

Victoria Transport Policy Institute

www.vtpi.org info@vtpi.org
1250 Rudlin Street, Victoria, BC, V8V 3R7, CANADA
Phone & Fax (250) 360-1560

"Efficiency - Equity - Clarity"

Transportation Cost Analysis:

Techniques, Estimates and Implications

Executive Summary

By Todd Litman

Victoria Transport Policy Institute

June 2002

Abstract

This report develops a framework for estimating and comparing the total costs of various forms of transportation. It includes an extensive review of previous cost studies. Twenty costs are defined and discussed, and existing estimates summarized. Cost estimates are provided for 11 travel modes under urban peak, urban off-peak, and rural travel conditions. This framework is used to compare costs per passenger mile for different modes. Implications of current cost distribution on economic efficiency, economic development, equity, and land use are explored. Case studies demonstrate how cost estimates can be applied to specific planning and policy decisions. Recommendations are provided for reforming current transport decision making. This document should be useful for transportation professionals, planners, economists, policy analysts and environmentalists.

Cost Analysis Framework

Transportation provides tremendous benefits to individuals and society. It also incurs significant costs. Transportation expenditures represent 15-20% of average household income and Gross Domestic Product in North America, and transport activities impose non-monetary costs including accidents, environmental degradation, and social impacts. This report describes techniques for quantifying these costs, including non-market costs such as the value of travel time, accident risk and environmental impacts.

Twenty transportation costs are defined, described, and categorized according to whether they are internal or external, fixed or variable, market or non-market, as listed in Table 1. These categories affect how a cost typically affects decisions, since external, fixed and non-market costs tend to be undervalued by users and decision makers.

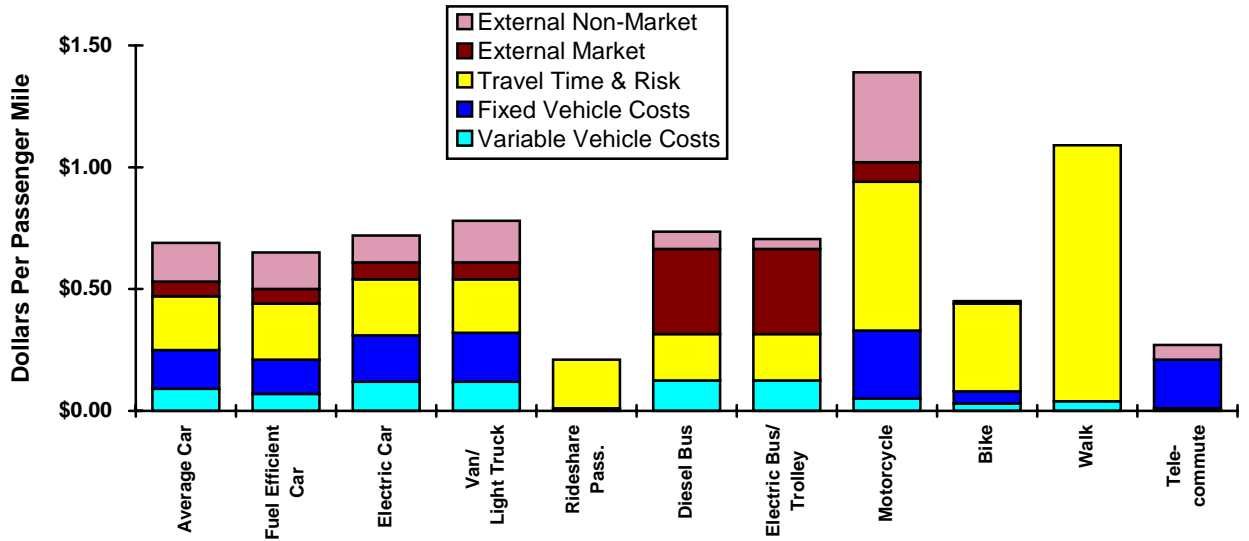
Table 1 Transportation Cost Categories

Cost	Internal/ External	Fixed/ Variable	Market/ Non-Market	Cost	Internal/ External	Fixed/ Variable	Market/ Non-Market
1. Vehicle Ownership	Internal	Fixed	Market	11. Roadway Land Value	External	Fixed	Market
2. Vehicle Operating	Internal	Variable	Market	12. Municipal Services	External	Variable	Market
3. Operating Subsidies	External	Fixed	Market	13. Equity & Option Value	External	Variable	N-M
4. Travel Time	Internal	Variable	N-M	14. Air Pollution	External	Variable	N-M
5. Internal Accident	Internal	Variable	N-M	15. Noise	External	Variable	N-M
6. External Accident	External	Variable	Mixed	16. Resource Consumption	External	Variable	Mixed
7. Internal Parking	Internal	Fixed	Market	17. Barrier Effect	External	Variable	N-M
8. External Parking	External	Variable	Market	18. Land Use Impacts	External	Fixed	Mixed
9. Congestion	External	Variable	Mixed	19. Water Pollution	External	Variable	N-M
10. Road Facilities	External	Variable	Market	20. Waste Disposal	External	Variable	N-M

This table lists the 20 costs identified in the study and indicates how they are distributed.

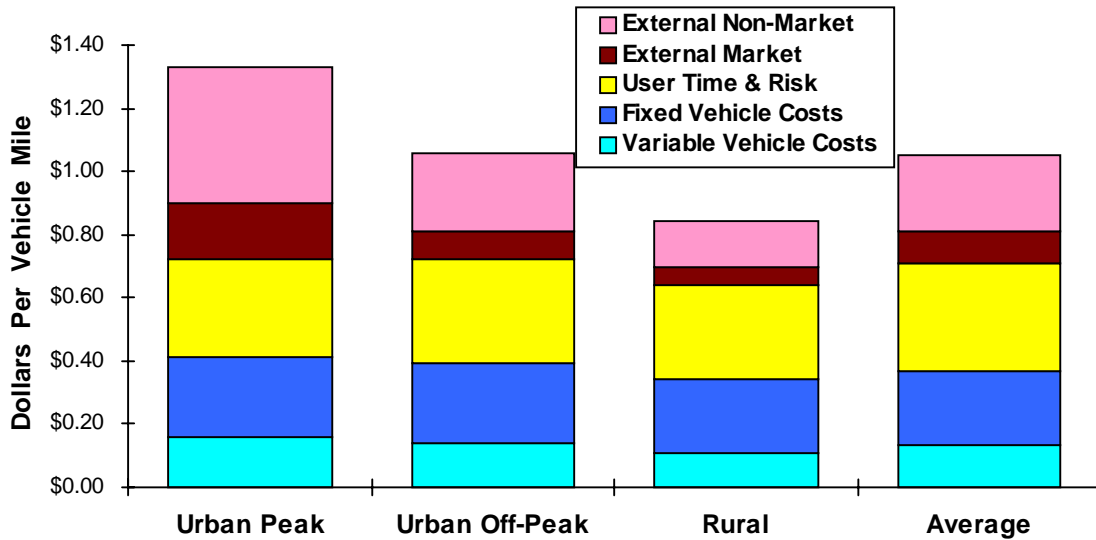
Estimates are developed of each cost for the eleven travel modes under three travel conditions (urban peak, urban off-peak and rural), based on existing research adjusted to this analysis framework. If no estimate exists, such as for land use impacts, an original estimate is developed. The precision of some cost values used in this study are variable depending on specific circumstances, and uncertain due to a lack of research. However, the *existence* of each cost has been demonstrated, the best available data used, and double counting avoided. Even using the lowest reasonable cost estimates, total external costs are significant. Figures 1 and 2 illustrates the results.

Figure 1 Average Cost Distribution for Various Modes



This graph shows the cost distribution for eleven modes by major category.

Figure 2 Average Automobile Cost Distribution



This graph summarizes the distribution of costs by major category. Most costs are either fixed or external so they have little effect on users' short term travel decisions.

Implications

A primary conclusion of this research is that a major portion of transportation costs are external, fixed or non-market. Users' perceived variable costs are significantly lower than the total marginal costs they impose. Due to high fixed costs, vehicle owners perceive economies of scale for driving (the more a car is driven the lower its average cost). This underpricing leads to transportation patterns that are economically inefficient and inequitable, and exacerbates environmental and social problems. On average, each dollar spent on vehicle operating costs (the variable cost of driving) imposes about \$2.70 in costs to society.

Another conclusion is that the magnitude of non-market costs is significant compared with other costs and benefits normally considered in transport decision making. Failure to consider these costs can lead to decisions that result in negative net benefits. For example, society is overall worse off if a roadway improvement that saves drivers an average of 5¢ per mile worth of travel time imposes infrastructure and environmental costs averaging 10¢ per mile. Incorporating external costs is especially important when evaluating projects, such as urban highway improvements, that increase total automobile use due to induced travel and increased automobile dependency.

Transportation underpricing is often justified on the assumption that it increases economic development. Although underpricing provides benefits it also incurs costs and leads to economic inefficiency. Underpriced driving increases urban sprawl, congestion, accidents, energy use, pollution, and municipal costs, and reduces travel choices. The result is more driving, increased total costs, and reduced productivity.

Individuals will drive less if given incentives and substitutes. Although the elasticity of driving with respect to fuel price is relatively low (typically -0.1 to -0.2 in the short term, which means a 10% price increase reduces driving by 1-2%), this is not surprising since fuel is a small portion of users' costs. The long term elasticity of driving with respect to total user costs is -1.0 or more.

Underpriced driving is horizontally inequitable because some individuals are forced to bear costs imposed by others. It is vertically inequitable because it tends to benefit the wealthy and disadvantages non-drivers. Whether price increases are regressive depends on how revenues are used. Actions that increase travel options for non-drivers, such as better transit service, improvements to the pedestrian and bicycling environment, and reduced urban sprawl, tend to be overall progressive because they benefit disadvantaged people.

Applications

Cost estimates are used in a variety of typical applications to demonstrate the practicality and importance of incorporating total costs. Below are some examples:

- Net savings are calculated for a Transportation Demand Management program. Total savings, including reduced parking, congestion and environmental costs, average several dollars per round trip shifted from automobile to alternative modes.
- Benefits are estimated for alternative pricing strategies such as pay-as-you-drive insurance and "cashing out" free parking. These measures can provide user savings, reduce total vehicle travel, and improve economic efficiency.
- Potential benefits of neighborhood traffic management are evaluated. Reduced traffic speeds and volumes on residential streets provide substantial benefits that are undervalued by transportation professionals because they are non-market benefits.
- A case study uses Least Cost Transportation Planning to determine the best congestion reduction investment in an urban area, taking into account full costs.

Conclusions

If you ask people what it costs to drive they typically mention vehicle operating expenses, which average approximately 12¢ per mile for a typical car. Some may also include a portion of vehicle ownership costs, which averages about 21¢ per mile. A few may also mention the value of their travel time and accident risk. These however are only a portion of total costs. The full cost of driving includes these internal costs plus several external costs. Total costs actually range from about \$0.84 per vehicle mile for rural driving to \$1.33 for urban peak driving. Of course there is considerable variation in the cost of any specific trip, but these estimates, and variations for different travel modes and specific conditions, provide a reasonable basis for analyzing true transport costs.

Although owning a car is expensive, driving is so cheap for any particular trip that other problems such as congestion, pollution, or reduced quality of life become the constraints to further increases. Users have little incentive to limit their driving to trips in which benefits exceed total costs.