impacts can make a large difference in property values and development potential.

Adams and VanDrasek (2007) describe methods for evaluating the economic development impacts of specific urban transportation improvements. Smith and Gihring (2006) summarize research concerning the effects that high quality public transportation and transit oriented development have on nearby property values and property tax revenues. Their research suggests that transit service improvements can often be partly or totally funded by the property value increases they provide. A number of studies indicate growing demand for transit oriented development (Nelson, et al. 2009; CTOD 2008).

Land Use Economic Productivity Impacts

Transportation policy and planning decisions can affect land use productivity (Litman 1995; Burchell, et al. 2002). Some of these impacts are direct: use of valuable land for transportation facilities (railroad, roads, parking lots, ports, etc.). Other impacts are indirect, resulting from the effect that transport planning decisions have on land use development patterns, such as the tendency of highway expansion and increased parking requirements to stimulate lower-density, dispersed, urban fringe development (commonly called *sprawl*), and the tendency of walking, cycling and public transit improvement, and mobility management strategies, to encourage more compact, mixed, infill development (commonly called *smart growth*).

Increased urban density (people and jobs per acre or square mile) tends to increase economic productivity due to the combined effects of agglomeration efficiencies (increased productivity as more activities are located close together), infrastructure and public service cost efficiencies (lower costs per capita of providing public services), and improved accessibility (less travel required to access goods, services and activities, reducing total transportation costs).

Agglomeration efficiencies tend to significantly increase economic productivity and incomes (Graham 2007; Webber and Athey 2007; Bettencourt, et al. 2007). Carlino, Chatterjee and Hunt (2006) found that, all else equal, doubling employment density (jobs per square mile) increases patent intensity (patents per capita) about 20%, up to about 2,200 jobs per square mile. Haughwout (2000) found that doubling county-level density is associated with a 6% increase in state-level productivity.

Smart growth tends to reduce unit costs of providing public services, including roads, utilities, emergency services, public transit, and schooling (particularly if it reduces school busing costs). It typically provides 20-40% savings per capita compared with providing the same service levels with sprawled development (Burchell, et al. 2002).

More compact, mixed, multi-modal urban land use development tends to be more transportation efficient and therefore economically efficient due to proximity (cities can be defined as place with minimal distance between people and activities) and transport diversity (urban transportation systems generally offer good walking and sometimes cycling conditions, good public transit and taxi services, and better Internet and delivery service). However, conventional planning methods are biased in ways that undervalue smart growth policies. Commonly-used, *mobility-based* transport system performance indicators which measure impacts per vehicle-mile (roadway level-of-service, average travel speeds, and vehicle operating costs) measure costs per vehicle-mile. They imply that more compact development is undesirable because it reduces travel speeds (due to more intersections, more pedestrians, and more traffic congestion), and does not recognize the benefits from reduced travel distances. *Accessibility-based* performance indicators which measure impacts per capita (per capita transport expenditures, accidents, hours of congestion delay; and the number of services located near a location [www.walkscore.com]) tend to recognize more smart growth benefits.

Affordability

Affordability refers to the degree that households can afford basic goods and services. Transportation affordability refers to lower-income households' ability to afford basic mobility and accessibility, such as access to health care services, basic shopping, school and work, and a certain amount of social and recreational activities. Transportation affordability tends to increase with improvements to affordable modes (walking, cycling, ridesharing, and public transit), and with more affordable housing in accessible locations, such as more lower-priced housing in attractive, multi-modal urban neighborhoods.

Transportation and housing affordability can affect economic development (Litman 2008a). Cost savings are equivalent to increased income, and lower-wage jobs are an important economic input, representing 20-50% of total employment. Even high wage industries require numerous lower-wage support employees. For example, physicians, lawyers and business executives require receptionists, technicians and cleaners. These industries are particularly dependent on lower-wage employees:

- Hospitality/dining
- Medical/dental
- Construction
- Arts
- Retail
- Building services
- Light industry
- Landscaping
- Education

Unaffordable transportation and housing can constrain economic development. Businesses may have difficulty filling positions, be forced to pay higher wages, have higher turnover, and more employees working multiple jobs, reducing their availability and work quality. Workers forced to commute long distances in old cars experience stress and unreliability. Colleges may have difficulty recruiting students, fewer seniors will retire in the area, while artists and innovators may move away due to inaffordability.

The table below illustrates how high transportation and housing costs that increase the cost of living in a community drive up the wages required to attract a given quality of employee. If basic transportation and housing costs are $300 per month higher than other communities, local employers must pay an extra $1.88 per hour. If these costs are $700 per month higher, employers must pay an extra $4.38 per hour.

Table 22 **Wage Impacts of High Transportation and Housing Costs**

Monthly	Affordable	Unaffordable Transport	Unaffordable Housing	Unaffordable Transport & Housing
Monthly transport costs	$200	$500	$200	$500

Monthly housing costs	$600	$600	$1,000	$1,000
Total monthly costs	$800	$1,000	$1,200	$1,500
Monthly wage premium	$0	$300	$400	$700
Hourly wage premium	*$0*	*$1.88*	*$2.50*	*$4.38*

This table indicates how unaffordable transportation and housing tends to raise wages.

Inaffordability does not affect all employees equally. Some pay no rent because they live with family, own their homes, or have subsidized housing. Some may accept inferior housing in exchange for a better quality of life or long-term economic opportunities. But once this pool is tapped businesses must pay higher wages to attract additional employees. The result is less economic activity and lower profits than would occur with more affordable transportation and housing. This suggests that policies and programs that increase transportation and housing affordability support economic development, particularly in rapid growth communities that wish to expand industries that rely significantly on low- and medium-based employees, or to attract students and retirees.

Household Wealth Accumulation

Households often make trade-offs between housing and transportation costs. For example, a household might choose between a cheaper suburban house with high transportation costs or a more expensive urban house with lower transport costs (CNT 2008). In the short-run their total costs may be equal but over the long-run mortgage payments build much more equity than vehicle expenditures, providing hundreds of thousands of dollars in additional wealth to households that choose more costly but accessible homes. Since homes are an important source of capital (households often borrow against their homes for educations and businesses), this contributes to overall economic development. As a result, policies that help household purchase location-efficient homes (such as more transit-oriented development, and location-efficient mortgage policies) support wealth accumulation and economic development ("Location-Efficient Development," VTPI 2008).

Outcomes

As discussed earlier, the ultimate goal of economics is to maximize social welfare (overall human happiness). Although conventional economic analysis often assumes that increased material wealth and market activity (such as increased income, economic productivity and sales) are inherently desirable, some economists challenge these assumptions (Talberth, Cobb, and Slattery 2006). They argue that conventional economic indicators overlook important non-market impacts and values, and economic development should be evaluated based on desirable outcomes such as health, education, social equity, environmental quality, and life satisfaction (van den Bergh 2007).

For example, the Happy Plant Index (www.happyplanetindex.org) is calculated by multiplying indicators of *Life Satisfaction* times *Life Expectancy* and dividing by *Ecological Footprint* (resource consumption). The *Genuine Progress Indicator* (GPI) is an economic performance indicator that adjusts Gross Domestic Product (GDP) to account for the costs of crime, environmental degradation, loss of leisure, income inequality, public infrastructure, volunteering and housework.

Economic Development Impact Analysis Summary

The table below summarizes various transportation economic development impact categories described in this report and possible methods for evaluating them. These factors represent different perspectives and issues, so the appropriate factors should be selected for analyzing a particular policy or project. For example, roadway expansion proposal may require consideration of different impact factors than a transit improvement or pricing reform. Many of these impacts overlap. For example, reducing transportation costs and improving transport system efficiency can improve affordability and local economic productivity, employment and property values.

Table 23 **Economic Development Impacts**

Factor	Description	Evaluation Methods	Development Strategies
Direct economic impacts	Jobs and business activity generated by project expenditures.	Regional economic models, input-output tables	Favor policies and projects with greater job creation.
Consumer expenditures	Impacts of future consumer transport expenditures.	Consumer expenditure surveys and regional economic models	Favor policies and projects that reduce future fuel and vehicle expenditures.
Transport project cost efficiency	Whether transport facility investments repay costs and optimize value.	Comprehensive benefit/cost models that account for all impacts.	Choose projects with high return on investment or benefit/cost ratios.
Transport system efficiency	Ratio of benefits to costs. Whether transport policies support economic objectives	Whether transport policies reflect efficient market principles.	Use efficient pricing and policies that favor higher value trips (such as freight) and efficient modes.
Basic access	Effects on basic mobility for non-drivers (access to shops, schooling and jobs)	Analysis of travel options between affordable housing, services and jobs	Support projects that improve commute options for disadvantaged workers.
Specific industries and businesses	Impacts on specific industries (e.g., vehicle and fuel producers, taxis, etc.)	Analysis of employment and productivity of specific industries and businesses	Identify potential negative impacts and arrange transition and compensation if needed.
Property values and development	Whether policies and projects increase real estate values and development.	Property valuation studies. Surveys of real estate professionals.	Support projects that increase property values. Capture value for transport project funding.
Land use objectives	Support for more accessible, efficient land use development.	Land use development impact analysis.	Favor projects that support strategic land use objectives (smart growth).
Affordability	Impacts on transport and housing affordability.	Transport and housing affordability analysis.	Favor affordable modes and affordable-accessible housing.
Wealth accumulation	Household wealth created by housing investments.	Portion of household spending on housing and transport.	Support location-efficient development.
Outcomes	Improved health, education, housing quality, environmental quality, etc.	Sustainable development indicators. Various data sources.	Favor projects that help achieve desired outcomes.

This table categorizes transportation economic development impacts, methods for evaluating them, and strategies that help achieve economic development objectives.

Transportation Economic Development Strategies

This section discusses transport ways to help achieve specific economic development objectives.

Improve Transport System Efficiency

As discussed earlier in this report, one of the most effective ways to support economic development is to improve transportation system efficiency by reducing the resources (money, time, land, risk, etc.) required for a given level of accessibility, particularly for productive activities such as freight and service delivery, and business travel. Transport efficiency improvements contributed significantly to economic development during the last few centuries and, although the rate of improvement is declining, even minor efficiency gains can provide savings throughout the economy and make a particular business or location more competitive.

Transportation efficiency improvements, called *logistical improvements*, reduce costs to businesses to distribute goods and services, costs to governments to construct and operate transportation facilities and services, and costs to the economy from indirect and external transportation costs, such as congestion, accident and pollution damages. Transport system efficiency is also improved by policies that prioritize transport activity by favoring higher value trips and more efficient modes over lower-value trips and less efficient modes. The box below lists typical logistical improvements.

Typical Logistical Improvements

- Increased vehicle loads (larger trucks, and shifts to rail, higher load factors).
- More efficient operations (faster loading, reduced downtime).
- Lower equipment costs (less expensive or more durable vehicles, higher fuel efficiency).
- Reduced labor costs (automation, and lower wages and benefits).
- Higher travel speeds (faster vehicles, reduced congestion delays).
- Reduced shipping distance and volume (better distribution, stores located closer to customers, reduced packaging).
- Truck and HOV lanes, and efficient road pricing, so higher-value trips (freight, service vehicles, business travel and public transit vehicles) have priority in traffic.

Mobility management and smart growth strategies tend to increase transport system efficiency, as indicated in Table 11. They reflect economic efficiency principles and reduce transportation costs such as vehicle and fuel expenses, congestion delays, road and parking facility costs, accident costs and pollution damages. Some types of travel have are particularly valuable, so improving their efficiency provides large economic development benefits. Freight transport supports economic activity and has high marginal costs (a typical freight truck has time costs over $100 per hour considering wages and the time value of the equipment and cargo) so freight transport improvement can provide significant economic benefits.

Airport transport tends to involve high-value travel (business trips, courier services, tourism and emergency travel) and impose significant external costs, so efficiency gains can provide economic benefits. Improving commute travel efficiency can also increase productivity if it improves education and employment access, allowing better match between workers and jobs, but the main benefit of improvements such as suburban highway expansion is to allow employees to live farther from their worksites, providing consumer benefits but little productivity benefits.

Improving transportation options (improving walking, cycling, ridesharing, public transit, taxi, carsharing, delivery services, telework and more accessible land use) can increase economic efficiency if demand exists (new facilities and services are used sufficiently), and provide particularly large economic benefits if they substitute for more costly modes such as automobile travel. Alternative modes can provide additional benefits, for example, exercise and recreation, and basic mobility for non-drivers, so investments may be justified even if they have relatively high unit costs (cost per passenger-mile).

Congestion pricing, road tolls and HOV/HOT lanes increase economic efficiency by allowing higher value vehicles (such as freight and service vehicles, business travelers, emergency vehicles, people making urgent trips, and higher occupant vehicles) to outbid lower value vehicles for scarce road space, avoiding congestion delays. By reducing congestion, more efficient pricing can avoid the need to expand roadways, providing additional savings. Similarly, more efficient parking pricing and other parking management strategies can reduce parking congestion and reduce total parking costs, providing economic savings and allowing more compact development.

More efficient road, parking, insurance and fuel pricing tends to increase efficiency and therefore productivity. Although underpricing vehicle travel (for example, financing roads and parking facilities indirectly, through general taxes and rents) reduces transport costs, it reduces overall economic efficiency since the costs are borne elsewhere in the economy. Efficient pricing may be constrained by policies in nearby jurisdictions, for example, if a neighboring country or state has very low fuel prices it may be impractical to maintain high fuel prices, but such distortions that should be minimized by maintaining the highest feasible price, and by coordinated, inter-jurisdictional fuel price increases.

People sometimes assume that economic and environmental objectives conflict, but environmental damages impose real economic costs so the actual conflict is often between different industries. For example, air, noise and water pollution harm fishing, farming and recreation industries. Excessive vehicle traffic reduces nearby property values. Reducing these impacts supports economic development.

Policies and programs that reduce transportation fuel consumption provide economic development benefits that are likely to increase in the future. Many countries devote 10-30% of their export exchange to petroleum imports, and this increases when oil prices rise. Oil producing countries also benefit from domestic energy conservation because it leaves more product to export, increasing their wealth.

Transportation Planning Reforms For Efficiency

Several planning reforms tend to increase transport system efficiency and therefore productivity.

Accessibility-Based Planning

Conventional planning evaluates transport systems based on *mobility* (physical travel). But mobility is seldom an end in itself, most transport activity it is intended to achieving *accessibility* (people's ability to reach desired goods, services and activities), and some mobility improvements can reduce overall accessibility. For example, wider roads and increased traffic speeds tend to degrade walking and cycling conditions, large expenditures on roads and parking facilities leave few resources for other modes, and automobile-oriented land use (dispersed development along major highways) tends to be inaccessible by other modes. *Accessibility-based planning* accounts for these impacts and expands transport solutions to include improvements to alternative modes, mobility management, more accessible land use, and mobility substitutes such as telecommunications and delivery services.

Comprehensive Economic Evaluation

Conventional transportation planning tends to focus on a limited set of objectives, impacts and options, and so can result in inefficient solutions. For example, performance indicators, such as roadway level-of-service ratings and average traffic speed, tend to evaluate transport systems in terms of motor vehicle mobility. They overlook other planning objectives (parking cost savings, consumer cost savings, improved mobility for non-drivers, energy conservation, and even accident reductions), and undervalue alternative modes and mobility management. They can result in solutions to one problem that exacerbate other problems (for example, widening highways although that tends to stimulate VMT and sprawl, and so tends to increase other transport problems such as downstream congestion, total accidents, total emissions, and inadequate mobility for non-drivers), and tend to undervalue "win-win" transportation solutions that provide more modest but multiple benefits.

Least-cost Planning and Funding

Least-cost planning is a resource planning method that considers demand management solutions equally with capacity expansion, and these alternatives are funded whenever they are most cost effective, considering all objectives and impacts ("Least-Cost Planning," VTPI 2008). For example, with conventional planning, transportation planning tends to favor automobile transportation improvements over other modes and facility expansion over demand management strategies; In many cases transportation improvement funds can only be used for roadway improvements, and cannot be spent on alternative modes or demand management programs even if they are more cost effective and consistent with strategic planning objectives, such as efforts to improve mobility for non-drivers and conserve energy.

Employment and Income Growth

Policies and programs that increase economic productivity and competitiveness support economic growth, which tends to increase employment and incomes. As a result, efficient transport policies (such as efficient road, parking, insurance and fuel pricing), efficient transport planning (such as least-cost funding, so the most cost-effective transportation improvement is selected), and smart growth land use policies that improve land use efficiency tend to increase employment and income.

Some transport policy and planning decisions involve tradeoffs between different industries and consumer expenditures. For example, improving a highway a city and nearby rural communities may stimulate development and reduce agricultural activity in the area. The result will be more construction and retail jobs, but fewer farming jobs.

Some transportation projects and activities generate more jobs per dollar spent than others, particularly within a particular area. As described earlier, vehicle and fuel expenditures tend to create few jobs, particularly local jobs, and this is likely to decline as vehicle production is more automated and as petroleum prices rise. Transportation policies that allow households to reduce their vehicle ownership and fuel consumption tend to increase local and national employment.

Public transportation tends to generate relatively large numbers of jobs per dollar spent. Particularly large employment gains tend to result from policies that expand high-quality public transportation systems, in part because of transit service employment and in part because of the reduction in automobile expenditures. Transit investments are only cost effective employment generators if the resulting services are well used (and therefore respond to consumers' demand), are integrated into communities (so they provide efficient access) and allow households to reduce their vehicle and fuel expenditures.

Property Values

Transportation improvements can increase nearby property values (Smith and Gihring 2006). Land value increases reflect the capitalized value of transportation cost savings, which is a productivity gain. What type of transport improvement provides the greatest value depends on specific conditions, including the degree that accessibility is improved, the amount of demand for such accessibility, and the effects of negative impacts such as congestion, noise and pollution around highways and transit stations. For example, if demand is high for land with good highway access and supply is limited, highway improvements may significantly increase nearby property values. However, once a region has highways providing access to a significant amount of land, marginal increases in highway supply or quality do little to increase productivity or land values; much of the gain in one location is offset by reductions in land values elsewhere in the region. Proximity to a highway also reduces the value of nearby land that bears negative impacts.

Similarly, access to high quality walking, cycling and public transit tends to increase property values. Limited supply and growing demand for use of these modes, and for living in multi-modal communities, can result in large property value gains.

Affordability and Basic Accessibility

Improving affordable modes (walking, cycling, ridesharing, public transit, delivery services) and increasing the supply of affordable housing in accessible locations tends to increase overall affordability and basic accessibility. Reducing the number of vehicles a household must own can provide significant savings, as indicated in Table 24 These savings can be considered equivalent to an increase in household income.

Table 24 **Vehicle Expenses As Portion of Household Income** (BLS 2008)

	Income Quintile				
	Lowest	Second	Third	Fourth	Highest
Gross Income	$10,531	$27,674	$46,213	$72,460	$158,388
Avg. Expenditures Per Vehicle	$4,468	$4,825	$5,054	$5,691	$6,793
Portion of Income	*42%*	*17%*	*11%*	*8%*	*4%*

Reducing the number of vehicles a household must own can provide substantial savings.

The following strategies can help increase affordable, accessible housing:

- Supporting more infill development and brownfield reclamation (for example, cleaning up older urban industrial sites so they can be redeveloped).
- Increase development density limits, for example, allowing higher FARs and building heights.
- Allow more mixed use development, such as urban villages (which often involves converting residential to neighborhood commercial) and housing over retail.
- Allow and encourage secondary suite development.
- Allow and support conversions of single-family to multi-family housing.
- Apply reduced and more flexible parking requirements, and more efficient parking management.
- Improve walking and cycling conditions, and public transit and taxi service quality.
- Implement mobility management programs, such as commute trip reduction programs, streetscaping and traffic calming, and efficient road and parking pricing. Unbundling parking from housing costs (i.e., renting parking spaces separately from housing units).
- Encourage *location efficient mortgages*, which mean that lenders recognize the potential savings of a more accessible housing location when assessing a household’s borrowing ability.
- Reduce development and utility costs for more compact, accessible, multi-modal development, since it generates fewer car trips and reduces the costs of providing public services compared with more automobile-dependent, sprawled development.
- Improve public services in smart growth locations to attract more residents and businesses.
- Improve walking and cycling conditions, and public transit and taxi service quality.
- Implement mobility management programs, such as commute trip reduction programs, streetscaping and traffic calming, and efficient road and parking pricing.

Below is a summary of general economic development strategies:

- All else being equal, favor investments that maximize jobs, income and business activity.
- Favor higher value trips and more efficient modes, including freight and business transport, and high occupant vehicles (carpools, vanpools and public transit).
- Improve more affordable modes (walking, cycling, ridesharing, public transit, telework) and more accessible community development, and encourage fuel efficiency in order to reduce consumer expenditures on vehicle and fuel.
- Implement policy and planning reforms that reflect efficient market and planning principles, such as improved consumer options, cost-based pricing, and neutral investment and tax policies.
- Improve alternative modes when cost effective overall, taking into account all objectives and impacts, including basic mobility for non-drivers and land use impacts.
- Use comprehensive analysis of impacts and options to identify the most cost effective and efficient transportation investments.
- Emphasize asset management. Insure that existing infrastructure is properly maintained before adding more capacity.
- Implement transportation projects that reflect strategic land use development objectives and future demands.

Evaluation Methods

Various techniques and models can be used to evaluate the economic impacts of specific transport policies and programs (Weisbrod 2007; Peters, Paaswell and Berechman 2008):

- Transportation economic evaluation models estimate the value of a transport project or program (CalTrans 2006). Most of these models consider only a limited set of impacts (construction costs, travel time savings, vehicle operating costs, and accident and emission rates per vehicle-mile) and ignore other impacts (downstream congestion, parking costs, vehicle ownership costs, induced travel accident and emission impacts), and so may result in inefficient planning decisions ("Model Improvements," VTPI 2008). More comprehensive analysis can provide more accurate economic evaluation and therefore better indication of truly optimal policies and projects (Litman 2009a).
- Input-Output tables and other econometric models predict how changes in expenditures affect economic activity in a particular geographic area or industry (REMI, 2005). These can be used to calculate incremental changes in employment, profits and tax revenues.
- Real estate market analysis can be used to predict changes in property value and tax revenue due to improved access and local traffic impacts (Smith and Gihring 2006).
- Integrated transportation economic evaluation models such as *TREDIS* (Transportation Economic Development Impact System, www.tredis.com) take into account personal and freight travel time and cost, reliability, logistics efficiencies, congestion, and ground access to intermodal terminals for various modes (of highway, bus, rail, aviation, marine) to quantify costs savings, productivity, employment, incomes and business growth.
- Fiscal impact analysis evaluates how incremental public infrastructure and service costs compare with incremental government revenues from development fees and taxes (Edwards 2000; NRDC 2001).
- User and market surveys can be used to determine how people respond to, or expect to respond to, specific transportation system changes, the value they place on these changes, impacts on their costs and expenditures, and user recommendations for improvement.
- Policy analysis to determine whether specific transport policies and planning practices favor higher value trips and more efficient modes.
- Special studies can help evaluate specific economic impacts, such as how a policy or program affects household affordability (from transportation cost savings) and wealth generation (for example, taking into account equity gains from home ownership).
- Case studies can be used to predict impacts, and to identify problems and potential improvements, in similar situations.

It is important that practitioners and decision-makers understand the limits of these tools. For example, most transportation benefit-cost analysis considers a limited portion of total impacts, and input-output table analysis can indicate how a particular policy or project affects employment and productivity, but excludes other types of economic impacts, such as changes in property values, household wealth and external costs, or equity impacts such as changes in affordability. In many cases the impacts that are overlooked may be more important to a community than the impacts that are quantified. The results of such analysis should clearly indicate what impacts are and are not considered.

Examples and Case Studies

Some specific examples of transportation economic evaluation are summarized below.

Downtown Parking Subsidies

Downtown merchants often advocate government parking subsidies to attract customers and stay competitive with suburban shopping centers that offer abundant, free parking. Table 25 identifies economic productivity impacts. Parking subsidies can improve motorist convenience and make downtowns more competitive with suburban locations, but it reduces productivity by increasing total parking costs and stimulating more vehicle traffic which increases congestion, accidents and pollution costs.

Table 25 **Productivity Impacts – Parking Subsidies**

Increases Productivity	Reduces Productivity
• Reduces delays and extra driving when motorists have difficulty finding a parking space. • Makes downtowns more competitive with suburban areas.	• Increases total parking costs. • Subsidizes automobile travel and so increases urban traffic and therefore congestion and other external costs.

This table summarizes productivity impacts of downtown parking subsidies.

An alternative to subsidizing parking is to implement demand management programs, which could include more sharing of parking (such as a sharing agreement between an office building and a nearby restaurant), better regulation and pricing, improvements to alternative modes (such as better sidewalks and crosswalks, bicycle parking, rideshare promotion, and public transit service improvements) and commute trip reduction programs. The table below compares the economic impacts of these two alternatives.

Table 26 **Parking Subsidies Versus Demand Management Economic Impacts**

Economic Impact	Parking Subsidies	Demand Management
Project expenditures	Generates construction jobs.	Generates ongoing administration and enforcement jobs.
Future consumer expenditures	Stimulates driving which increases vehicle and fuel expenditures.	Tends to reduce vehicle travel and therefore vehicle and fuel spending.
Investment cost efficiency – investment economic returns	Subsidies are generally inefficient and so reduce economic efficiency.	Management programs are often most cost effective and efficient.
Transport system efficiency	Tends to be inefficient.	Favors higher value trips and more efficient modes.
Basic mobility and affordability	Often causes automobile dependency, which reduces basic mobility.	Often improves basic mobility and affordability.
Property values and development	Can increase downtown property values, but may increase taxes.	Can increase property values with less tax burden.
Land use development patterns	Supports downtowns but stimulates car travel and therefore sprawl.	Supports downtowns but reduces car travel, and so reduces sprawl.

This table compares parking subsidies with demand management strategies with regard to various economic impacts. More efficient management provides often greater economic benefits overall.

Table 27 identifies questions to consider when evaluating parking subsidy proposals.

Table 27 **Critical Analysis – Parking Subsidies**

Questions	Conclusions and Comments
Does the proposal really increase overall productivity?	A perceived shortage of parking in one area does not generally constrain total shopping activity, it simply shifts its location.
Is this proposal the best way to support local development?	Other improvements (streetscaping, marketing, and improving alternative modes, etc.) might stimulate more economic activity.
Is the proposal the best way to improve access?	Improvements to alternative modes and better parking management may address the problem at a lower total cost.
Does it provide true economic gains rather than just economic transfers?	Much of the benefit would be an economic transfer from other shopping centers.
Do the benefits justify subsidies?	Charging users directly for parking is generally more efficient and equitable since it rewards people for reducing their parking costs.
Do economic benefits offset indirect costs?	Parking subsidies stimulate automobile travel which tends to increase problems such as congestion, accidents and pollution.

This table summarizes critical questions to ask when evaluating whether public parking subsidies are an optimal way to support downtown economic development.

Empirical evidence indicates that parking subsidies often do little to support economic development: many business districts with abundant and free parking are unsuccessful while others are quite successful despite limited and priced parking. If a downtown is attractive and manages parking efficiently it can be competitive with relatively few spaces. This analysis suggests that downtown parking subsidies generally provide less total economic development than demand management strategies, because they tend to be more cost effective and support other planning objectives such as traffic congestion reduction, consumer cost savings and pollution emission reductions.

Case studies indicate that parking management can support economic development (Kolozsvari and Shoup, 2003). During the 1970s Old Pasadena's downtown had declined, with many derelict and abandoned buildings and few customers, in part due to the limited customer parking, since employees often used the most convenient, on-street spaces. After negotiating with local merchants, the city priced parking with all revenues dedicated to downtown improvements such as street furniture and trees, security patrols, better lighting, more street and sidewalk cleaning, pedestrian improvements, and marketing. This created a cycle of increased business activity, more parking revenue, and further improvements, resulting in extensive downtown redevelopment. With efficient parking management delivery vehicles and customers can almost always find a convenient parking space. Local business activity has grown far faster than in other shopping districts with lower parking prices and nearby malls that offer free customer parking. This indicates that efficient parking pricing with revenues dedicated to local improvements can support urban redevelopment and business activity.

Roadway Expansion

Roadway expansion is often proposed for traffic congestion reduction, but the added capacity is often soon filled with generated traffic (additional vehicle travel that would not occur). Most of this is additional personal travel, which provides minimal net economic productivity gain, and increases external costs such as downstream congestion, parking costs, energy imports, accidents and pollution. Table 28 identifies ways that roadway expansion affects economic productivity.

Table 28 **Productivity Impacts – Roadway Expansion**

Increases Productivity	Reduces Productivity
• Reduces traffic congestion. • Provides short-term employment.	• Costs per additional peak-period vehicle trip are often high. • Wider roads and increased vehicle traffic often degrade walking and cycling conditions. • Often increases automobile dependency and sprawl, which reduces travel options and increases parking, accident, consumer, fuel import, and pollution costs.

This table summarizes productivity impacts of expanding congested highways.

Mobility management is an alternative approach to reducing traffic congestion. This includes improvement to alternative modes, transportation pricing reforms, special programs to encourage travelers to choose efficient modes, and smart growth land use policies. The following table compares the economic impacts of these two alternatives.

Table 29 **Road Expansion Versus Demand Management Economic Impacts**

Economic Impact	Roadway Expansion	Mobility Management
Project expenditure impacts	Generates construction jobs.	Generates construction and ongoing management jobs.
Future consumer expenditures	Stimulates driving which increases vehicle and fuel expenditures.	Reduces vehicle travel and therefore vehicle and fuel expenditures.
Investment cost efficiency – economic returns on investments	Tends to be less cost effective than demand management.	It often most cost effective and efficient overall.
Transport system efficiency	Is inefficient	Increases efficiency by favouring higher value trips and more efficient modes.
Basic mobility and affordability	Tends to reduce basic mobility and affordability by stimulating automobile dependency.	Many demand management strategies improve basic mobility and affordability.
Property values and development	Can increase urban fringe property values.	Mixed. Can increase property values near transit stations.
Land use development patterns	Stimulates sprawl.	Tends to support smart growth.
Wealth accumulation (increased home equity value)	Encourages consumer expenditures on vehicles rather than housing.	Allows households to reduce vehicle costs and invest more in housing.

This table compares the economic development impacts of roadway expansion with mobility management. Mobility management generally provides greater economic benefits overall.

Highway expansion advocates generally assume that traffic congestion significantly reduces productivity, roadway expansion can significantly reduce these costs, and alternative congestion reduction strategies are infeasible. These assumptions are often untrue. Congestion is a moderate cost overall so it would be inefficient to reduce it in ways that increase other transport costs such as consumer costs, parking costs or accidents. Highway expansion tends to provide modest long-term congestion reductions, most benefits are captured by consumers, and it increases other costs, so net productivity gains are small. Mobility management generally provides greater net economic benefits because it increases overall efficiency. Table 30 identifies critical questions to consider when evaluating the economic impacts of such a proposal.

Table 30 **Critical Analysis – Roadway Expansion**

Questions	Conclusions and Comments
Does the proposal really increase overall productivity?	Reducing congestion, particularly for freight and delivery vehicles, can improve productivity.
Is this proposal really the best way to support local development?	Building the first highway to an area tends to support economic development, but road expansion provides much less marginal benefit.
Is the proposal really the best way to improve access?	Improved vehicle traffic flow may be partly offset over the long term by generated traffic and sprawl.
Does it provide true economic gains rather than just economic transfers?	In the short-term congestion is reduced, increasing productivity, but long-term benefits are often small or negative due to generated traffic.
Do the benefits justify subsidies?	Such projects are most efficiently financed by user fees.
Do economic benefits offset indirect costs?	To the degree that the roadway expansion induces additional travel it increases external costs that offset some of the direct benefits.

This table summarizes critical questions concerning economic development impacts of road expansion.

This analysis indicates that, although a good basic highway system is important for economic development, expanding highways to reduce congestion is inefficient and can reduce economic development overall, as previously described. Mobility management solutions are generally more productive and economically beneficial overall.

Public Transportation Investments

Major public transportation investments, such as new rail systems and bus rapid transit, are often proposed to increase transport efficiency and support economic development. They generally require significant subsidies, so their overall economic value depends on how much total incremental benefits exceed total incremental costs.

High quality public transit provides various economic benefits, as summarized in Table 31. Many of these result from reduced automobile ownership and use, and from transit-oriented development, so economic development impacts depend on consumer demand for these options, and whether transport and land use policies support transit.

Table 31 **Productivity Impacts – Public Transit Improvements** (Litman 2004)

Increases Productivity	Reduces Productivity
• Provides short-term employment. • Attracts travelers who would otherwise drive on major urban corridors, and so reduces traffic congestion, road and parking costs, accidents, energy consumption and pollution emissions. • Stimulants more compact, multi-modal land use development, which provides savings and benefits. • Allows households to reduce vehicle ownership and so leverages additional reductions in automobile travel and associated costs. • It improves mobility for non-drivers, providing basic mobility and affordability benefits. • Improved efficiency due to scale economies.	• It requires substantial subsidies. • Costs and subsidies per passenger-mile are often high. • Public transit can impose external costs, such as barrier effect if it blocks pedestrian access, and noise pollution.

This table summarizes productivity impacts of expanding congested highways.

Table 32 identifies issues to consider when evaluating public transit economic benefits.

Table 32 **Critical Analysis – Public Transit Improvements**

Questions	Conclusions and Comments
Does the proposal really increase overall productivity?	It can if total benefits (congestion reductions, road and parking infrastructure savings, consumer savings, etc.) exceed total costs.
Is the proposal really the best way to improve access?	High quality public transit tends to improve accessibility, particularly if implemented with supportive transport and land use policies.
Does it provide true economic gains rather than just economic transfers?	Transportation cost savings are true economic gains. Some property value increases may be economic transfers.
Do the benefits justify subsidies?	In some cases.

This table summarizes critical questions to ask when evaluating whether public transit subsidies are an optimal way to support urban economic development.

Empirical evidence indicates that high quality public transit tends to support economic development (Litman 2004). Figure 14 showed that per capita GDP tends to increase with per capita transit ridership. EDRG (2007) estimated that the current Chicago region transit plan provides a 21% annual return on investments, an enhanced plan would provide a 34% return, and the Transit-Oriented Development proposed in the regional comprehensive plan would increase the return to 61%. Allowing transit service quality to decline would impose economic costs exceeding $2 billion annually. Such analysis indicates that public transit improvements can be cost effective and increase economic development if constructed in appropriate locations, where there is sufficient travel and land use development demand, in conjunction with supportive policies.

Transportation Pricing Reforms

Various transport pricing reforms can help solve specific problems and increase efficiency. Table 33 indicates the efficient fees for various transport costs. An optimal transportation system would apply all of these fees.

Table 33 **Appropriate Pricing Of Various Transport Costs**

Cost	Pricing Method	How Calculated
Congestion	Time and location based vehicle fees or road tolls.	Prices are higher under congested conditions. Price to reduce traffic volume to optimum flow.
Roadway costs	Weight-distance fee or road tolls.	Cost allocation applied to all roadway costs, including traffic services, rent and taxes on roadway land.
Accidents	Time- and location-based fees, or distance-based fees.	Current insurance premiums prorated by annual mileage, increased to account for uncompensated accident costs.
Parking	Charge users directly for parking using time and location based fees.	Fees set to recover parking facility costs and maintain 85% maximum occupancy during peak periods.
Pollution Emissions	Time and location based fees (if possible) or distance-based fee.	A vehicle's emission rate (such as grams per mile) times regional pollution unit costs (such as cents per gram).
Fuel externalities	Fuel tax.	External costs of producing, importing and consuming fuel, including greenhouse gas emissions.
General taxes	General sales and property taxes.	General taxes should be applied in addition to special fees.

This table describes the appropriate way to price various transport costs.

Table 34 identifies ways that pricing reforms affect economic productivity. They can reduce specific transport problems, and they tend to increase overall transportation system efficiency by favoring higher value trips and more efficient modes. Some of these fees increase transaction costs and harm certain industries (automobile and petroleum industries, and businesses that depend on automobile-oriented locations), although these impacts can be minimized with good planning.

Table 34 **Productivity Impacts – Pricing Reforms**

Increases Productivity	Reduces Productivity
• Reduces specific costs such as traffic and parking congestion, accidents, and pollution damages. • Increases economic efficiency – encourages efficient use of scarce resources. • Provides revenues. Generally the most efficient and equitable funding source.	• Often increases transaction costs (costs of collecting fees). • May reduce low-income motorists' access to school and jobs. • Reduces profits of vehicle and fuel industries and businesses in automobile-oriented locations.

This table summarizes productivity impacts of pricing reforms.

Table 35 summarizes the economic impacts of transportation pricing reforms. This analysis indicates that pricing reforms tend to support economic development in various ways: they encourage consumers to reduce future vehicle and fuel expenditures, they are generally cost effective compared with road and parking facility expansion, and they tend to encourage more accessible land use development patterns.

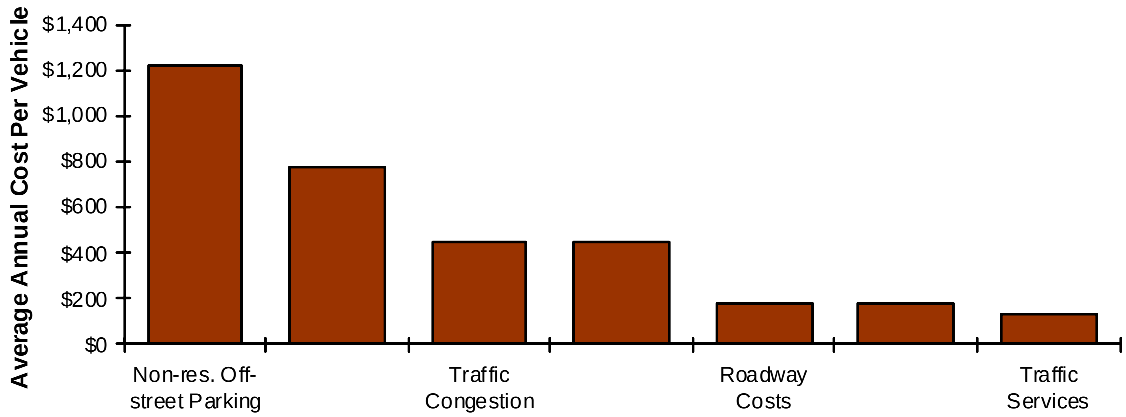
Table 35 **Transportation Pricing Reform Economic Impacts**

Economic Impact	Effects of Efficient Pricing	Maximizing Economic Benefits
Program expenditure impacts	Small to moderate. Older systems that use toll booths have high local labor requirements, but newer systems are largely automated.	Favor locally supplied pricing services if possible.
Future consumer expenditures	Many pricing reforms encourage use of alternative modes and energy conservation, significantly reducing future vehicle and fuel spending.	Implement efficient road, parking, insurance and fuel pricing as much as feasible to encourage use of alternative modes and fuel conservation.
Investment cost efficiency – economic returns on investments	Is often cost effective compared with alternatives. Provides revenue. Some pricing methods have high transaction costs that reduce their cost efficiency.	Minimize transaction costs by choosing efficient pricing methods and through good planning.
Transport system efficiency	Increases efficiency. Favors higher value trips and more efficient modes.	Apply all types of efficient pricing, and integrate with supportive policies such as improvements to efficient modes.
Basic mobility and affordability	Tends to support basic mobility but can reduce affordability, although overall impacts depend on the quality of alternatives available and how revenues are used.	Use positive financial incentives, such as parking cash out and PAYD insurance, insure that affordable transport options are available, and use revenues to support affordable options and benefit lower-income people.
Property values and development	Impacts are mixed and highly variable. Efficient pricing tends to increase development and property values in accessible locations, but reduce them in automobile-dependent locations.	Integrate transportation and land use planning to maximize the supply of development that can occur in accessible, multi-modal areas, in conjunction with pricing reforms that favor accessible locations.
Land use development patterns	Most transport pricing reforms support and are supported by smart growth.	Integrate transportation and land use policies to maximize the impacts and benefits of transport pricing reforms and smart growth.
Wealth accumulation (increased home equity value)	Mixed.	Increase supply of affordable, accessible owned housing (condominiums and single-family homes) suitable for lower-income households.

This table compares the economic development impacts of roadway expansion with mobility management. Mobility management generally provides greater economic benefits overall.

Figure 22 illustrates the estimated magnitude of various external transportation costs (costs not borne directly by users). These externalities total about $3,500 per vehicle-year or 28¢ per average vehicle-mile, so efficient pricing would approximately triple current U.S. vehicle operating costs (the variable costs of driving). If some costs cannot be efficiently priced other fees may be justified on second-best grounds. For example, if efficient road tolls or emission fees are infeasible, it may be appropriate to raise fuel taxes to internalize roadway costs and discourage pollution emissions.

Figure 22 **Estimated Average Automobile External Costs** (Litman 2009a)



This figure illustrates the estimated annual costs of motor vehicle external costs.

This suggests that efficiency justifies significantly higher motor vehicle user fees. Among oil consuming countries, GDP tends to increase with fuel price, as indicated in Figure 17. The 2004 FHWA *Conditions and Performance* report estimates that $79 billion is needed annually to maintain the Interstate Highway System performance but congestion pricing would reduce this cost by 28% by reducing peak-period traffic demand, and the revenues could cover about 40% of highway costs.

Automobile-Oriented Versus Transit Oriented Development Expenses

Households in Portland, Oregon's transit-oriented neighborhoods own an average of 0.93 vehicles and drive an average of 9.8 daily vehicle-miles, compared with 1.93 vehicles and 21.8 daily vehicle-miles elsewhere in the region (Ohland and Poticha 2006). This occurs because transit-oriented development improves travel options (better walking, cycling and public transit) and increases land use accessibility (jobs and services are closer together, reducing the amount of travel required to access activities). This provides true resource savings: less money, time and energy are required to meet transportation needs. This can provide substantial savings and benefits that support economic development.

Table 36 **Automobile and Transit Oriented Development Costs**

	Cost Per Vehicle	Auto-Oriented	Transit Oriented	Difference
Vehicles		0.93	1.93	1.0
Vehicle Expenses	$3,072	$2,857 (4.5%)	$5,514 (8.7%)	$2,657 (4.2%)
Fuel	$1,255	$1,167 (1.8%)	$2,253 (3.6%)	$1,085 (1.7%)
Residential Parking	$1,000	$930 1.5%)	$1,795 2.8%)	$865 (1.4%)
Public Transit		$500 (0.8%)	$100 (0.2%)	-$400 (0.6%)
Totals		*$5,454 (8.6%)*	*$9,661 (15.3%)*	*$4,207 (6.7%)*

Transit-oriented development reduces transportation costs. Numbers in parenthesis indicate percentage of $63,091 average household income.

In 2007 U.S. households spent an average of $3,072 on fixed vehicle expenses and $1,255 on fuel per vehicle (BLS 2008). Residential parking typically costs about $1,000 per vehicle-year. Table 36 compared typical annual household transport expenditures for these locations. This indicates that transit-oriented locations provide various user savings.

- $4,207 in annual vehicle, fuel and residential parking expenses, equivalent to 6.7% of average household income. Since vehicle and fuel expenditures provide relatively little domestic employment and business profits this increases national economic development.
- Since about 60% of petroleum prices are for crude oil and about 70% of U.S. oil consumed is imported, a typical household that shifts from an automobile-oriented to a transit-oriented location reduces $456 sent to a foreign country.
- Parking savings reduce development costs, which increases housing affordability.

To the degree that living in a transit-oriented community is voluntary (consumers could choose other options) the resulting travel shifts provide direct benefits to consumers, in addition to any indirect or external benefits, and can be considered equivalent to an increase in household income. For example, if households voluntarily choose to live in transit-oriented neighborhoods and as a result drive less and rely more on walking, cycling and public transit, they must be better off overall, even if their travel time increases, or they would not have made the change.

In addition to these direct user savings and benefits reduced per capita vehicle travel and shifts to public transit for urban trips tends to provide external benefits (Litman 2004):

- Reduced traffic congestion. A portion of peak period travelers shift from driving to public transportation because the service is efficient, comfortable and integrated with land use (many schools and worksites are located near stations).
- Non-residential parking cost savings. In a typical city businesses and governments provide 2-6 subsidized parking spaces per vehicle, each typically costing $500 to $1,500 per year. Fewer vehicle trips per capita allow the number of parking spaces to be reduced, providing financial savings and allowing more compact development.
- Reduced traffic risk. Less vehicle traffic reduces traffic densities, which reduces total crash risk.
- Pollution emission reductions and reduced sprawl.

As described earlier, shifting expenditures from vehicles and fuel to other consumer goods tends to increase economic development in most regions since vehicle and fuel have low labor input and are largely imported. This indicates that policies that help accommodate demand for transit-oriented development tend to increase economic development. If some households prefer transit-oriented locations but cannot afford that option due to inadequate supply, everybody is worse off overall, including people who live in more automobile-oriented locations and rely entirely on automobile travel.

Multi-Modal Transportation Economic Development Benefits

The following analysis estimates the economic benefits of more multi-modal transportation planning in a two-million population urban region. Residents of automobile-oriented regions typically average 12,500 annual miles per capita and spend about $3,500 per capita in fixed vehicle expenses, while residents of multi-modal communities typically average 7,500 annual miles and spend $2,500 in fixed vehicle expenses. Table 37 indicates resulting employment gains, based on the analysis summarized in Table 10 which indicates that a million dollars of vehicle expenditures shifted to general consumer spending generates 3.6 national jobs, a million dollars of fuel expenditures shifted to general consumer spending generates 4.5 jobs, and a million dollars spent on public transit generates 14 additional jobs (Chmelynski 2008).

Table 37 **National Economic Development Benefits of Multi-Modal Transport**

	Fuel Prices			
	$2.00	$3.00	$4.00	$5.00
Vehicle cost savings per capita	$1,000	$1,000	$1,000	$1,000
Fuel cost savings	$500	$750	$1,000	$1,250
Vehicle savings employment gains	7,200	7,200	7,200	7,200
Fuel savings employment gains	4,500	6,750	9,000	11,250
Transit employment gains	5,600	5,600	5,600	5,600
Total employment gains	*17,300*	*19,550*	*21,800*	*24,050*

This table indicates national employment gains that result if two million residents shift from automobile-oriented to more multi-modal transportation systems, using current multipliers.

These impacts are much greater at the regional level and are expected to increase in the future as international oil prices rise. Table 38 indicates estimated future regional employment gains resulting from more multi-modal transport, assuming a million dollars shifted from vehicles to general consumer spending generates 8 regional jobs, and a million dollars shifted from fuel to general consumer spending generates 12 jobs.

Table 38 **Regional Economic Development Benefits of Multi-Modal Transport**

	Fuel Prices			
	$3.00	$4.00	$5.00	$6.00
Vehicle cost savings per capita	$1,000	$1,000	$1,000	$1,000
Fuel cost savings	$750	$1,000	$1,250	$1,500
Vehicle savings employment gains	16,000	16,000	16,000	16,000
Fuel savings employment gains	18,000	24,000	30,000	36,000
Transit employment gains	5,600	5,600	5,600	5,600
Total regional employment gains	*39,600*	*45,600*	*51,600*	*57,600*

This table indicates estimated regional employment gains that result if two million residents shift from automobile-oriented to more multi-modal transportation systems, using future multipliers.

More multi-modal transport and land use policies reduced per capita vehicle travel in Portland, Oregon about 20%, providing economic development, consumer savings, reduced pollution, better health, and more livable neighborhoods (Cortright 2007).

Automobile Industry Subsidies

In exchange for building or maintaining production facilities in a particular jurisdiction, automobile manufactures often demand subsidies, including reduced taxes and utility fees, special infrastructure such as access roads, and various loans and grants. Advocates argue that these subsidies support economic development but critics argue that they:

- Reduce or eliminate the economic benefits, when all public costs are considered.
- Encourage inefficient business practices and prevent industries from restricting as needed to be productive in the future.
- Are largely economic transfers, pitting one jurisdiction against another.

Since North American vehicle manufactures tend to earn their greatest profits from large, fuel inefficient vehicles, transportation policies are also affected. For many years, U.S. and Canadian fuel efficiency standards were kept low in response to political pressure from the domestic automobile industry, and efforts to encourage use of alternative modes are sometime opposed on the assumption that reduced demand for vehicles and fuel is economically harmful.

At one time, when the North American motor vehicle industry was expanding (between 1910 and the 1960s) it was a leader in wages, profits, and technological innovation (McShane 1994). During that period vehicle and road production experienced scale economies, so increased domestic demand reduced unit costs. You benefitted as your neighbors purchased more vehicles and drove more annual miles because this helped reduced your costs and expand the road system. At that time, policies that encouraged automobile ownership and use may have supported economic development.

The world automobile industry is now overcapitalized, with far more production capacity than justified by demand, and for most manufactures, real profits (excluding subsidies) are small or negative. Other industries are more profitable and have more future potential. As described earlier in this report, motor vehicle and fuel expenditures provide fewer jobs and less business activity than most other consumer spending, and far less than public transit expenditures. As a result, policies that favor automobile travel or encourage the purchase of fuel intensive domestic vehicle are likely to reduce economic development (Litman 2009b).

Best Practices

Transportation economic development analysis should be comprehensive, considering all significant objectives, impacts and options. Planning should consider a variety of options, including improvement to alternative modes and mobility management strategies.

Conventional transportation project evaluation tends to focus on some economic impacts but often overlooks other impacts of equal or greater magnitude. For example, conventional analysis tends to focus on short-term employment and business activity impacts, but overlooks how current transport planning decisions affect future consumer expenditures, and therefore the portion of household expenditures exported to purchase vehicles and fuel: goods which tend to provide relatively little domestic economic development. Similarly, conventional economic analysis focuses on congestion costs and congestion cost savings, but tends to ignore parking costs, and vehicle ownership costs.

Table 39 Transportation Economic Impact Analysis

Generally Considered	Often Overlooked
• Project impacts on local employment and business activity. • Increased traffic speeds and reduced congestion delay • Reduced vehicle operating costs.	• Impacts on future consumer expenditures on vehicles and fuel, and their effects on future local employment and business activity. • Parking facility costs and its impacts on development patterns and affordability. • Generated traffic and sprawl effects, and resulting impacts on downstream congestion, per capita vehicle costs, accidents, energy consumption and pollution emissions. • Basic mobility and non-drivers' ability to access services, schooling and employment. • Mobility management options as alternatives to conventional solutions.

This table identifies economic impacts that are often overlooked in conventional analysis.

These omissions tend to exaggerate the economic benefits of automobile-oriented improvements (parking subsidies, roadway expansion, low fuel taxes, sprawled land use development, etc.) and undervalue the benefits of alternative modes and mobility management strategies. For example, when evaluating the economic benefits of improvements to alternative modes and mobility management strategies that reduce vehicle ownership and use, conventional analysis generally places no value on the parking and vehicle ownership cost savings (vehicle operating savings are often recognized, but the evaluation assumes that the total number of vehicles in a community are not reduced), although these are among the largest economic costs. Similarly, conventional economic analysis places no value on local employment and business activity benefits from policies that reduce future household expenditures on vehicles and fuel, although this is increasingly significant if oil prices rise in the future.

Transportation economic analysis should reflect basic economic and planning principles. For example, it should highlight when a particular policy increases mispricing or in some way biases planning decisions. It should identify and consider a variety of options, including alternative modes and mobility management strategies.

The following factors should be considered when evaluating economic impacts:

- *Transportation system efficiency* - Whether the policy or program increases economic efficiency and productivity, particularly for freight and service delivery.
- *Direct economic impacts* - Jobs and business activity generated by project expenditure.
- *Transportation project cost efficiency* – Project net benefits should be compared with various alternatives, including other modes and demand management.
- *Indirect and external costs* – Analysis should identify indirect and external impacts, including downstream traffic congestion, road and parking facility costs, accidents, energy imports, pollution emissions, and subsidies.
- *Consumer expenditures* – Impacts on future household expenditures, particularly for vehicles and fuel, and their impacts on employment and business activity.
- *Land use impacts* – Impacts on strategic development objectives (such as redevelopment of older neighborhoods, or reducing sprawl), and increases in land values.
- *Basic mobility and affordability* - Impacts on basic mobility, and transportation and housing affordability.
- *Wealth accumulation* - Household wealth created by housing investments.
- *Outcomes* – Indicators such as community health, longevity, education attainment, and life satisfaction.

Analysis of specific policies and projects should critically consider the following issues:

- Does the proposal really increase overall productivity?
- Is this proposal really the best way to support local development?
- Is the proposal really the best way to improve transportation and access?
- Does it provide true economic gains rather than just economic transfers?
- Do direct economic benefits offset indirect costs and subsidies?

Transportation economic impact analysis should report as many of these impacts as possible. Impacts that cannot be quantified should be described. The planning process should acknowledge analysis limitations, so stakeholders understand what is and is not included in analysis, and the direction of any biases.

Characteristics of An Efficient Transportation System

An economically efficient transportation system reflects efficient market principles, including consumer options, efficient pricing and neutral public policies. It will therefore include the following features:

- Well designed and maintained transportation facilities. This includes a network of roadways that accommodate walking, cycling, automobile and truck travel and public transit; a network of walking and cycling facilities; and an efficient network of railroads, ports and airports. These facilities should be efficiently sized. Not every community needs a major port or airport; excess capacity is costly to maintain and can dissipate demand so no facility operates efficiently.
- A multi-modal transportation transport system which offers travelers a diverse range of options, which typically includes walking, cycling, public transit, automobile, taxi services, and delivery services. Although the combination of options that are optimal vary from one area to another depending on demographic and geographic factors, in general, the more options available the easier it is for users to choose the most efficient options for each trip.
- Efficient pricing, including cost-based pricing of roads, parking, insurance and fuel.
- Pricing and policies that favors higher value trips over lower-value trips, and more efficient modes (such as those that require less road space per passenger-mile under congested conditions) over less efficient modes, including special traffic lanes and parking facilities for freight vehicles and High Occupancy Vehicles (HOVs) where sufficient demand exists.

Characteristics of An Efficient Transportation Improvement Project

Transportation improvements are generally incremental: a particular project is being considered to address a particular problem, such as a new or significantly improved roadway to improve access to a particular area, or an expanded roadway to reduce traffic congestion.

In general, basic roadway improvements, such as paving a gravel road, supports economic development by reducing transportation costs, provided that increased development in that area is desirable. However, expanding existing roadways to reduce traffic congestion is not necessarily cost effective if some combination of improvements to alternative modes, more efficient pricing, or other incentives to reduce peak-period vehicle travel can reduce congestion at a lower total cost. To the degree that peak-period automobile travel is underpriced (and in most cases it is to a significant degree), expanding highways can have negative overall impacts on economic development because incremental costs resulting from in induced travel (downstream congestion, parking facility costs, accident damages, increased sprawl and associated costs, increased energy imports and pollution emissions) often exceed the incremental congestion reduction benefits.

An overbuilt transportation system is inefficient. Excessive capacity is costly to maintain and can dissipate demand so individual railroads, ports and airports operate below their efficient capacity. It is therefore important to apply strategic regional planning to transportation system development.

Conclusions

Transportation policy and planning decisions can have various economic impacts, including direct and indirect impacts on employment, industrial activity, productivity, competitiveness, profits, property values, tax revenues, equity, affordability and wealth accumulation. It is important that transport policy and planning evaluation include comprehensive economic impact analysis.

Economic development objectives can vary depending on specific needs and priorities. Conventional economic analysis tends to focus on employment and GDP impacts, but other indicators, such as increased affordability, may also be important. Conventional transport policy and project evaluation tends to focus on some economic impacts but ignores or undervalues others of equal or greater magnitude, such as parking and vehicle ownership costs, and how current planning decisions will affect future consumer expenditures on vehicles and fuel.

Transportation policies and planning practices tend to support economic development when they reflect economic efficiency and good planning principles: adequate consumer options, cost-based pricing (unless subsidies are specifically justified), and comprehensive, neutral planning. Improving producer transport (freight and service delivery, and business travel) tends to support economic development much more than improving personal transport. The following transportation improvements are especially likely to support economic development:

- Improving freight and service delivery, and other types of business travel.
- Reducing costs such as congestion, crashes, energy imports and pollution.
- Improving access to an area with undeveloped economic potential.
- Stimulating industries with growth potential, such as a nascent tourism industry.
- Reducing total expenditures on imported vehicles and fuel.
- Increase education and employment access.

During the last century transportation productivity increased substantially: the money and time costs of travel declined more than order of magnitude. This contributed significantly to economic development. Although some transportation productivity gains may occur in the future due to improved technology, they may be partly offset by rising congestion and energy costs. Larger economic benefits are likely to result from improved mobility substitutes (better teleconferencing and delivery services), and mobility management strategies (improvements to alternative modes, efficient road and parking pricing, more accessible land use development, and least-cost planning). These strategies are often the most cost effective way to improve transportation and support economic development.

Some people claim there is a direct relationship between mobility and economic productivity, so efforts to reduce vehicle travel are economically harmful. Mobility contributes to economic productivity, but beyond an optimal level marginal benefits decline. Although, increasing from low to moderate mobility (less than 1,000 up to about

4,000 annual VMT per capita) tends to increase economic productivity, there is little gain from additional vehicle travel. Many economically successful countries and cities have relatively low per capita vehicle travel. Within North America, regions with lower per capita VMT tend to be more economically productive. Economic productivity also tends to increase with public transit travel, land use density and fuel prices, and declines with increased roadway supply; all indicating that more diverse and efficient transportation system tends to increase economic productivity and support economic development.

This report describes various factors to consider when evaluating the economic development impacts of specific transport policies and programs. This analysis should consider a wide range of impacts and options.

Comprehensive analysis of economic impacts indicates that:

- Parking subsidies are generally an inefficient way to support downtown economic development. More efficient parking management is generally more cost effective and beneficial overall.
- High quality interregional highways support economic development, but once this basic highway system exists, expanding its capacity to reduce congestion has negative as well as positive impacts. By stimulating automobile dependency (fewer travel options) and sprawl it tends to reduce transportation system efficiency and increase external costs such as parking costs, accident risk, and pollution damages.
- Mobility management strategies tend to increase transport system efficiency and economic productivity, reduce specific costs such as traffic congestion, accidents and consumer costs, and provide basic mobility for non-drivers. Such strategies tend to be particularly beneficial if implemented as an integrated program. Many of these strategies reflect basic market and planning principles, and so tend to increase productivity and economic development.
- High quality public transportation provides many economic benefits and so can be cost effective, provided there is sufficient consumer demand and supportive transport and land use policies.

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