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Productivity foregone corrections of the value of business travel time savings

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ABSTRACT: In the current practice of the economic appraisal of transport projects, the value of travel time savings (VTTS) for business trips is derived predominantly from the cost savings approach (CSA) where travel time savings are valued at the marginal product of labour (MPL), defined as the average wage rate plus overhead costs. Specifically, the CSA approach does not require that travel time is unproductive, only that any time saved should be unproductive. This approach has been adopted in Australia by Austroads and Transport for NSW, and internationally by the UK, other European countries and throughout North America. Supported by portable computing and smart phone devices, there is a view that an increasing proportion of business travellers work to some extent while travelling. Furthermore, a proportion of business travel time savings has been used for leisure instead of work on the argument that such savings are in non-income earning time. This paper uses the Hensher Equation developed in the 1970s, which is resurfacing as an appealing alternative valuation method for business travel time savings, to quantify productivity foregone corrections for the loss of productive use of business travel time savings. The purpose of this paper is to translate recent research on the valuation of business travel time savings into practical tools for incorporation in economic appraisal methods.

KEY WORDS: ***value of business travel time savings, The Hensher equation, productivity in travel, project evaluation***

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1. Introduction

The value of travel time savings (VTTS) is a central concept of transport demand analysis and project appraisal. It is used not only as a parameter in the generalised cost specification in travel demand analysis to convert time into money (or money into time), but also as a resource cost in economic appraisal for evaluating transport changes. In project evaluation, the reduction in travel time has long been recognised as a major user benefit, requiring a dollar value for a unit of travel time saved by transport investment.

An analysis of recent transport projects in NSW, for example, indicates that time savings converted to dollars via the VTTS account, on average, for 85% of all user benefits associated with urban freeway projects (noting that travel time reliability is not included). For urban public transport (specifically light rail and heavy rail projects) and regional highway projects, the estimates are 44% and 34% respectively[1]. The major focus of research to obtain estimates of VTTS has been for travel that is not associated with business activity. Within the non-work trip segment, a range of estimates have been obtained to account for trip purpose, income, mode, and location (e.g., urban versus rural), as well as components of travel time such as in-vehicle time, access /egress time, and waiting time. VTTS have also been obtained as a distribution across a population in each of these segments to recognise preference heterogeneity for the marginal disutility of time and/or cost.

The willingness to pay (WTP) approach has been used for measuring the VTTS for non-work travel, using revealed preference choice data based on observations of actual travel choices involving different travel time, costs and other attributes, and/or stated preference data that is based on hypothetical choice settings with varying travel time, cost, travel time reliability, mode, route etc. (see Hensher et al. 2015 for details). The dominating approach used for official economic appraisal guidelines for measuring business VTTS is the cost savings approach (CSA), where the VTTS is defined by the marginal productivity of working time equated with the wage rate plus a marginal wage increment for overheads.

Business-related travel has been given less focus, but it is resurfacing as a controversial area for recent major projects such as HST2 in the UK (see UK House of Commons Transport Committee 2011), where business related travel and especially the ability to undertake productive work activity while travelling, suggests that the VTTS may indeed be lower than previously assumed in studies that attributed no work-related activities while travelling. This has resulted in a renewed questioning of the appropriateness of the CSA approach (see for example, Wardman et al. 2015, and Curtis 2012). The UK House of Commons Transport Committee (2012, pp 31) noted that "the most suspect part of current appraisal methods as applied to high speed rail is the valuation of business travel time." …"The core assumption that travel time is unproductive was flawed."

This paper examines the potential influence on the VTTS of business trips in urban areas and for long distance travel outside of urban area associated with two features:

- Work-related productivity achieved while travelling. The advent of technologies such as internet enabled laptops, tablets and smart phones enable people to work on the train, and ferry and to a lesser extent on the bus and in the car.
- Leisure use of business travel time savings. Although the cost savings approach assumes that all business travel time savings will be used for work, leisure use has been found to account for a non-marginal proportion of total business travel time savings (typically 30 to 40 percent of business-related travel time in Australian cities – see Hensher 2011), which has behavioural and economic implications on the business VTTS.

The paper is organised into four sections. The existing literature is reviewed in the following section with the Hensher equation used as the theoretical framework for two productivity foregone corrections that are designed to account for the loss of productive work associated with travel time savings while

[1] Based on the authors' analysis of the economic appraisal of 10 large projects in NSW. As the sample size is small, the values are indicative only.

travelling on business and the leisure use of the business travel time savings. Section 3 presents the evidence that we use to identify the loss of productive work due to time savings which is the basis of the productivity foregone correction. Concluding remarks, including the implications on economic appraisal and transport demand forecasting, is discussed in the final section.

2. Review of existing approaches

2.1 Approaches to estimating the VTTS for business trips

"A 'triangulation" of different approaches covering the cost savings approach, the Hensher Equation (HE) and willingness to pay have been used for estimating the VTTS of business trips. In CSA, the VTTS is equal to the marginal product of labour (MPL), which in turn is estimated at the gross wage rate plus a marginal wage increment (or on costs) for superannuation charges, long service leave and work cover etc. as well as any costs of office space and associated overheads. In Australia, on costs were estimated at 28% of the average wage rate in 2008, revised to 29.8% in 2015 (Transport and Infrastructure Council 2015, p. 12). For WTP estimates, stated preference data, revealed preference data, or a combination of both, is used to estimate the VTTS for business trips. Although the employer pays for the travel time incurred by the employee, under the opportunity cost of such time approach, this justifies the use of the employer's WTP. However, the employee will benefit from the travel time savings as represented by a marginal disutility change. Thus the employee's WTP will be also relevant.

The framework incorporating working while travelling existed in the late sixties (see Hensher 1976, 1978). The Hensher equation (Equation 1, Hensher 1977, Fowkes et al. 1986) provides a theoretical mechanism in which the VTTS for business trips captures the effects of the work-related productivity achieved while travelling, and hence the loss of productivity associated with travel time savings, possible use of travel time savings for leisure and work purposes, fatigue of travel, and traveller's preference between travel time and office time:

$$VTTS = (1 - r - pq)MPL + MPF + (1 - r)VW + rVL \qquad (1)$$

where:

r = the proportion of business travel time savings that is used for leisure instead of additional working hours. (1-r) is the proportion of travel time savings that is used for working.

p = the proportion of travel time that is used for working by engaging in productive activities.

q = the relativity of the productivity of working while travelling (on train or bus) to work at the workplace.

MPL = the marginal product of labour which is traditionally used as the value of business travel time in the cost saving approach.

MPF = the marginal product of fatigue reduction. A travel time reduction would reduce worker fatigue from travelling, which in turn increases the productivity of working hours.

VW = the employee's value of time at work relative to travelling. Most studies have made the simplifying assumption that VW is zero; however no empirical studies have measured it (as far as we are aware).

VL = the employee's value of leisure time savings, which is assumed equal to the value of private (or leisure) travel time savings. In the current definition of VL, there is no disutility from leisure travel, and the demand for leisure travel is not derived from a desire to engage in leisure activity at the destination.

The Hensher equation is promoted as an appealing method of estimating the value of business travel time savings. At various times, it has been the basis of official appraisal guidance in the Netherlands, Norway and Sweden (Wardman et al. 2013, Beca Carter Hollings and Ferner et al. 2002). The Hensher equation indicates that the value of business travel time savings has beneficiary value components to both employers and employees. The first two terms (MPL+MPF) in equation (1) are values to employers, comprising the proportion of travel time savings that is used for working and the additional productivity of reduced travel fatigue. When people do work while travelling, any travel time savings means that the time availability for working while travelling is also reduced. The productivity foregone from travel time savings imposes a negative effect on employers. The productivity gain while travelling is measured as pqMPL. The remaining two terms (VW+VL) are values to the employee, comprising the proportion of time savings used for leisure and the value of personal preference on spending the equivalent amount of time in work relative to leisure.

In practice, the marginal product of labour (MPL) and employee's value of leisure time savings (VL) can be considered as given. For example, TfNSW (2013, p. 231) provides the business and private VTTS as part of the economic appraisal parameters to be used in NSW. The Hensher equation requires the estimation of five additional parameters: r, p, q, MPF and VW. It is particularly difficult to estimate the extra output of reduced travel fatigue (MPF) resulting from a shorter travel time and the value of personal preference for spending time in work relative to leisure (VW). This has resulted in simplified versions of the HE, with most studies assuming that MPF and VM are zero (e.g., Wardman et al. 2013; Mackie et al. 2003). The simplified, or often referred to modified Hensher equation, is:

$$VTTS = (1 - r)\,MPL + rVL - pqMPL \qquad (2)$$

Equation (2) has three components:

1. (1 – r)MPL - the proportion of travel time savings used for working that is valued at the marginal product of labour.
2. rVL - the proportion of travel time savings used for leisure that is valued at the leisure time value.
3. pqMPL – a correction for the loss of productive work associated with travel time savings.

The simplified Hensher equation is applicable for business-related travel (including briefcase travellers) where travel time is distinguished from 'normal' working time at the office. For example, a plumber travels to the customer's site and if this is not income-earning (or billable) time, then it is a trade off with leisure time. Likewise, someone travelling to the airport for a business trip may be travelling in a time period when they would otherwise be at work and/or at home. The formula does not apply to bus drivers and train operators, and professional drivers (e.g., taxi and delivery drivers). For these people, driving is always working, and thus any productivity foregone correction is double counting.

Despite the (theoretical) appeal of the Hensher equation, CSA dominates international appraisal practice. In 16 countries and organisations initially reviewed by Odgaard et al. (2006), and updated by Wardman et al. (2015, p.2), 14[2] use CSA to estimate the VTTS for business travel for all modes. Only the Netherlands and Sweden use a version of the 'restricted' or 'simplified' HE. No countries use the value directly elicited from WTP, although there have been research studies that obtain such an estimate including the 2014 UK VTTS study (Department of Transport 2015).The argument mainly put for staying with the simplified CSA is the lack of agreement on the estimates of productivity during travel and controversy over the extent of business-related travel undertaken during non-income earning hours. The CSA however, does not require that travel time is unproductive, only that any time saved should be unproductive. Despite these concerns, the original Hensher Equation remains an appealing method that combines the productivity approach to measure the opportunity cost of time (essentially the employer-related time cost) and the marginal disutility (or WTP) approach to measure the value the employee places on spending the equivalent time on leisure vs. travel or work vs. travel.

[2] Australia, Denmark, European Investment Bank, European Commission, Finland, France, Germany, Ireland, New Zealand, Norway, Switzerland, UK, USA and World Bank.

2.2 The VTTS for business trips

Table 1 summarises the VTTS for business trips that is currently recommended for use in NSW. It is derived in line with the CSA approach and is associated with a number of underlying assumptions:

- Travel time savings should be unproductive and hence there is no loss of productive work due to time savings
- All business travel time savings is used for work and not for leisure.
- Time is divisible in its use. Every minute of time savings is equally valuable. For example, delivery drivers could find some productive activities between two scheduled delivery jobs.
- Employees are indifferent (i.e., have the same preference) between business travel time and work time. The marginal disutility of travel during working hours is equal to the marginal disutility of being at work in the office or on site.
- A competitive labour market condition is prevalent in which firms hire labour to the point where the value of the marginal product is equal to the wage rate plus on costs. Thus the value of a unit of time transferred between travelling and working is equal to the marginal gross cost of labour.

Table 1 Value of travel time of business trips (in June 2014 dollars) used in NSW under the CSA

Mode	Car drivers and passengers	(A)Truck Drivers	(A)Bus drivers	(B)Briefcase travellers in other modes
Business VOT ($/hr)	$48.45	$26.81 -$29.64	$28.36	$48.45

Source: TfNSW (2013, p. 230)

(A) Values are from an employer's perspective that includes the wage rate plus on costs. Values vary depending on industrial agreements or awards.

(B) Briefcase travellers are people using the transport system for employer's business purposes including business meetings inside or outside of the firm or to meet a client or secure a contract. Travel is purely a means to get to the destination, and the traveller may be able to work or think during the journey. Such trips can be identified from the Sydney Household Travel Survey. If the trip purpose is "work-related business" and mode is public transport, they are briefcase travellers. If the mode is car on work-related business, then the occupation is used to establish whether the driver is a "technicians and trades workers" (e.g., plumber and electrician) which would be excluded. Freight and commercial vehicles (e.g., heavy trucks) are also identified and excluded.

A major concern with the traditional set of assumptions underlying the business VTTS is a failure to establish the extent of loss of productive work due to travel time saved. For example, in the Australian High Speed Rail Study (AECOM et al. 2013) with a capital cost of 93bn in 2012 dollars, the value of business travel time savings was estimated at $38/person hour for short regional trips, $81/person hour for long regional trips and $57/person hour for inter-city trips (AECOM et al. 2013, p. 361). The total economic benefits for the 30 year evaluation period were estimated at $180bn.(ignoring the loss of productive time due to time savings) with 52% of the benefits associated with business users (mainly business travel time savings), 26% from private users and the remaining 22% from externalities, residual values and operator surplus (AECOM et al. 2013, p. 378). Another example is the UK's £32bn High Speed Rail (known as HS2) project where the largest component of the monetised benefits came from the time savings of business travellers. The assessment of benefits assumes that workers cannot use their journey time productively, and hence savings in time do not include an allowance for loss of productive work. Critics pointed out that many people work on the train, and the productivity achieved whilst travelling implies that the travel time savings is less valuable. In the HS2 project, sensitivity tests were undertaken by reducing the business VTTS by one third or one half to adjust for loss of productive work while travelling (Curtis 2012, UK House of Commons Transport Committee 2011, p. 65). The existing literature points in one direction – the value of business travel time savings would be reduced if the productivity gained while travelling (and hence reduced when travel time is saved) is included in an economic appraisal (Wardman et al. 2013, Curtis 2012).

2.3 The VTTS for non-business trips

Given the need to establish the incidence of travel time saved being traded against leisure in contrast to income-earning activity, as an important element in determining potential productivity losses and gains, we need to establish the leisure values of time savings, typically obtained from private (i.e., non-business related) trips. The majority of the values used in recent times, derived from stated preference (SP) surveys in which travellers are asked to trade-off between travel time and cost. The productive use of travel time has not been used as a design attribute, on the assumption that there is no work-related activity while travelling to work (i.e., in commuting). Whether the ability to work while travelling is implicit in non-business VTTS estimates is not known.

An individual's behavioural 'willingness to pay' for travel time savings has been found to vary by income, trip purpose, comfort and the urgency of the journey. The VTTS also varies by transport modes mainly because of socio-economic characteristics of user groups served by different modes. Recent WTP values in Sydney are summarised in Table 2. In economic appraisal, if the VTTS is based on individuals' behavioural values which are highly related to income, investment decisions will be biased towards projects in higher income areas and/or highway projects (usually car users have a higher VTTS than public transport users). The interests of public transport users and lower income individuals, who may already suffer from relatively lower mobility and accessibility, will be given a lesser weight. For this reason, an equity value has been recommended by Transport for NSW. This approach has also been used by UK and recently adopted by NZ from July 2014.

Table 2 Value of travel time savings of private trips (in June 2014 dollars)3

Mode	(A)Train	(A)Light Rail	(A)Ferry	(A)Bus	(B)Equity Value
Private VTTS ($/hr)	$15.3	$13.3	$11.7	$11.3	$15.14

Source: (A) Estimated VTTS in recent stated preference surveys in Sydney from Douglas Economics (2014a). (B) Equity value based on 40% of the average weekly earnings assumed in Austroads (1997) and adopted by TfNSW (2013, p. 231), applicable for all modes.

Waiting and walking values associated with private trip purposes usually have a higher value - travellers dislike waiting or walking more than the equivalent in-vehicle time. However, typically, in-vehicle, waiting and walking time savings have been assigned the same value (wage + on costs) for business trips.

It is also worth noting that VTTS used for demand modelling should be based on behavioural values in order to accurately simulate the trip decision making and mode choice. Behavioural values are often different to those used in economic appraisal, and a resource cost correction is needed if behavioural values are directly used for estimating economic values, for example in the logsum approach (Bates 2005). For resource cost corrections, user benefits measured in 'perceived cost' or willingness to pay are adjusted for indirect tax and other considerations to reflect the opportunity cost in the next best alternative use of a resource. Differences between behavioural and resource costs arise when, for a given cost, the opportunities foregone are different for the individual incurring the cost and for society as a whole. Taxes, subsidies, tariffs, import quotas and non-competitive pricing by producers can all result in resource costs differing from private costs, which are adjusted in the resource cost corrections. Bray (2006) presents the resource cost correction method for economic benefits and travel demand estimated from a variable trip matrix.

[3] UK Department for Transport assigns different values for commute and other private trips.

3. Productivity foregone corrections

To reconcile the difference between the CSA assumption that all business travel time savings is unproductive and the reality that many people work while travelling, and that some business travel time savings are leaked to increased private leisure time, we introduce two corrections linked to the proportion of travel time saved at the expense of work done while travelling (as defined in Hensher (2011):

1. A correction to account for working while travelling. If a business traveller does work while travelling, the productivity achieved is lost if travel time is reduced.
2. A correction to account for the leisure use of time savings associated with business-related travel. If travel time savings are used for leisure, the value of the travel time savings should be valued at a rate lower than the work value.

These corrections are applicable for car drivers and passengers, taxi passengers, and briefcase travellers in public transport modes (bus, train, ferry and light rail) who are on business-related trips of which there is a mix of trading travel for leisure time and for work-time. For bus, train, truck, taxi and delivery vehicle drivers, these corrections are not applicable as the driving time is considered unambiguously income earning time. The theory is also applicable for business travel by air which generates significant consumer benefits, including business travel time savings (Oxford Economics 2009).However, air is excluded in the paper due to lack of data and evidence. In most official guidelines, CSA, as expressed as the marginal product of labour, provides a single value applicable for urban and long distance travel. Thus, both corrections are assumed applicable for business trips in urban areas and long distance travel by car, train, coach or high speed rail. To estimate these corrections, we use the Hensher equation as the theoretical framework. Table 3 summarises the applicability of the productivity foregone corrections.

Table 3 Applicability of productivity foregone corrections

Category	Correction Applies to:	Does not apply to:
Trip purpose	Business trips Briefcase travellers Trade persons where driving time is distinct from working time (plumber, electrician)	Commute and private trips Professional drivers (taxi, delivery drivers) Public transport operators (bus drivers, train drivers)
Mode	Focus on car drivers and passengers, train and high speed rail passengers Can apply to other public transport (bus, light rail, ferry) passengers Taxi passengers	Air (out of scope for this study) Taxi drivers
Travel distance	Urban trips (short to medium distance) Rural long distance business trips (High Speed Rail, Coach)	
Access and egress	In-vehicle time of main mode	Access / egress time Transfer time Waiting time

3.1 The productivity foregone correction accounting for working while travelling

The productivity from working while travelling can be expressed as:

$$Productivity = p \bullet q \bullet Journey\ Time \bullet MPL \qquad (3)$$

A review of the international evidence from 1977 to 2013 has identified the range of empirical evidence on reported values for p and q as presented in Table 4. There is a lot of variability in the evidence, and we have selected what might be best described as the 'most commonly obtained' finding as the basis for selecting most likely values for *p* and *q*.

Table 4 International studies on p and q values

Study	Year	Car	Train	Bus
p - proportion of travel time used for productive activities				
UK Business Travel Study (a)	1986	3%	20%	
Netherland VOT study (a)	1988	2%	11%	3%
UK VOT study (a)	1994	4%		
Sweden VOT study (a)	1995	14%	28%	13%
Netherland VOT study (a)	1997	4%	16%	3%
Norway VOT Study (a)	1997	3%	18%	6%
NZ Study (b)	2002	22%		
Swiss VOT study (a)	2003	30%		
UK National Passenger Survey (NPS) (c)	2004		30%	
UK Study of the Productive Use of Rail Travel-time (SPURT) (c)	2009		46%	
Sydney Train Quality Study (d)	2013		27%	
Most likely p value (median)		4%	24%	5%
q - relativity of working efficiency in travel time to working time at usual workplace				
UK Business Travel Study (a)	1986	101%	95%	
Netherland VOT study (a)	1988	90%	89%	93%
UK VOT study (a)	1994	102%		
Sweden VOT study (a)	1995	101%	103%	93%
Netherland VOT study (a)	1997	90%	89%	93%
Norway VOT Study (a)	1997	32%	39%	20%
NZ Study (b)	2002	93%		
Swiss VOT study (a)	2003		98%	
UK Study of the Productive Use of Rail Travel-time (SPURT) (c)	2009		97%	
Most likely q value (median)		93%	95%	93%

Sources: (a) Wardman et al. (2013) (b) Beca Carter Hollings and Ferner et al. (2002) (c) Mott MacDonald et al. (2009) (d) Douglas (2014a)

The p and q values in Table 4 are used for inferring the indicative proportion of travel time used for working and relative working efficiency in travelling to work at the usual workplace. The proportion of the business travel time used for working is very low for car and bus relative to rail. For business trips, car occupancy ranges from 1.1 in urban areas to 1.3 in rural contexts (TfNSW 2013, p. 231). Given that the majority of car users are car drivers, this constrains their capacity for working while driving. (However, they can think about work, discuss with passenger or make hands free telephone calls on work related issues). The ride quality of car and bus also limits the use of a laptop or work in general, even though smart phones are now very easy to use. However, international evidence suggests that, on average, a quarter of the business travel time on train was used for work. This would have a significant impact on VTTS if the productivity impact while travelling is incorporated. Large variations are evident within a mode. For car, Sweden, NZ and Swiss studies give a higher proportion ranging from 14% to 30%, while other studies suggest a much lower proportion. Specific reasons for the large variation are difficult to explain as studies span over three decades and have been undertaken in different countries and different times in the evolution of smart communication technology. To reduce the impact on a high or low value, the likely value is estimated from the median instead of the mean.

Table 4 also suggests that people could work almost as efficiently while travelling as in the workplace. Three studies in the UK and Sweden claim that people could work more productively while travelling (q>100%), because they were away from normal office distractions. The Norway study is an outlier that shows the relative working efficiency in travelling is much lower at 20% to 39% compared to that in the workplace. On average, people can work 93% as efficiently in a bus and car compared to the workplace. For train, it is slightly higher at 95%[4].

Table 5 shows the productivity foregone correction associated with business travel time savings. The average productivity foregone is around $1.80 for car, $10.82 for train and $2.03 for bus. After the correction, the business VTTS for each mode is 96%, 78% and 96% of the original MPL for car, train and bus respectively. It shows that the productivity foregone correction is small for car and bus, but it is substantial for train.

Table 5 The productivity foregone correction on the business VTTS accounting for working while travelling (June 2014 dollars)

Mode	Car	Train	Bus
MPL – Marginal Product of Labour ($/hr)	$48.45	$48.45	$48.45
Productivity foregone correction made while travelling (pqMPL)[(a)]	$1.80	$10.82	$2.03
The business VTTS for business after productivity foregone correction	$46.65	$37.63	$46.42
% of corrected business VTTS to the original MPL	96%	78%	96%

Note (a) The most likely p and q values in Table 4 are used for the productivity foregone correction

For train and bus, the productivity impact is applied to in-vehicle time but not to access, waiting and egress time, as each of the out-of vehicle time components tends to be quite short; and we reasonably assume that people are not likely to work in such circumstances. If there is shown to be work-related activity in out of vehicle time that is saved, then it can be accounted for but we expect the loss of productive work to be small. Specifically for Sydney, a recent survey of Sydney train users (Table 6) suggests that 6% of travellers do some work in waiting time and 31% of travellers possibly work by using the internet or an electronic device, and this loss of productive activity could be added in but is not done so in this paper.

[4] This is more relevant to marginal activities (e.g., catching up on emails) but not always true for average activities (e.g., a major report writing exercise). For details, see Hensher (1977).

Table 6 Passenger activities at stations

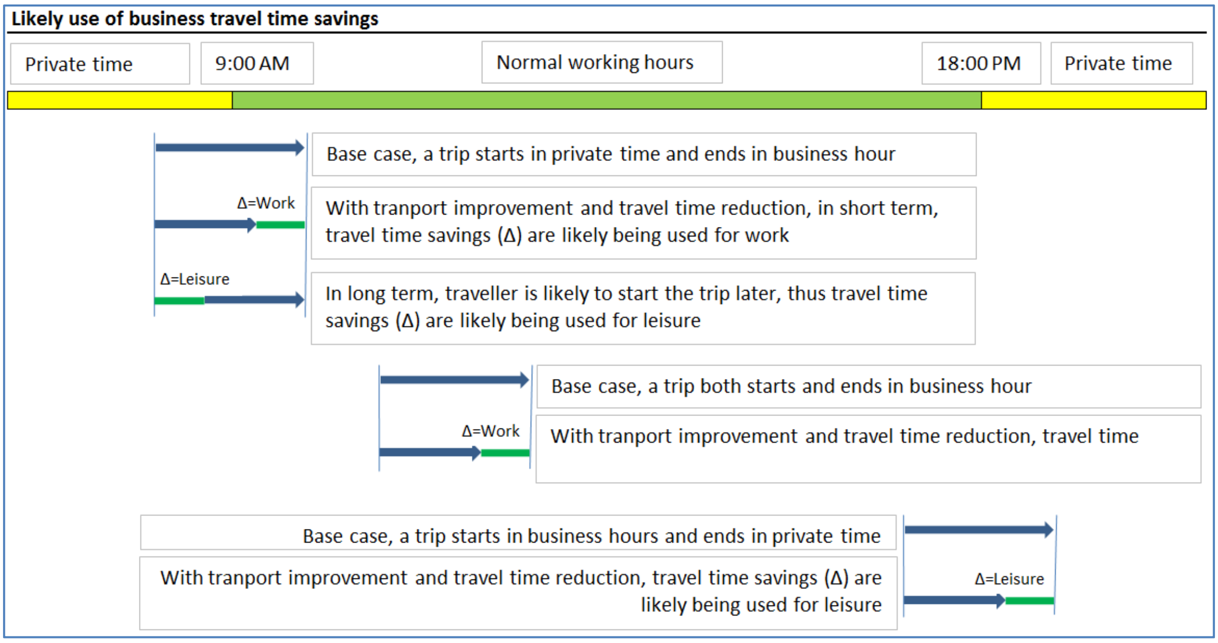
Activity	Peak				Off-peak				All
	Short	Med	Long	All peak	Short	Med	Long	All off-peak	
Bought a ticket	28%	28%	28%	28%	46%	47%	59%	49%	37%
Bought a coffee, newspaper	6%	8%	9%	7%	9%	9%	14%	9%	8%
Read a book/magazine	8%	10%	3%	6%	10%	10%	7%	9%	9%
Did some work, thought about work	8%	7%	3%	7%	4%	5%	4%	4%	6%
Used internet	23%	27%	25%	24%	26%	23%	17%	24%	24%
Electronic device but not internet	9%	4%	13%	8%	6%	8%	4%	6%	7%
Talked to my travelling companions	6%	7%	3%	6%	9%	14%	17%	12%	9%
Just waited for my train	45%	43%	50%	45%	36%	36%	46%	38%	42%
Something else	2%	2%	3%	2%	5%	3%	4%	4%	3%
Total	134%	135%	138%	135%	152%	154%	173%	156%	144%
Average wait (mins)	7	7.5	8	7.5	8.5	9.5	11.5	9.5	8.5

Source: Douglas Economics (2015)

3.2 The productivity foregone correction accounting for the leisure use of business travel time savings

Business travel time savings can be used either for work or leisure, although the cost saving approach assumes that all business travel time savings will be used for work. Figure 1 provides a schematic explanation on how business travellers will likely use the travel time savings under various scenarios using a simplified normal working hour construct.

Figure 1 Schematic explanation of the possible use of travel time savings: short term and long term



For business trips starting from home early morning and ending in business hours, travel time savings might initially be assigned to work in the short term. In the longer term, travellers may adjust their travel behaviour by departing later; thus the travel time savings might go to leisure. For business trips starting from business hours and ending after-hours, travel time savings may be transferred to leisure. Within business hours, all business travel time savings would technically be used for work. The general inference is that for business trips, travel time savings for trips that start and end within business hours are likely be converted to work activity. In the long term, travel time savings for those trips that start or end outside of business hours are likely to be translated into leisure time.

Table 7 shows the likely proportions of travel time savings used for leisure and work. Roughly speaking, a 50% (i.e., equal) split is evident for business trips, although existing evidence suggests variations between transport modes and countries. For example, travel time savings from car trips appear less likely to be used for leisure (45%), while bus trips it is more likely (55%), and train trips fall in-between (53%). The absolute time saved that is allocated between leisure and business varies within and between studies, and is often not provided, although there are exceptions. For example, Hensher’s 2005 Brisbane study found that 28% of travel time on business-related travel occurs outside of income-earning hours. This was obtained from two questions:

Q1: Firstly thinking about the last five working days, approximately how many hours did you spend driving or travelling as a passenger in a private car on company business? Please do not include travelling to or from work and driving that is part of your job description (such as couriers, salespeople who are always on the road, trades people or technicians)?

Q2: How much of that travel time was outside of the hours you would otherwise have been at your main place of work (including working at a satellite location of your organization, and/or working from home instead of going into the office).

The data was collected using a computer aided telephone interview (CATI) on a sample of 300 high-end business persons sampled according to Australian Bureau of Statistic (ABS) occupation codes 10-13, 20-25 and 30-39.

Table 7 Proportion of business-related travel time savings used for leisure instead of work (r)

Study	Year	Car	Train	Bus
UK Business Travel Study [(a)]	1986	32%	42%	
Netherland VOT study [(a)]	1988	34%	53%	48%
UK VOT study [(a)]	1994	46%		
Sweden VOT study [(a)]	1995	54%	78%	85%
Netherland VOT study [(a)]	1997	45%	63%	65%
Norway VOT Study [(a)]	1997	57%	72%	74%
NZ Study [(b)]	2002	28%		
Swiss VOT study [(a)]	2003		51%	
Australian Sydney VOT study (Hensher 2011)	2004	40%		
Australian Brisbane VOT study (Hensher 2011)	2005	28%		
UK Study of the Productive Use of Rail Travel-time (SPURT) [(c)]	2009		52%	
Likely proportion of business travel time savings used for leisure (*r*)		**45%**	**53%**	**55%**

Notes (a), (b) and (c) are the same as Table 3.

Table 8 shows the productivity foregone correction after accounting for the leisure use of business travel time savings. The calculation was based on the most likely values of p, q and r presented in Tables 4 and 7. The productivity foregone correction is $14.99 for car, $17.65 for train and $18.18 for bus. After the correction, the business VTTS are around 69%, 64% and 62% of the original MPL for car, train and bus respectively. It shows that the productivity foregone corrections are significant for all modes.

Table 8 The productivity foregone correction (r(MPL-VL)) on the business VTTS accounting for the leisure use of business travel time savings

	Car	Train	Bus
MPL – Marginal Product of Labour ($/hr) (1)	$48.45	$48.45	$48.45
VL - Value of leisure time savings ($/hr)	$15.14	$15.14	$15.14
r - proportion of business travel time savings going to leisure	45%	53%	55%
Correction for leisure use of business travel time savings	$14.99	$17.65	$18.18
VTTS business after leisure travel correction ($/hr)	$33.46	$30.80	$30.27
% of corrected business VTTS to the original MPL	69%	64%	62%

After the productivity foregone corrections are calculated for working while travelling togehre with the leisure use of business travel time savings (as given in Table 8), the business VTTS is reduced even further, accounting for 65%, 41% and 58% of the original MPL for car, train and bus respectively, as shown in Table 9. These estimates align closely to what Hensher (1977) found.

Table 9 Effects of productivity foregone corrections for working while travelling and the leisure use of business travel time savings

	Car	Train	Bus
MPL – Marginal Product of Labour ($/hr)	$48.45	$48.45	$48.45
Correction for working while travelling	$1.80	$10.82	$2.03
Correction for the leisure use of the business travel time savings	$14.99	$17.65	$18.18
The business VTTS post both corrections ($/hr)	$31.66	$19.98	$28.24
% the corrected business VTTS to the original MPL	65%	41%	58%

Most questions raised about the CSA approach are related to the productive use of travel time. The advent of computer-based technologies, including smart phones and fast internet wifi connection, facilitates working while travelling. However, the correction for working while travelling is much smaller compared to the correction for the leisure use of the business travel time savings. For car, the correction for working while travelling accounts for 4% of its original VTTS while the correction for leisure use accounts for a larger 31% of the original estimate. For train, the correction for working while travelling accounts for 22% of its original VTTS while the correction for leisure use accounts for a larger 36% of the original value. These findings suggest that the business VTTS is much more sensitive to how travellers use the saved time than assumed under CSA.

3.3 Other factors that may affect the productivity foregone corrections

The ability to work while travelling is dependent on the transport mode. It is easier to work in a smooth, quiet and air conditioned train than in a bumpy bus. Car also does not provide an amenable working environment, although it may be attractive for a car passenger.

Longer distance trips tend to have smaller productivity foregone corrections and higher VTTS. Evidence from New Zealand, Norway and UK point out that both the proportion of travel time used for productive activities (p value) and the relativity of working efficiency in travel time to time at the workplace (q value) will fall with a longer travel distance. Travel time savings on long distance travel is more likely to be used for leisure (i.e., a higher r value). With lower p and q values and a higher r value, the productivity foregone correction is smaller for long distance trips, resulting in a higher VTTS. The longer distance means that the trip is more costly and it is more likely that the senior staff will make such trips. These factors also lead to a higher business VTTS.

The public transport crowding level tends to have a more direct impact on the proportion of travel time spent working. Seating availability will impact on the ability to use travel time for work and the efficiency of work. The evidence suggests that the ability and willingness to work during a train journey falls with the load factor, as shown in Table 10. Working efficiency at 90% load factor is 10% lower than in less crowded trains with the load factor less than 80%. At or above the train capacity, some passengers have to stand; hence both the propensity for working and efficiency would drop. Service quality and amenities will affect the propensity of working while travelling. Facilitated by more power points on trains (mainly intercity and regional services) and more Wi-Fi connectivity, a study of the productive use of rail travel time ((MacDonald et al. 2009) found that as many as 80% of business travellers work in travel time. Conceptually, the load factor can be built into the productivity foregone correction. No such correction is undertaken in this paper as the proportion of time working while travelling, namely 24% for train (see Table 3), is already low compared with the values in Table 10.

Table 10 Business trip time used for working on the train by load factor

Train load factor (number of passengers / number of seats)	70%	80%	90%	100%
% time working in business journey time (p value)	60%	50%	40%	30%
Working efficiency while travelling (p value)	95%		85%	Lower than 85%

Source: Wardman et al. (2013, p. 66)

Douglas (2014b, p. 39) reviewed the effects of crowding on the value of travel time savings for non-business related travel, and found that the crowding multiplier (VTTS in crowded conditions relative to normal conditions) was 1.2 for a crowded seat, 1.65 for standing, and 2.1 for crush standing. While these findings apply to the VTTS of commuter or other private travel, we have no evidence on the how applicable these findings are for the productivity foregone corrections associated with the business VTTS.

4. Conclusions

The existing CSA approach adopts the same business VTTS values for car, bus and train. In Transport for NSW's economic appraisal guidelines, the business VTTS is $48.45 per hour in June 2014 dollars. After the two productivity foregone corrections presented in this paper, this value becomes much lower, with the value differentiated for car, train and bus. This modal difference will have a number of implications for economic appraisal. At the project level, including the productivity foregone corrections will result in a lower benefit cost ratio. In the generalised cost formula, the VTTS is required at the modal shift level, which will make the demand forecasting process more complex. It can also lead to an increased mode share for train and bus. Table 11 shows that the majority of business trips are made by car. The business trips made by train and bus only account for around 3% of total trips. 89% of all business trips are made by car, and thus the productivity foregone corrections may have a greater impact on road projects through reduced time benefits.

Table 11 Mode share of business and commute trips

	Car	Train	Bus	Other	Total
Commuter	74%	12%	5%	8%	100%
Work related business	89%	2%	1%	7%	100%

Source: Household Travel Survey 2011 – 2013. "Car' includes taxi. 'Other" refers to short distance trips by walking and cycling and trips by ferry and light rail. The HTS data does not allow further mode share breakdowns in 'other'.

In summary, this paper shows that some people on business trips undertake productive working activities while travelling. The proportion of travel time used for working is largely dependent on the transport mode. People are more likely to work on a train than on a bus or in a car. On train, around 24% of business travel time is used for working, while on bus or in car, only about 4% to 5% of travel time is used for working.

If business travellers do work while travelling, their working efficiency might be expected to be as high (on marginal activities at least) as in their workplace. The findigs suggest that, on a train, working efficiency is around 95% of that in the office. On a bus or in a car, the working efficiency is slightly lower at 93% (see Table 4).

Although people on business trips do work while travelling, a significant proportion of business travel time savings is used for leisure instead of work. This is partly because some business travel either starts from home in the morning or ends at home in the afternoon; thus travel time savings will most likely be converted to leisure time. The analysis suggests that business travel time savings used for leisure activities account for 45%, 53% and 55% for car, train and bus respectively.

These findings contrast with the underlying assumptions of the value of business travel time savings used in current practice. Specifically, since the early 1970s, Australian jurisdictions have adopted the cost saving approach for valuing business travel time savings (Hensher 2011) which assumes that business travellers do not undertake any productive activities while travelling, and that 100% of travel time savings will be used for business and not leisure (Batley 2015, Wardman 2003, Wardman et al. 2013).

This paper has introduced two productivity corrections to the business VTTS to account for working while travelling, and the leisure use of part of business travel time savings. Post corrections, it was found that the business VTTS is significantly lower than the original CSA value. The impacts of leisure use of business travel time savings are greater than those from the productive use of the travel time. The business VTTS after the productivity foregone corrections is 65% of the original MPL for car, 41% for train, and 58% for bus.

Finally, it is important to recognise that we have obtained the parameter values (p, q and r) of the Hensher equation from a meta-analysis of values reported in the existing literature. The studies are mostly from Europe with a few studies from New Zealand and Australia. To estimate a jurisdiction-specific business-related VTTS, the incidence of working while travelling and the leisure use of the business travel time savings needs to be identified, since it seems to vary quite a lot by location. In the Australian context, there is need for additional research to obtain updated parameters for those used in this paper that have been selected to illustrate the adjustments in the business VTTS for Australia.

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