PERSPECTIVES OF TRAVEL TIME COSTS

Gheorghe Camelia Monica
Romanian-American University School of Internal and International Economy of Tourism 1B EXPOZITIEI Blvd., Sector 1, code 012101, Bucharest – Romania Email: camighe@yahoo.com Tel: +40722512455
Firoiu Daniela
Romanian-American University School of Internal and International Economy of Tourism 1B EXPOZITIEI Blvd., Sector 1, code 012101, Bucharest – Romania Email: danafiroiu@yahoo.com Tel: +40722953514

This paper examines the value of travel time, and travel time savings. Travel time is one of the largest costs of transportation, and travel time savings are often the primary justification for transportation infrastructure improvements. Various studies have developed estimates of traveltime values for different user types and travel conditions.

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Travel time is one of the largest categories of transport costs, and time savings are often claimed to be the greatest benefit of transport projects such as new and expanded roadways, and public transit improvements. Factors such as traveler comfort and travel reliability can be quantified by adjusting travel time cost values. On average people devote 60-90 minutes a day to travel. Most people seem to enjoy a certain amount of personal travel, about 30 minutes a day, and dislike devoting more than about 90 minutes a day.

Time Valuation Perspectives

There are several types of travel time, as summarized in Table 1.1. *Clock time* is measured objectively, while *perceived* (also called *cognitive*) *time* is how users experience travel. Paid travel time costs should be calculated based on clock time, but personal travel time costs should be calculated based on perceived time. The *generalized cost of travel* refers to the sum of time and financial costs. *Effective speed* (also called *social speed*) refers to overall travel speed, including both time spent traveling and devoted to maintaining vehicles and working to pay transport expenses.

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Table 1.1. Transport Time Valuation Perspectives

Name	Description	Implications
Travel Time	Any time devoted to travel.	This is the least specific definition.
Clock Time	Travel time measured objectively.	This is how time is usually quantified.
Perceived Time	Travel time as experienced by users, which can vary greatly from clock time.	This reflects traveler comfort.
Paid (also called On-the-Clock or commercial)	When workers are paid for their travel time(for deliveries, traveling to worksites etc.).	This type of travel tends to have a relatively high value per hour.
Personal Travel Time	Time devoted to personal travel (commuting, errands,	This is the largest category of time value in most economic

	etc.).	studies.
Generalized Costs	Combined travel time and financial costs.	This is how travel time is incorporated into traffic models.
Effective Speed	Total time devoted to travel and paying for transport equipment and services.	Higher costs for more expensive modes.

Total travel time costs are the product of time spent traveling (measured as minutes or hours) multiplied by unit costs (measured as cents per minute or dollars per hour). Travel time unit costs vary depending on type of trip, travel conditions, and traveler preferences. For example, ten minutes spent relaxing on a comfortable seat imposes less cost than the same amount of time spent driving in congestion or standing on a crowded bus. Travel time costs often vary for different parts of a trip. For example, walking to a bus stop, waiting for a bus, riding an uncrowded bus, and riding a crowded bus may each have different unit costs. Travel time costs also vary depending on traveler needs and preferences. For example, a person might one day enjoying a relaxed recreational walk or drive, but another day pay generously for faster travel when rushing to an important event. Travel time unreliability (uncertainty how long a trip will take, and unexpected delays) imposes additional costs. Various studies have quantified travel time unit costs and the value of travel time savings, based on analysis of business costs, traveler surveys, and by measuring behavioural responses by travelers faced with a tradeoff between time and money, for example, when offered the option of paying extra for a faster trip.

Valuation Factors

Below are factors that tend to affect travel time values.

1. Commercial (paid) travel costs include driver wages and benefits, and the time value of vehicles and cargo, reflecting efficient use of assets and ability to meet delivery schedules.
2. Personal travel time is usually estimated at 25% to 50% of prevailing wages, but varies by factors such as type of trip, traveler and conditions. Most studies focus on commute travel and so may unrepresent other types of travel, such as personal errands and recreational travel.
3. There are often substantial differences between objectively measured (clock) travel time and *perceived* travel time, which tends to increase with congestion, discomfort and insecurity.
4. Travel time costs tend to increase with income, and are lower for children and unemployed people (put differently, employed people are often willing to pay more for travel time savings).
5. The first few minutes of a trip often has minimal time cost since people generally seem to enjoy a certain amount of daily travel, but unit costs usually increase if trips exceed about 20 minutes in duration or total personal travel exceeds about 90 minutes per day.
6. Travel time unit costs tend to increase with variability and arrival uncertainly, and are particularly high for unexpected delays during activities with strict schedules.
7. Some travel time has a low cost or positive value because people enjoy the experience, including recreational travel and errands that involve social activities.
8. Under pleasant conditions walking, cycling and waiting can have low or positive value, but under unpleasant conditions (walking along a busy highway or waiting for a bus in an area that seems dirty and dangerous), costs are two or three times higher than in-vehicle time.
9. Travel needs and preferences vary. For example, some people place a higher cost on time spent driving while others place a higher cost on transit travel.

Evaluating Travel Time Costs

Travel time costs are a large component of transport economic impacts, so how they are evaluated significantly affects planning decisions. Travel time is often worth more than monetary

costs. For example, a 30 mph car trip has about 15¢ per mile operating costs compared with 25¢ per mile time costs (valued at $6.00 per hour with 1.2 passengers).

Travel time costs are highly variable: a small portion of trips have high time values, a large number of trips have moderate to low time values, and some travel has zero or negative time cost (travel is a desired activity). For example, congested roadway and crowded transit travel tend to have high time value since people making lower-value trips will avoid such conditions. On the other hand, travelers who voluntarily choose a slower mode (such as walking or public transit) in response to positive incentives must be better off overall or they would not make that change; their increased minutes of travel are offset by lower per minute costs or other savings.

Conventional transport evaluation often undervalues qualitative travel time cost factors, which skews planning decisions to favor increased travel speed at the expense of other improvements. For example, conventional evaluation accounts for roadway widening travel time savings but not the additional delay it causes for walking and cycling (called the Barrier Effect). Similarly, reduced unit cost from improved walking conditions and more comfortable transit vehicles are seldom quantified and so

are undervaluted compared with projects that increase vehicle travel speeds.

The true value of changes in travel speed can be difficult to determine because people tend to have *fixed travel time budgets*, typically devoting about 70 daily minutes or 8 weekly hours to personal travel. As a result, incrased travel speeds tend to increased travel rather than save time.18 For example, if a highway or transit improvement increases travel speeds, commuters often accept longer distance commutes. As a result, the true benefits are increased mobility and improved location options, not travel time savings. Much of the benefit is often capitalized in land values, the more dispersed land use reduces accessibility, and the induced vehicle travel impose additional costs.

Based on an extensive review of international studies, World Bank economist Kenneth Gwilliam recommends that, when evaluating transportation improvements for international development, work travel time should be valued at wages and benefits, and that a default value for adult personal travel (including commuting) travel time should be 30% of household income per hour unless better local data are available, as summarized in the table below.

Table 1.2. Recommended Travel Time Cost Values

Purpose	Rule	Recommended Value
Work (paid) travel	Cost to employer	133% wages
Commute and other personal (unpaid) travel	Empirically observed values	Adult: 30% household hourly income Child: 15% household hourly income
Walking/waiting	Empirically observed values	150% value for trip purpose
Freight and public transport	Resource cost approach	Vehicle time cost + driver wages + occupants' time costs

Monetary Estimates

North America

Apogee Research estimated travel time costs per passenger mile for urban peak and urban off-peak travel at high, medium and low densities in two cities. Time values were based on 50% of average local wages for commuting and 25% for other travel.

Table 1.3. Travel Time Costs in Two Cities (¢ per passenger mile)

	Express way		Non expwy		Comm. Rail		Rail Transit		Bus		Bicycle		Walk	
Boston, MA	***Peak***	***Off***	***Peak***	***Off***	***Peak***	***Off***	***Peak***	***Off***	***Peak***	***Off***	***Peak***	***Off***	***Peak***	***Off***
High	24.3	9.6	40.4	23.9	28.9	22.7	40.1	28.6	50.5	39.8	60.6	47.8	243	159
Medium	15.2	8.0	24.3	15.9	19.8	14.0	28.1	25.3	50.5	39.8	60.6	47.8	202	159
Low	11.0	8.0	20.2	13.6	19.0	13.3	n/a	n/a	50.5	39.8	60.6	47.8	202	159
Portland, MA														
High	11.1	7.8	19.9	13.1	n/a	n/a	n/a	n/a	42.6	33.5	49.8	39.2	166	131
Medium	10.0	7.1	16.6	11.2	n/a	n/a	n/a	n/a	42.6	33.5	49.8	39.2	166	131
Low	7.7	6.0	12.4	9.8	n/a	n/a	n/a	n/a	30.2	23.8	49.8	39.2	166	131

Brownstone and Small analyze motorists' willingness to pay road tolls for reduced travel time and travel time variability. They find that morning commute travel time savings average $10-40 per hour, and reliability is also valued. Other researchers find similar travel time savings values on the New Jersey Turnpike.These relatively high values are considered typical in large urban areas where income levels are relatively high, user flexibility is low, and possibilities to shift other modes/routes are limited.

The U.S. DOT uses the following travel time values for evaluating transportation projects (1997 U.S. dollars): in-vehicle time, $8.90/person-hour; out-of-vehicle time (e.g. waiting for a bus), $17.00/person-hour; commercial truck, $16.50/person-hour. Table 1.4. indicates US DOT recommended travel time factors.

Table 1.4. Recommended Value of Travel Time

Time Component	Reference	Value
In-Vehicle Personal (local)	Of wages	50%
In-Vehicle Personal (intercity)	Of wages	70%
In-Vehicle Business	Of total compensation	100%
Excess (waiting, walking, or transfer time) Personal	Of wages	100%
Excess (waiting, walking, or transfer time) Business	Of total compensation	100%

This table summarizes USDOT recommended travel time values. For business travel costs are estimated to average 120% of wages to reflect total compensation, including non-wage benefits.

Australia and New Zealand

Booz Allen Hamilton used stated preference survey data to estimate own and crosselasticities for various costs (fares, travel time, waiting time, transit service frequency, parking fees) modes (automobile, transit, taxi) and trip types (peak, offpeak, work, education, other) in the Canberra, Australia region.They developed generalized costs and travel time cost values, including

estimates of the relative cost of walking and waiting time for transit users. The travel time cost values from a similar study in Brisbane, Australia are summarized in Table 1.5.

Table 1.5. Travel Time Costs in Brisbane, Australia (Aus. Dollars)

Mode	Short (Under 30 Minutes)				Medium (30-45 Minutes)			
	Peak		Off Peak		Peak		Off Peak	
	CBD	Non CBD	CBD	Non CBD	CBD	Non CBD	CBD	Non CBD
Bus	9.20	7.70	7.50	5.90	9.20	8.70	7.60	7.50
Rail	9.30	6.90	6.90	6.00	8.80	7.70	7.90	6.70
Ferry	10.70	-	8.30	-	-	-	-	-
Car	10.60	9.00	8.30	7.10	7.10	8.00	9.00	6.40

Europe / UK

Cirillo and Axhausen use travel surveys to determine the value of travel time for residents of German cities.They found that travel time has an overall average value of about $10/hour, but that for a portion of trips (estimated at 10-15% overall and up to 24% during non-working days), travel time has positive rather than negative value. The table below summarizes typical values of time used for transport project evaluation in Europe.

Table 1.6. Illustrative Values of Time

	Passenger Transport	Freight Transport
Interurban Rail	Business: € 21.00 per person hour Commuting / Private: € 6.40 per person hour Leisure / Holiday: € 3.20 per person hour	Full trainload (950 tonnes): € 725.00 per tonne-hour Wagon load (40 tonnes): € 30.00 per tonne-hour Average per tonne: € 0.76 per tonne-hour
Road	Business: € 21.00 per person hour Commuting / Private: € 6.00 per person hour Leisure / Holiday: € 4.00 per person hour	Light Goods Vehicle: € 40.00 per vehicle-hour Heavy Goods Vehicle: € 43.00 vehicle-hour

A study for the U.S. Federal Highway Administration publication identifies various travel reliability indicators:

1. The *90th or 95th percentile travel times*, which reflects the longest travel time during a ten or twenty day period. This is reported in minutes and seconds.

The *buffer index* reflects the extra time travelers must add to their average travel time to ensure on-time arrival, computed as the difference between the 95th percentile and average travel times, divided by the average travel time. It is expressed as a percentage. For example, a 40% buffer index means that, for a trip that averages 20 minutes travelers should budget an additional 8 minutes (20 minutes × 40% = 8 minutes) to ensure on-time arrival. The extra minutes are called the *buffer time*.

2. The *planning time index* reflects the total travel time required to provide an adequate buffer time, including both typical and unexpected delay. The planning time index compares near-worst case travel time to a travel time in light or freeflow traffic. For example, a planning time index of 1.60 means that a 20-minute trip in light traffic requires 32 minutes of total time planned (20 minutes × 1.60 = 32 minutes).

3. The *frequency that congestion exceeds some threshold* reflects the degree to which congestion exceeds a performance standard. It is typically expressed as the percent of days or time that travel

times exceed X minutes or travel speeds fall below Y mph. This is relatively easy to compute if continuous traffic data is available, and it is typically reported for weekdays during peak traffic periods.

Highway construction traffic delays can impose significant travel time costs and spillover effects on other roadways. For some projects, such delays can offset a significant portion of projected travel time savings.

Conclusions

Travel time costs are highly variable, including a small portion of travel with very high time values, to a significant portion of travel with little or no *cost*, since travelers enjoy the experience and would pay nothing to reduce it. High-time-value travel includes: paid travel, urgent personal trips, travel under congested or uncomfortable conditions, unexpected delays, relatively long trips (more than about 20 minutes) or high daily mileage (more than about 90 minutes a day).

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