

# TRANSPORT NOTES

TRANSPORT ECONOMICS, POLICY AND POVERTY THEMATIC GROUP



THE WORLD BANK, WASHINGTON, DC

Transport Note No. TRN-15

January 2005

## Notes on the Economic Evaluation of Transport Projects

*In response to many requests for help in the application of both conventional cost benefit analysis in transport and addressing of the newer topics of interest, we have prepared a series of Economic Evaluation Notes that provide guidance on some of issues that have proven more difficult to deal with.*

*The **Economic Evaluation Notes** are arranged in three groups. The first group (TRN-6 to TRN-10) provides **criteria** for selection a particular evaluation technique or approach; the second (TRN-11 to TRN-17) addresses the selection of values of various **inputs** to the evaluation, and the third (TRN-18 to TRN-26) deals with specific **problematic issues** in economic evaluation. The Notes are preceded by a **Framework** (TRN-5), that provides the context within which we use economic evaluation in the transport sector.*

*The main text of most of the Notes was prepared for the Transport and Urban Development Department (TUDTR) of the World Bank by Peter Mackie, John Nellthorp and James Laird, at the Institute for Transport Studies (ITS), University of Leeds, UK (The draft text of Note 21 was prepared for ITS by I.T. Transport Ltd). TUDTR staff have made a few changes to the draft Notes as prepared by ITS.*

*The Notes will be revised periodically and we welcome comments on what changes become necessary. Suggestions for additional Notes or for changes or additions to existing Notes should be sent to [rcarruthers@worldbank.org](mailto:rcarruthers@worldbank.org)*

## VALUATION OF TIME SAVINGS

Travel time savings are a major benefit arising from investments in transport infrastructure. Estimating the monetary value which individuals or companies attribute to these travel time savings is important for two reasons, namely

- In order to be able to forecast the level of traffic which will be attracted to a new or improved facility
- In order to include the value of the savings in a formal cost benefit analysis. Within developed countries they can often account for up to 80% of overall benefits.

However, the lack of data regarding the economic value of time savings within a developing country mean that traffic assignments are done on a much cruder basis and the value of time savings omitted from appraisals. In such instances benefit estimates may be based on vehicle operating cost savings only. Such omissions will bias appraisals to favour schemes that reduce vehicle operating costs, rather than those which may reduce traffic congestion or induce a mode shift from slow modes, such as walking and headloading, to faster, motorised forms of transport.

This note has been drawn from a number of texts including *The Value of Time In Economic Evaluation of Transport Projects* (Gwilliam, 1997) [i], *Values of Travel Time Savings in the UK Summary and Conclusions* (Mackie et al, 2003) [ii] and *The Value of Time in least Developed Countries* (IT Transport, 2002) [iii].

The conceptual basis for valuing time is discussed in Section [1](#). Sections [2](#) and [3](#) discuss the theoretical basis for valuing work time savings and non-work time savings respectively, whilst Sections [4](#) and [5](#) discuss the value of time savings to buses and to freight. The manner that the value of time varies with time, the treatment of small time savings are presented in Sections [6](#) and [7](#). Section [8](#) sets out the manner that disparities between regions for values of time should be treated within the cost benefit analysis and the use of standard values of time. Section [9](#) summarises the practical methodologies that should be used for the estimation of travel time savings, whilst Section [10](#) summarises the key recommendations of this note.

## **THE CONCEPTUAL BASIS OF TIME VALUATION**

The conceptual model underlying the valuation of travel time savings is one of consumer welfare maximisation. It postulates that each individual maximises the satisfaction or utility he gets by consuming and by engaging in leisure activities. Consumption of goods and leisure activities is constrained in two important ways.

- ❑ First, expenditure is limited by income which must be earned by devoting time to working; and
- ❑ Second, work, leisure activities and travel compete for an amount of time available strictly limited by the number of hours in the day.

In allocating time between activities the individual must trade off the extra consumption that work earns against the foregone leisure which he requires. But he also has possibilities of extending the amount of working or leisure time available by spending extra money to save travel time. This may arise in the narrow context of choice between fast and expensive modes or routes and cheaper, slower, alternatives or in the broader context of choices of activity or residential location. By analysing the relative sensitivity of such choices to variations in money and time cost, the implicit value of time of travellers can be identified.

The consumer maximizing approach does not only take account of the alternative uses that could be made of travel time, but also of the discomfort of travelling itself. If we overlook for the time being travel that is made for the sake of the travel itself, most travellers find the experience uncomfortable and even stressful, and travel on some modes is more uncomfortable and stressful than on others. It is also possible that the perception of discomfort and stress increases more than proportionally with the amount of time that a trip takes. So in making the trade off between travelling or not travelling and in using one mode rather than another, these considerations are taken into account, and are reflected in the mode choice and evaluation models that are used as a component of the value of time.

This conceptual framework yields important insights into the nature of the value of travel time savings.

- ❑ Working time savings have a value because output is otherwise lost to the employer, whilst the employee is travelling;
- ❑ Non-working time savings have a value because travellers are willing to pay for them. Additionally, the value of non-working time savings is influenced by:
  - Individual preferences, variations in which influence the value of time so that practical application will require some simplifying categorization.
  - The value of the activity with which travel is associated, as a result of the fact that activities and time are jointly consumed; and
  - The tightness of the money budget constraint (and hence incomes) and the time budget constraint (and hence person type).
- ❑ Both working and non-working time includes a measure of discomfort and stress, that is probably different for each mode of travel

### **Characteristics of the Value of Travel Time Savings**

The theoretical basis for the inclusion of travel time costs within transport appraisal has been developed over a substantial period of time. Travellers experience disutility (or in exceptional cases, utility) from the time that they spend travelling, thus a change in travel time will either give rise to benefits or disbenefits, through a change in consumer surplus, or in the case of travel during the course of work can give rise to a change in business productivity. In valuing travel time the challenge arises in understanding the manner that travel time valuations may vary according to:

- ❑ Work trip or Non-Work trip;
- ❑ For Non-work trips;
  - Journey purpose (e.g. commuting, market day, leisure, etc.);
  - Income of traveller;

- Socio-economic characteristics (e.g. retired status);
  - Length of journey (e.g. long distance or short distance);
  - The conditions under which the travel is made (e.g. congestion).
- ❑ Mode of transport (e.g. bus, rail or car driver or passenger);
  - ❑ Passenger travel to freight travel; and
  - ❑ Size of the change in travel time (e.g. can travellers perceive small time savings and does the level of discomfort and distress increase more than proportionally with trip length? ).

The most important distinction is between travel in the course of work and travel for non-work purposes. A practical consequence of this is that travel demand data ought at the very minimum to distinguish between these categories of journey.

### **WORK TRIPS**

A fundamental distinction is drawn between travel in the course of work (on employer's business) and non-work travel. This section discusses the valuation of travel during work hours, whilst the following [section](#) discusses non-work related travel. Travel in the course of work has productive value to employers and society as a whole. Two main models exist for the valuation of these savings, the wage rate or cost savings model and what is now known as the Hensher model [iv].

The wage rate or cost savings approach is based on classical economic theory of marginal productivity. Any savings in production costs will be met through an increase in production up until the point that the marginal cost of production once again equals marginal revenue. Reductions in labour costs (due to shorter journeys) will therefore result in more units of labour being hired to increase production. This will occur up to the point that the value of an extra unit of labour is equal to the cost of that labour. Thus the cost savings approach suggests that the value of in-work time savings is the wage rate plus the overhead costs associated with the employment of an extra unit of labor.

The Hensher model seeks to modify the cost savings approach by allowing for various factors which might reasonably be expected to affect the value. The specific modifications relate to:

- ❑ The proportion of travel time savings that the employee uses for leisure rather than additional work. The cost savings approach assumed a full transfer of saved travelling time to work time.
- ❑ The proportion of time spent engaged in productive work whilst travelling, the productivity of that work (compared to the work place) and any loss in work undertaken whilst travelling due to travel time savings. The cost savings model assumes that no work can be undertaken during the course of travel.

As both the Hensher model and cost savings model are based on marginal productivity theory, both models are vulnerable to weaknesses in that theory, namely monopolistic practices in the labour market, possibilities of substitution between labour and capital and divergence from profit maximising assumptions. Nevertheless the models form an important starting point for valuing the economic cost of travel during the course of work.

The Hensher model is difficult to apply and its use has, historically, been limited [ii, 4]. **In the majority of circumstances it is therefore recommended that the cost savings or wage rate model be used to determine the value of time savings for work trips.**

### **What is a Work Trip?**

What is a work trip? Whilst this appears an apparently simple question the answer is in fact far from simple, particularly when considered within the context of a subsistence rural economy.

Classically, a work trip is defined as a trip undertaken on employer's business. Thus the person making the trip is paid a wage for the duration of the trip. Such a definition works well in a structured economy as maybe found in an urban environment and a developed country. In such places formal employment occurs over a defined number of hours. However, within a subsistence rural economy:

- ❑ Few people have employers. IT Transport (2003) [iii] found less than 1% of rural trips in the Jessore area of Bangladesh could be classed as conventional work trips. This rose to 3.5% if self employed workers were also included;
- ❑ The subsistence nature of living implies that time is spent travelling to undertake wider economic activities that would not occur if the person was in paid employment. For example, travelling to sell produce or buy items required for subsistence food production (tools, seeds, etc.); and
- ❑ Trips have multiple purposes, particularly in areas where long distances of travel are common. Often a work related trip maybe combined with a social trip such as a visit to the health centre, civic authority or a visit to friends and relatives.

In urban areas and for inter-urban movements it is therefore recommended that the conventional approach to defining work trips be used. However, for local travel within a rural subsistence economy it is considered that the conventional definition is enhanced to include other business related activities (e.g. travelling for the purchase/selling of goods for profit). IT Transport (2003) [iii] contains a worked example of such an approach. The sensitivity of the economic appraisal to the definition of the proportion of work trips should be examined as discussed in *Note 2: Risk and Uncertainty Analysis*.

### **Variations by Industrial Sector and Mode**

Under the recommended cost savings approach the economic value of work travel time savings is the marginal productivity of the person making the saving (i.e. their wage rate). Thus different workers will have different time valuations. One would expect that within a developing country agricultural workers will have a lower valuation of time than blue collar workers (skilled tradesman) or white collar workers (e.g. doctors and lawyers).

Ideally, values of time should be developed for each worker classification. However, for the economic appraisal to operate at this level of disaggregation also requires the demand forecasting to occur at the same level. This in turn requires detailed interview data upon which the travel demand patterns can be segmented by worker type; such data is often not available. Often the only data that is available is traffic or passenger volume counts by mode. In such instances the evaluation needs to be adapted to reflect this data constraint.

The fall back position is therefore to vary the economic value of time savings for work trips by the mode of travel (e.g. car, local bus, long distance bus, non-motorised traffic, walking, etc to take account of varying discomfort etc.).

Travel time savings for professional drivers such as bus, train, taxi and freight transport drivers plus attendants should be included within the economic appraisal. Care, however, should be taken to ensure that the wage costs of such drivers and attendants are not double counted with the operating costs of the vehicle. This is because some operating cost models already include the time related costs of drivers and attendants within them (see *Note 9: Sources of Operating Costs*).

### **Journey Length, Walking and Wait Time**

The cost savings component of the model gives the same value for time savings to work trips irrespective of journey length and whether walking or waiting time is required to access the mode. This is because the time the employee spends travelling is time lost from production irrespective of how they are travelling. Work time savings should therefore only be modified to reflect the travellers personal discomfort and stress through variations in journey length and mode (including walking or waiting times).

### **NON-WORK TRIPS**

The economic value of time savings for non-work trips (i.e. non-wage earning trips) is the difference between the marginal valuation of time associated with travelling and that associated with leisure. This is set out in MVA/ITS/TSU (1987) [v] and also summarised in IT Transport (2002) [iii]. The implication is that there is no theoretical basis for deriving the economic value of non-work trips from the wage rate. Instead the values have to be inferred from behaviour. Cultural attitudes will

therefore influence the value of non-working time and make the transfer of values between countries and cultures difficult. For example, Chilean studies indicate that the value of time for non-work journeys, particularly for inter-urban trips, is considerably higher as a proportion of household income than studies in the OECD nations [i] [vi]. These cultural variations apply not only to the alternative use component of non-work travel time savings, but also to the discomfort and stress component.

### **Journey Purpose**

Theoretically the value of non-working time may differ between journey purposes (e.g. market day related travel, commuting and other non-work related travel). Evidence of such differences exist and are sometimes used for demand forecasting purposes (e.g. modelling route choice in a highway network model).

Within a subsistence rural environment it may be more important to distinguish between non-work journeys on market days compared to other days (see IT Transport (2002)) than between commuting and other trips. Conversely, within urban areas and on inter-urban routes it may be more important to distinguish between commuting and other purposes, than between market days and non-market days.

### **Income and Socio-Economic Status**

The conceptual model of time valuation suggests that individuals' values of non-work time will vary with the amount of both free time and the amount of money at their disposal. In fact some relationship whereby value of time increases with income has been found in all major value of time studies. However, the recent UK study [ii] suggests from both cross-sectional data and time series evidence that the value of non-work time increases less than proportionally with income.

Socio-economic status can influence the amount of free time available. Retired people appear to consistently exhibit lower values of non-work time than their working counterparts, other things (e.g. income and journey purpose) being equal.

### **Walking and Waiting Time**

Typically all other things being equal an individual prefers travelling within a vehicle to spending time walking, waiting or transferring between services. This is borne out from evidence (see Gwilliam (1997) [i]). Also, travelling in one type of vehicle (private car) is usually (but not always) preferred to travelling in a different type (bus or train). As such the value of non-working time saved walking and waiting is higher than time saved whilst travelling within a vehicle, and travel time savings on some vehicle types is valued more highly than that on others.

The exact magnitude of the difference between non-working in-vehicle time and walking and waiting time is dependent upon national cultures and characteristics. For example, IT Transport (2002) found that walking time savings in Bangladesh were only valued at 11% more than in-vehicle time savings, whilst Mackie et al (2003) have found within the UK walking time savings are valued at double in-vehicle time savings. Such variations may be explained by a range cultural, racial and economic factors which drive personal preferences. Such factors also raise issues regarding the transferability of values from one country to another.

## **Mode**

In-Vehicle-Time (IVT) savings by mode may be expected to vary according to the relative qualities and comforts of one mode compared to the other modes, all other things being equivalent (i.e. income, socio-economic group and journey purpose). The more uncomfortable the mode, the larger the value of the time saving is. Thus, typically, for any given individual a time saving by bus is valued more highly than a time saving by car or train.

However, when considering average values of time associated with travellers using a certain mode of travel the opposite ranking order is found. That is the average value of time of a bus traveller is lower than that of a car traveller. This does not conflict with the previous observation but is a characteristic of the fact that people with low values of time (i.e. poor people and people making leisure trips) will select slower modes of transport (e.g. the bus).

## **Travel Conditions**

A number of other personal, trip and ambient circumstances appear to affect personal time variations. The IT Transport study found a significant effect regarding travelling with a load and uncomfortable travelling conditions (e.g. over crowded bus) in Bangladesh [iii]. In developed countries values of time savings in congested car driving situations exhibit higher values than those in uncongested situations in both the UK and the Netherlands (this may reflect the value of reducing the variability of travel time as well as the unpleasantness of driving in congested conditions).

## **Journey Length**

There are reasonable grounds for expecting to find a relationship between the value of travel time savings (non-work) and journey length. These include increasing marginal disutility of travel time with journey length, greater significance of time constraints in longer distance journeys and differences in the trip purpose mix at long, relative to short distances. Previous studies such as the Swedish and Norwegian value of time studies have found such a relationship. The recent UK study [ii], however, did not recommend varying the value of non-working time with distance.

Consequently, it is recommended that in the majority of instances a single value for journey time savings is used irrespective of journey length. The exception to this would be one in which robust local or national specific data indicated that the values of non-working travel time savings increase with journey distance. It is expected that such situations will be rare as it is a complex exercise to obtain such data from revealed or stated travel behaviour.

## **The Distribution of Values of Time**

It follows from all of the above considerations that there may be a very large wide distribution of values of time within a given population. As not all of the sources of this variation are understood, or can be identified within a particular application context, it is common to use the population mean value (the arithmetic average) to represent the whole population.

For evaluation this does not matter so long as traffic effects have been correctly forecast. But the distribution of values of time does have a significant effect (separate from the mean), especially where a toll is charged for the use of the improved facility. The distribution of incomes, which is one of the main sources of variation in values of time is very skewed in most developing countries, with a few rich people with incomes a long way above the average, and a majority number of people with incomes below the average. As each individual is trading off the toll against the achievable time saving at his own personal value of time, the consequence of this is that there will be fewer people willing to pay a particular level of toll than use of the average value of time would predict. It is therefore very important to take this into account in appraising toll road schemes. This effect is discussed in detail by Hensher and Goodwin [8]

### **LOCAL AND INTER-URBAN BUS TRAVEL TIME SAVINGS**

Local and inter-urban bus time savings comprise of the sum of the time savings made by the passengers and that of the driver and attendant (see [above](#)). Operating cost savings associated with reduced journey times should be captured within the operating cost model (see *Note 9: Sources of Operating Costs*).

### **FREIGHT TRAFFIC TIME SAVINGS**

A reduction in journey times will benefit freight traffic in the following ways:

- ❑ Reduced driver and attendant wage costs per trip;
- ❑ Reduced vehicle operating costs per trip; and
- ❑ Benefit from goods arriving at markets or distribution point earlier.

The valuation of the first of these is discussed above in the above section on [Work Trips](#), whilst the valuation of the second should be captured through the vehicle operating cost model (see *Note 9: Sources of Operating Costs*). The last item of benefit is difficult to quantify and may arise through a number of mechanisms such as:

- ❑ Agricultural produce, particularly perishables, arriving at market earlier and in better condition thereby attracting better prices; and
- ❑ Reduced stockholding required through re-structuring of logistics and supply sector.

The inclusion of benefits associated with goods arriving at their destination earlier will require detailed case by case analysis. Such analysis should be considered where large step changes in transport infrastructure are under consideration, otherwise not (see *Note 14: Projects with Significant Re-structuring Effects*).

### **TIME TRENDS IN THE VALUE OF TIME**

#### **Work Trips**

The value of work trips is directly related to the wage rate (as discussed [above](#)). The value of such trips will therefore grow with the projected wage rate, which is typically assumed to equal the growth in GDP per capita (in the absence of other data).

#### **Non-Work Trips**

The value of non-work trips is not related to the wage rate and as such there is no theoretical justification for linking it to wage rate growth. However, its value is related to income and any changes in income will affect that value. As discussed earlier the values attributed to non-working time are cultural and need to be derived explicitly. Studies in the UK and Netherlands have indicated elasticities of VoT with respect to income of approximately 0.5 to 0.8. However, given the limited evidence available, it is generally recommended that the value of non-working time be treated as increasing over time in proportion to GDP per capita unless there is local evidence to the contrary. However, it may be prudent to use a more conservative estimate of increases in the value of time over time when assessing the buoyancy of toll revenues, and hence the commercial viability of toll road projects.

### **SMALL TIME SAVINGS**

Classical economic theory suggests that time savings, no matter the size, should have equal value (per unit of time saved). Recent UK and Dutch studies have, however, indicated lower time savings per minute for small time changes compared to large. However, while this could reflect the disproportionately greater discomfort and stress associated with longer trips, it could also arise through the difficulty associated with using Stated Preference methods to measure the value of small

time savings (Mackie et al, 2003 [ii]). It is therefore recommended for the time being that the same unit values be attributed to time changes irrespective of the size or sign of the change.

#### **REGIONAL DISPARITIES AND "STANDARD VALUES OF TIME"**

The previous discussion identifies that values of travel time savings vary by economic, social and trip characteristics. In the ideal world therefore the assessment of the value of time savings:

- ❑ Should establish their value for all relevant industries for work trips. For non-work trips the willingness to pay for time savings by income group, socio-economic group, trip type and trip conditions should be discovered;

These values should be used in all assessments of travel demand, whether total amount of travel, allocation of that total between modes or between routes. However, evaluation of any time savings that might be attributed to a policy change or to an investment should take account of what has been termed the "welfare" value of time for non-work travel. It has been argued above that the value of non-work time is non related to the wage rate but to income. If we evaluated non-work time savings based on the income of the travellers involved, we would tend to build more and better transport facilities for people with higher incomes and adopt transport policies that tended to favour them over other travellers.

The usual solution to this problem is to evaluate non-work travel time savings at a national average rate rather than at the rate the travellers appear to value their time themselves.

This would go some way in avoiding the potential vicious cycle arising through the use of local and regional differences in income. High income areas will yield high project returns, thereby attracting investment and potentially crowding out investment in low income areas. Such investments would further increase income in the high area thereby widening the income gap between regions.

To be done within the context of a typical transport project a full distributive weighting approach to evaluation should be undertaken, but this would be very ambitious due to:

- ❑ High cost of determining local values of time for every scheme appraisal and the cost of obtaining the necessary data on the pattern of usage by worker types, income and social group;
- ❑ Potential for bias in appraisals where entirely locally determined values of time were used;
- ❑ Difficulty in defining the final incidence of costs and benefits to income and social groups (see *Framework*); and
- ❑ Ability to define an agreed set of social weights.

A common way to get round these difficulties is to use **national standard or average values of time for evaluation (but not for demand assessments)**. The exceptions to this general approach are projects that allow people to pay to save time (e.g. new metro schemes or toll roads). For such projects it is recommended that at a minimum values of time by income group (non-working time) and industrial sector (working time) be used. This is for two reasons; firstly such variations will be paramount to ensure the demand forecasts are robust and secondly it is preferable to have consistency between the parameters used in the demand forecasts and those used in the evaluation (also see Note 7: *Demand Forecasting Errors*). Ideally, the values of time should in these cases also be representative of local conditions, particularly in areas where local conditions differ significantly from national averages.

As with other aspects of the economic evaluation, the relationship between willingness to pay values and income levels implies that an evaluation based on values differentiated by willingness to pay could favour high income areas. It is therefore critical that the evaluation is **augmented with poverty impact analysis and, at the project screening and sifting stage, cost effectiveness analysis**. Cost effectiveness and poverty impacts are discussed in the Note 4: *Where to Use Cost Effectiveness Techniques rather than Cost Benefit Analysis* and Note 21: *and Distribution of Benefits and Impacts on Poor People*.



## **METHODOLOGIES FOR VALUATION OF TIME SAVINGS**

### **Work Trips**

The recommended approach for valuing work trips is the cost savings or wage rate approach (see [above](#)). A staged process is usually adopted:

- ❑ Establishing average wage rate;
- ❑ Adjustment to reflect additional employee related costs. This would include paid holidays, employment taxes, other compulsory contributions (e.g. employer pension contributions) and an allowance for overheads required to keep someone employed; and
- ❑ Adjustment to the price base of the appraisal (see *Framework* [\[Link\]](#)). Typically resource prices are used, in which case this adjustment will reflect the level of unemployment or underemployment in the area (i.e. the shadow wage rate).

[Table 1](#) presents a range of approaches that can be used to derive a value of time for work trips according to the level of data and resources available. All the approaches use the cost savings or wage rate approach.

**Box 1. Methodologies for Valuing Travel Time Savings**

**Table 1. Method for Valuing Working Time Savings**

Approach to be adopted (data and resource dependent)	Method
Base (or minimum) approach (Single value of work time savings)	Option 1: National average wage rate adjusted by observed adjustment factors Option 2: 1.33 x wage rate (adjusted by shadow wage rate)
Second best approach (By mode)	Adjusted from observed wage rate using observed adjustment factors (e.g. overheads and shadow wage rate)
Ideal approach (By work sector)	Adjusted from observed wage rate using observed adjustment factors (e.g. overheads and shadow wage rate)

- Note 1: The proportion of work trips needs to be carefully defined particularly in rural subsistence type economies (see [Section 2](#))  
 2: Walking and waiting time savings as part of work trips have the same value as IVT (see [Section 2](#))  
 3: Method for "Base approach Option 2" is detailed in Gwilliam (1997) [i]

**Table 2: Method for Valuing Non- Working Time Savings**

Approach to be adopted (data and resource dependent)	Method
Base (or minimum) approach (Single value of non-work time savings)	Adults: 0.3 x Household income (per head) Children: 0.15 x Household income  Walk/wait time modifier: 1.5 x value for IVT
Second best approach (By mode - plus modifications for trip characteristics (e.g. walk, wait, journey quality))	Revealed and Stated Preference methods for values of time savings and modifiers. Results adjusted to price base
Ideal approach (By income group, socio-economic group, journey purpose. Plus modifications for trip characteristics (e.g. walk, wait, journey quality))	Revealed and Stated Preference methods for values of time savings and modifiers. Results adjusted to price base

- Note 1: Method for "Base approach" is detailed in Gwilliam (1997) [i]

## Non-Work Trips

The economic value of non-work trips must be inferred from travellers revealed or stated preferences.

Revealed preference (RP) analysis estimates values of time which best explain actual observed choice behaviour (for example choice between a fast expensive mode and a slow cheap mode). Conceptually this would appear to be the most realistic basis for study. In practice it tends to be expensive because many people really have little effective choice of travel alternative; at best only one decision can be analysed per respondent. It is also surprisingly uncertain because, even where there is a choice, direct evidence only exists on the alternative chosen and not on the alternative rejected.

Stated preference (SP) analysis overcomes the expense and clarity problems of RP by presenting hypothetical alternatives closely related to an activity currently being undertaken (for example, by interviewing people in the course of a journey). This can be done in a wide range of contexts offering alternatives designed to give numerous credible trade-off possibilities at little cost in a single experiment. This overcomes the limitation of RP analysis to situations where the number of "traders" is great and the nature of the trade obvious (mostly choice of mode for the journey to work and some choice between tolled and untolled routes). Most studies now use SP, though RP is also required to correct for the "scale factor" problem that is present within SP (see also Note *Demand Forecasting Errors* [\[Link\]](#)).

Additionally an adjustment may be required to convert the value of time savings into the correct cost base. Typically this is resource prices (see *Framework* [\[Link\]](#)). An adjustment to resource prices will require an adjustment for the level of import/export taxation and the level of indirect taxation within the economy.

[Table 2](#) presents a range of approaches that can be used to derive a value of time for non-work trips according to the level of data and resources available. [Box 3](#) presents a case study of the application of revealed and stated preference methods within Bangladesh.

## Box 2. Calculation of Travel Time Savings in Bangladesh

The purpose of the study was to develop, empirically test, and disseminate a methodology for deriving values of travel time savings (VOT) in Lesser Developed Countries for transport/accessibility project appraisal. VOTs for work trip time savings were calculated from the wage rate, whilst for non-work trips the study investigated the calculation of VOTs by Revealed and Stated Preference methods.

### Work Trips

- Village level interviews indicate that the agriculture labour wage rate varies seasonally. The maximum wage is between mid-May and mid-June at Tk90 per day, whilst between mid-June and mid-August there is no or marginal work. The average wage over the year is Tk6/hour.
- The average wage rate increases to Tk6.82 once non-agricultural employees are included.
- The shadow wage rate factor is estimated at 0.75.
- The resource cost of average work trip time savings is therefore Tk5.1

### Non-Work Trips

#### **Revealed Preference (RP)**

The RP methods failed to provide consistent results. The reasons include:

- For many travellers the options are very limited and often none at all (walking is their only option);
- Commercial vehicles (e.g. buses, rickshaws, etc.) do not run to schedule and wait until the vehicle is full. Waiting times therefore vary enormously. Establishing the waiting times of competing modes therefore relies on a "best guess" by the respondent; and
- Poor timekeeping awareness of rural people makes it difficult to establish walking, waiting and in-vehicle times.

#### **Stated Preference (SP)**

The SP methods proved successful. Respondents from all social and gender classes were able to respond rationally. Values of non-working time were derived that varied by: gender; travelling within a vehicle compared to walking; uncomfortable journey conditions (e.g. overcrowded); market day; and travelling with a load.

Regarding the application of SP the following issues were noted:

- Respondents needed to be constantly advised by the interviewer about the cost implication of making their choice. This is important in rural economies where cash is only used for a limited number of transactions;
- Respondents tended to generalise their trip purposes.

### **Results**

The average value of non-working time savings was found to be Tk 4.3. Adjustment to resource prices (accounting for the level of indirect taxation and import/export duty) reduced this to Tk3.8. This is 62% of the value of working time savings.

Source: IT Transport (2002) [iii]

### **SUMMARY**

It is recommended that the value of time savings should be included in all economic appraisals where travel time impacts will occur:

- At a minimum there should be a distinction between working time and non-working time;
- Ideally, consideration should also be given to:
  - Relationship to wage rates for different workers (e.g. unskilled rural, skilled rural, white collar) (working time only);

- Relationship to income, socio-economic group and journey purpose (non-working time only);
  - Modifiers for walking and waiting time;
  - Modally specific values;
  - Distribution of time values about the arithmetic mean for a given population..
- For major projects that involve significant reductions in travel time but for which a fare or toll must be paid (e.g. new metros, toll roads, etc.) it will be essential to distinguish between different income groups (non-working time) and industrial sector (working time);
- The value of time should grow in real times over the appraisal period (see [Box 1](#)); and
- It is essential to augment the economic appraisal with a poverty impact analysis.

This Note has presented different methods by which values of travel time savings can be estimated, depending upon the availability of data and resources (see [Box 2](#)). Such methods have been successfully applied within developing countries. Gwilliam (1997) also presents some travel time savings values that have been previously used for World Bank projects, of which further use could also be made in the absence of more recent data.

#### FURTHER READING

---

[<sup>i</sup>] Gwilliam, K M (1997) *The Value of Time in Economic Evaluation of Transport Projects*, Infrastructure Note OT-5, World Bank, Washington DC, USA. [Available online at <http://www.worldbank.org/transport/publicat/td-ot5.htm>]

[<sup>ii</sup>] Mackie P. J., Wardman M., Fowkes A. S., Whelan G., Nellthorp J. and Bates J. (2003) *Values of Travel Time Savings in the UK Summary and Conclusions*, Report to the Department of Transport (UK). [Available online at [http://www.dft.gov.uk/stellent/groups/dft\\_transstrat/documents/page/dft\\_transstrat\\_022708.hcsp](http://www.dft.gov.uk/stellent/groups/dft_transstrat/documents/page/dft_transstrat_022708.hcsp)]

[<sup>iii</sup>] IT Transport (2002) *The Value of Time in Least Developed Countries* Report to the Department for International Development (UK).

[<sup>iv</sup>] Hensher, D.A. (1977) *The Value of Business Travel Time* Pergamon. Oxford. 1977

[<sup>v</sup>] MVA Consultancy, ITS of the University of Leeds and TSU of the University of Oxford, (1987) *The Value of Travel Time Savings: A Report of Research Undertaken for the Department of Transport*, MVA Consultancy.

[<sup>vi</sup>] FONDECYT (1994) *Valor de tiempo para evaluación de proyectos* Pontificia Universidad Católica de Chile, Departamento de Ingeniería de Transporte. Santiago

[7] Galvez, T.E. and Jara-Díaz, S. (1998) *On the Social Value of Travel Time Savings* International Journal of Transport Economics (Revista) Vol. 35 No 2.

[8] Hensher, D.A. and Goodwin, P. *Using values of travel time savings for toll roads: avoiding some common errors* Transport Policy Vol 11, 2004