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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, income, 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.

This report was summarized in:
Economically Optimal Transport Prices and Markets: What Would Happen If Rational Policies Prevailed? presented at the International Transportation Economic Development Conference, 2014 in Dallas, Texas (https://tti.tamu.edu/conferences/ited2014); at www.vtpi.org/ITED_optimal.pdf.

Contents

Executive Summary

Economic development refers to progress toward a community's economic goals such as increased employment, income, productivity, property values, and tax revenues. Transport policy and planning decisions can affect economic development in various ways, including some that are indirect and long-term.

Conventional transport economic evaluation tends to recognize some of these impacts but overlook others. Some guidebooks and software tools exist for evaluating transportation economic development impacts, but most can only evaluate a limited range of modes, impacts or project types. Few tools can evaluate the full economic impacts of mobility management and smart growth policies and programs.

This has important implications for transport policy and planning decisions. Theoretical and empirical evidence indicates that once a region has a basic paved roadway system, further roadway expansion provides declining marginal benefits, while investments in alternative modes and mobility management generally provide greater economic returns. Similarly research indicates that efforts to minimize vehicle, road, parking and fuel prices (through low taxes, and direct and indirect subsidies) reduces economic competitiveness and wealth generation. In addition, research also indicates that excessive land use sprawl creates economic costs.

Described differently, sustainable transport planning balances economic, social and environmental objectives. Comprehensive economic impact analysis is essential for true sustainability planning, similar to comprehensive evaluation of social and environmental impacts. This helps identify "win-win" solutions, which are policy and planning decisions that help achieve economic, social and environmental objectives together.

How Transport Impacts Economic Development

To evaluate the economic impacts of transport policy and planning decisions it is useful to consider the specific mechanisms by which transport can affect economic activity. There are often several steps between a particular planning decision and its ultimate economic impacts, as summarized below. Comprehensive economic analysis must consider these various impacts and outcomes.

Transport Policy or Planning Decision
(investments, management changes, pricing reform, smart growth land use policy, etc.)
⇩
Intermediate Impacts
(changes in infrastructure supply efficiencies, transport costs, land use, external costs, consumer expenditures, etc.)
⇩
Economic Development Outcomes
(changes in economic productivity, employment, affordability, etc.)

Types of Economic Impacts

Major categories of economic impacts are described below.

Accessibility

Accessibility (the ability of people and businesses to reach goods, services and activities) affects productive activities (education, work, manufacturing, trade, etc.), so improving accessibility tends to increase productivity. Access can be improved by reductions in shipping costs, travel time, vehicle operation, and infrastructure, and by using resources more efficiently by favoring higher value travel over lower value travel (for example, by favoring freight over personal transport on congested roadways).

Indirect and external costs

Traffic congestion, road and parking facility costs, accident and pollution damages tend to reduce economic productivity. Reductions in these costs support economic development.

More efficient land-use development patterns

More compact, mixed, connected land use development patterns tend to improve overall accessibility, increase agglomeration efficiencies, and increase productivity, for example, by making more land available for agriculture.

Consumer expenditures

How consumers spend money affects economic activity in an area. Some goods provide more regional employment and business activity than imported goods.

Supports specific industry

A particular transport service or activity may affect a particular industry. Improving that type of transport can support those industries, which may support strategic economic development. For example, improving visitors' ability to reach an area supports tourist industries, and improving customer access supports local retail industry.

The table below summarizes these mechanisms and the degree that they are considered in conventional transport planning.

Table ES-1 **Types of Transport Economic Impacts**

Mechanism	Examples	Degree Considered in Planning
Accessibility and transport costs	Paving roads, reducing congestion, improving transit service.	Generally considered for motor vehicle improvements, particularly increased motor vehicle traffic speeds and reduced vehicle operating costs.
Reduced external costs	Policies and programs that reduce congestion, accidents, pollution emissions.	Sometimes considered.
Efficient land use	Road and parking facility expansion, and reduced vehicle operating costs tend to stimulate sprawl, while walking and public transit improvements support more compact development.	Generally ignored.
Expenditure impacts	Per capita expenditures on transport vehicles and fuel.	Generally ignored.
Supports specific industries	Certain industries are particularly affected by transport activities.	Often considered if that industry is considered important in a community.

This summarizes ways that transport policy and planning decisions affect economic development.

Since industries and areas vary in the types and amount of transportation they require, a particular transport policy or project may have very differing impacts on their productivity and development. For example, for natural resource and bulk retail industries, freight transport is a major portion of production costs, so changes in freight transport speeds and costs can have a major impact on their productivity and profits, and economic development in communities where they are located. For service industries (retail, restaurants, hotels, etc.), commuting costs, and therefore businesses' ability to attract and retain suitable employees, can have significant impacts on their productivity and profits. Even small differences in such costs can affect a business or area's competitiveness if others.

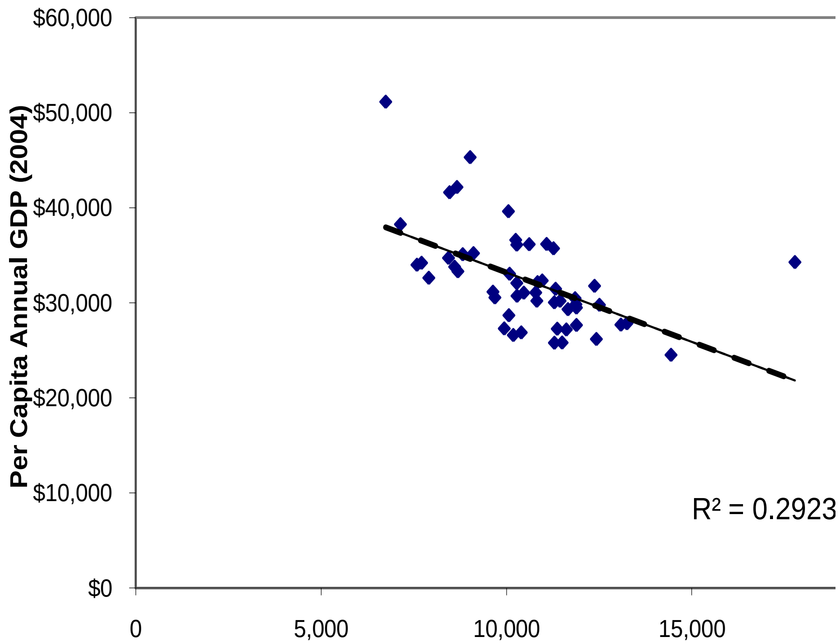
Some of these impacts reflect net economic efficiency and productivity gains. Others are economic transfers; one business or industry gains but another loses an equal amount. For example, improving access in a commercial area (such as government supplied parking or better public transit service) may benefit local businesses but does not necessarily increase total regional economic activity, without the improvements consumers would have purchased the same goods in a different location. Overall economic impacts often depend on whether a particular transport improvement increases overall productivity (for example, reducing retail activity labor costs) or supports strategic development (for example, by supporting a growing industry such as tourism).

Evidence of Transport Economic Impacts

Evidence about various transport-related economic development impacts is described below. This evidence indicates that many policies and programs that support environmental objectives also support economic development.

Figure 1 indicates that among U.S. urban regions, increased per capita vehicle-miles of travel (VMT) is associated with a reduction in per capita Gross Domestic Product (GDP). This relationship probably reflects a variety of factors: higher VMT results from more sprawled land use, and increases direct user costs and indirect costs to society. Higher consumer expenditures on vehicles and fuel reduce regional employment and business activity and increase the cost of living and therefore wages (i.e., the limit development of industries that require many lower-wage employees), and higher external costs (congestion, road and parking facilities, accident and pollution damages, etc.) impose economic costs. This suggests that transport policies that reduce VMT by improving alternative modes; more efficient road, parking and fuel pricing; and more accessible and multi-modal land use policies probably increase economic productivity. Conventional transport economic evaluation does not recognize these factors; it generally assumes that increased vehicle travel, and therefore polices that stimulate vehicle travel, are economically beneficial overall.

Figure ES-1 **Per Capita GDP and VMT For U.S. States** (VTPI 2009)[1]

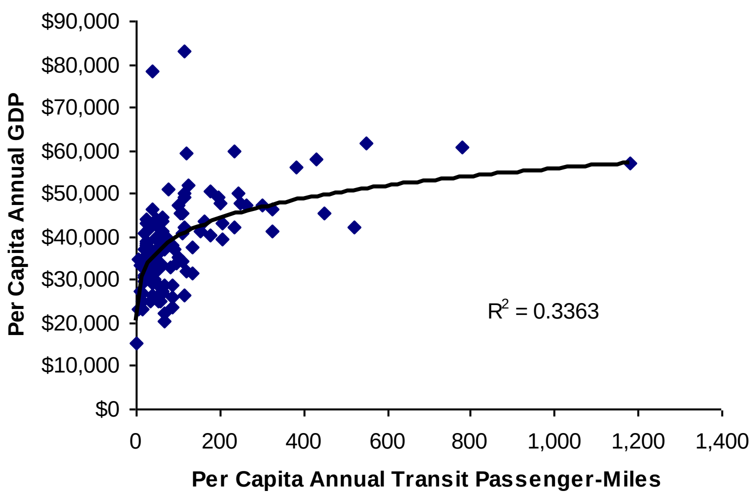


Per capita economic productivity increases as vehicle travel declines. (Each dot is a U.S. state.)

[1] 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*, the TTI's *Urban Mobility Report*, and the Bureau of Economic Account's *Gross Domestic Product By Metropolitan Area* (www.bea.gov/regional/gdpmetro).

Similarly, Figure 2 indicates that GDP tends to increase with public transit travel. A similar positive relationship is found between non-motorized travel and GDP. This can be explained by the same mechanisms described above: higher per capita transit travel is associated with more compact land use and lower transport costs which provide various economic development benefits. This suggests that transport policies that improve alternative modes (walking, cycling and public transit); more efficient road, parking and fuel pricing; and more accessible land use are likely to increase economic productivity.

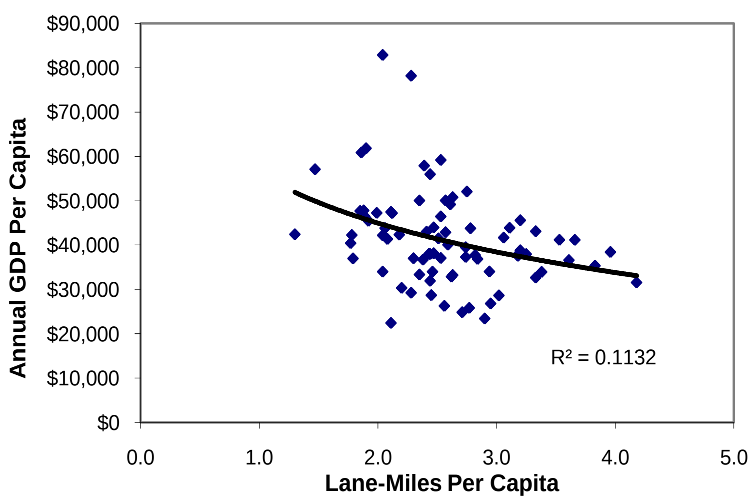
Figure ES-2 **Per Capita GDP and Transit Ridership** (VTPI 2009)



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

Figure *ES-3* indicates that per capita GDP tends to decline with increased roadway lane miles, which probably reflects the same mechanisms as the previous two slides.

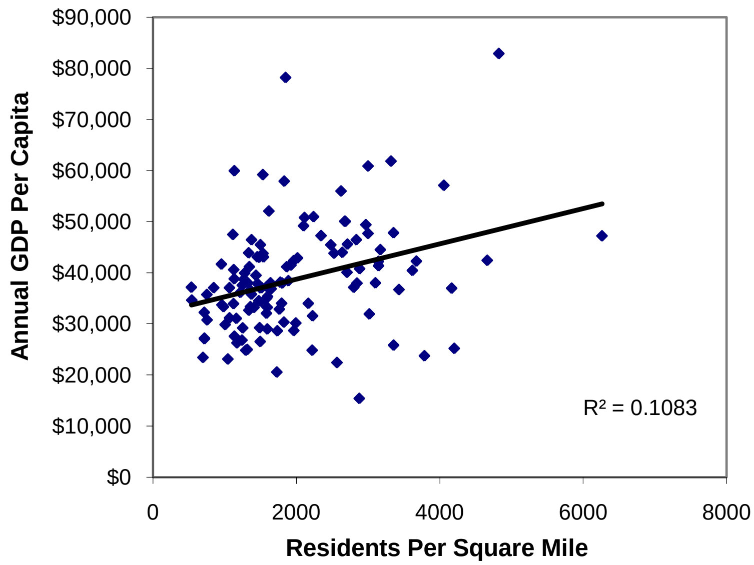
Figure ES-3 **Per Capita GDP and Road Lane Miles** (VTPI 2009)



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.)

Figure ES-4 indicates that per capita GDP tends to increase with regional population density. This probably reflects the economic benefits of improved land use accessibility (reduced distances between activities), increased transport system diversity, and reduced sprawl costs. It implies that smart growth policies tend to support economic development.

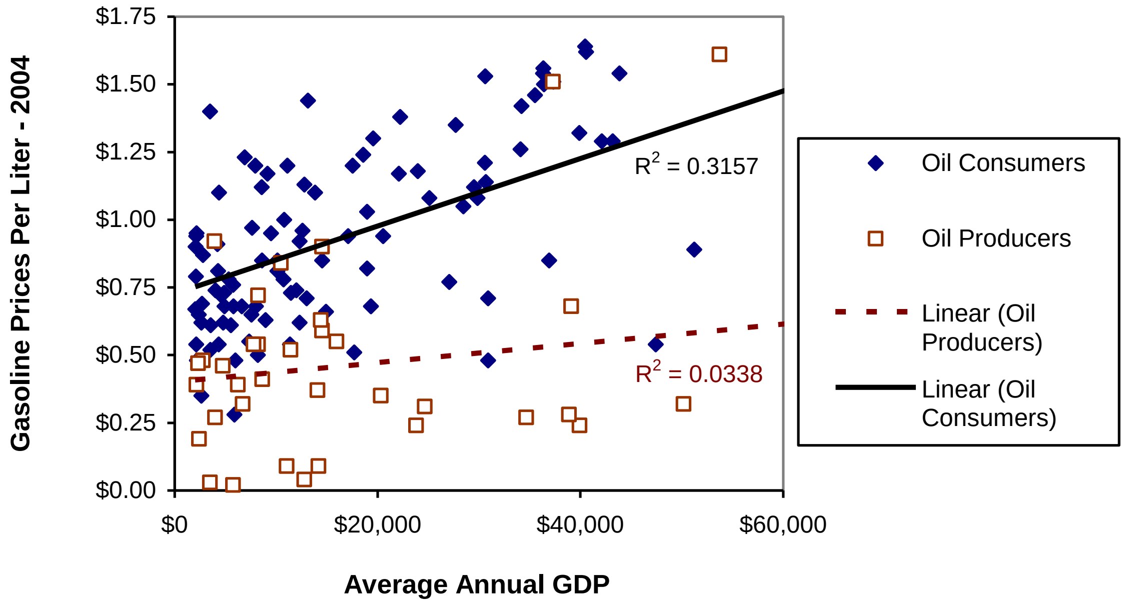
Figure ES-4 **Per Capita GDP and Urban Density** (BTS 2006 and BEA 2006)



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

Figure ES-5 shows that per capita GDP increases with fuel prices, particularly among oil importing countries ("Oil Consumers"). This probably reflects the economic benefits of reduced fuel importation, plus the efficiency benefits of reduced per capita VMT, and associated impacts such as shifts to alternative modes and reduced sprawl. This suggests that high fuel prices, and probably increases in other vehicle user fees (more road pricing, parking pricing and distance-based fees) tend to increase economic productivity and development.

Figure ES-5 **GDP Versus Fuel Prices, Countries** (Metschies 2005)[2]



Economic productivity tends to increase with higher fuel prices, indicating that substantial increases in vehicle fees can be achieved without reducing overall economic productivity.

Comparisons of international cities shows similar patterns, beyond an optimal level, automobile mode share declines with increased wealth. This research indicates that many transportation policy reforms recommended for achieving social and environmental objectives can also support economic development. Some of these relationships are contrary to popular assumptions that increased vehicle travel and reduced fuel taxes support economic development. More research is needed to improve our understanding of these relationships and provide practical tools to allow these factors to be incorporated into normal transport policy and planning analysis.

[2] 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.

Degree Impacts Are Considered In Current Economic Evaluation

Current economic evaluation tends to consider some economic impact categories and overlook others when evaluating specific policies and projects, as summarized in Table 2.

Table 2 **Evaluation of Specific Transport Policies and Programs**

Policy/Program	Economic Impacts				Conclusions/Comments
	User Costs	External Costs	Land Use Impacts	Expenditure Impacts	
Roadway expansion	Reduces congestion costs	Increases most costs due to induced travel	Increases sprawl	Increases fuel expenditures	Conventional evaluation tends to recognize congestion reduction benefits but overlooks other impacts
Market distortions (such as underpricing roads and parking)	Reduces vehicle expenses	Increases congestion, accidents, pollution costs	Increases sprawl	Increases fuel expenditures	Conventional evaluation underestimates the economic costs of market distortions
Improve alternative modes	Reduces costs	Reduces costs	Supports compact development	Reduces veh. and fuel spending	Conventional evaluation underestimates economic benefits
Efficient road, parking, insurance, fuel pricing	Increases costs	Reduces costs, provides revenue	Supports compact development	Reduces veh. and fuel spending	Conventional evaluation underestimates these economic benefits
Mobility Management programs	Mixed	Reduces costs	Supports compact development	Reduces veh. and fuel spending	Conventional evaluation underestimates these economic benefits
Smart growth land use policies	Reduces costs	Reduces costs	Supports compact development	Reduces veh. and fuel spending	Conventional evaluation underestimates these economic benefits

Conventional transport economic evaluation tends to consider some economic impacts but overlook others. Overall, current practices tend to exaggerate the benefits of roadway expansion and underestimate the benefits of alternative modes, efficient pricing and more accessible land use patterns.

This analysis indicates that, by overlooking external costs, sprawl costs, and the economic effects that result when transport decisions increase consumer expenditures on vehicles and fuel, conventional transport economic evaluation tends to exaggerate the economic benefits of roadway capacity expansion, underestimates the economic costs of market distortions, and undervalues the economic benefits of improvements to alternative modes, efficient pricing, and smart growth land use policies.

These omissions can be significant in magnitude. Various studies suggest that, once a roadway system is mature, with high-grade paved highways connecting most regions, further roadway expansion provides diminishing marginal economic benefits, while many external transportation costs and sprawl costs are increasing in magnitude. Overlooking the tendency of common transport policy and planning decisions to exacerbate these economic impacts is likely to significantly skew planning decisions.

Introduction

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

Economic development (also called *macroeconomics*) refers to progress toward a community's strategic 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.
Desired 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.

Transportation planning decisions can affect economic development in various ways:

- As an input to economic activities (shipping, business travel, the delivery of services), which affects production and distribution costs.
- 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 policy and project evaluation, but others are often overlooked or undervalued. Economic development is sometimes a primary planning objective but other times overlooked. Both extremes can lead to bad decisions: economic development strategies that contradict other planning objectives, or decisions to achieve social and environmental objectives that contradict economic development. More comprehensive analysis considers economic, social and environmental objectives together, to identify truly optimal policies.

Although transportation contributes to economic productivity it also imposes significant economic costs, so excessive mobility can be as economically harmful as too little. For example, it would be economically inefficient if people are forced to carry heavy loads on their back instead of using vehicles, but it is also economically inefficient if people are forced to drive for trips that can easily be performed by walking or bicycling. Efficient transport policies result in optimal mobility: neither too little nor too much mobility, with each mode used for what it does best. This maximizes productivity and therefore economic development.

Economic impacts are affected by context. For example, in competitive markets, small differences in a company or area's costs and prices can lead to large differences in market share and profitability. It is therefore important to understand these factors when evaluating impacts.

Transportation economic development evaluation 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?

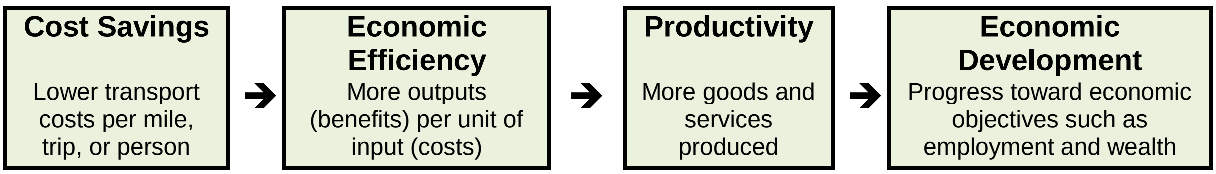
This report provides guidance for evaluating the economic development impacts of specific transportation policies and planning decisions. It defines economic development concepts, investigates the role that transportation plays in economic production, how transport improvements contribute to economic 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.

How Transportation Affects Economic Development

This section discusses basic concepts related to transport economic analysis.

Economic Efficiency and Productivity

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



Increasing transport system efficiency provides productivity gains that filter through the economy (TRB 2002; Duncan 2014). For example, reduced shipping costs may increase business profits, reduce retail prices, improve service quality (more frequent deliveries), allow tax increases or a combination of these. Even modest efficiency gains can provide significant benefits. If a business has an 8% annual return on investment and transport represents 16% of its costs, a 5% reduction in transport costs increases profits 10%.

Economic efficiency increases if transport resource costs (including time, land, risk and energy) are reduced or if the value provided by transport activity increases. For example, transport system efficiency can be increased if higher value trips are given priority over lower-value trips, such as if a freight or service vehicle with a $100 per hour opportunity cost is given priority over vehicles with only $10 per hour opportunity cost. This is why efficient road and parking pricing, which tests users willingness to pay for roads and parking, can increase transport system efficiency even if this reduces total vehicle traffic.

The ultimate goal (or *output*) of transportation is *accessibility*, people and industry's ability to access desired resources, services and markets, which can include raw materials, labor, worksites, professional services, business meetings, clients and distributors. Increased accessibility (a reduction in the time, money or risk required to reach resources and services) increased productivity.

Conventional planning tends to be *mobility-based*: it assumes that *transportation* means *vehicle travel* and evaluates transport system performance using such as vehicle traffic speeds, miles-per-gallon, cents-per-passenger-mile and ton-miles-per-dollar, which reflect the speed and affordability of vehicle travel, and so favor automobile-oriented transportation improvements and sprawled land use development. Accessibility-based analysis expands the range of impacts and options considered in transport planning. For example, accessibility-based analysis recognizes that land use sprawl can increase the distances between destinations and therefore accessibility costs, and that telecommunications and delivery services can substitute for physical travel.

Accessibility-based planning expands the range of solutions that can be applied to solve transport problems, including some strategies that reduce total vehicle travel, for example, by improving alternative modes (walking, cycling, ridesharing, public transit, etc.), encouraging more efficient use of existing transport resources (such as more efficient road, parking, insurance, and fuel pricing, and roadway management that favors more efficient modes and higher value trips, such as high-occupant and freight vehicles), more accessible (more compact, mixed, connected, multi-modal) land use development, and improved mobility substitutes (telecommunications and delivery services). These strategies can result in more efficient use of transport resources, for example, by encouraging travelers to shift to more resource efficient modes (walking, cycling, ridesharing, public transit, telework) when feasible, so higher value vehicles (freight, service, bus, urgent personal errands, etc.) can travel unimpeded by congestion.

Table 2 **Mobility Versus Accessibility Transport Improvements**

Mobility Improvements	Other Accessibility Improvements
Reduced Costs Per Travel Mile or Kilometer	Other ways to reduce access costs
• Road and parking facility expansion (reduced traffic and parking congestion) • Increased vehicle fuel efficiency • Reduced per-mile crash rates • Reduced per-mile emission rates • Reduced driver wages • Improved travel comfort (reduced discomfort costs).	• More accessible land use (reduced travel distances to reach goods and activities) • Improvements to alternative modes (walking, cycling, public transit, taxi, carsharing, etc.) • Improved logistical management • More efficient pricing • Improved mobility substitutes (telecommunications and delivery services) • Improved user information

Mobility-based transportation improvements reduce travel costs and so tend to increase VMT. Other strategies improve accessibility in ways that often reduce vehicle travel.

This distinction between mobility and accessibility is becoming more important. Various trends are reducing the marginal economic benefits of increased automobile travel and increasing demand for alternative modes (Litman 2006a), including increasing traffic and parking congestion, increasing road and parking facility expansion costs, increased urbanization, rising future fuel prices, and improved communications technologies. As a result, policies and projects that encourage more efficient use of existing transportation resources are likely to provide greater economic returns that simply expanding road and parking facility capacity. Accessibility-based analysis allows these opportunities to be identified. For example, in many situations business will find it more cost effective to efficiently manage parking facilities (using more sharing, efficient pricing, encouraging use of alternative modes, more accessible locations, etc.) than to expand parking facilities, and transport agencies will find it more cost effective to efficiently manage roadways (using HOV priority, efficient pricing, encouraging use of alternative modes, smart growth land use policies, etc.) than to continue to expand roadways.

Resource Impacts Versus Economic Transfers

When evaluating economic impacts it is important o make a distinction between *resource impacts* (a change in the supply of scarce resources such as time, land or fuel) and economic transfers (a shift of resources from one person or group to another). For example, an increase in fuel consumption is a resource cost, but an increase in fuel taxes is an economic transfer since the additional cost to consumers is offset by an increase in government revenue. Similarly, a reduction in business costs (such as parking requirements or employee travel time) is a resource savings, but a shift in the location of business activity (for example, people working in one location rather than another) is an economic transfer. In general, changes in resource consumption affects economic productivity and efficiency issues, while economic transfers are equity issues.

Equity Analysis

Equity relates to the distribution of impacts and the degree this is considered fair. 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.

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 evaluated with regard to equity objectives. For example, rather than only providing special services for wheelchair users, a broader effort to enhance equity also insures that all transport facilities and services accommodate people with disabilities, overall public transit service quality is improved, and affordable housing is located in accessible locations.

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.

Table 3 identifies transport equity indictors that can be used to evaluate specific policies and programs.

Table 3 **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.

Economic Efficiency Principles

The following market principles tend to maximize economic efficiency and productivity:

- *User sovereignty* (also called *consumer choice*). Markets respond to consumer demands, allowing users to obtain the combination of goods that best meets their needs.
- *Efficient pricing.* Prices (what consumers pay for each good) should reflect the marginal costs of producing that good unless a subsidy is specifically justified, for example, to achieve equity objectives or achieve strategic objectives.
- *Prioritization*. Higher value trips and more efficient modes get priority over lower value trips and less efficient modes, through regulations or pricing.
- *Economic neutrality.* Public policies should not arbitrarily favor one good over others, unless specifically justified. For example, it would be inefficient for transportation planning to arbitrarily favor automobile travel over other modes.

Current transportation markets often violate these principles, as summarized in Table 3. The additional travel that results tends to be economically inefficient: its marginal costs can exceed its marginal benefits. Correcting these market distortions tends to increase transport system efficient and therefore supports economic development.

Table 3 **Transport Market Distortions** (Litman 2006b; Clarke and Prentice 2009)

Principle	Distortion	Examples	Potential Reforms
Consumer sovereignty and information	Markets often offer limited alternatives to automobile transportation and automobile-oriented location	Poor walking and cycling conditions Inadequate public transit service Lack of vehicle rental services in residential areas Lack of affordable housing in accessible, multi-modal locations	Improve alternative modes, particularly affordable modes such as walking, cycling and public transit Integrate alternative modes Improve location options, particularly affordable housing in accessible areas
Underpricing	Many motor vehicle costs are fixed or external.	Unpriced roads Unpriced parking Fixed insurance and registration fees Low fuel prices Tax policies that favor vehicle use	As much as feasible, charge motorists directly for roads, parking and emissions, and convert fixed costs, such as insurance and registration fees, into variable costs
Transport Planning Practices	Transportation planning and investment practices favor automobile-oriented improvements, even when other solutions are more cost effective	Dedicated highway funds Transport system performance indicators that only consider vehicle traffic conditions, ignoring impacts on other modes Planning and evaluation tools that overlook many impacts and options	Apply least-cost planning so alternative modes and demand management strategies are funded if they are the most cost-effective transport improvement option. Develop more comprehensive, multi-modal evaluation tools
Land Use Polices	Current land use planning policies encourage lower-density, automobile-oriented development.	Generous minimum parking requirements Restrictions on compact, mixed land use development Development fees, utility rates and taxes that fail to reflect location-based costs	Smart growth policy reforms that help create more accessible, multi-modal communities Pricing that reflects the lower costs of providing public services in more accessible locations.

This table summarizes transportation market principles, common distortions, and appropriate reforms which tend to increase economic efficiency, productivity and development.

Consider a specific example. Vehicles require parking spaces. There are two general ways to supply it: include parking with building space, so building occupants pay for parking spaces regardless of whether or not they demand[3] them (called *bundled* parking), or charge users directly for using parking spaces (called *unbundled parking*). In developed countries most communities have minimum parking requirements which require parking to be bundled with

[3] *Demand* refers to the amount of a good that consumers would choose to purchase at a particular price.

buildings, such as two parking spaces per housing unit, reflecting average vehicle ownership rates. However, not all households own an average number of vehicles. We can divide households into four categories:

1. Owns fewer than two vehicles and would demand fewer than two parking spaces.
2. Would own fewer than two vehicles if parking spaces were unbundled but will own two vehicles if bundled.
3. Owns two vehicles and so demands two parking spaces regardless of code requirements.
4. Owns more than two vehicles and so demands more than two parking spaces.

Current parking requirements are economically inefficient because they force some households to pay for parking spaces they do not want and encourages some households to own more vehicles than they would if parking were efficiently priced. In typical situations the total number of parking spaces would decline by 10-30% if users paid directly for parking. This indicates that current parking practices significantly increase vehicle ownership and use, and therefore associated problems such as traffic congestion, accidents, pollution and sprawl.

Of course, there are reasons that governments mandate that parking be bundled with building space: it is more convenient to users, because it guarantees that parking spaces will be available, and it is more convenient to governments because it avoids spillover problems (motorist parking were they are not wanted) and the need to enforce parking regulations. It is therefore understandable that many people accept the inefficiency of bundled parking.

Special interests often argue that a particular transportation industry or activity provides social benefits that justify market distortions such as underpricing and subsidies. However, the mere existence of benefits does not justify such policies (Rothengatter 1991). Only if an activity provides significant *marginal external benefits* (you benefit if your neighbors increase their vehicle travel) are subsidies efficient. Transportation systems sometimes have scale economies, particularly during a growth phase when new technologies are developing and networks expanding, but once mature there is seldom marginal efficiency gains from underpricing. External benefits seldom last because rational economic agents capture them. For example, if vehicle manufacturing provides local economic benefits manufacturers demand subsidies for locating in a community.

Production Versus Consumption Travel Impacts

Transportation economic development benefits result primarily from increased production efficiency (savings to businesses and governments). Reductions in consumer costs provide user benefits but do not necessarily increase productivity, employment or incomes. As a result, economic productivity and development impacts vary by travel purpose, as indicated in Table 4. Freight, service delivery, and business travel improvements tend to provide the largest economic development benefits. Commute travel improvements can increase productivity if it increases education and employment opportunities, improving the match between workers and jobs (Angel and Blei 2015). Personal travel improvements (cheaper or faster travel for errands, social and recreation) benefits users but do not generally increase productivity, employment and income. Retail access improvements can attract more shoppers to a particular store, only supports regional economic development if consumers would actually spend less overall, or if more concentrated shopping provides significant scale economies.

Table 4 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 agglomeration efficiencies (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.

Goals, Objectives and Performance Indicators

In economic evaluation it is important to maintain a distinction between *goals* (what we ultimately want), *objectives* (specific ways to achieve goals) and *performance indicators* (practical ways to measure progress toward goals). The ultimate goals are generally to maximize *social welfare* (total happiness in society) and *equity* (the fair distribution of impacts). Productivity and wealth are objectives, indicators of which, such as GDP and income, are often used as performance indicators.

Table 6 Economic Goals, Objectives and Performance Indicators

	Examples
Goals – What people ultimately want	Social welfare (happiness), equity, future legacy
Objectives – specific ways to achieve goals	Increased economic productivity, wealth, improved opportunity for disadvantaged people
Performance Indicators – practical ways to measure progress toward goals	Gross Domestic Product (GDP), average incomes, employment rates, wages, income distribution

Commonly-used economic performance indicators tend to measure the *quantity* of economic activity (the amount of production and consumption that occurs), but indicate little about its *quality*, and so can provide distorted guidance, leading to harmful policies (Talberth, Cobb, and Slattery 2006). For example, GDP is stimulated by policies that increased working hours, medical problems that increase healthcare costs, and increased cost of living (the cost to purchase basic goods). Some parents may prefer to work less to spend time with their children, and some people may prefer early retirement, although these actions reduce productivity and therefore GDP. If jobs are inflexible or living costs excessive, people may be forced to work more than optimal. Similarly, policies that reduce affordable housing options (such as favoring single-family homes over townhouses and apartments) and transport modes (walking, cycling and public transit), can force consumers to spend more than optimal, which increases GDP but reduces consumer welfare.

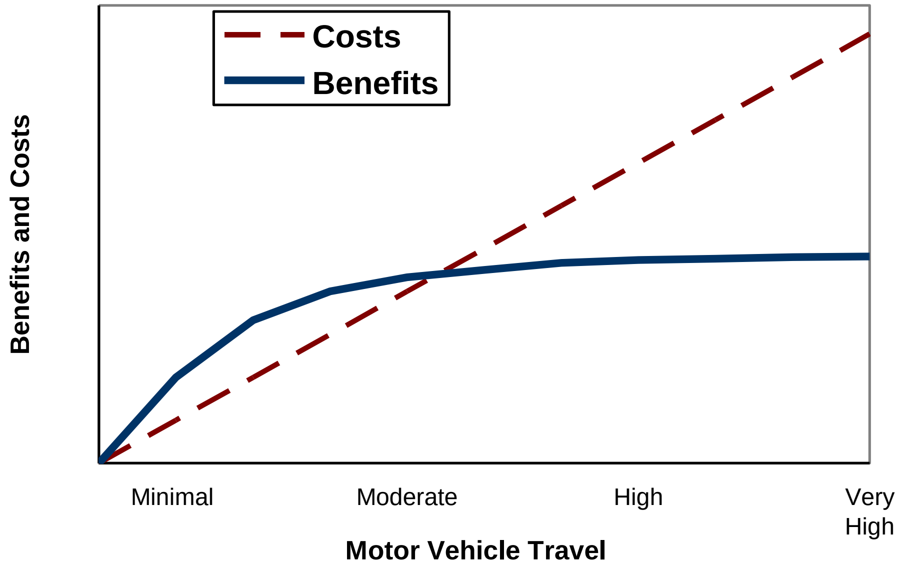
Two groups can have the same income but one is much happier than the other due to policies that affect their costs of living, health, and opportunities in life. Similarly, two industries may have the same productivity and gross revenue, but one provides much more local employment, business activity and tax revenue than another, and so does more to support local economic development.

More comprehensive analysis, sometimes called *sustainable economics*, attempts to more clearly reflect society's goals (Marsden, et al 2007). It applies a wider set of performance indicators that account for economic, social and environmental outcomes. For example, sustainable development indictors reflect health and longevity, education attainment, social equity, employment opportunity, community livability and environmental quality, in addition to indicators of productivity and wealth.

These distinctions become increasingly important as society becomes wealthier and more mobile, due to diminishing marginal benefits. Rising from low to middle incomes tends to provide large social welfare benefits, but as people's basic material needs are satisfied, additional wealth provides less incremental benefit, and non-market goods (personal time, family, friendship, health and respect) become relatively more important. Similarly, an increase from low to moderate mobility (for example, from only walking, to a combination of walking, cycling, public transit and automobile travel) tends to provide large benefits, but additional mobility tends to provide less marginal benefit although external costs, such as congestion, accidents and pollution, continue to increase as indicated in Figure 1.

Conventional indicators fail to account for these factors. They generally consider any increase in GDP incomes desirable, even if lower-income households are no better off. Similarly, they assume that any increasing in vehicle travel is desirable, even if it results from public policies that reduce the availability of alternative modes or increase sprawl and therefore the distances people must travel to access goods, services and activities.

Figure 1 **Diminishing Marginal Benefits and Linear Costs**



Increasing from minimal to moderate income or mobility provides large benefits, but marginal benefits tend to decline as incomes and mobility increase, while total costs (including external costs such as congestion, accident risk and pollution costs) increase linearly.

Progressive economists recognize a distinction between *growth* (expansion) and *development* (improvement). Many economic performance indicators reflect the assumption that physical expansion (more people, more material consumption, more commercial transactions, more transport activity) is inherently desirable. From this perspective, a community is considered economically successful if population and business activity increases, consumers shift from home production (home cooking, parents staying home to raise children, walking and cycling for transport) to commercial products (processed and restaurant food, paid childcare, automobile travel). Growth is quantitative, making it relatively easy to measure. Development is more qualitative, and so tends to be more difficult to measure. Yet, once basic material needs are met,

This suggests that accurate evaluation of transportation economic development impacts should reflect the following:

- Clearly define *goals* (what you ultimately want), *objectives* (specific ways to achieve goals) and *performance indicators* (practical ways to measure progress toward goals).
- Account for weaknesses of common performance indicators.
- Measure the *distribution* of economic impacts, such as changes in incomes, mobility and economic opportunity for people with low incomes and physical disabilities.
- Use *accessibility-based* indicators rather than just *mobility-based* indicators. For example, strategies that improve accessibility by improving telecommunications, delivery services and more accessible land use should be considered equally with strategies that increase mobility. Similarly, the reduced accessibility that results from degradation of alternative modes (walking, cycling, public transit) and from sprawled land use should be recognized as increasing transportation costs and reducing economic productivity.

- Account for indirect and external costs. Transportation facilities and activities can impose various external costs, including traffic congestion, barrier effects, road and parking facility subsidies, accidents, externalities associated with energy consumption, and pollution emissions. All of these should be considered in economic evaluation.
- Account for diminishing marginal benefits. Although a certain amount of mobility may provide large benefits, additional mobility tends to provide less incremental benefits.

Can Transportation Inefficiency Support Economic Development?
It may sometimes seem that policies that transport market distortions are economically beneficial, and policies that encourage efficiency are economically harmful. For example, many people assume that because motor vehicle manufacturing and petroleum production are major industries with many employees, policies that encourage vehicle and fuel consumption must be economically beneficial, so policies that encourage alternative modes and energy conservation must be economically harmful. However, this is generally untrue.

Expenditures on vehicles and fuel leave consumers with less money to spend on other goods, so policies that encourage automobile travel benefit some industries but harm others. Because they are capital rather than labor intensive, and a major portion of components are imported, vehicle and fuel expenditures provide less employment and business activity than most other consumer expenditures. As a result, transport policies that shift domestic expenditures from vehicles and fuel to other goods tend to support economic development (Litman 2009b). Although a country may benefit economically from exporting vehicles and fuel, policies that increase domestic consumption tend to be economically inefficient and harmful overall.

Similarly, a city's taxi industry may argue that it is economically harmful to improve regional airport public transit service, since taxi travel cost more and employs more drivers than transit, which increases economic activity. This would be true if visitors were price inelastic, so the same number of people would visit the region regardless of local transport costs. However, tourism tends to be quite price sensitive: if a city is considered expensive it often loses visitors. For example, if budget tourists hear that they must pay $50 for an airport taxi, they may shift to a more affordable city or spend less on food, accommodations and entertainment. Conversely, affordable airport transport options can help a city attract more tourists and allow visitors to spend more on local services. In other words, policies and projects that increase tourist transport efficiency tend to support economic development by meeting visitors' demands and maximizing their value they receive from their expenditures. As a result, improving public transit service may reduce taxi driver revenues but support the tourism industry and overall regional economic development.

These are just two examples illustrating how transport efficiency tends to support overall economic development, even if it reduces expenditures in some industries.

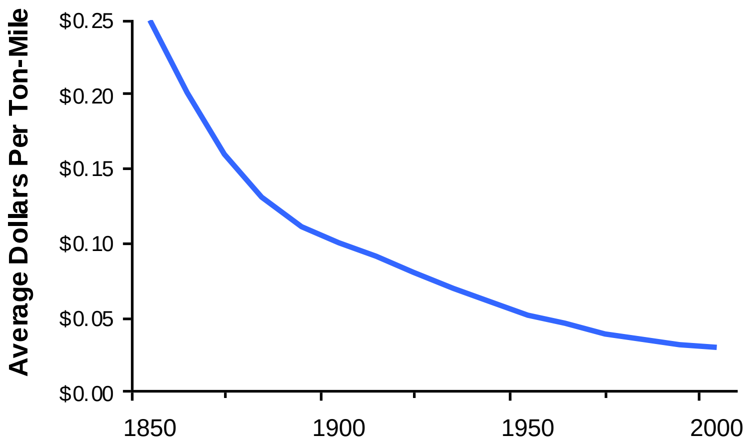
Transportation Productivity Trends

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 2 shows how rail freight costs declined over a 150 year period. This resulted from technological improvements such as larger, faster and more efficient vehicles, and more efficient loading and operations (such as containerization and automated dispatching).

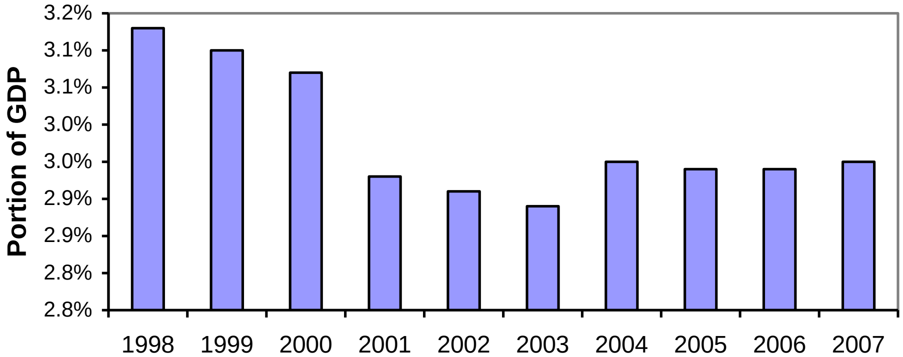
Figure 2 **Railroad Freight Costs** (Garrison and Levinson 2006 p. 290)



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

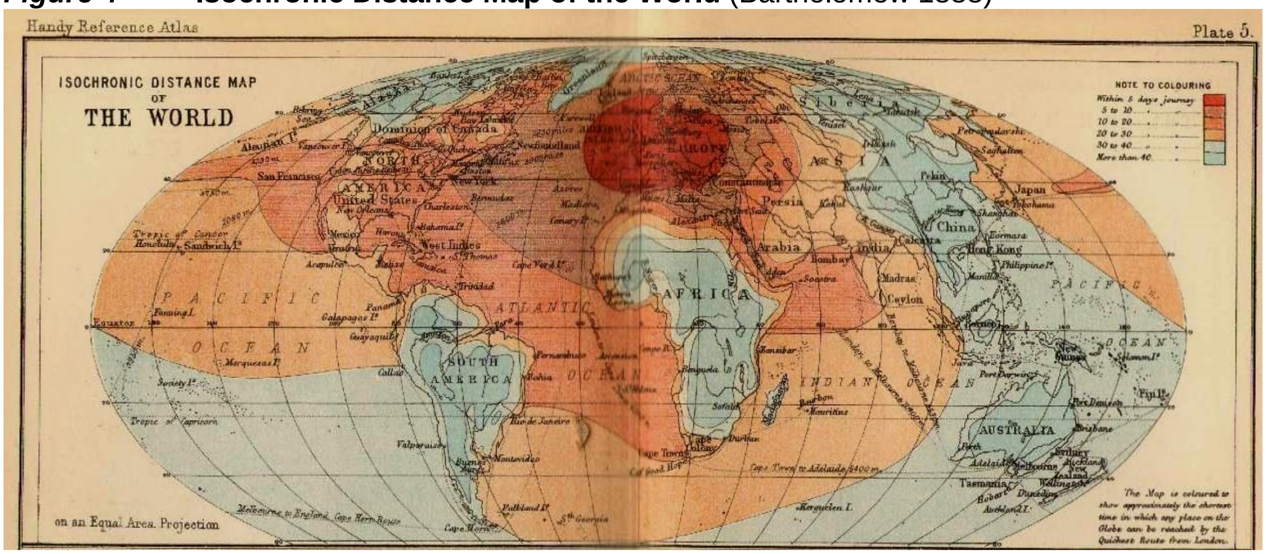


Transportation services declined as a portion of the U.S. economy during the last decade.

Personal Transport

Personal travel also experienced large productivity gains. Figure 4 is an 1888 map showing travel times from England to other world locations. It indicates that travel to New York required 5-10 days, to San Francisco required 10-20 days, and to much of Asia, most of South America and Africa, 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 4 **Isochronic Distance Map of the World** (Bartholomew 1888)



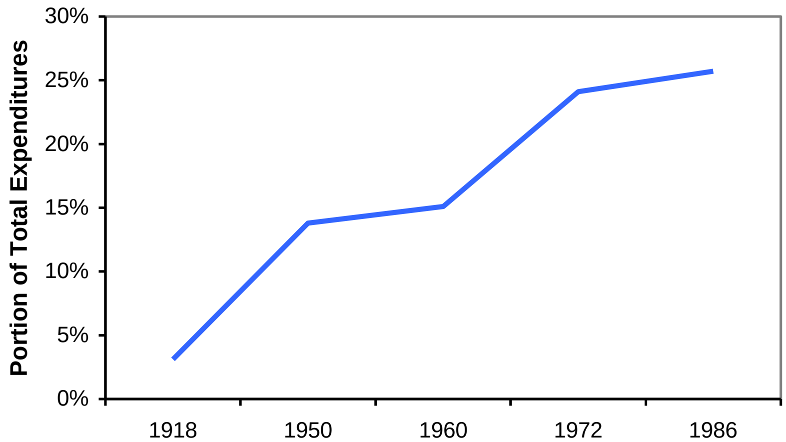
This 1888 map shows days of travel time from London to other world locations. It is now approximately accurate if measured in hours, indicating average travel speeds increased more than an order of magnitude during the last century.

Passenger fares have also declined significantly. Indentured servants typically worked three to seven years to repay their transport from Europe to Colonial America. 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 major city within a day or two, and electronic communication allows nearly instantaneous information transmission. 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 be significantly faster or cheaper in 2050 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 5, 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 5 **Household Transportation Expenditures** (Johnson, Rogers and Tan 2001)



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

Table 7 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 7 **Changes In Vehicle Transport Productivity** (cost per vehicle-mile)[4]

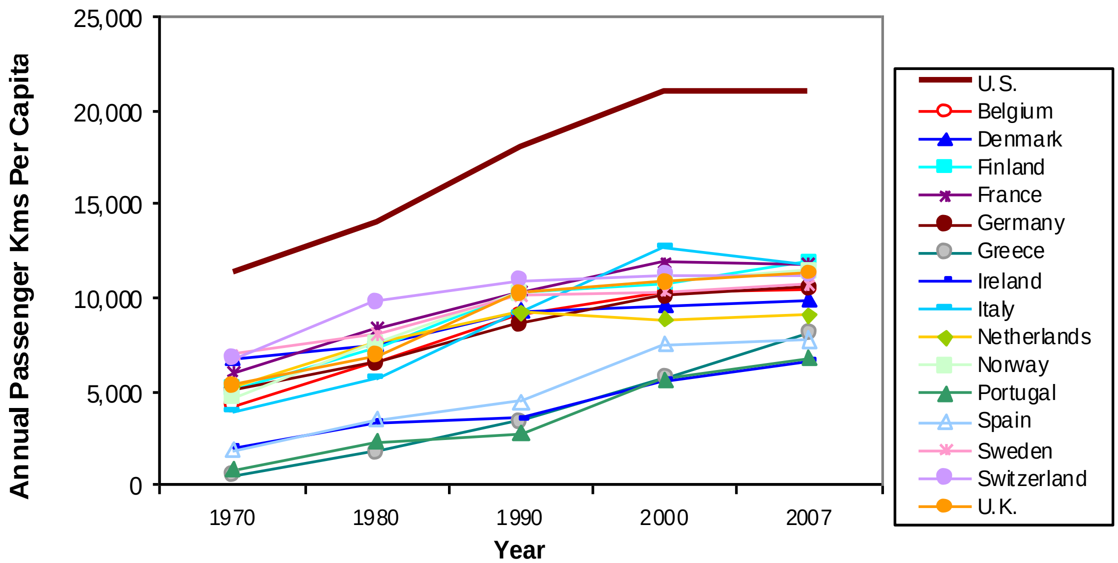
Year	Typical Vehicles	Vehicle Operation Costs	Travel Time Costs	Other Costs	Vehicle Mileage
1900	Horse-drawn wagon	High. Short operating life, high fuel costs (for feed)	Very high. 5-10 miles per hour (MPH)	Requires lots of road and parking space. Air and noise pollution.	Low. Few people used personal 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.

Although motor vehicle travel grew steadily during the twentieth century, demographic and economic trends (aging population, increased urbanization, rising fuel costs, etc.) are causing vehicle travel to peak in affluent countries, as illustrated in Figure 6. 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.

[4] 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).

Figure 6 **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.

Similarly, during the twentieth century, economic development depended on increased motor vehicle travel, so expanded roads and cheap fuel may have supported economic development, but there is growing evidence of economic decoupling, and that economic development benefits from policies that increase transport system efficiency and diversity, and protect local environmental quality (Ecola and Wachs 2012; Sivak 2014). As economies become more global and knowledge-based, competitiveness increasingly depends on attracting talented entrepreneurs (MML 2011).

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 vehicle travel and economic development.

There is no doubt that a certain amount of 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, increased transport efficiency 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 consumer travel. In addition, high levels of VMT can result from reduced accessibility (more money, time and land needed to reach services and activities such as shops, schools and jobs), reduces transport system efficiency and increases costs. As a result, in automobile-dependent regions there is often 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 higher-income regions.

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* (also called *transportation demand management*) strategies, which are policy and planning reforms intended to increase transport system efficiency. This includes various policy reforms advocated by economists to increase efficiency, such as more pricing, more neutral transport planning and funding, and more accessible land use development, are classified as mobility management strategies by transportation professionals. These strategies tend to increase productivity and so support economic development.

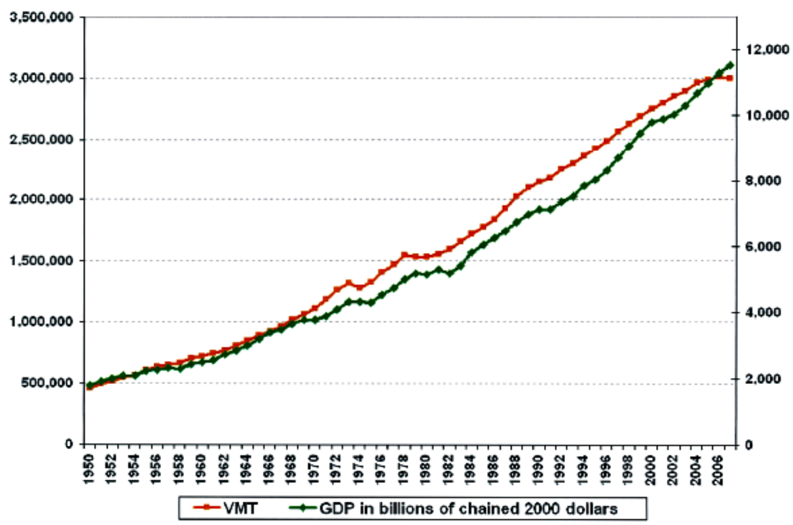
How Vehicle Travel Affects Economic Productivity

Some people claim there is a direct relationship between motor vehicle travel and productivity, so policies that increase motor vehicle travel (subsidized roads and parking facilities, inexpensive fuel, automobile-oriented land use development) 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 7 **US VMT and GDP Trends** (HUA 2009)

Vehicle Miles Traveled (VMT) and Gross Domestic Product (GDP) are extremely closely correlated:

Since 1950, the cumulative correlation rate between VMT and Real GDP, calculated using Pearson's R, is .9946. This is an extraordinarily strong correlation even when calculating the R-square value of 98.9% which indicates the predictive value between the two variables (VMT or GDP).

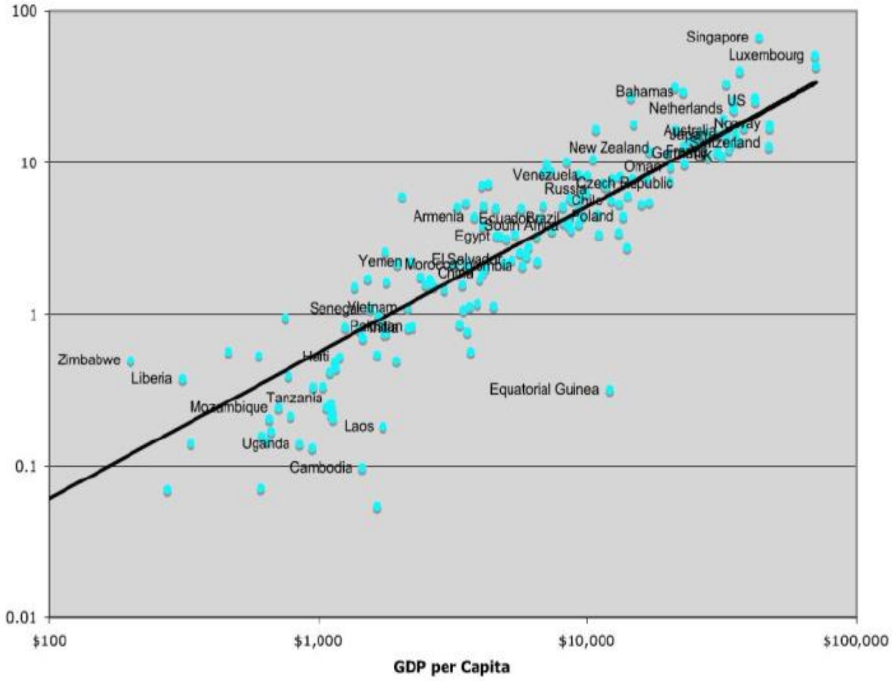


The Highway Users Alliance claims that this graph proves that a reduction in vehicle travel will reduce economic productivity, but correlation does not prove causation.

Similarly, economist Randall Pozdena (2009) claims that Figure 8, and case studies of the effects of oil price spikes on economic productivity, prove that policies which 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)." But this analysis misrepresents these issues.

The log-log format in Figure 8 exaggerates the relationships between energy and economic development. For example, although the U.S. and Norway appear close together in the graph, Norwegians actually consume about half as much fuel per capita as U.S. residents. The graph includes countries with very different levels of development. Increased vehicle travel in very poor countries such as Zimbabwe and Liberia has 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 8 **Per Capita GDP Versus Barrels of Oil** (Pozdena 2009)

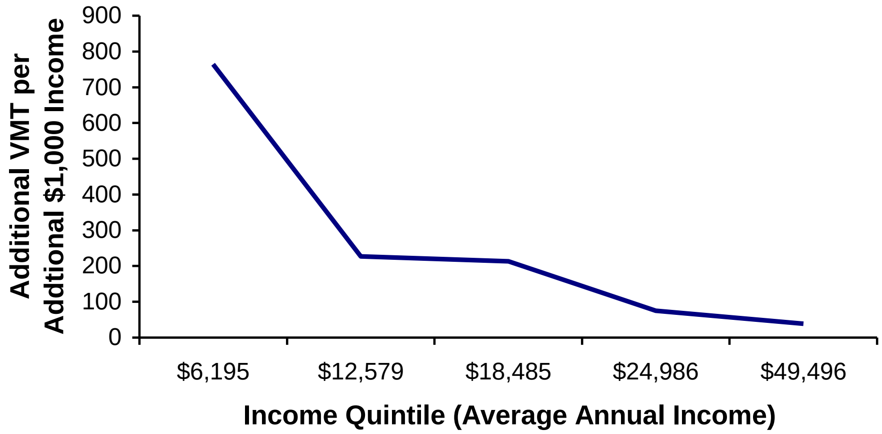


Pozdena claims this graph proves that increased petroleum consumption increases economic productivity so efforts to reduce transportation energy consumption must reduce productivity. The log-log scale used in this graph exaggerates such relationships.

A certain amount of motor vehicle travel increases productivity and supports economic development. For example, as headloading, pushcarts and animal wagon transport is replaced by motor vehicles there is likely to be a strong positive relationship between motor vehicle travel and economic productivity. But as per capita vehicle travel increases the marginal benefits decline while economic costs such as congestion, infrastructure costs, and accident damages increase. Among developed economies the relationship between vehicle travel and economic development is weak (SACRA 1999; Baird 2005; O'Fallon 2003). Puentes (2012) found a very strong positive statistical relationship between GDP and vehicle travel in the U.S. between 1956 and 2006, but virtually none between 2007 and 2012, an indication of *decoupling* or productivity and mobility. Several factors may contribute to the positive relationships between energy consumption, mobility and economic productivity:

1. Increased motor vehicle supports some productive activities as HUA and Pozdena emphasize.
2. Increased wealth tends to increase vehicle ownership and use, particularly with increases from low to moderate income, as illustrated in Figure 9.
3. Increased wealth allows some wealthy households to choose more accessible locations, allowing them to reduce their vehicle travel.
4. Automobile-oriented land use patterns increase the mobility needed for a given level of accessibility. This increases vehicle travel and associated costs, which increases GDP, although social welfare does not necessarily increase.
5. Vehicle travel imposes external costs (congestion, accident and pollution damages, oil import costs, etc.), which increase some economic activities (vehicle repairs and medical services) but reduces and social welfare.

Figure 9 **Annual Per Capita Vehicle Mileage By Income Quintile** (BLS 2007)



Increased wealth causes declining marginal increases in VMT.

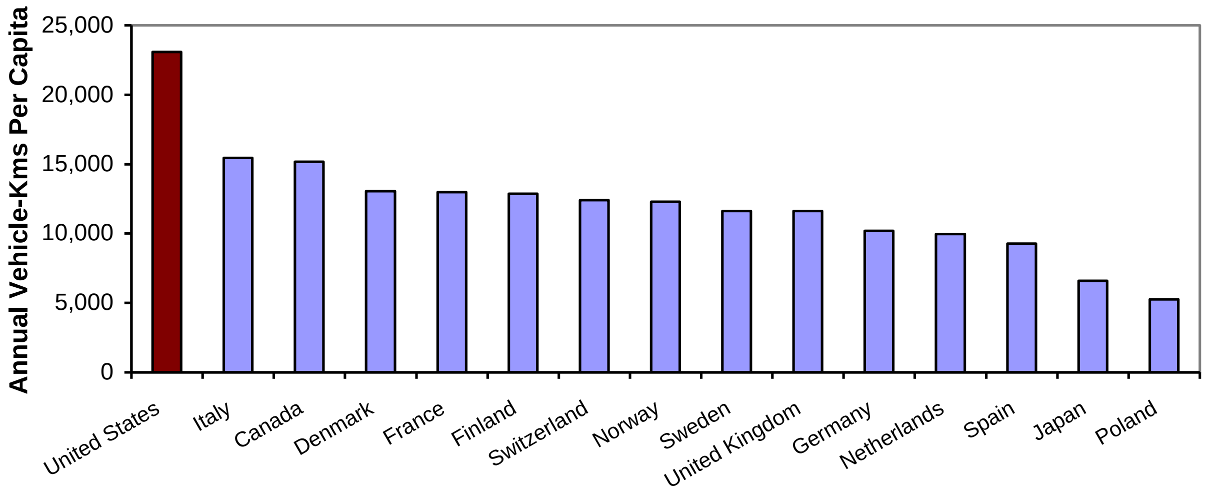
Factor 1 *causes* wealth to increase, while factors 2-5 *result from* increased wealth. Factors 1 and 2 cause *positive* relationships between VMT and GDP, while factors 3, 4 and 5 cause negative relationships. Factors 4 and 5 partly reflect the increased mobility and transport costs required to maintain a given level of accessibility as transport systems become more automobile-dependent, which increases GDP but not social welfare.

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 about 10%. However, this does not necessarily reflect true economic development that increases social welfare. For example, public policies that favor automobile travel over walking and bicycling for children's travel to school, force parents to spend more money on vehicles and fuel, although consumers and society could be worse off overall. In such situations, policies that improve walking and cycling conditions may reduce VMT in ways that support economic development and increase social welfare overall.

Researchers find only a weak positive relationship between personal vehicle travel and economic productivity (Baird 2005; O'Fallon 2003; Kooshian and Winkelman 2011; McMullen and Eckstein 2012). Empirical evidence suggests that increasing from very low to moderate levels of mobility increases productivity since vehicles serve high-value trips, but beyond that marginal benefits decline and eventually becomes negative as external costs and inefficiencies increase (Kooshian 2011). 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. The U.S. averages more than twice the per capita vehicle travel as most other OECD countries as illustrated in Figure 10. Economically successful countries such as Norway and Germany have half the per capita VMT as in the U.S.

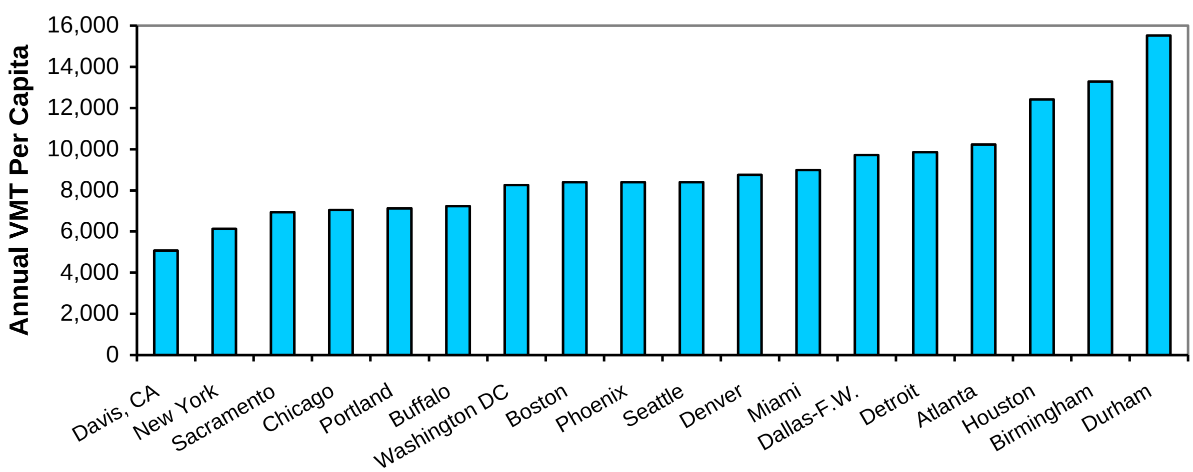
Figure 10 **Per Capita Annual Vehicle Travel By Country** (OECD 2009)



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, as illustrated below, due largely to differences in transport and land use policies. 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.

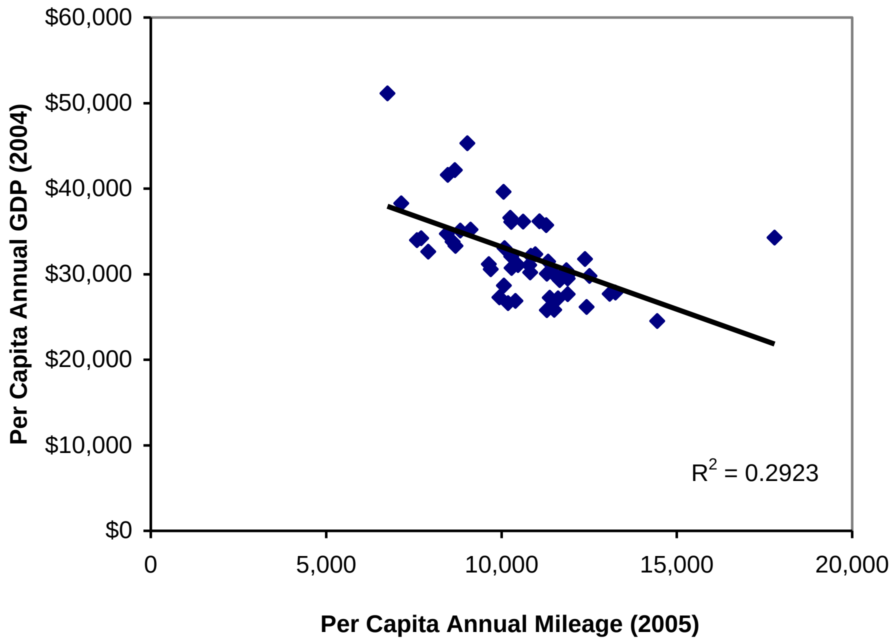
Figure 11 **Per Capita Annual Vehicle Travel Selected U.S. Cities** (FHWA 2007)



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. 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 12, which indicates this relationship for U.S. states.

Figure 12 **Per Capita GDP and VMT For U.S. States** (VTPI 2009)[5]

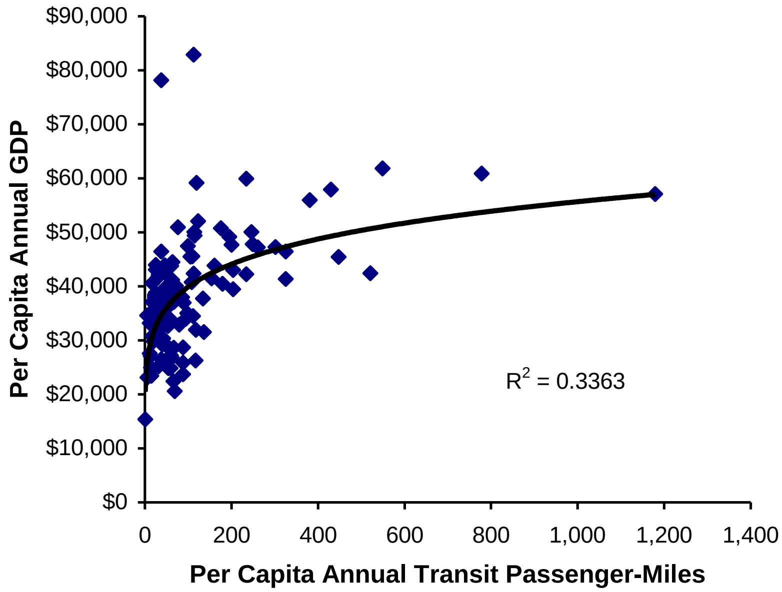


Per capita economic productivity increases as vehicle travel declines. (Each dot is a U.S. state.)

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 13.

[5] 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).

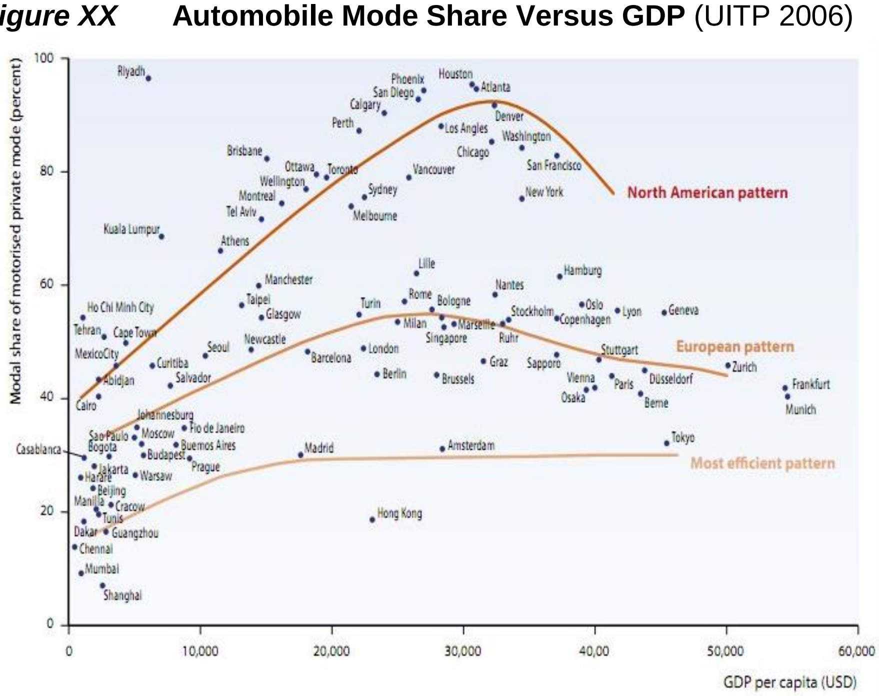
Figure 13 **Per Capita GDP and Transit Ridership** (VTPI 2009)



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

Figure XX indicates that automobile mode share tends to increase, peak and then decline with increased productivity.

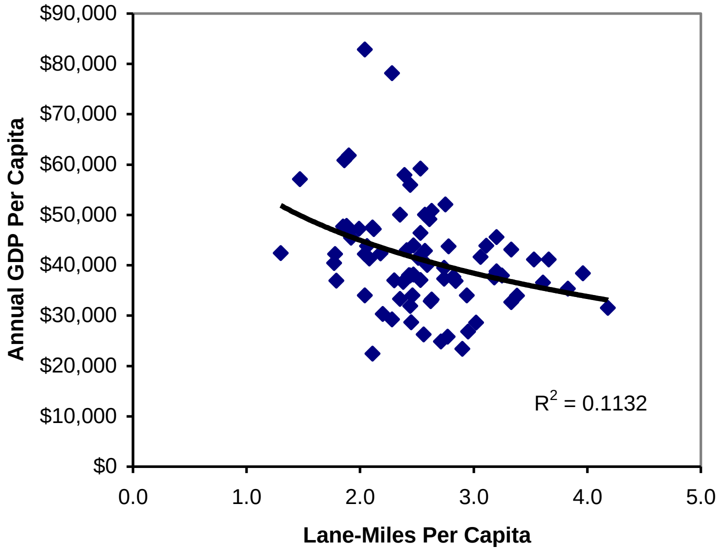
Figure XX **Automobile Mode Share Versus GDP** (UITP 2006)



In wealthy countries, automobile mode share tends to increase, peak and then decline with increased productivity and wealth.

Per capita GDP tends to decline with roadway lane miles, as illustrated in Figure 14.

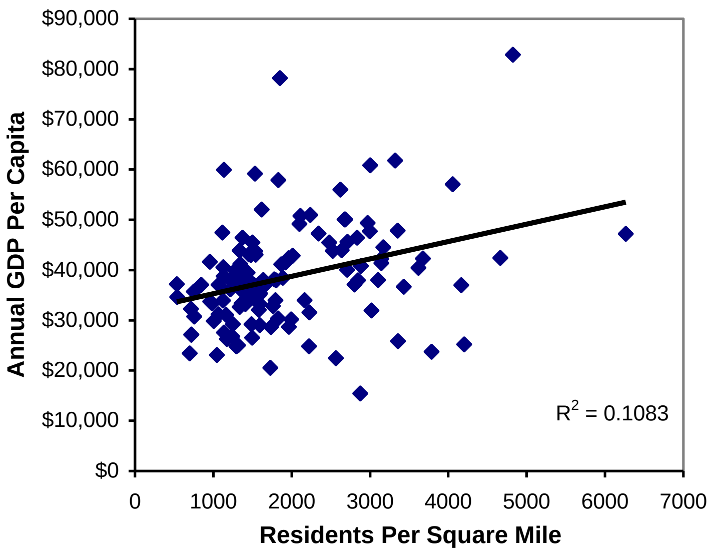
Figure 14 **Per Capita GDP and Road Lane Miles** (VTPI 2009)



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 (Figure 15), reflecting the positive effects of improved land use accessibility, increased transport diversity and agglomeration efficiencies (Chatman and Noland 2013). Glaeser and Resseger (2009) and Abel, Dey and Gabe (2011), find that this correlation is particularly strong for knowledge-based industries which supports the hypothesis that urban proximity helps to spread knowledge. Population-weighted density, which reflects the density that urban residents experience in their neighborhood, may be a better indicator of land use productivity impacts than average regional density (Florida 2013).

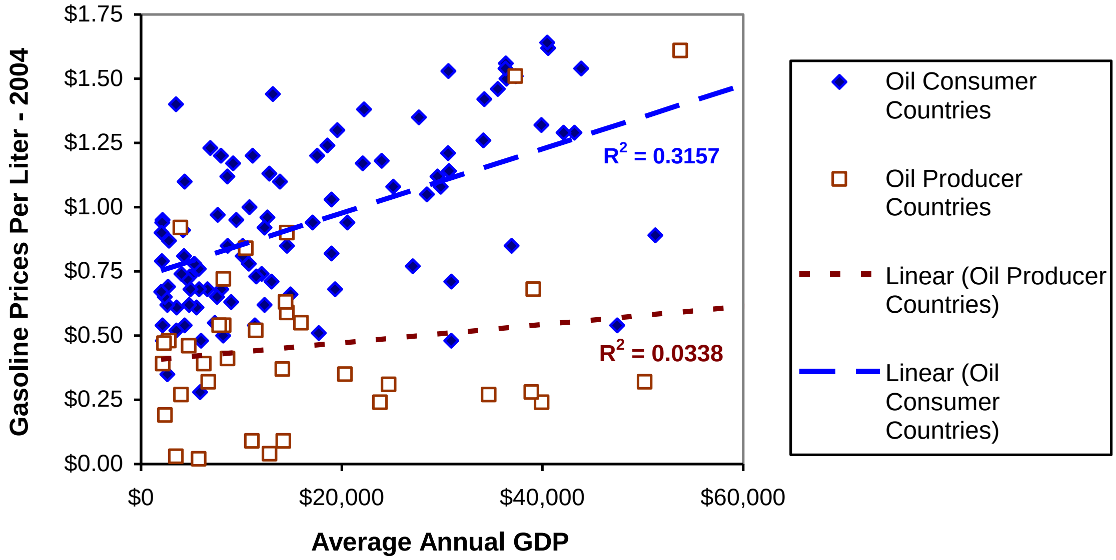
Figure 15 **Per Capita GDP and Urban Density** (BTS 2006 and BEA 2006)



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

Figure 16 shows that per capita GDP increases with fuel prices, particularly among oil consuming countries (countries that produce no petroleum).

Figure 16 **GDP Versus Fuel Prices** (Metschies 2005)[6]



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

Fuel costs typically range from about 2¢ up to about 15¢ per vehicle-mile, while external costs (congestion, road and parking facility costs, accidents and pollution impacts) are typically estimated to total 10-30¢ per vehicle-mile (Litman 2009a; Vermeulen, et al. 2004). High fuel prices tend to increase economic efficiency by internalizing costs. Although fuel taxes are an imperfect vehicle user fee (fees that vary by time, location and vehicle type can be more efficient), they are 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*.[7] This partly results from policies such as low fuel prices that stimulate inefficient

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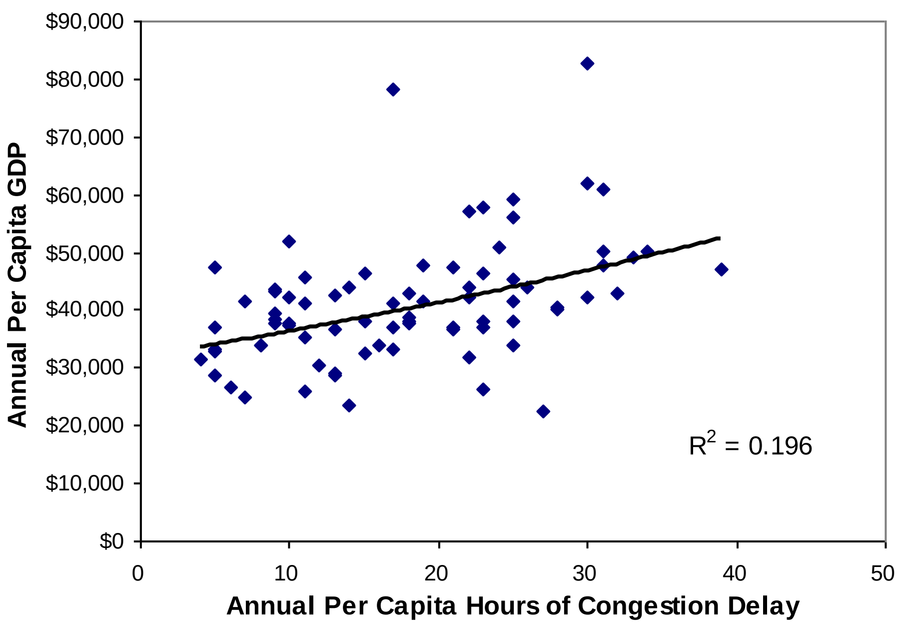
[6] Fuel price (www.internationalfuelprices.com), GDP (http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita), petroleum production (http://en.wikipedia.org/wiki/Petroleum); excluding countries with average annual GDP under $2,000.
[7] See http://en.wikipedia.org/wiki/Resource_curse.

resource consumption (see Frankel 2010 for literature review). This suggests that high fuel prices (and therefore, high vehicle operating costs) do not 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.

Some studies suggest that traffic congestion imposes large economic costs and roadway expansion can provide large productivity benefits, but empirical evidence suggests that traffic congestion is not a major constraint on economic development. Figure 17 illustrates the relationship between per capita annual traffic congestion delay and per capita Gross Domestic Product (GDP) reported for major U.S. cities. The results indicate that traffic congestion and economic productivity increase together. Dumbaugh (2012) found that every 10% increase in per capita traffic congestion delay is associated with a 3.4% increase in per capita GDP. This does not necessarily mean that congestion stimulates economic productivity, these cities' productivity would probably increase if congestion were reduced, but it suggests that other factors are much more important. Transportation system efficiency should be evaluated based on overall accessibility, taking into account all transport modes, land use patterns, and mobility substitutes such as telecommunications and delivery services, not just automobile travel speeds.

Figure 17 **Per Capita Congestion Delay Versus GDP**[8]



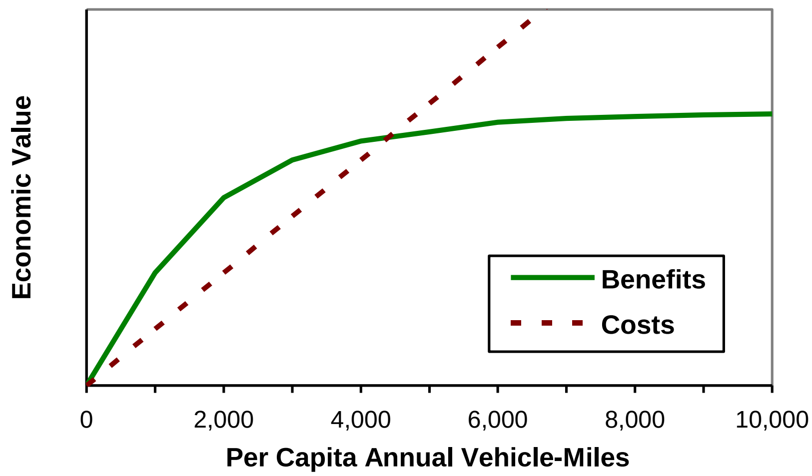
Economic productivity tends to increase with congestion, indicating that congestion costs are modest overall compared with other economic costs.

[8] VTPI (2009), *Urban Transport Performance Spreadsheet*, Victoria Transport Policy Institute (www.vtp.org); at www.vtpi.org/Transit2009.xls. Congestion delay data from the Texas Transportation Institute's *2007 Urban Mobilty Report*. GDP information from the US Bureau of Labor Statistics.

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.).

Figure 17 **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.

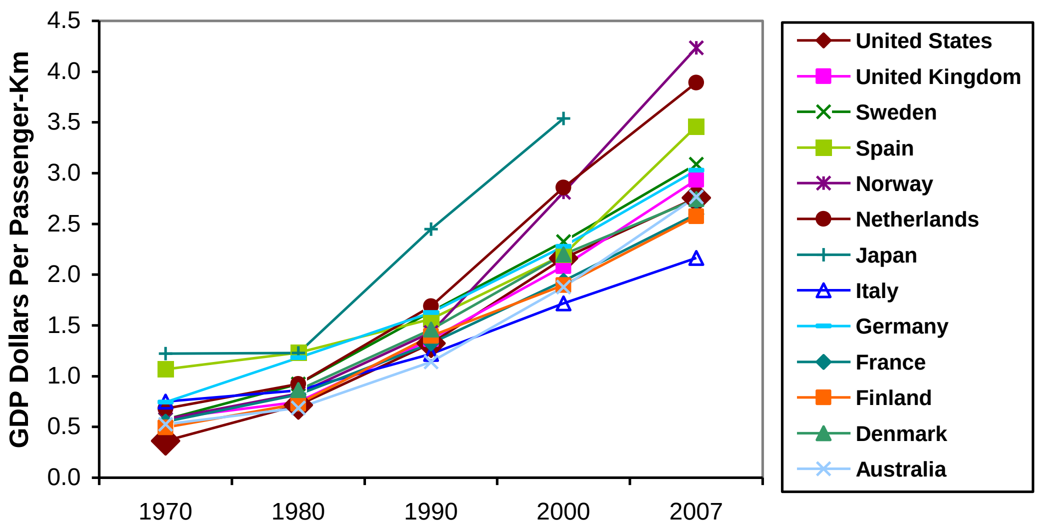
This analysis suggests that there are three general levels of motor vehicle travel:

1. *Inadequate* (typically less than 2,000 annual VMT per capita). Freight, service delivery, and business travel are inefficient; labor pools are limited; 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, an individual gains speed, comfort and status by driving, so motorists gain a competitive advantage. However, as more people become motorists the advantages disappear, and total social costs (congestion, parking problems and accident damages) increase.

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. Experience indicates that public policies can increase transport system efficiency, so more productivity is generated per unit of mobility. This is called *decoupling*. 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. Virtually all developed countries are increasing transport economic efficiency (GDP per unit of travel), as illustrated in Figure 18. The U.S. lags many other countries.

Figure 18 **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.

Automobile Transportation Productivity

The previous section indicates that excessive vehicle travel can reduce productivity. The additional mobility may benefit users by increasing motorist convenience, comfort and status, but does not increase productivity, employment or tax revenue; in fact, the analysis indicates that high levels of automobile travel tends to be economically harmful.

To individuals, automobile travel is often faster and more cost effective than other modes, and so appears to increase productivity, allowing more activities to be accomplished in a day. However, this increased productivity 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. The average *effective speed* (distance divided by total time spent on travel, vehicle maintenance, and working to pay vehicle 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 indirect costs. It forces motorists to chauffeur non-drivers; reduced walking and cycling force residents to devote special time to exercise; and increases traffic congestion, road and parking costs, accident and pollution damages.

Table 8 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).

Table 8 **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 9.

Table 9 **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; Sallman, et al. 2012; VTPI 2008). Table 10 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 10 **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 11. Described differently, many transport market and planning reforms that economics support are classified as mobility management strategies by transportation professionals.

Table 11 **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 12.

Table 12 **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)	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 13 **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 regions that import oil 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). As illustrated in Figure 16, per capita GDP tends to increase with fuel prices, particularly in oil consuming countries.

Even among oil producers, high fuel taxes tend to increase productivity. 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 19. 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 19 **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 ways specific transportation policy decisions affect economic development. For more discussion see Kooshian and Winkelman (2011); Laube, Rainville and Lyons (2014).

Transportation Program Expenditures

Transportation policies and planning decisions affect 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 jobs or higher incomes than others. These impacts can be quantified using *Input-Output Tables* (REMI 2005; Lindall and Olson 2005; BEA 2008; Seneca, et al. 2010), 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 analyses by Heintz, Pollin and Garrett-Peltier (2009) and EDRG (2009) suggest such impacts are actually 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 fuel is a relatively unprofitable product compared with their other retail goods such as fast food, tobacco products and lottery tickets (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 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 14 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 14 **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 15 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 15 **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; SGA 2010; Swanstrom, Winter and Wiedlocher 2010). 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; 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 16 summarizes employment generation of various infrastructure investments. Transportation maintenance and repair projects are generally faster to implement (due to minimal planning and land assembly requirements), 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 expansion projects (Troth 2009).

Table 16 **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 and Business Expenditures

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

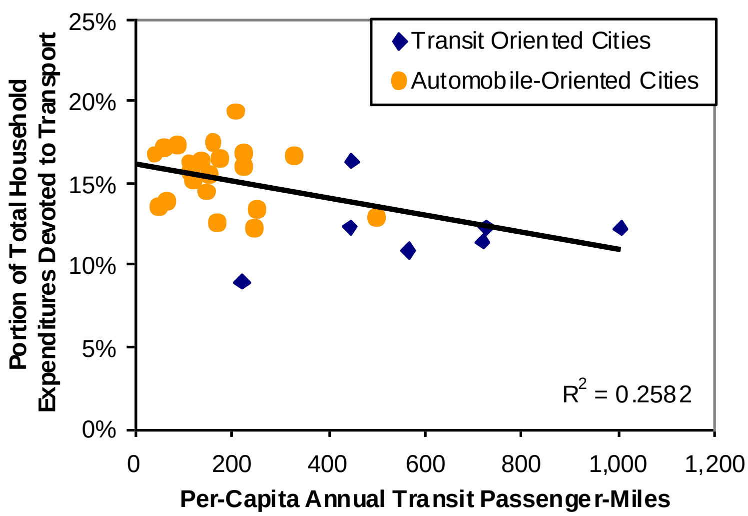
Table 17 **2007 Transportation Expenditures By Income** (BLS 2008)

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 14-19% of their budgets to transport (Table 17), and more including indirect costs such as residential parking and taxes spent on roads. This portion tends to increase with 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 annual savings per resident (Figure 20).

Figure 20 **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 smaller geographic scales, 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 18 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 18 **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 19 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 19 **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 20 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 20 **$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.

Excessive vehicle travel is economically harmful (ASTRA 2000; "Resource Externalities," Litman 2008a). Petroleum and vehicle imports transfer wealth from consumers to producers, and excessive dependence on imported oil makes a region vulnerability to *price shocks* (sudden price increases) and supply disruptions (IEA 2012). The last three major oil price shocks were followed by recessions. The majority of the U.S. trade deficit can be attributed to petroleum and vehicle imports: in 2009 the U.S. imported $253 billion in petroleum products and a vehicle trade deficit (vehicle imports minus exports) of $79 billion, a total of $332 billion, 87% of the $381 billion total trade deficit.

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," excluding military intervention costs) to be $13.60 per barrel (Leiby 2007). Including even a small portion of military expenses significantly increases these cost estimates. This indicates that policies that reduce vehicle and fuel consumption tend can provide significant economic development benefits.

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 among the most valuable assets and most costly investments in most 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 facility improvements can increase economic productivity and support economic development (Dept. of Treasury 2010; EDRG 2012; TRB 2006). Seneca, et al. (2010, pp. 42-25) provide a detailed review of this research. Bhatta and Drennan (2003) find elasticity of production costs as a function of transport infrastructure investment ranges from -0.05 to -0.21, meaning that a 1% increase in transport infrastructure investment increases economic productivity 0.05% to 0.21%.

However, these impacts vary widely. 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 (Iacono and Levinson 2013; Kopp 2005; SACTRA 1999). 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).

Based on detailed analysis of the net economic effects of roadway improvements, Duranton and Turner (2011) conclude that average extensions of the interstate network do not result in sufficient travel time improvements to justify their cost. 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. Iacono and Levinson (2013) found no statistically significant economic gains from highway expansion projects in Minnesota. 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).

Phillips (2014) evaluated the relationship between roadway expansion and economic productivity for U.S. states. He found that between 2000 and 2010:

- States that increased their urban road mileage by less than 30% experienced an average of 14.40% economic productivity growth, while those that increased mileage by greater than 30% experienced 8.77% productivity growth.
- States that increased urban roadway mileage less than 20% experienced 17.97% productivity growth, while states that expanded urban highways by more than 20% experienced 9.24% average productivity growth.
- States that increased urban roadway mileage less than 10% experienced 20.70% productivity growth, compared with 10.66% average productivity growth in states that expanded urban highways more than 10% .

Analyzing the correlation between road-building and economic growth he found an r-score of -0.34, which indicates a relatively strong statistical relationship. He concludes,

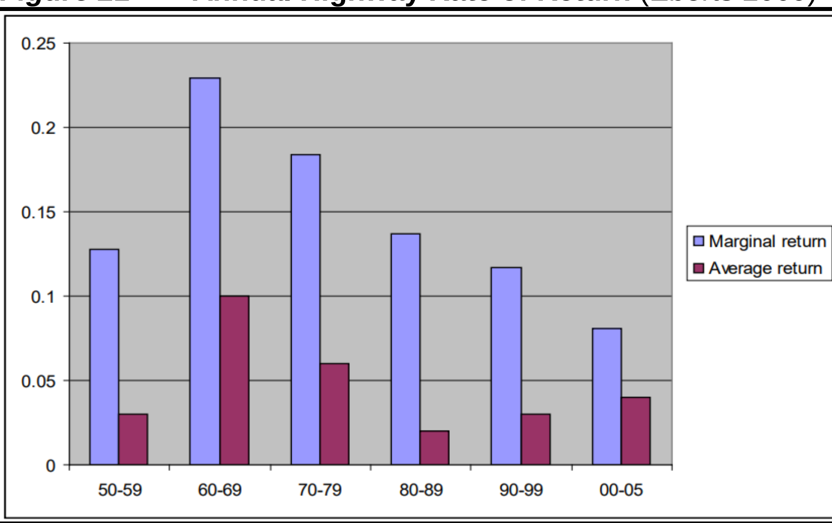
> "While politicians and advocates love to tout the job-creating value of new road and highway capacity, congestion reduction rarely lasts more than five years and widened roads ultimately only succeed in extending the boundaries of wasteful, unproductive sprawl. In the case of road widenings, it's entirely possible that the disruption caused during the construction phase completely erases —or even exceeds — the fleeting benefits of reduced congestion. Then there's the opportunity cost: think of all the good that could have been done with the hundreds of billions of dollars spent on roadways over that period: more responsible transportation spending, education, renewable energy ... take your pick."

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).

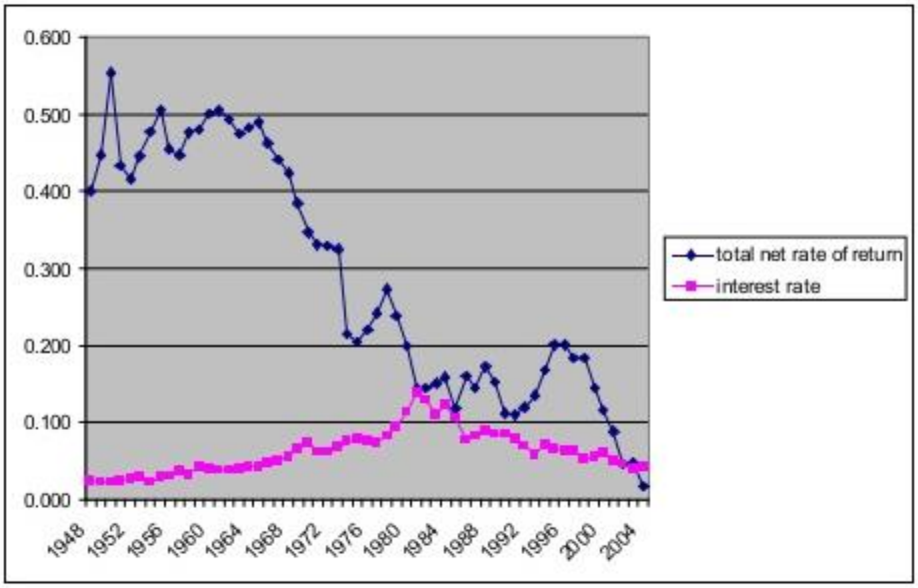
Although highways showed high economic returns during the 1950s and 60s, this declined significantly by the 1990s and has probably continued to decline since the most cost effective projects have already been implemented (Eberts 2009; Mamuneas and Nadiri 2006), as indicated in Figures 21 and 22.

Figure 21 **Annual Highway Rate of Return** (Eberts 2009)



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.

Figure 22 **Annual Highway Rate of Return Versus Interest Rates** (Eberts 2009)



Source: Author's calculations of Mamuneas's data.

Highway investment economic returns are now estimated to be less than interest rates, suggesting that most new highway projects are not economically justified.

Jiwattanakulpaisarn, et al. (2012) 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. Melo, Graham and Canavan (2012) found a positive relationship between U.S. urban highway expansion and economic output between 1982 and 2009, but conclude that other types of transportation system improvements could provide greater net benefits.

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%.

A U.S. Department of Treasury study suggests that, because user satisfaction is relatively higher for highways than for public transit services, investments in transit improvements may provide greater overall benefits than highway investments (Dept. of Treasury 2010).

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."

Similarly, a major U.S. literature review concluded that (Shatz, et al. 2011):

- Public infrastructure supply, including highways, can have significant positive effects on economic outcomes, including productivity and output.
- In the absence of a complete network, construction of transportation infrastructure can have large, positive effects on economic outcomes. As the network becomes more complete, effects of network expansion tend to diminish.
- These effects appear to be both direct—with transportation infrastructure serving as an input in production processes—and indirect—with transportation infrastructure making other types of inputs more productive.
- The condition as well as the quantity of infrastructure and its level of congestion may be important for inducing positive economic benefits.
- Transportation infrastructure has effects beyond the geographic area in which it is located. These can be positive or negative, and so the net economic effect could be positive, zero, or even negative.

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.

Public Transit Service Improvements

Public transit improvements can support economic development in several ways (CTOD 2011; EDRG 2014).

Direct Expenditures

Because transit is labor intensive, transit expenditures tend to provide more jobs and local business activity than most other transportation investments.

Consumer Expenditures

Transit supports economic development by shifting consumer expenditures. Residents of cities with quality transit systems tend to spend less on transportation overall. For example, residents of cities with large, well-established rail transit systems spend an average of $2,808 on personal vehicles and transit (12.0% of their total household expenditures), compared with $3,332 in cities that lack rail systems (14.9% of total household expenditures), despite higher incomes and longer average commute distances in rail cities.

Land Use Efficiencies

As described earlier, transit tends to create higher density, more accessible land use patterns, which tends to increase regional productivity. This suggests that high quality transit systems with transit oriented development around stations tend to support regional economic development by encouraging efficient polycentric land use development patterns. Although these impacts are difficult to measure and may partly reflect economic transfers, there are often large net gains in productivity and economic activity.

Supports Strategic Economic Development Objectives

Transit services can support specific strategic economic development objectives, such as tourism. For example, bus or trolley systems can be designed to serve visitors and provide access to major sport and cultural attractions, and historic train stations can be a catalyst for downtown redevelopment. This can be considered a special type of productivity gain often overlooked with conventional economic evaluation methods. Certain high-skill "knowledge-based" industries (professional, scientific, information services, finance, and insurance sectors) tend to concentrate in higher density regional commercial centers where transit access is important to achieve agglomeration efficiencies (ADIT 2012; Chatman, et al. 2012; CTOD 2011; Dachis 2013; Hazledine, Donovan and Bolland 2013; Nelson, et al. 2013).

Property Values

Property values generally increase in areas served by quality transit (Smith and Gihring 2003). The table below summarizes various studies on rail station proximity impacts on property values. Rodriguez and Targa (2004) found that, after controlling for other factors, a reduction of 5 minutes walking time to BRT stations increases property prices 6.8% to 9.3% in Bogotá, Colombia. Munoz-Raskin (2007) found that middle-income households, who tend to use BRT most, pay 2.3% to 14.4% more for housing located close to Bogotá BRT stations.

Transit System Efficiency Improvements

Many transit improvements increase system efficiency. Transit priority and improved payment systems increase operating speed and reduce delays, reducing operating costs. Many transit costs are fixed, so increased ridership reduces unit costs, particularly if ridership increases when there is excess capacity. Transit services experiences efficiencies and network effects. As per-capita ridership increases the system can expand, increasing service frequency, coverage, and operating hours, and transit can be more integrated with other transportation system features (for example, more businesses will choose to locate near transit). For these reasons, strategies that increase transit ridership can increase service efficiency and quality. Transit systems in cities with higher-quality transit systems and higher levels of per capita transit ridership tend to have lower transit operating costs, higher cost recovery, and lower per capita transportation expenditures than more automobile-dependent cities (Newman and Kenworthy 1999; Litman 2004a).

Basic Mobility - Employment Access

Economic productivity may be constrained if people lack basic mobility, particularly if workers have difficulty accessing jobs (Boarnet 2007). 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.

In automobile-oriented areas, automobile ownership increases unemployed people's chance of obtaining a job and their average incomes (Blumenberg and Waller 2003). 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 often 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). Minneapolis's Hiawatha light rail line increased the number of low-wage jobs accessible within 30 minutes of peak period transit travel by 14,000 jobs in station areas and 4,000 jobs in areas with direct light-rail bus connections (CTS 2010). This resulted from a combination of improved transit networks, and a concentration of low-wage worker households and lower-wage jobs moving to light-rail station areas.

Retail and Tourism Industries

Retail and tourism are major industries, providing employment, business activity and tax revenues. These industries are sensitive to the ease and price of access, the quality of travel conditions, and the quality of local environments, and so are vulnerable to traffic impacts such as noise and air pollution, and unattractive road and parking facilities.

When transportation costs increase, consumers tend to reduce their spending on restaurant meals and vacation travel (Ferdous, et al. 2008). Increasing transport system efficiency and affordability can leave consumers with more money to spend on retail goods and tourist services.

Impacts depend on specific conditions. For example, retail businesses often argue that a particular transportation policy change, such as pricing parking will discourage customers, but many retail centers with abundant, unpriced parking are less successful than commercial centers with priced parking: it turns out that many consumers are willing to pay if they benefit from more convenient parking (a parking space is always available) and a more attractive local environment (Kolozsvari and Shoup 2003).

Walkability can affect retail area attractiveness and therefore economic success (Hass-Klau 1993; European Commission 1999). Retailers sometimes favor automobile access (traffic and parking lanes) over non-motorized access (such as wider sidewalks, bike lanes and traffic calming) because they assume motorists spend more than customers who travel by other modes, but in many urban areas a majority of customers arrive by alternative modes, and although motorists tend to spent more per trip, pedestrians and cyclists shop more frequently and spend more per capita over a month or year (Clifton, et al. 2013; Fleming, Turner and Tarjomi 2013; Transportation Alternatives & Schaller Consulting 2006; Stantec 2011; Sztabinski 2009; Rowe 2013; Tolley 2011).

Pedestrian Malls and Districts

Pedestrianized commercial districts can support urban revitalization and economic development by creating a lively and friendly environment that attracts residents and visitors, although they must be carefully implemented to be effective (Rodriguez 2010; Tolley 2011). Some are closed to motor vehicle traffic altogether, at least during certain time periods such as evenings or weekends, while others allow automobile traffic but use traffic calming design strategies to control traffic speeds and volumes. Success varies depending on specific conditions. Many pedestrian-only commercial streets created in North American towns and cities during the 1970s failed to attract customers, and many were subsequently reopened to automobile travel, but others thrived, particularly in resort communities or as part of overall downtown redevelopment. Below are guidelines for creating successful pedestrianized streets and districts:

- It is generally better to calm vehicle traffic and improve non-motorized conditions throughout an area, than to let high speed and volume motor vehicle traffic dominate except on a token pedestrian street.
- Pedestrian areas require a critical mass of users. They should be both a destination and a thoroughfare that connects diverse attractions (housing, shops, offices, etc.). Encourage development that attracts a broad range of customers and clients, including retail, housing, education and employment. Apartments and offices can often be located over shops.
- Develop a pleasant environment, with greenery, shade and amenities. Building features and street furniture should be pedestrian scale and attractive. Maintain high standards for security, cleanliness and physical maintenance. Minimize blank building walls.
- Allow motor vehicles as required for access, with appropriate restrictions based on need, time and vehicle type. This may include unrestricted motor vehicle traffic during morning hours, transit vehicles, resident and hotel pickup, service and emergency vehicles, or other appropriate categories.
- Pedestrian streets should be located in pedestrian-friendly areas with good access to public transit and parking. Slow and restrict vehicle traffic on cross-streets.
- Develop a variety of artistic, cultural and recreational amenities (statues, fountains, playgrounds) and activities (concerts, fairs, markets). Highlight historical features.

A survey performed in Seattle neighborhood business districts (SDOT 2011) found that only 3-20% of residents drive to local shops. Most residents (61%+) either walk or take transit to get to neighborhood districts. Most residents identified their local neighborhood district as their primary neighborhood for shopping and dining. Convenience is the top reason for choosing a particular mode of travel. Because bicycle parking is space efficient it generates about five times as much spending per square meter as automobile parking (Lee and March 2010). Schoner, et al. (2012) found that in the Twin Cities (Minneapolis and St Paul, Minnesota) economic activity at restaurants, coffee shops, bars or nightclubs, and grocery stores increased in areas surrounding bikesharing services.

Although tourism requires transport, excessive emphasis on motor vehicle access (for example, expanding highways, parking facilities and airports) can spoil the attributes that attract visitors. Unique transport activities, such as walking, cycling and train travel, can help attract tourists (Tourism Vermont 2007).

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 22 **Imported Versus Locally Produced Cost Example**

	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 local businesses' shipping costs but also encourages local residents to shop at more central locations, which over the long-run often reduces local shopping options (SACTRA 1999). In these ways, underpriced transport often harms local industries. This is not to suggest that transport costs should be kept artificially high to favor local businesses, but it does point out that policies that underprice transport often have negative as well as positive economic impacts.

Such impacts should be identified and evaluated in terms of overall economic efficiency. If a transport policy or project harms certain businesses or industries the best response is often a compensation or transition program to facilitate needed change. For example, it may be appropriate to help a business or region that currently depends on automobile production to diversify into other products and industries.

Land Use Economic Productivity Impacts

Transportation policy and planning decisions can affect land use development patterns in ways that affect productivity (Litman 1995; Burchell, et al. 2002). More compact, mixed, connected land use patterns tend to increase employment, economic productivity, land values and tax revenues due to the combined effects of reduced land consumption, improved accessibility, reduced transportation costs, agglomeration efficiencies, and more efficient provision of public services (IEDC 2006; Chatman and Noland 2013; Renaissance Planning Group 2012).

Agglomeration efficiencies can significantly increase economic productivity (Chatman, et al. 2012; Graham 2007; Hazledine, Donovan and Bolland 2013; Webber and Athey 2007; Bettencourt, et al. 2007; Melo, Graham, and Noland 2009). One published study found that doubling county-level density index is associated with a 6% increase in state-level productivity (Haughwout 2000; also see discussion in Muro and Puentes 2004). Carlino, Chatterjee and Hunt (2006) and Carlino and Hunt (2007) 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. Sohn and Moudon (2008) found that office development values in the Seattle, Washington region tended to increase with development intensity at central regional locations, indicating efficiency benefits from accessibility, multi-modalism and agglomeration. Ferreyra and Roberts (2018), find that, although productivity tends to increase with density in Latin American cities, this primarily reflects higher education levels in cities.

In a comparison of European cities, Prud'homme and Lee (1998) conclude that urban areas with better public transit and less sprawl are more economically productive overall due to improved employment access. Meijers and Burger (2009) found that metropolitan region labor productivity declines with population dispersion (a higher proportion of residents live outside urban centres), and generally increases with polycentric development (multiple business districts, cities and towns within a metropolitan region, rather than a single large central business district and central city). This suggests that suburbanization is not economically harmful if new cities and towns reflect smart growth principles, such as if transit-oriented communities are developed around regional rail transit systems, creasing efficient polycentric development patterns, but automobile-oriented sprawl does reduce productivity.

More compact land use development tends to reduce the 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 development, including reductions in the amount of land required for transport facilities such as roads and parking, frees up land for other productive uses, including businesses, housing, farmlands, and recreation, which increases employment, business and tax revenue per unit of land (McCarty 2017). The box on the following page describes how this can increase regional economic productivity.

Some research is ambiguous. Angel and Blei (2016) found that, although economic productivity tends to increase with metropolitan region size and therefore labor pools, the shares of jobs in the CBD or in employment sub-centers does not significantly affected metropolitan population or employment growth, which they consider indirect proxies for overall urban productivity.) Considering the number of jobs in the city, the average density of jobs in the city, the share of jobs in the CBD, and the share of jobs in employment sub-centers, they found that only the number of jobs in the city had a significant effect on labor productivity; the shares of jobs in the CBD or in employment sub-centers did not. As a result, they conclude that dispersed development patters can be economically productive, and so recommend transportation systems that serve dispersed employment locations.

Transportation Policy Impacts On Farm Productivity
This example describes how transport land use impacts can affect agricultural productivity.

The Netherlands and Southern California (Los Angeles, Ventura, Orange, and eastern Riverside and San Bernardino counties) are similar in area (~ 16 thousand square miles) and population (~16 million residents). Both have significant agricultural potential. The Netherlands produces more than $40 billion annually in agricultural products. Farming was once major industry in Southern California but it is now minor, accounting for less than a billion dollars in direct economic productivity.

Several factors account for this differences, including topography (much of Southern California is hilly), water supply (Los Angeles has less) and economic policy (agricultural is well supported by the Dutch government), but a major factor is land use policy, which in turn is affected by transport policy. The Netherlands encourages compact development, with minimal land consumed for housing, parking and roads, which leaves more land for farming.

The following table compares the amount of land required for 16 million residents with multi-modal and automobile-oriented transport systems. Automobile dependency increases land consumption for buildings, surface parking and roads.

Typical Land Consumption Per Capita (Square Feet)

	Multi-Modal	Auto-Oriented
Housing (1,200 sq. ft. interior space per capita)	(Three stories) 400	(One-story) 1,200
Parking (300 sq. ft. per space)	(2 spaces) 600	(6 spaces) 1,800
Roads (15 foot right-of-way width per lane)[9]	(30 lane-feet) 450	(100 lane-feet) 1,500
Impervious surface per capita (sq. ft)	1,450	4,500
Total impervious surface (sq. miles)	832	2,582
Portion of 16 thousand sq. miles	5%	16%

Multi-modal transportation reduces per capita land consumption for housing, parking and roads. In can increase the amount of land available for agricultural or other productive uses.

In the multi-modal community residents consume about 5% of the land base for buildings, parking and roads, compared with 16% in automobile-oriented areas, leaving about 11% more land available for productive uses such as agricultural. Of course, the actual impacts depend on many factors, including other land uses (such as residential lawns, parks and industrial facilities) and the quality of land displaced. Increasing per capita land consumption will not reduce agricultural production if it uses land unsuited for farming, but urban development often occurs on agricultural lands (valleys and deltas) and so reduces agricultural production.

This example illustrates how transportation policies can significantly affect per capita land consumption, which can have significant economic impacts. This indicates that transportation policies that encourage more compact development and reduce the amount of land required for roads and parking facilities can increase the productivity of farming or other land-intensive industries.

[9] *Federal Highway Statistics*, Table 71 (www.fhwa.dot.gov/policyinformation/statistics/2008/hm71.cfm) provides data on road miles in various cities, suggesting that per capita lane-miles range from about 30 in multi-modal communities up to about 100 in more automobile-dependent areas.

Chapple and Makarewicz (2010) analyzes business growth trends in California between 1990 and 2005. That find that most expanding firms locate near transportation infrastructure, such as highways and major airports, but this is often existing infrastructure in urban areas. The businesses that contributed the majority of growth during that period did not expand into the urban periphery with undeveloped sites. Rather they seek sites with existing major infrastructure that has developed other urban amenities, an ample labor force, and appropriate housing for workers. They conclude that smart growth development policies need not reduce economic development, and may support economic development by improving affordable and accessible housing options.

Kane (2010) argues that transportation planning decisions can support future economic development by maximizing connections between urban activity centres that focus on knowledge and digital economic production, such as major commercial centers, universities and modern industrial parks. Comparing countries around the world, Chen, et al. (2014) find a strong correlation between urbanization and economic productivity, but not between urbanization and productivity growth rates; in some cases rapid urbanization occurs in countries with zero or negative economic growth. They conclude that only if urbanization occurs with other structural changes (education, infrastructure development, etc.) will it lead to economic development. Hsieh and Moretti (2014) analyzed the economic impacts of density-limiting policies in large, highly-productive U.S. cities. They estimate that such policies reduce aggregate national economic output by 13%, or more than $1 trillion annually.

More compact, mixed, multi-modal urban land use development tends to be more transportation efficient (transport costs are lower overall) due to proximity (less travel is needed for a given level of access) and transport diversity (good walking and cycling conditions, and public transit, taxi and delivery service quality). However, conventional planning methods tend to undervalue these efficiencies. Commonly-used, *mobility-based* transport system performance indicators (roadway level-of-service, average travel speeds, and vehicle operating costs) often 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 tend to recognize these efficiencies.

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; Leinberger and Alfonzo 2012).

Lower-density, automobile-oriented commercial development tends to produce less employment, business activity and tax revenue per area than more compact, multi-modal development (Strategic Economics 2013). In a case study by Marohn (2012), an older traditional, traditional commercial area occupied by a mix of retail and office uses had about 40% greater total property value and tax revenue per acre than a new, auto-oriented fast-food development.

Where conditions are suitable, transport improvements can leverage large amounts of private investment and economic development. In competitive markets, small differences in accessibility and local environmental quality can make a large difference in property values and development potential. For example, a ten million dollars invested in a new rail line can stimulate a hundred million dollars in nearby property development (Portland 2009).

Adams and VanDrasek (2007) describe methods to evaluate 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).

Affordability

Affordability refers to the degree that households can afford basic goods and services. 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

Transportation demand management and Smart Growth policies can increase affordability by reducing consumer costs, including transportation costs, and supporting more urban affordable housing development. Transportation affordability tends to increase with improvements to affordable modes (walking, cycling, ridesharing, and public transit) and more affordable housing in accessible, multi-modal locations. By increasing retail agglomeration efficiencies and competition, larger and more connected urban development tends to reduce costs of common consumer goods (Handbury and Weinstein 2014).

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 23 **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.

Transportation inaffordability appears to contribute to home foreclosure. A 2009 study of 40,000 mortgages in three U.S. cities found that, controlling for demographic and economic factors, foreclosure rates increased as a household's vehicle ownership rates increased, suggesting that living in more multi-modal community increases household economic resilience (NRDC 2010).

Economic Mobility

Economic mobility refers to the chance that a child will be more economically successful than their parents. Studies show that more compact and mixed development tends to increase poor residents' economic opportunity by improving access to education, employment and positive role models (Levy, McDade and Dumlao 2010). This is particularly important for those who lack a driver's license or cars (Kneebone and Holmes 2015). Using *Equality of Opportunity Project* (Chetty, et. al. 2014) data, Ewing and Hamidi (2014) found that each 10% increase in their Smart Growth index is associated with a 4.1% increase in residents' upward mobility (probability of children born in the lowest income quintile reaching the top quintile by age 30). Ewing, et al. (2016) found that Smart Growth increases economic mobility (the chance that children born in low-income families will become economically successful as adults); doubling their compactness index increases the probability that a child born to a family in the bottom income quintile will reach the top quintile by age 30 by about 41%. Corak (2017) found higher rates of economic mobility in Canadian urban areas compared with rural areas, although some suburbs, those with large immigrant populations, have higher rates of mobility than their cities. Using different research methods, Chyn (2016) found that children who left concentrated poverty neighborhoods are 9% (4 percentage points) more likely to be employed as adults relative to their non-displaced peers, and have $602 higher average annual earnings – an 16% increase relative to their counterparts who remained in concentrated poverty.

Lens and Monkkonen (2016) find that regulations that limit infill development increase economic segregation.

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).

Desirable Outcomes

As discussed earlier, the ultimate goal of economics is to maximize social welfare. Economists often use material wealth and market activity (income, economic productivity, etc.) when evaluating economic development, but some challenge this approach (Talberth, Cobb, and Slattery 2006). They argue that economic development should be evaluated based on 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*. The *Genuine Progress Indicator* (GPI) adjusts *Gross Domestic Product* (GDP) to account for the costs of crime, environmental degradation, loss of leisure, income inequality, public infrastructure, volunteering and housework.

Researchers Reid Ewing and Shima Hamidi (2014) used sophisticated statistical analysis and extensive data sets to measure how various aspects of sprawl affect economic, social and environmental outcomes. They assigned a Sprawl Index (although, since it increases with smart growth attributes, it is better to think of it as a Compactness Index) score to 221 U.S. metropolitan areas and 994 counties. Table 3 summarizes key results.

Table 3 **Impacts of More Compact Development** (Ewing and Hamidi 2014)

Outcome	Relationship to Compactness	Impact of 10% Score Increase
Average household vehicle ownership	Negative and significant	0.6% decline
Vehicle miles traveled	Negative	7.8% to 9.5% decline
Walking commute mode share	Positive and significant	3.9% increase
Public transit commute mode share	Positive and significant	11.5% increase
Average journey-to-work drive time	Negative and significant	0.5% decline
Traffic crashes per 100,000 population	Positive and significant	0.4% increase
Injury crash rate per 100,000 pop.	Positive and significant	0.6% increase
Fatal crash rate per 100,000 population	Negative and significant	13.8% decline
Body mass index	Negative and significant	0.4% decline

Obesity	Negative and significant	3.6% decline
Any physical activity	Not significant	0.2% increase
Diagnosed high blood pressure	Negative and significant	1.7% decline
Diagnosed heart disease	Negative and significant	3.2% decline
Diagnosed diabetes	Negative and significant	1.7% decline
Average life expectancy	Positive and significant	0.4% increase
Upward mobility (probability a child born in a bottom-income-quintile family reaches the top quintile by age 30)	Positive and significant	4.1% increase
Transportation affordability	Positive and significant	3.5% decrease in transport costs relative to income
Housing affordability	Negative and significant	1.1% increase in housing costs relative to income.

This table summarizes economic, health and environmental impacts from compact development.

These results indicate that more compact development reduces motor vehicle travel and associated costs which provide positive outcomes including financial savings, improved health and increased economic mobility.

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.

Table 24 **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.
Indirect expenditures	Impacts of consumer expenditures, particularly on vehicles and fuel	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.
Retail and Tourism	Impacts on local retail and tourism industries	Surveys, input-output tables.	Improve access and travel conditions, reduce negative

			impacts.
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.
Desirable 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 12 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.

The report, *Value Per Acre Analysis: A How-To for Beginners* (Herriges 2018), describes how to measure the amount of tax generated by various development patterns, and therefore local tax revenue per land unit. This analysis indicates that more compact commercial development with less land devoted to off-street parking tends to generate more tax revenue per acre or hectare.

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 25. These savings can be considered equivalent to an increase in household income.

Table 25 **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 methods are used to evaluate the economic impacts of specific transport policies and programs (CASE 2013; Herriges 2018; Peters, Paaswell and Berechman 2008; PCT 2011; Weisbrod 2007):

- 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 (CMAP 2014; 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.

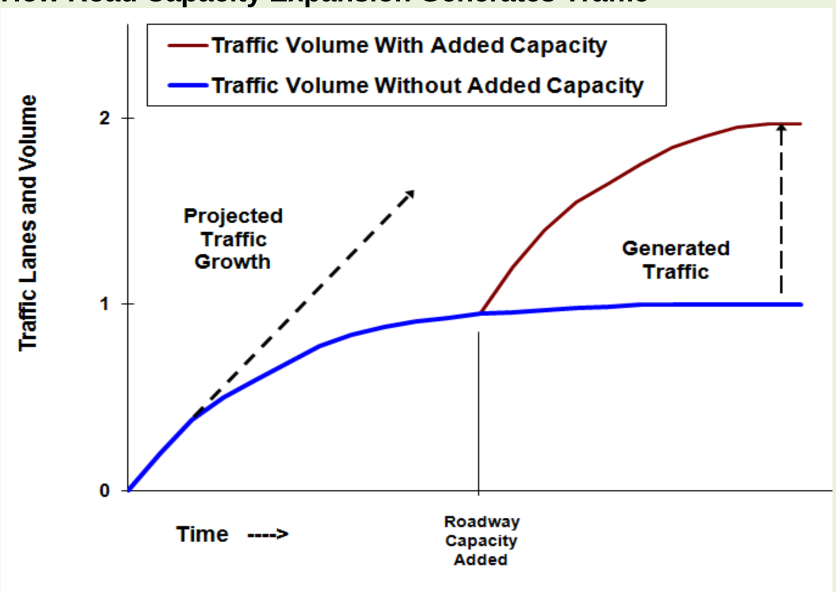
- Special studies can help evaluate specific economic impacts, such as how a policy or program affects household affordability (from transportation cost savings) and wealth generation (for example, taking into account equity gains from home ownership).

- 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 these tools' limitations. For example, most transportation benefit-cost analysis considers a limited portion of total impacts, and input-output table analysis indicates employment and productivity impacts but excludes other types of economic impacts such as changes in household wealth, property values and external costs, and equity impacts such as changes in affordability. Communities often value these overlooked impacts as much as impacts that are quantified. Analysis results should indicate which impacts are and are not considered.

Generated Traffic and Induced Travel: Implications for Economic Analysis (Litman 2001b)
Traffic congestion tends to maintain equilibrium: it increases to the point that some peak-period vehicle trips are foregone. If roadways are expanded, the additional capacity tends to be filled by latent demand, additional peak-period trips previously discouraged by congestion. These additional peak-period vehicle trips are called *generated traffic*. The subset of generated traffic that results in net increases in vehicle travel (longer and more frequent trips, and shifts to automobile mode, but excluding route and time shifts) is called *induced travel*. Experience indicates that when congested urban roadways are expanded, in the medium-term (2-5 years) generated traffic fills the majority of added capacity, and significant amounts of vehicle travel is induced, particularly if it stimulates sprawled land use development.

How Road Capacity Expansion Generates Traffic



Traffic grows when roads are uncongested, but growth rates decline as congestion develops, reaching a self-limiting equilibrium (the curve becomes horizontal). If capacity increases, traffic grows until it reaches a new equilibrium. This additional peak-period vehicle travel is called "generated traffic." The portion that consists of net increases in vehicle travel (as opposed to shifts in time and route) is called "induced travel."

Generated traffic can significantly affect roadway expansion benefits. It means that benefits consist more of increased mobility and less of reduced traffic congestion. Transport economic evaluation should consider these three impacts:

- Generated traffic significantly reduces roadway expansion congestion reduction benefits, particularly over the long run.
- Induced travel increases external costs, including downstream traffic and parking congestion, accidents, fuel subsidies and pollution emissions. Over the long term it helps create more automobile dependent transportation systems and land use patterns which reduces accessibility for non-drivers.
- The mobility benefits of generated traffic are relatively small since they consist of marginal value trips. Much of the benefits are often capitalized into land values.

Failing to fully account for these factors tends to exaggerate urban roadway expansion benefits and undervalue other congestion reduction strategies such as improvements to alternative modes (particularly grade-separated transit), transport pricing reforms and more accessible land development.

Evaluating 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 21 **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.

Figure 21 **Intelligent Cities Program, National Building Museum**
(www.nbm.org/assets/images/intelligent-cities/ic_city_graph_large.jpg)

According to this analysis by the U.S. National Building Museum, only an estimated 16% of automobile (vehicles and fuel) expenditures stay in a local economy. As a result, more efficient and affordable transport supports local economic development.

Examples and Case Studies

Examples of transport economic evaluations are summarized below. Also see NADO (2012) and EDRG (2012).

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 26 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 26 **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 27 **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 28 identifies questions to consider when evaluating parking subsidy proposals.

Table 28 **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 29 identifies ways that roadway expansion affects economic productivity.

Table 29 **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 30 **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	Increases transport costs and reduces options 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 this cost, 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 costs such as consumer, parking or accident costs. Highway expansion tends to provide modest long-term congestion reductions, and it increases other costs, so net productivity gains are often small. Mobility management can often provide greater net economic benefits by increasing overall efficiency. Table 31 identifies questions to consider when evaluating the economic impacts of such a proposal.

Table 31 **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 32. 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 32 **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 33 identifies issues to consider when evaluating public transit economic benefits.

Table 33 **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 13 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 34 indicates the efficient fees for various transport costs. An optimal transportation system would apply all of these fees.

Table 34 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 35 identifies ways that pricing reforms affect economic productivity. They can reduce specific transport problems and tend to increase overall transport 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 35 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 36 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.

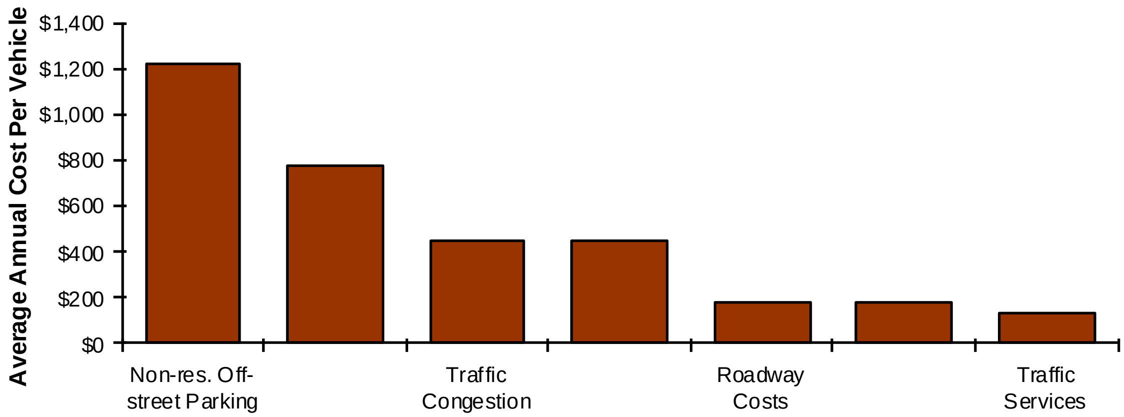
Table 36 **Transportation Pricing Reform Economic Impacts**

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, improve affordable transport options, 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 transport and land use policies to maximize the 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).

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 16. 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 37 **Automobile and Transit Oriented Development Costs**

	Cost Per Vehicle	Transit-Oriented	Auto 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 37 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 38 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 38 **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 39 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 39 **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).

High Speed Rail Economic Benefits (Ahlfeld and Feddersen 2010)
High-speed rail lines provide significant economic benefits to the communities they serve according to a study by European researchers. Towns connected to a new high-speed line saw their GDP rise compared to neighbours not on the route.

The research focused on the rail line between Cologne and Frankfurt, which opened in 2002. The authors looked at the prosperity and growth of two towns with stations on the new line – Limburg and Montabaur – and compared them with more than 3,000 other municipalities in the surrounding regions. The new line brought Limburg and Montabaur within a 40-minute journey of both Cologne and Frankfurt. Over a four-year period, the researchers found that both towns and the area immediately around them experienced significantly higher economic growth rates than their unconnected neighbours. Their study also found that increased market access through high-speed rail has a direct correlation with a rise in GDP – for each one per cent increase in market access, there is a 0.25 per cent rise in GDP.

The researchers concluded, "It is quite clear that the line itself brought significant and lasting benefits in access to markets, growth, employment and individual prosperity. One of our key findings is a positive market access elasticity, which means that improvements in accessibility to other towns, cities and regions, will be reflected in economic growth. We believe this research develops a new framework for predicting the economic effects of large-scale infrastructure projects and will help governments to define future spending priorities."

Sustainable Transportation Economic Evaluation
Zheng, et al (2011) evaluate transportation system economic impacts using a sustainability perspective. Their evaluation framework considers the factors listed below. This analysis suggests that a more diversified transportation system, and more urbanized land use patterns tend to increase economic sustainability.

- *Affordability* (portion of household budgets devoted to transport).
- *Productivity* (ratio of current GDP to VMT, and ratio of the growth rate of GDP to VMT).
- *Self-sufficiency* (portion of road and public transit expenditures from federal funding).
- *Resiliency* (percentage of wealth spent on fuel)

Their analysis indicates that U.S. states that reflect these principles tend to have higher economic productivity (per capita GDP).

Comprehensive Emission Reduction Benefit Analysis (Climate Works 2014)
The report, *Climate-Smart Development: Adding Up The Benefits Of Actions That Help Build Prosperity, End Poverty And Combat Climate Change*, evaluates the full economic and social benefits of various climate change emission reduction strategies. It describes various economic

impact models that measure the impacts of resource conservation and emission reductions which reduce air pollution deaths, including the U.S. EPA's *Environmental Benefits Mapping and Analysis Program* (BenMAP), the European Commission *Joint Research Centre's Fast Scenario Screening Tool* (TM5-FASST), and a new rapid assessment tool being developed by the Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants (CCAC).

It investigates the effectiveness of various case studies, and estimates the impacts and benefits that would result if they were scaled up and applied worldwide. The case studies include sustainable transport policies that encourage more efficient and alternative fueled vehicles, freight transport shifts from truck to rail and passenger transport shifts from automobile to high quality public transit. Considering just energy savings and emission reduction benefits (it does not account for reduced traffic congestion, roadway infrastructure savings, vehicle ownership cost savings, accident reduction, or other benefits) the analysis concludes that these policies could reduce approximately 10% of the energy-related emission reductions necessary to stabilize CO_2e concentration at 450 ppm with a net *savings* of $169 per tonne. The report also evaluates cleaner cookstoves in China, solid waste management in Brazil, and renewable fuel production in Mexico.

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.

Transport policies are affected by the perceived profitability of large, fuel inefficient vehicle sales. 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 vehicle and fuel sales 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 more production capacity than justified by demand, and for many producers, real profits (excluding subsidies) are small or negative. Other industries are more profitable and have more growth potential. As described earlier in this report, 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 inefficient vehicles are likely to reduce economic development (Litman 2009b).

Bicycle Improvement Benefit/Cost Analysis (Gotschi 2011)

This study assessed how costs of Portland's past and planned investments in bicycling relate to health and other benefits. Bicycle facility costs are compared with 2 types of monetized health benefits: health care cost savings and value of statistical life savings. Levels of bicycling are estimated using past trends, future mode share goals, and a traffic demand model. This analysis indicates that by 2040, investments in the range of $138 to $605 million will result in health care cost savings of $388 to $594 million, fuel savings of $143 to $218 million, and savings in value of statistical lives of $7 to $12 billion. The benefit-cost ratios for health care and fuel savings are between 3.8:1 and 1.2:1, and an order of magnitude larger when value of statistical lives is used. This indicates that such efforts are cost-effective, even when only a limited selection of benefits is considered.

Best Practices

Transportation economic development analysis should be comprehensive, considering all significant objectives, impacts and options. Economic analysis should reflect various issues and perspectives when evaluating a particular policy or project, including various types of economic impacts, and perspectives of different groups and geographic scales.

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 40 **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 market principles, including consumer options, efficient pricing and neutral public policies. It therefore includes:

- 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 implemented to address a particular problem, such as roadway expansion to reduce traffic congestion, and new parking facilities to reduce parking problems.

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.

Just as consuming too much food is as harmful as consuming too little, excessive mobility can be as economically harmful as too little mobility. Some vehicle travel is more beneficial than others, and an increasing portion of vehicle travel is economically inefficient; its marginal costs exceed its benefits. The key to increasing transport system efficiency is to facilitate the high value trips while discouraging low-value trips. With more efficient pricing, consumers would forego low-value vehicle travel, making the overall transportation system more efficient and reducing problems such as congestion, accidents and pollution emissions. This analysis suggests that underpricing vehicle travel is economically harmful, and road, parking and fuel prices can increase significantly without reducing economic productivity.

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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