

7. Evaluating Transportation Benefits

This chapter discusses techniques for quantifying transportation benefits, including benefits of marginal cost savings, external benefits, consumer surplus benefits, economic productivity and development, and benefits of transportation diversity.

7.1 Chapter Index

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|--|----|
| 7.1 Chapter Index | 1 |
| 7.2 Introduction to Transportation Benefits | 1 |
| Benefits and Costs..... | 2 |
| Consumer Surplus Analysis..... | 2 |
| Transport Affordability..... | 5 |
| External Benefits and Costs | 6 |
| 7.4 Economic Productivity and Development Benefits | 8 |
| 7.5 Benefits by Mode..... | 9 |
| 7.7 Information Resources..... | 11 |

7.2 Introduction

Accessibility (people’s ability to reach desired activities) and *mobility* (physical movement) provide benefits to society, including direct benefits to users (people engaged in the transport activity) and external benefits. Most economic and social activities involve transport and some, such as a life-saving trip to a hospital or delivery of a valuable goods, have extremely large benefits. However, the existence of such benefits does not mean that all travel provides net benefits (benefits exceed costs) nor that increased mobility is necessarily desirable. Beyond an optimal level, additional mobility provides declining and eventually negative marginal benefits. Nobody would spend all their time and money on travel, nor should a community devote excessive resources to transport facilities. As an analogy, people must eat to live but that does not mean that increased eating is always desirable, that current diets are optimal, or that society should subsidize all foods. At the margin (i.e., relative to current consumption) many people are better off eating less because overeating is unhealthy, and consuming less food leaves more resources for other beneficial goods, including healthier foods (improve quality).

Transportation net benefits tend to be maximized by policies that reflect market principles, such as consumer choice, efficient pricing and economic neutrality, as discussed in Chapter 3. These principles favor higher value trips and more efficient modes over lower-value trips and inefficient modes, and discourage travel in which benefits are less than total costs. More optimal transport markets, with efficient road and parking pricing and more neutral planning practices are likely to increase total benefits while reducing total vehicle travel.¹

¹ EU (1996), *Towards Fair And Efficient Pricing in Transport*, European Union (www.europa.eu); Todd Litman (2007), *Socially Optimal Transport Pricing and Markets*, VTPI; at www.vtpi.org/sotpm.pdf; “Market Reforms,” *Online TDM Encyclopedia*, VTPI, at www.vtpi.org/tdm/tdm29.htm.

Benefits and Costs

Critics sometimes argue that transportation cost research is “anti-automobile” or ignores the benefits of mobility, as discussed in Chapter 8, but this reflects a misunderstanding of the relationships between benefits and costs. Benefits and costs tend to have a mirror-image relationship: benefits can be defined as a reduction in costs, and costs can be defined as reduced benefits. Transport benefits are often measured based a reductions in transport costs. For example, roadway expansion benefits are calculated based on the reduction in travel time and vehicle costs they provide. Vehicle safety improvement benefits are measured in terms of reduced crash injuries and deaths. As a result, transport economic analysis generally starts by quantifying costs.

Standard models are available for calculating highway and transit improvement benefits, based on reductions in travel time, vehicle operation and crash risk costs.² However, these models overlook some significant costs (see discussion in Chapter 3). For example, most ignore parking cost savings that result when travelers shift from automobile to an alternative mode, or the reductions in crash costs that result when motorists reduce total vehicle travel. As a result, such models tend to undervalue alternative modes and mobility management strategies.³

Consumer Surplus Analysis

Direct transportation benefits can be evaluated using *consumer surplus* analysis, which refers to the value consumers place on consuming a good (in this case, mobility can be considered a consumer good).⁴ For example, if in a particular situation you would willingly pay up to \$10 to reach a particular destination, but your actual cost is \$4, you would enjoy net benefits worth \$6. If another person were only willing to pay up to \$5 for the same trip, their net benefit would be \$1. The total consumer surplus of the two trips would be \$7. This represents *travel demand*, that is, the amount and type of travel that people would consume under specific conditions.

When evaluating consumer surplus, benefits from trips that would occur anyway are calculated at their full value, and benefits from trips that occur as a result of reduced costs are calculated using the “rule of half,” as described in the box on the following page. For example, a 50¢ per trip transit fare reduction would provide a \$500 consumer surplus gain from 1,000 transit trips that would have been made anyway (1,000 x 50¢), and a \$100 consumer surplus gain if this price reduction resulted in 400 additional transit trips (400 x 50¢ x ½).

² TTI (1997), *MicroBENCOST*, Texas Transportation Institute (<http://tti.tamu.edu>); World Bank (2000), *Highways Design and Maintenance (HDM) 4 Model*, World Bank (www.worldbank.org).

³ “Comprehensive Transportation Planning,” *Online TDM Encyclopedia* (www.vtpi.org/tdm/tdm76.htm).

⁴ Kenneth Small (1999), “Project Evaluation,” in *Transportation Policy and Economics*, Brookings (www.brookings.edu); DfT (2003), *National Transport Model*, UK Dept. for Transport (www.dft.gov.uk); at www.dft.gov.uk/pgr/economics/ntm.

Explanation of the “Rule of Half”

Economic theory suggests that when consumers change their travel in response to a financial incentive, the net consumer surplus averages half of their price change (called the “rule of half”). This takes into account total changes in financial costs, travel time, convenience and mobility as perceived by consumers.

Let’s say that vehicle operating costs increased by 10¢ per mile due to higher fuel prices, road tolls or parking fees, and as a result you reduced your annual vehicle use by 1,000 miles. You would not give up highly valuable vehicle travel but there are probably some lower-value vehicle-miles that you would reduce by shifting modes or choosing closer destinations.

These vehicle-miles foregone have an incremental value to you, the consumer, between 0¢ and 10¢. If you consider the additional mile worth less than 0¢ (i.e., it has no value), you would not have taken it in the first place. If its worth is between 1-9¢ per mile, a 10¢ per mile incentive will convince you to give it up – you would rather have the money. If the additional mile is worth more than 10¢ per mile, a 10¢ per mile increase is inadequate to convince you to give it up – you’ll keep driving. Of the 1,000 miles foregone, we can assume that the average net benefit to consumers (called the *consumer surplus*) is the mid-point of this range, that is, 5¢ per vehicle mile. Thus, we can calculate that miles foregone by a 10¢ per mile financial incentive have an average consumer surplus value of 5¢. A \$100 increase in vehicle operating costs that reduces automobile travel by 1,000 miles imposes a *net cost* to consumers of \$50, while a \$100 financial reward that convinces motorists to drive 1,000 miles less provides a *net benefit* to consumers of \$50.

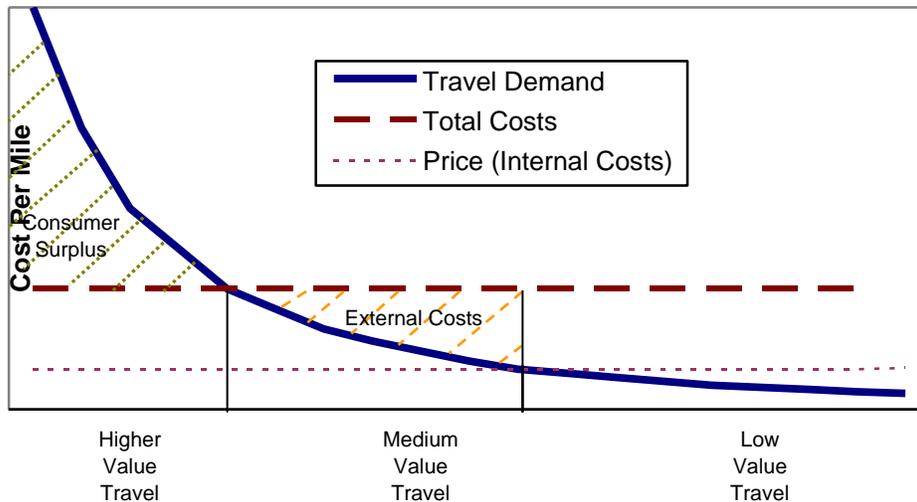
Some people complicate this analysis by trying to track individual changes in consumer travel time, convenience and vehicle operating costs, but that is unnecessary information. All we need to know to determine the net consumer benefits and costs is to know the perceived change in price, either positive or negative, and the resulting change in consumption. This incorporates all of the complex trade-offs that consumers make between money, time, convenience and the value of mobility.

The following factors should be considered when evaluating the consumer surplus benefits of transportation activities and improvements.

Consumer benefits tend to decline as personal mobility increases since rational consumers choose more valuable travel over lower value travel, so additional mobility consists of trips that consumers consider less valuable and are most willing to forego if constrained by price, time costs or discomfort. For example, a certain amount of mobility (say, the first 5,000 annual miles of vehicle travel) tend to provide large benefits because this will consist of consumer’s most valuable trips, but each additional thousand miles of travel provides less benefit because it consists of increasingly lower value travel. Travel demand tends to have a long tail, meaning that if user costs (including money, time, discomfort, etc.) decline, consumers can find reasons to increase their consumption. For example, if travel costs were low enough (for example, if somebody else paid for first class service), many consumers would regularly travel to other continents or accept long-distance commutes, even if their net benefits are modest. To the degree that this travel is

underpriced (subsidized or imposes external costs), an increasing portion of this travel has negative net costs (total benefits are smaller than total costs).

Figure 11 Travel Demand Curve



Travel demand curves tend to have long tails: as prices decline mobility increases even if the additional travel provides little incremental benefits and imposes significant external costs. As a result, an increasing portion of travel has negative social value (total benefits are less than total costs, including energy and environmental externalities), indicated by the orange shaded area.

Mobility is usually considered a *derived demand*; that is, people travel to access goods, services activities and destinations. However, users often enjoy a certain amount of mobility, which may involve walking, cycling, driving or various forms of public transport.⁵ Most people seem to want to spend an average of 30-60 daily minutes in travel outside their home (when people cannot do this they often complain of being *housebound*). Purely recreational travel which has no destination, generally represents a minor but not insignificant portion of total travel, and a larger share of transport decisions are probably influenced by positive feelings people have for mobility. For example, people may accept a longer commute or take non-essential business trips because they enjoy travel. This suggests that a certain amount of travel activity may provide direct user benefits, and that qualitative factors, such as comfort, interest, aesthetics, and physical exercise may significantly affect the value of personal travel. This factor is incorporated in this report by assigning a zero or low cost to a certain amount of daily travel time, as discussed in Chapter 5.2.

Transportation benefits are also affected by the tendency of some transport modes and activities to be *positional goods*, that is, goods that people consume to raise their social

⁵ Patricia Mokhtarian and Ilan Salomon (2001), “How Derived is the Demand for Travel?” *Transportation Research A*, Vol. 35, No. 8, (www.elsevier.com/locate/tra), Sept. 2001, pp. 695-719.

status.⁶ For example, many motorists choose vehicles that are more powerful than actually needed because these features are considered prestigious, and people sometimes avoid modes such as walking, cycling and public transportation because they are considered socially inferior. From an individual's subjective perspective positional value is rational, because it provides a competitive advantage, but from society's perspective, positional goods provide little or no net benefit because gains to one individual are offset by losses to others.⁷ For example, as more people drive prestigious cars their peers must obtain equally prestigious vehicles to maintain status. It represents a form of inflation, popularly called "keeping up with the Joneses," which raises everybody's costs without increasing overall welfare. Positional value is an *economic trap*, a situation in which individuals compete in ways that waste resources. Described differently, prestige value is an economic transfer rather than a net economic gain.

Most transport decisions involve marginal changes in travel costs, options or activity. For example, once a basic road system exists, most additional roadway expansions provide marginal changes in travel time, vehicle costs and crash risk. Similarly, a new public transit route or freight delivery service provides marginal benefits compared with otherwise available options. Consumer surplus benefit evaluation should therefore carefully define the *base case* (the conditions that are assumed to exist with the change being considered) and the incremental changes in order to determine marginal impacts. For example, alternative fueled vehicles may provide energy savings and emission reduction benefits compared with the same trips made by an average automobile, but not compared with travel by walking, cycling, ridesharing or public transit.

Transport Affordability

Transportation affordability refers to users' financial costs for basic transport.⁸ Improved affordability can provide substantial benefits by offering financial savings to consumers and helping achieve equity objectives, by reducing cost burdens and increasing opportunities for disadvantaged people. Transport affordability is affected by vehicles ownership rates, the costs of owning and operating vehicle, the quality and costs of alternative modes, and residential parking impacts on housing affordability. Transportation cost savings are equivalent to increased household income. For example, in an automobile dependent community, a household with two employed adults needs to own two automobiles, costing approximately \$10,000 a year; but in a community with a more diverse transportation system, the same household may only need one car, plus \$1,000 in transit and taxi fares, saving \$4,000 annually, equivalent to more than \$5,000 in additional pre-tax income.

⁶ Todd Litman (2009), "Mobility as a Positional Good: Implications for Transport Policy and Planning," *Car Troubles: Critical Studies of Automobility and Auto-Mobility* (Jim Conley and Arlene Tigar McLaren eds), Ashgate (www.ashgate.com); at www.vtppi.org/prestige.pdf.

⁷ Robert H. Frank (2005), *Positional Externalities Cause Large and Preventable Welfare Losses*, American Economic Association Annual Meeting (www.aeaweb.org/annual_mtg_papers/2005/0108_1015_0601.pdf).

⁸ "Transportation Affordability," *TDM Encyclopedia*, VTPI (www.vtppi.org/tdm/tdm106.htm).

External Benefits

This guidebook shows that transport facilities and activities impose many external costs; that is, costs not borne directly by users, including traffic congestion and crash risk imposed on other road users, roadway and parking facility costs not funded through user fees, and pollution emissions. People sometimes argue that external benefits offset these external costs. For example, The Highway Users Federation,⁹ the International Road Union, the Deutsche Strassenliga (a German freight organization), and the German Club of Automobilists have published reports arguing that driving provides significant external benefits.¹⁰ Supposed benefits include improved personal mobility, improved economic productivity, and general regional economic development.

These studies have been criticized for failing to distinguish between internal and external benefits, counting economic transfers as benefits, and non-marginal analysis.¹¹ A 1982 USDOT study concluded, “*the preponderance of expert opinion probably lies on the side of saying that there are no external benefits of highway consumption beyond the benefits to the users.*”¹² Other studies reach similar conclusions.¹³ An Office of Technology Assessment report also concludes that there are no significant marginal external benefits of transportation.¹⁴

These studies of external transportation benefits are often used to justify underpricing and other policies that favor motor vehicle travel, on the grounds that even people who do not benefit directly will benefit indirectly. But such underpricing would only be justified if the project provides *external marginal benefits* that exceed *external marginal costs*. Most transport benefits are internal, that is, benefits to the people or businesses that use a transport activity or service. Economic studies have found few external benefits from increased automobile travel, and virtually no external *marginal* benefits in economically developed countries.¹⁵ That is, you are unlikely to benefit if your neighbors increase their vehicle ownership and use, so there is little rationale for underpricing or other policies that encourage vehicle use.

⁹ Eric Beshers (1993), *External Costs of Automobile Travel and Appropriate Policy Responses*, Highway Users Federation (Washington DC).

¹⁰ Cited in Werner Rothengatter (1991), “Do External Benefits Compensate for External Costs of Transport?”, *Transportation Research*, Vol. 28A (www.elsevier.com/locate/tra), p.325.

¹¹ Per Kageson (1993), *Getting the Prices Right*, European Fed. for Transport & Env. (www.transportenvironment.org), p. 37; Werner Rothengatter (1994), “Obstacles to the Use of Economic Instruments in Transport Policy,” in *Internalising the Social Costs of Transport*, OECD (www.oecd.org).

¹² USDOT (1982) *Final Report on the Federal Highway Cost Allocation Study*, (www.dot.gov), p. E-9.

¹³ Werner Rothengatter (1991), “Do External Benefits Compensate for External Costs of Transport?”, *Transportation Research*, Vol. 28A (www.elsevier.com/locate/tra), p. 321-328; Heini Sommer, Felix Walter and Rene Neuenschwander (1993), *External Benefits of Transport?*, ECOPLAN (Bern); Jacques Girard and Christopher Hurst (1994), *Investment and Growth: Quality versus Quantity*, European Investment Bank (www.eib.org).

¹⁴ Office of Technology Assessment (1994), *Saving Energy in U.S. Transportation*, (www.access.gpo.gov/ota), p. 97.

¹⁵ Werner Rothengatter (1991), “Do External Benefits Compensate for External Costs of Transport?”, *Transportation Research*, Vol. 28A, (www.elsevier.com/locate/tra), p.321-328; Dr. Heini Sommer, Felix Walter, Rene Neuenschwander (1993), *External Benefits of Transport?*, ECOPLAN (Bern).

As explained by a Swiss study of external transportation benefits,¹⁶

There exists no justification for subsidising transport with the motivation of creating additional benefits and not either for compensating non-existing external benefits. The main elements of a modern transport policy will consist in a correct financing of infrastructure, a social marginal tariffication and an optimal regulation of the market. For the evaluation of single projects cost benefit analyses should be undertaken.

That external costs tend to be small is to be expected, because rational consumers and producers try to internalize benefits and externalize costs, so external costs tend to be much larger than external benefits. External benefits are usually lost through competition.¹⁷ For example, communities often subsidize roads and parking to attract development.¹⁸ This benefits the first communities to use this approach, but other communities are then forced to provide comparable subsidies until most benefits are captured by developers or new residents. Similarly, vehicle manufacturing can provide external benefits to a community by creating employment and tax revenues so they rationally try to extract subsidies and tax discounts from jurisdictions, internalizing much of these benefits.

Even vehicle travel activity that provides indirect benefits, such as employees driving to work or shoppers driving to stores, only provide external marginal benefits if reduced driving would reduce the total amount of beneficial economic activity that occurs. For example, if employees who currently drive to work could otherwise commute by walking, cycling, ridesharing, public transit or telecommuting, there is no external benefit from automobile use; the benefit of driving over other modes consists of the *internal* benefit to the commuter from the additional speed, convenience, comfort or prestige they gain. Similarly, if shoppers who cannot drive on a particular road would otherwise spend the same money at local stores, there is no external benefit from driving, only an economic transfer from one store to another.

¹⁶ Swiss ARE (2006), *The Debate on Benefits of Transport*, Swiss Federal Office of Spatial Development (www.are.admin.ch); at www.are.admin.ch/themen/verkehr/00252/00472/00486/index.html?lang=en.

¹⁷ Kenneth Button (1994), *Internalising the Social Costs of Transport*, OECD (www.oecd.org), p.12.

¹⁸ Samuel Nunn (1995), "Role of Local Infrastructure Policies and Economic Development Incentives in Interjurisdictional Cooperation," *Journal of Urban Planning and Development*, Vol. 121, No. 2 (<http://pubs.asce.org/journals/urban>), June 1995, pp. 41-56.

7.4 Economic Productivity and Development Benefits

Transportation is essential for most economic activities, and transport decisions can have significant productivity impacts. Various techniques can be used to estimate the economic impacts of a particular transport policy or project.¹⁹ In general, projects that reduce industrial transport costs, such as shipping costs, tend to increase productivity. However, reduced consumer transport costs (such as reduced costs of travel) generally do little to increase productivity. Much of their perceived value consists of economic transfers, one group or area benefits at another's expense. For example, expanding urban fringe highways may increase economic development in suburban areas at the expense of existing urban areas, but will not increase total regional economic activity.

Transport improvement are not always the best way to improve productivity or increase economic development. In general, such improvements only increase economic development where inadequate transport is a significant constraint on economic activity. An area that lacks paved roads may experience significant economic growth from a new highway or bridge that significantly reduces travel costs, but once an area has basic highway access, each increase in highway capacity tends to provide less overall benefit.²⁰ Economic returns from highway expenditures have declined below that of private investments, a trend that can be expected as the most cost effective and beneficial projects have already been completed.²¹

Even if highway expenditures increase economic productivity, they are not necessarily the *best* investment. Highway improvements can harm as well as benefit local economies.²² Investments in alternative modes and management strategies that encourage more efficient use of existing road capacity tend to increase productivity more than expanding existing highways. One major study found that economic growth rates are higher in regions with more diverse, less automobile dependent transport systems.²³ Mobility management strategies often provide the greatest economic development benefits by increasing system efficiency.²⁴

¹⁹ Glen Weisbrod (2000), *Synthesis of Current Practice for Assessing Economic Development Impacts from Transportation Projects*, NCHRP Study 20-5, TRB, National Academy Press (www.nap.edu); Phil Goodwin and Stefan Persson (2001), *Assessing the Benefits of Transport*, European Conference of Ministers of Transport; OECD (www.oecd.org).

²⁰ Amy Helling (1997), "Transportation and Economic Development; A Review," *Public Works Management & Policy*, Vol. 2, No. 1 (<http://pwm.sagepub.com>) July 1997, pp. 79-93; Marlon Boarnet (1997), "New Highways & Economic Productivity: Interpreting Recent Evidence," *Journal of Planning Literature*, Vol. 11, No. 4 (<http://jpl.sagepub.com>), May 1997, pp. 476-486.

²¹ M. Ishaq Nadiri and Theofanis Mamuneas (1998), *Contribution of Highway Capital to Output and Productivity Growth in the US Economy and Industries*, FHWA (www.fhwa.dot.gov).

²² Standing Committee on Trunk Road Assessment (1997), *Transport Investment, Transport Intensity and Economic Growth*, (www.dft.gov.uk/pgr/economics/sactra).

²³ Peter Newman and Jeff Kenworthy (1999), *Sustainability and Cities; Overcoming Automobile Dependency*, Island Press (www.islandpress.org).

²⁴ Todd Litman (2002), *Economic Development Impacts of Transportation Demand Management*, presented at the Transportation Research Board Conference on Transportation And Economic Development, Portland, Oregon, May 5, 2002, Victoria Transport Policy Institute (www.vtpi.org).

7.5 Benefits by Mode

Each mode tends to have a unique benefit profile. These are discussed in Table.

Table 7.5-1 Benefits by Mode

| Mode | Major Benefits |
|----------------------|--|
| Average Automobile | High level of user mobility and convenience. |
| Compact Car | Somewhat more affordable and reduces some external costs (fuel consumption and external crash risk) compared with an average automobile, otherwise provides similar benefits. |
| Electric Car | Reduces some external costs (fuel consumption and pollution emissions) compared with an average automobile, otherwise provides similar benefits. |
| Van or Light Truck | Greater carrying capacity compared with an average automobile, otherwise provides similar benefits. Important for many economically productive activities (deliveries, construction, tourism, etc.). |
| Rideshare Passenger | Lowest incremental costs. Does not require ability to drive and so provides equity benefits. |
| Diesel Bus | Relatively low costs per passenger-mile compared with automobile travel, particularly under urban-peak conditions. Does not require ability to drive and so provides equity benefits. Complements walking and cycling and therefore provides physical activity benefits. |
| Electric Bus/Trolley | Reduces some external costs (fuel consumption and pollution emissions) compared with diesel bus, otherwise provides similar benefits. |
| Motorcycle | Relatively low purchase and fuel costs compared with average automobile. |
| Bicycle | Low costs compared with automobile travel. Does not require ability to drive and so provides equity benefits. Provides internal and external health benefits of physical activity. |
| Walk | Low costs compared with automobile travel. Does not require ability to drive and so provides equity benefits. Provides internal and external health benefits of physical activity. |
| Telework | Minimal external costs. Does not require ability to drive and so provides equity benefits. |

Table 7.5-2 summarizes the typical benefits of various modes. Automobile and motorcycle travel tend to provide the greatest level of mobility, but provide few other benefits. Rideshare and public transit reduce external costs (particularly under urban-peak conditions) and provide affordability and mobility for non-drivers. Walking and cycling minimize external costs, and provide affordability, mobility for non-drivers and physical fitness. Transit passengers often walk or cycle far enough to provide health benefits. Telework reduces external costs and provides accessibility for non-drivers. Of course, these benefits may vary depending on the particular situation.

Table 7.5-1 Benefits by Mode Evaluation

| Mode | Mobility | Relative Affordability | Reduced External Costs | Access for Non-Drivers | Physical Fitness |
|----------------------|----------|------------------------|------------------------|------------------------|------------------|
| Average Automobile | 3 | | | | |
| Compact Car | 3 | 1 | | | |
| Electric Car | 3 | | | | |
| Van or Light Truck | 3 | | | | |
| Rideshare Passenger | 1 | 3 | 3 | 3 | |
| Diesel Bus | 1 | 2 | 1 | 3 | 2 |
| Electric Bus/Trolley | 1 | 2 | 2 | 3 | 2 |
| Taxi | 1 | 1 | | 3 | |
| Motorcycle | 2 | 1 | | | |
| Bicycle | 2 | 2 | 3 | 3 | 3 |
| Walk | 1 | 3 | 3 | 2 | 3 |
| Telework | | 1 | 3 | 2 | |

Rating from 1 (small benefit) to 3 (very beneficial).

7.7 Information Resources

Information sources on transportation benefit evaluation techniques are described below.

Ulrich Blum (1998), “Positive Externalities and the Public Provision of Transportation Infrastructure,” *Journal of Transportation Statistics*, Vol. 1, No. 3 (www.bts.gov), pp. 81-88; at www.bts.gov/publications/journal_of_transportation_and_statistics/volume_01_number_03.

Economic Development Research Group (www.edrgroup.com) provides economic evaluation resources.

EDRG (2007), *Monetary Valuation of Hard-to-Quantify Transportation Impacts: Valuing Environmental, Health/Safety & Economic Development Impacts*, NCHRP 8-36-61, TRB (www.trb.org); at www.statewideplanning.org/resources/63_NCHRP8-36-61.pdf.

FHWA (2002), *Highway Economic Requirements System: Technical Report*, Federal Highway Administration, (www.fhwa.dot.gov); at <http://isddc.dot.gov/OLPFiles/FHWA/010945.pdf>.

Phil Goodwin and Stefan Persson (2001), *Assessing the Benefits of Transport*, European Conference of Ministers of Transport; OECD (www.oecd.org).

David Greene, Donald Jones and Mark Delucchi eds. (1997), *The Full Costs and Benefits of Transportation*, Springer (www.springer.com).

Thomas Hogarty (1998), “Social Benefits of Personal Vehicle Travel,” *Transportation Quarterly*, Vol. 52, No 2, (www.enotrans.com), Spring, pp. 5-9.

Walter Hook (2003), *Appraising the Social Costs and Benefits of Road Projects*, Institute of Transportation and Development Policy (www.itdp.org) at www.itdp.org/index.php/information_center/document_detail/costs_benefits_road_projects.

Todd Litman (2008), *Evaluating Accessibility for Transportation Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/access.pdf.

Christopher Nash and Bryan Matthews (2005), *Measuring the Marginal Social Cost of Transport*, Research in Transportation Economics Vol. 14, Elsevier (www.elsevier.com).

SACTRA (1997), *Transport Investment, Transport Intensity and Economic Growth*, Standing Committee on Trunk Road Assessment, (www.dft.gov.uk/pgr/economics/sactra/).

Swiss ARE (2006), *The Debate on Benefits of Transport*, Swiss Federal Office of Spatial Development (www.aren.admin.ch); at www.aren.admin.ch/themen/verkehr/00252/00472/index.html?lang=en.

Transport For Development (www.transport-links.org) provides transport impact evaluation tools.

Erik Verhoef (1994), “External Effects and Social Costs of Road Transport,” *Transportation Research*, Vol. 28A, No.4, (www.elsevier.com/locate/tra), pp. 273-287.

William Vickrey (1994), *Public Economics; Selected Papers by William Vickrey*, Cambridge University Press (www.cambridge.org).

Glen Weisbrod (2000), *Synthesis of Current Practice for Assessing Economic Development Impacts from Transportation Projects*, NCHRP Study 20-5, TRB, National Academy Press (www.nap.edu), ISBN 0-309-06873-8.