VALUATION OF TRAVEL TIME SAVINGS FOR BUSINESS TRAVELLERS

Main Report

Prepared for the Department for Transport

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EXECUTIVE SUMMARY

Objectives

The objectives of this study were clearly specified in the Request for Proposal as:

"*The Department wishes to investigate the feasibility of differing approaches to valuing business travel time savings*" and also:

"*Identifying and assessing the advantages and disadvantages of practically feasible methods for valuing business travel time savings*".

It is not the purpose of this study to provide a recommended approach to valuation but rather to provide an authoritative evidence base to allow the Department to make informed judgements as to the best way forward. The key issues that the Department asked us to address were:

- Set out the theoretical foundations for the valuation of travel time savings for business passengers;
- Report on international appraisal practice in the area, and review the existing empirical evidence base;
- Identify and assess practically feasible methods for valuing business travel time savings;
- Describe options for further analytical work to inform the Department's future research programme; and
- Identify an appropriate range of tests based on existing evidence and covering alternative methodologies that could be applied to transport scheme appraisals.

Background

The value of travel time savings is one of the most important parameters of transport planning and cost benefit analysis. And business travel typically accounts for over a third of the monetised benefits of highway improvements, even though it is a minor activity forming less than 10% of trips and mileage.

The current UK procedure, and that adopted in most countries, is to value business travel time savings at labour cost, the so-called Cost Saving Approach (CSA), on the grounds that unproductive travel time that is saved can be converted into productive time which has a value equal to the cost of labour. This approach has the attraction of simplicity in application and, according to Fowkes et al. (1986) can be shown to provide a reasonable approximation to more comprehensive and sophisticated approaches. It is our understanding that the findings of that pioneering study influenced the Department for Transport's retention of the Cost Saving Approach in the light of what the first UK national value of time study (MVA et al., 1987) termed "well-rehearsed" possible shortcomings.

An alternative approach, which has been widely examined but seldom implemented due to the difficulties and uncertainties involved, is the Hensher approach (Hensher, 1977). It provides a conceptual framework for capturing a range of additional factors that might influence the value of business travel time savings to employers and employees, with the key features being; accounting for the productive use of travel time, its efficiency relative to working at the normal workplace and whether time saved is converted into work or leisure, and the employee's valuation.

Another approach, which has intuitive appeal and was covered in the pioneering Hensher (1977) and Fowkes et al. (1986) studies, is to determine the value of business travel time savings directly from what companies are prepared to pay, the so-called willingness to pay (WTP) approach. Such an approach could either be based on observations of actual behaviour (a 'revealed-preference' approach) or hypothetical choices (a 'stated preference' approach). The key benefits of such methods are that they avoid rather tortuous theoretical debate and are relatively straightforward to implement.

It is timely to revisit this issue, not only because of recent interest in the use of travel time (Lyons et al., 2007) and the work by Mott McDonald et al. (2009) that has stimulated debate, but also because departures from the pure wage rate approach have been introduced in other countries and amidst on-going concerns as to the applicability of the current method.

Whichever approach the Department adopts, the values derived need to be fit for purpose; appropriately robust, applicable to the appraisal cases for which they are used and capable of being updated over time.

The Methods Used Here

In order to achieve the objectives of this study as set out above, we have examined the underpinning of business travel time savings from a theoretical perspective, adopting the classic economists' approach of maximising welfare (of the employer and employee).

Appraisal practice in numerous other countries has been identified and reviewed and we have also conducted a critique of the features of the labour market relevant to business travel valuations and of the use of travel time. Our understanding of and expertise with appraisal and forecasting practice has proved useful to various aspects of the study, not least the practical implications section where we provide advice on updating the current value of time, segmentation, consistency of modelling and appraisal and implications for modal transfer.

We have completed an extensive review of business travel time valuation evidence. On the one hand, this has covered 10 international studies relating to the Hensher equation and its parameterisation, clearly setting out the implications for valuation, and on the other we have examined a very large volume of UK and mainland European WTP evidence assembled as part of previous meta-analysis studies. We have also reviewed 11 high speed rail studies and a number of others providing methodological insights. This evidence review has been used to inform the

specification of a series of tests of relevance to transport scheme appraisal and the future options specified.

Our Findings

We summarise our findings in each of the main areas that we have examined.

Theoretical Background

The theoretical foundation of the Cost Saving Approach (CSA) is described in Fowkes et al. (1986). Through codifying the Hensher approach it was demonstrated that the Cost Savings Approach is a 'special case' of the broader Hensher framework.

Having clarified the origins of the Hensher equation our judgement is that, as originally conceived, it was based more on intuition, and less on theory. Mindful, however, that the methods of evaluating journey time savings should, ideally, be grounded in both theory and intuition, we have sought to clarify the theoretical underpinnings of the Hensher equation, by deriving the equation from first principles.

This exercise has exposed some limiting assumptions of the method. For example, the method implicitly assumes that the Marginal Productivity of Labour is equal to the wage rate ($MPL=w+c$), in exactly the same fashion as CSA. We have also presented arguments for producing generalised versions of the Hensher equation that relax the limiting assumptions, such as if the productivity of business travellers travelling during work or leisure time is different then this would require an adjustment to the Hensher equation.

International Appraisal Practice

It is important to recognise that in many countries no firm official published guidelines are provided, but where they are the Cost Saving Approach dominates. Sweden, based on UK evidence, and the Netherlands use a restricted version of the Hensher approach. Norway used to advocate it but reverted to the Cost Saving Approach in 2010. Outside of Europe, the Cost Saving Approach is unchallenged. We have not uncovered use of a full Hensher model nor values derived from direct elicitation of employer or indeed employee WTP.

In our view, the Cost Saving Approach remains dominant in official recommendations because it is based on a theoretical model with simple appeal that can be populated cheaply and is said to approximate the results from alternative approaches. The alternatives require data collection, interpretation and analysis and doubts have been raised about the robustness of their results and their transferability across a broad portfolio of different transport interventions.

The Empirical Evidence on Business Values of Time

Our review of the evidence base indicates conflicts in the implied Business Values of Time both across and within different valuation methodologies. High values from WTP studies conflict with lower values from the Hensher equation. Implied values are seen to vary by distance, mode and circumstance (waiting, walking, delay etc.) and would suggest a broad deviation around the values derived from labour costs via the Cost Savings approach[1].

As far as the most typical formulation of the Hensher equation is concerned, the productive use of time would have an impact on the valuation of travel time savings, particularly for rail and to a lesser extent air, reducing them to varying degrees below the wage rate. However, there are concerns about the robustness of the evidence base and uncertainties surround the extent to which in the long run all time saved is converted to work rather than leisure. This is reflected in mixed findings across different studies.

Similarly, the WTP evidence is not homogeneous. In studies that have compared this approach to the Hensher approach, there is typically a close degree of correspondence between the WTP values and the wage rate with the WTP values somewhat exceeding the Hensher values. WTP studies are either based on revealed preference (inferring valuation of travel time savings from data on actual decisions and behaviour) or stated preference (asking people or employers to make hypothetical choices which imply their valuations).   However, the actual WTP values themselves can vary across geographies and study types; UK studies suggest that WTP estimates conducted using a Revealed Preference approach are broadly equivalent to the wage rate, although the Stated Preference based evidence suggests a somewhat lower value. European evidence indicates WTP values higher than the wage rate as does the evidence relating to high speed rail.

As far as professional drivers are concerned, we have observed no dissent to the appropriateness of the Cost Saving Approach.

The Labour Market

There is some evidence that markets for products and services are imperfect, and that some sections of the labour market are not competitive. In a perfectly competitive labour market one would expect the marginal productivity of labour and the wage rate to be equal. For an uncompetitive labour market this is unlikely to be the case.. There is very little evidence on whether or not they differ, but what does exist appears to suggest observed wages can be used as a proxy for the marginal product of labour and therefore supports the application of the CSA. Nonetheless, further research is needed in this area.

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[1] Comparisons to the CSA valuations of WebTAG are made throughout this report. The values are for the existing August 2012 guidance and not the 2013 update.

Future Options

On the basis of our review, there are a number of possibilities going forward from which the Department can choose. These are:

- Do Nothing and retain the Cost Saving Approach in its current format
- Update the Cost Saving Approach – maintaining the principle of the Cost Saving Approach but refreshing the input data
- Adopt the Hensher equation using the review of evidence here provided
- Adopt a WTP based approach using the large amount of evidence here provided
- Adopt the Hensher equation but with fresh empirical evidence to support it
- Adopt a WTP based approach but with fresh evidence based on:
    Employer WTP based upon SP and supplemented with RP
    Employee RP and SP
- Triangulation of Various Approaches

Applying the Empirical Evidence to Transport Appraisals

The timescale for producing the fresh empirical evidence which underpins some of the Future Options (options 5-7) is twelve months at least, involving significant resources, with implementation taking somewhat longer. Adopting existing evidence (such as options 1-4) would be possible within a shorter timeframe and would have a lower resource cost attached but would not necessarily provide a consistent answer. Clearly, the lead time in incorporating any new evidence in Departmental guidance would add a significant amount of time to these timescales. Nonetheless, it is prudent to consider how robust the case for various interventions is to a range of different values of travel time savings on the basis of alternative theoretical and empirical methods.

We have used our review of the evidence to provide, on the basis of the Hensher and WTP approaches, a range of values of time that can serve as sensitivities around the currently recommended values for briefcase travellers. These extend to cover crowding and out-of-vehicle time.

In Conclusion

It is clear that there is no consensus on the theoretical underpinnings of the business value of time. Whilst the Cost Saving Approach dominates international appraisal practice, several practitioners have reservations about its theoretical underpinnings. All in all, it is not simply a matter of stating that people work while travelling and hence the Cost Saving Approach produces inflated values, because it is the work that would have been done in the saved time, and not on average, that is pertinent. A range of other issues are potentially relevant, such as the value of more time at the destination, the avoidance of long days, relative productivity at work and while travelling, and possible premium valuations of walk and wait time.

Nor is the empirical evidence clear. We are not aware of detailed research that has aimed to determine how companies value the time saving benefits of their employees whilst not only do different approaches yield differing values there is also variation in values within particular approaches.

This uncertainty was reflected in the opinions expressed by experts in the field at the seminar we held in November 2012. There were strong advocates of the Hensher approach whilst others favoured WTP methods. Of the latter, some supported RP methods whilst others felt SP provided the best way forward. Of course, in the spirit of the first British study in this area, triangulation represents another alternative approach, involving a number of methods compared in a tightly controlled experiment, and such a suggestion received some support.

GLOSSARY OF TERMS

CSA	Cost Saving Approach
MCS	Modified Cost Saving approach; a version of the full Hensher equation that does not account for all its terms
Restricted Hensher	A version of the Hensher equation that does not account for all its terms; terminology sometimes used interchangeably with MCS
w	The wage rate
c	Non-labour cost of employing a unit of labour
p	The proportion of business travel time saved that is at the expense of work done while travelling
p^*	The proportion of business travel time that is productive
q	The relative productivity of work done while travelling relative to at the workplace
r	The proportion of business travel time saved that is used for leisure
r^*	The proportion of business travel time that takes place in leisure time
MPF	The value of extra output due to reduced (travel) fatigue
MPL	Monetary value of the marginal product of labour
VBTTS	Value of Business Travel Time Savings
VTTS	Value of (non-work) Travel Time Savings
VL	The value to business travellers of time savings that accrue to them
VW	The value to the employee of work time at the workplace relative to travel time

1. INTRODUCTION

1.1 Objectives

The objectives of this study were clearly specified in the Request for Proposal as:

> "*The Department wishes to investigate the feasibility of differing approaches to valuing business travel time savings*" and also:

> "*Identifying and assessing the advantages and disadvantages of practically feasible methods for valuing business travel time savings*".

It is <u>not</u> the purpose of this study to provide a recommended approach to valuation but rather to provide an authoritative evidence base to allow the Department to make informed judgements as to the best way forward in the valuation of travel time savings for business travellers.

As will be clear below, the study has aimed to address a wide range of issues regarding the valuation of business travel time savings (VBTTS). However, following from the project inception meeting, the key issues that the Department has asked us to address are:

- Review the existing empirical evidence and appraisal practice in the area, particularly taking an international perspective;

- Identify and assess practically feasible methods for valuing business travel time savings;

- Identify appropriate applications of the existing evidence covering a range of alternative methodologies;

- Describe options for further analytical work in the area.

All modes, distances and relevant valuation methods and approaches are within scope, alongside the option of updating the existing WebTAG approach. The study is not just concerned with 'briefcase' travellers even though this is, for the large part, the focus of recent debate.

1.2 Study Team and Responsibilities

This study has been led by ITS Leeds with valuable collaborations from other leading professionals in the field.

- Professor Mark Wardman led the project and was responsible for the review of the empirical evidence as it relates to briefcase travel. He also led the specification of the future options and discussion of how to apply the evidence review to appraisal.

- Dr Richard Batley developed the theoretical frameworks and has contributed to the economic aspects of business travel time savings.

- Dr James Laird was responsible for the review of international appraisal practice, overview of the business travel market and investigation of labour market issues as they relate to the value of business travel time savings. He also produced the material on updating the input values and disaggregation and contributed to the application of the evidence review.

- Professor Peter Mackie has provided input across the entire project and has acted as a peer reviewer.

- Dr Tony Fowkes provided the material on professional drivers and input to our work on the theoretical aspects. He also contributed to our understanding of previous studies.

- Professor Glenn Lyons, of the Centre for Transport and Society at the University of the West of England, delivered a review of existing evidence on travel time use.

- Dr John Bates provided advice and assistance on numerous matters. He produced the material on consistency between modelling and appraisal and appraisal of modal transfer.

- Professor Jonas Eliasson, of the Centre for Transport Studies at the Royal Institute of Technology (KTH) in Stockholm, contributed to the international aspects of appraisal practice and evidence base and to the investigation of the labour market.

- Dr Steve Gibbons of the London School of Economics provided expert input to our considerations of the labour market.

1.3 Policy Background

The value of travel time savings is one of the most important parameters of transport planning, with a long history of estimation and its application in project appraisal.

It has long been recognised that the valuation of time savings in the course of employer's business might differ from valuation of time savings in private travel. The former is clearly to some extent driven by the benefits to the company on whose behalf the journey is being made whilst the latter is purely a matter of personal preference and willingness to pay.

The current UK procedure, and that adopted in most countries and by international agencies, is to value business travel time savings at labour cost, the so-called Cost Saving Approach (CSA), on the grounds that unproductive travel time when saved can be converted into productive time which has a value equal to the wage rate. This approach has the attraction of simplicity in application, requiring no distinction between different types of travel time (e.g. walking, waiting and in vehicle time) whilst, according to Fowkes et al. (1986), who provided the first and in our understanding only empirical comparison of different valuation methods, also providing a reasonable approximation to more comprehensive and sophisticated approaches.

It is our understanding that the findings of the pioneering Fowkes et al. (1986) study influenced the Department for Transport's retention of the cost saving method in the light of what the first UK national VoT study (MVA et al., 1987) termed the "well-rehearsed" possible shortcomings of the assumptions underpinning the cost saving approach.   The latter stated, in the context of briefcase travellers, that "On the other hand, there are a number of empirical questions which are in principle capable of resolution. For instance, what values of time do individuals travelling in the course of work reveal on the basis of their travel choices. And what use is likely to be made of time savings".

The Cost Savings Approach involves a number of assumptions which, it must be said, have been questioned to various degrees by commentators from very different backgrounds and over many years.   It is therefore refreshing that the Department is recognising these issues[2] and is seeking to identify the best way forward.

An alternative approach, but with a pedigree almost as long as the Cost Saving Approach, is the Hensher (1977) approach, the key features of which are the recognition of time spent working while travelling, whether time saved is returned to work or leisure, the relative productivity of work at the normal workplace to that carried out whilst travelling and the valuation that individuals place on time savings. The DfT Strategy Unit document reviewing value of time assumptions for business travellers on HS2 claims: "it remains the most comprehensive theoretical approach to capturing the various factors that determine the value of business time savings, to both employers and employees".

The main reservations concerning this approach have been the degree of accuracy with which its key parameters can be estimated and whether it does indeed provide an accurate account of the benefit to companies of time saved travelling by their employees as might be reflected in the company's willingness to pay. It has been recognised by many commentators that such a willingness to pay, expressed directly by the company or implicit in the decisions made by business travellers, would

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[2] The Department for Transport's Strategy Unit review of value of time assumptions for business travellers stated that "Simple observation and a range of academic studies confirm that some of the time spent on trains by business travellers is used productively" and "The current approach should therefore be seen as a necessary simplification in the absence of robust evidence to underpin a more sophisticated approach".

provide another suitable basis for valuing business travel time savings. Indeed, there is a wealth of such evidence.

It is timely to revisit the issue of the appropriate basis for the value of business travel time savings, not only because of recent interest in the use of travel time and the pioneering work by Mott McDonald et al. (2009) that has stimulated debate, but also because departures from the pure wage rate approach have been introduced into official valuations in other countries and due to the on-going debates in the UK as to the time saving benefits of high speed rail and more generally whether time spent travelling actually has some positive benefits.

1.4 Scope

We have in the course of this study covered the following issues:

- The theoretical underpinning of the valuation of business travel time savings from first principles. Just as Fowkes et al. (1986) provided the first codification of the Hensher approach, this study provides the most definitive theoretical derivation hitherto.

- International appraisal practice in valuing business travel time savings, identifying cases where alternatives to the traditional Cost Savings Approach are used.

- A comprehensive review of international evidence on the Hensher parameters and on RP and SP evidence relating to willingness to pay for time savings during employer's business trips. This is supplemented with discussion of specific issues, such as evidence relating to high speed rail, investigations into company travel policy and the interpretation of SP based valuations, amongst other things

- Critique of the labour market as it relates to valuing business travel time savings.

- An overview of recent developments in travel time use research and valuing the time of professional drivers.

- Practical issues in implementation, including updating of business values, implications for appraisal of modal transfer and consistency of treatment between modelling and appraisal.

- Identification of the practical options open to the Department over the short term in the absence of any new analytical research

- Specification of Future Options for the Department to evaluate as it addresses the basis of its official recommendations going forward. This covers the use of existing evidence and the conduct of fresh primary research

- On the basis of existing empirical evidence, drawing together some tests that might be applied to official recommendations

- The identification of some avenues of research, over and above those associated with the Future Options, that the Department might like to consider.

We also subjected our thinking to a workshop, held on the afternoon of Friday 9th November 2012 at the Department for Transport, to which experts in the field were invited. This provided a number of useful addition insights, comments and corrections.

1.5 Sources of Evidence and Material Covered

Useful background is provided by giving a flavour of the range and amount of material that has been covered.

- International appraisal practice has covered the 10 European countries where guidance values are provided and also countries outside Europe and international organisations

- Our review of evidence relating to the Hensher parameters has dealt with 10 studies from 7 countries. Most of these were from so-called national value of time studies.

- The review of willingness to pay evidence in the business travel market covers 6 UK RP values, 165 UK SP values, 32 mainland Europe RP values and 81 mainland Europe SP values. To this is added a large amount of evidence on values of walk time, wait time and other attributes.

- Evidence from a large number of Japanese studies is covered whilst we have reviewed 11 high speed rail studies.

- Our examination of existing evidence on travel time use has assembled a set of 66 potentially relevant articles and a close review of around a third of these.

- Examination of various data sets to describe the business travel market and to advise on how best to update (rebase) official values

1.6 Structure of Report

After this introduction, section 2 presents background material in the form of a description of the travel market in Britain and the basis for appraising business travel time savings in the U.K. and elsewhere. It also sets out alternatives to the conventional Cost Saving Approach, considering how in different circumstances the Hensher approach relates to the Cost Saving Approach.   Section 3 presents our review of empirical evidence and the labour market followed by consideration of a range of practical implementation issues in Section 4. The Future Options for the Department to evaluate in taking forward this area are set out in Section 5 along with some other research ideas that we have identified during the study. The final section provides, on the basis of our review evidence, some values of time that can be used as sensitivities around current recommendations.

The main text is supplemented with more detailed annexes. These are:

- Annex 1: Technical Annex of the Hensher Equation
- Annex 2: Current Appraisal Practice
- Annex 3: Review of Evidence on Briefcase Business Travel Time Savings
- Annex 4: Travel Time Use: An Examination of Existing Evidence
- Annex 5: Labour Market Conditions and Implications for the Valuation of Business Travel Time Savings

2. BACKGROUND TO THE VALUATION OF BUSINESS TRAVEL TIME SAVINGS

2.1 Business Travel in Great Britain

For infrastructure projects with the objective of improving accessibility, travel time savings are important, and they typically comprise the majority of the direct benefits of such projects. As business travel time changes are valued per unit on average at more than 4 times non-working time savings (DfT, 2012a), the value of business travel time savings is critical to the economic appraisal of such projects. For example time savings form half of all user benefits for the proposed London to West Midlands high speed rail line, and aggregate business time savings comprise almost three times the aggregate value of non-work time savings (DfT, 2012b Table 10 p42).

For a package of national highway improvements appraised for the Eddington study in 2006, travel time benefits accounted for 72% of all monetised benefits including reliability and wider impacts. Of the time benefits, the breakdown was 20% to freight (LCV and OCV drivers), 34% to car employers business and 46% to non-work car purposes including commuting. So, for that analysis, 39% of the total monetised benefits of the package were accounted for by business travel of all kinds including those by professional drivers. Obviously these proportions might vary significantly between schemes but as a generality we can say that the valuation of business purpose travel time savings is an important issue for national highway as well as rail schemes.

Despite its economic importance business travel (excluding mileage by professional drivers) actually comprises a minority of trips made in Great Britain (GB). 8.5% of all trips made per year within GB and 8.8% of all miles travelled per year[3] are made on employers' business. 12.7% of car driver mileage and 10.7% of rail travel mileage is business travel.. We can also see that there is a great deal of heterogeneity in who makes business related trips and when they are made. Cars and vans dominate the mode of travel for business travellers, as can be seen in Table 2.1.

Most business trips (60%) start within the core of the working day (9am to 5pm), as is apparent Table 2.2, although 21% start before 9am and 18% after 5pm. A greater proportion of business trips start outside the core working day when looking at rail as 33% of business trips start before 9am, and 20% after 5pm.

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[3] NTS 2010 Tables 0409 and 0410 Note that the National Travel Survey excludes professional driver mileage the UK NTS specifically excludes the following types of motorised trips as they are commercial rather than personal travel: trips made specifically to deliver/collect goods in the course of work; trips made by professional drivers or crew in the course of their work; trips made by taxi drivers if they are paid or charge a fare for making a trip; and trips made by professional driving instructors whilst teaching or driving their vehicles in the course of their work.

Table 2.1: Proportion of Domestic Business Trips by Mode (by Distance Travelled and by Trips Made)

	Walk	Bicycle	Car/ van driver	Car/ van pass	Motor -cycle	Other private[1]	Local bus	Rail[2]	Other public[3]	All modes
By distance	0.2%	0.2%	73.0%	8.2%	0.3%	0.6%	0.7%	11.5%	5.3%	100.0%
By trip	6.1%	1.4%	71.6%	7.9%	0.8%	0.5%	4.0%	6.5%	1.3%	100.0%

[1] Mostly private hire bus (including school buses).
[2] Surface rail and London underground.
[3] Non-local bus, taxi/minicab and other public transport (air, ferries, light rail).

Source: NTS 2011 Tables 0409 and 0410

Table 2.2: Start Times of Trips (All Modes and Rail Only)

Start time		All modes	Rail
Before 9am	0000 - 0059	0%	0%
	0100 - 0159	0%	0%
	0200 - 0259	0%	0%
	0300 - 0359	0%	0%
	0400 - 0459	0%	0%
	0500 - 0559	1%	2%
	0600 - 0659	3%	9%
	0700 - 0759	7%	13%
	0800 - 0859	10%	10%
Between 9am and 5pm	0900 - 0959	8%	6%
	1000 - 1059	7%	4%
	1100 - 1159	7%	4%
	1200 - 1259	7%	4%
	1300 - 1359	7%	5%
	1400 - 1459	7%	5%
	1500 - 1559	8%	7%
	1600 - 1659	9%	11%
After 5pm	1700 - 1759	8%	10%
	1800 - 1859	4%	5%
	1900 - 1959	2%	2%
	2000 - 2059	1%	1%
	2100 - 2159	1%	1%
	2200 - 2259	1%	1%
	2300 - 2359	1%	0%
	All day	100	100%

Source: NTS 2011 Table 0503

There also exist differences between the types of workers who make business trips as Table 2.3 shows. Managerial and professional staff not only make more trips per person (averaging at more than 1 per week), but also travel the furthest. Whilst there is no NTS table to show it we would also hypothesise that such workers dominate travel by rail (for business purposes), given the high wages of such travellers (DfT, 2012a) and their propensity to travel further as is apparent in Table 2.3.

We can also see from Table 2.4 that whilst travel is more evenly split between different industrial sectors (compared to occupations), employees in certain industries appear to travel further than others. These are employees in the high value service sector (financial and real estate) and those in construction and agriculture/fishing.

Table 2.3: Business Travel[1] by Socio-economic Classification (All Modes)

NS-SEC	2010
Average number of trips (per employed person per year)	
Managerial and professional occupations	58
Intermediate occupations	38
Routine and manual occupations	20
Never worked and long-term unemployed occupations	2
Not classified[2]	26
All employed people (aged 16+)	**35**
Average distance travelled (miles per employed person per year)	
Managerial and professional occupations	1,516
Intermediate occupations	596
Routine and manual occupations	258
Never worked and long-term unemployed occupations	15
Not classified[3]	463
All employed people (aged 16+)	**729**

[1] Business purpose trip: personal trips in the course of work, including a trip in the course of work back to work. This includes all work trips by people with no usual place of work (e.g. site workers) and those who work at or from home.

[2] Most of the people in the 'not classified' category are full-time students.
Source: NTS2010 Table 0708 (edited)

Table 2.4: Business Travel by Industry (All Modes)

Industry group	2008/09
Average number of trips (per person per year)	
Agriculture and fishing	88
Energy, water, mining etc.	34
Manufacturing	24
Construction	69
Distribution and hotels	16
Transport and communication	25
Financial and real estate	54
Public administration, education and health	50
Other service	57
All people (aged 16+)	**40**
Average distance travelled (miles per person per year)	
Agriculture and fishing	931
Energy, water, mining etc.	786
Manufacturing	717
Construction	1,586
Distribution and hotels	356
Transport and communication	836
Financial and real estate	1,349
Public administration, education and health	597
Other service	761
All people (aged 16+)	**780**

Note: Business purpose trip: personal trips in the course of work, including a trip in the course of work back to work. This includes all work trips by people with no usual place of work (e.g. site workers) and those who work at or from home.

2.2 Overview of Appraisal Practice

The 1960s heralded the first UK applications of social cost benefit analysis to transport projects (Coburn et al., 1960; Foster and Beesley, 1963). By the 1970s transport cost benefit analysis theory had been developed to a satisfactory state of the art and was widely accepted (Dodgson, 1973, 1974; Harrison, 1974; Mohring, 1976; Leitch 1978). In these early studies business travel was valued using what is termed the cost saving approach. Some fifty years later the cost saving approach is still in use in the UK and, in fact, in much of the rest of the world where transport appraisal is actively practised.

The cost saving approach (CSA) is based on the theory that in a competitive labour and product market, firms hire labour to the point at which the value of the marginal product is equal to the wage rate. Thus the value of a unit of time transferred between travelling and working is equal to the marginal gross cost of labour including labour related overheads. To arrive at this conclusion a number of well documented assumptions are made regarding the labour market and the allocation of time between work and leisure (Harrison, 1974). These include:

- Competitive conditions in the goods and labour markets;
- No indivisibilities in the use of time for production, so every minute of time change is equally valuable;
- All released time goes into work not leisure;
- Travel time is 0% productive in terms of work , or more specifically travel time *changes* do not displace work done during travel at the margin;
- The employee's disutility of travel during working hours is equal to their disutility of working—he/she is indifferent between the two activities.

It would be difficult to defend the proposition that each of these assumptions is always and everywhere satisfied. Plainly that is not the case. The issue is whether, taken in the round, the cost saving approach is a reasonable approximation to reality. In fact, the CSA is one of the few components of the appraisal regime which has survived more or less intact over the last forty years. During that time, the CSA has come under scrutiny on a number of occasions and it is worth giving a brief flavour of the reviews.

- In describing the CSA Leitch (1977 para 21.04) accepted the principle behind the Department's method, acknowledged practical difficulties, noted the high sensitivity of appraisal results to the value of working time savings and recommended the Department should keep the values under 'constant review'.

- MVA et al. (1987) stated that the possible shortcomings of the assumptions underpinning the CSA had been "well-rehearsed", that there was a lack of empirical data to deal with the shortcomings and that 'It is for that reason of practicability rather than anything else that

the implicit assumption is made that all working time saving is converted into extra productive employment'.

- Hague Consnulting Group et al. (1999 page 276/7 and Table 132) used a version of the Hensher method and obtained estimates for employer plus employee values of time savings on business trips around 4% higher than the CSA, "a comparable value given the various uncertainties of estimation and definition".

- Mackie et al. (2003) concluded that for professional drivers, the CSA should be retained; for other travellers on employers' business there remains a great deal of uncertainty regarding the true values for the above assumptions and that 'Given this, there is no strong case for abandoning the cost saving approach'.

- DfT (2007) in reviewing the New Approach to Appraisal noted four particular issues related to the valuation of travel time changes of which one was whether travel time can be used productively, particularly on trains. This led to the commissioning of the SPURT project (see below). Another issue was whether the value of travel time savings varies with journey length.

Current appraisal practice as set out in WebTAG, and Unit 3.5.6 in particular, can be briefly summarised as follows. Business travel is defined as travel taking place in the course of work— thus including professional driving or so-called briefcase travel—and excluding commuting. Business travellers are split into nine categories—car driver, other goods vehicle driver, rail passenger and so on. For each category, the annual mileage weighted average gross (pre-tax) income is obtained from the National Travel Survey. To this is added an employee-related overhead mark up to reflect National Insurance, pension costs and other costs to the employer. These annual gross employment costs are then divided by annual hours of work taken from the New Earnings Survey to yield a cost per hour (or per minute) for each category. These are then applied to the modelled journey time changes to obtain the social benefit/cost of those changes.

It should be noted that, unlike non-working time, all components of employers' business time spent on travelling such as walking, waiting and in-vehicle are valued the same--- a minute is a minute. There are several issues arising from the practice as described in this paragraph which are discussed later in the report.

While the official treatment of the valuation of business travel time has unfolded, two sorts of development have taken place in the literature. First, the economic framework for analysis has been codified much more tightly. Secondly, some important empirical studies have been undertaken which inform judgement about the appropriateness of the CSA. We turn to the first of these in the next section while the second is picked up in chapter 3.

2.3 Arguments for Change

From the previous sections, it can be seen that the use of the CSA for valuing business travel time savings, particularly for briefcase travellers, has been the subject of debate. The general flavour of previous work was that the CSA is a relatively simple and practicable basis for appraisal, whilst alternative methods are data-hungry and might not produce significantly different results. Does that mean that what was an acceptable judgement then is acceptable now? There are several respects in which things have changed over the last twenty years which need careful consideration.

First there is the mobile communications revolution including in-car phones and wi-fi enabled trains. There is clear evidence of willingness to pay for such facilities and it might be hypothesised that the usability of travel time for working has risen over time and that this needs to be taken into account.

Secondly, there is the change in economic structure and pattern of work occupations from manufacturing towards the knowledge economy. So a second proposition is that the proportion of business travellers in occupations and roles which enable them to use travel time productively has risen.

Thirdly, there has been a perceptible move to a more flexible working hours environment in which work may take place in or out of the office and not necessarily at 9 to 5. A proposition is that the implicit contract for many middle and senior managers is that long days involving business trips are part of the deal and that this makes it more likely that faster journeys switch time at least partially between travel and leisure rather than between travel and work.

These arguments are presented and evidenced in the time use literature (See Annex 4) and form a significant part of the motivation for the SPURT studies which DfT commissioned in 2008 and also for this scoping study.

2.4 Alternatives to the CSA

2.4.1 Review of Methods

A number of approaches have been adopted in the literature for the valuation of travel time savings in the context of employers' business. We shall categorise these approaches as follows:

- Cost saving
- Hensher
- Willingness-to-pay

In what follows, we shall briefly summarise the theory and intuition behind each of these three approaches.

Cost Saving Approach (CSA)

Standard UK practice is to adopt the 'cost saving' approach. The cost saving approach is also sometimes referred to in the literature as 'wage plus', reflecting the fact that the costs to the employer will typically consist of both direct compensation/reward to the employee (gross of tax), plus additional costs of employing staff. The Department's current methodological position is documented in WebTAG Unit 3.5.6; the key propositions that motivate this approach can be found under point 1.2.3 of this guidance:

> *'Time spent travelling during the working day is a cost to the employer's business. It is assumed that savings in travel time convert non-productive time to productive use and that, in a free labour market, the value of an individual's working time to the economy is reflected in the wage rate paid. This benefit is assumed to be passed into the wider economy and to accrue in some proportion to the producer, the consumer and the employee, depending on market conditions'.*

In practice, a wage plus approach is implemented, whereby the resource cost of time spent travelling in the course of work (i.e. excluding commuting) is calculated as being equal to the gross wage rate plus non-wage labour costs (e.g. national insurance, pensions, etc.), thus:

$$VBTTS = w + c \qquad\qquad (2.1)$$

where:

w is the gross wage

c is non-wage labour costs.

The gross wage rate is calculated for a range of segments (namely car driver, car passenger, LGV (driver or passenger), OGV (driver or passenger), PSV driver, PSV passenger, taxi driver, taxi/minicab passenger, rail passenger, underground passenger, walker, cyclist, and motorcyclist, as well as an overall average), based upon evidence from the 1999 – 2001 National Travel Survey (NTS) and the 2002 New Earnings Survey. An uplift figure of 21.2% is presently applied to reflect non-wage labour costs.

Hensher Approach

The so-called 'Hensher' approach differs from the cost savings approach in that it combines the perspectives of the employer and the employee. Whilst Hensher (1977) is credited with the underlying intuition, a formal statement of the Hensher approach was first presented by Fowkes et al. (1986), as follows:

$$VBTTS = (1 - r - pq)MPL + MPF + (1 - r)VW + rVL \qquad (2.2)$$

where:

>
> r is the proportion of travel time saved[4] that is used for leisure
> p is the proportion of travel time saved that is at the expense of work done while travelling
> q is the relative productivity of work done while travelling relative to at the workplace
> MPL is the monetary value of the marginal product of labour
> MPF is the value of extra output due to reduced (travel) fatigue
> VW is the value to the employee of work time at the workplace relative to travel time
> VL is the value to the employee of leisure time relative to travel time

See Figures 2.1 and 2.2 for an illustration of the Hensher equation.

In Annex 1 of this report, we devote detailed attention to the Hensher equation, with the objective of exposing its underlying assumptions and properties (including any which might be considered restrictive and/or inappropriate). Arising from this exercise, the economic problem underpinning the equation can be summarised as follows:

- The objective statement is one of **maximising welfare**, where welfare is additive in profit generated by the employer through the sale of output produced, and the utility of the employee, subject to a **time resource constraint**.

- According to the **profit function**, revenue is generated through the sale of goods, and costs are incurred through the employment of labour. Non-wage costs of employing labour are assumed zero (i.e. with reference to (2.1) $c = 0$), and there is no explicit consideration of tax. Both issues can be introduced into the analysis, but with a modest increase in complexity.

- The **production function** depends solely upon the time contributed by the labour input, adjusted for the productivity of the time. Productive time could, conceivably, include not only 'contracted' work time, but also a proportion of leisure time.

- The **utility function** depends upon the consumption of goods, and the quantities of time devoted to work, leisure and work travel, respectively.

- The **time resource constraint** is ostensibly the sum of 'contracted' work and leisure time, but entails three key propositions concerning business travel time, namely that:

---

[4] For simplicity we refer to travel time savings but the intention is to refer equally to changes of both signs. Symmetry is assumed.

- Business travel time may straddle 'contracted' work and leisure time (hence the *r* term)
- Business travel time may - to some extent - be unproductive (hence the *p* and *q* terms)
- Although business travel time may straddle 'contracted' work and leisure time, *p* and *q* remain constant. This gives rise to the implicit assumption that the productivity of business travel is constant, irrespective of whether it is undertaken during 'contracted' work or leisure time.

- In contrast to conventional work-leisure optimisation problems such as Becker (1965) and Oort (1969), an explicit **budget (or cost) constraint** is omitted. This reflects the following considerations:

  - It is assumed that the employer and employee face a common marginal utility of income. On this basis, the labour costs incurred by the employer in the course of production straightforwardly transfer to the wage-related income of the employee.
  - It is assumed that non-wage income to the employee is zero.

Having developed the economic problem in this manner, the Hensher equation (2.2) arises from a distinct focus on the value of *transferring* business travel time (which may be less than fully productive, and potentially overlaps into leisure time) into 'contracted' (and fully productive) work time. This is what we mean by VBTTS in the context of the Hensher equation.

Given these features, the Hensher equation is arguably most applicable to the case of self-employment, and/or some forms of co-operative or barter economy. It is less appropriate for economies that embody some degree of wage bargaining between employer and employee. That is to say, self-employment would justify:

- The notion of a joint welfare function, combining the perspectives of the employer and employee (who in this case would be one-and-the-same).

- The proposition that labour costs (income) should be represented in either the objective statement or the cost (budget) constraint, but not both.

Willingness-to-Pay Approach

In principle, the willingness-to-pay approach simply involves inviting the relevant economic agents to declare/reveal their WTP for saving journey time in the course of business, i.e.

$$VBTTS = WTP \tag{2.3}$$

where WTP equals the willingness-to-pay to save journey time in the course of business.

On the face of it, the approach is intuitively simple. In principle, it captures all of the relevant benefits of saving travel time, and avoids the complications of estimating the numerous distinct terms of the Hensher equation. In practice however, implementation of the approach encounters several questions and challenges. The most fundamental question is that of identifying the relevant economic agent(s) to survey – should it be the employer or employee? Theory suggests that, in this context, the employer's interests predominate, since it is the employer who decides how many labour units to employ, and how to utilise those units. Indeed, it is sometimes argued that, provided business travel time and work are explicitly linked (in the form of overtime for any travel encroaching upon leisure) then, apart from a tax adjustment, all costs or benefits will fall ultimately on the employer. We shall examine this proposition subsequently.

It is notable that, despite the intuitive attraction of the WTP approach, comprehensive applications have been few and far between; indeed, despite its age, the Fowkes et al. (1986) study is still frequently cited as an exemplar. Moreover, the WTP approach does not - to the best of our knowledge - form the basis of official national guidance in any country.

2.4.2   *Reconciling the CSA and Hensher Methods*

Although the typology of methods which we have introduced in the previous section is well-established, it is important to acknowledge that the methods are not as distinct as they might seem. In particular, the Hensher method can be rationalised as an expanded version of the CSA which relaxes the assumption of the CSA that p and r are zero. Otherwise it retains the same features. Specifically, MPL (and MPF) need to be valued. If MPL is proxied by the gross employment cost per unit time, $w+c$, we are relying on competitive labour markets and the assumption of full employment for our benefit estimates. Importantly, (2.2) also relies on the assumption of complete fungibility of time within activities or weaker assumptions which yield equivalent results. It is sometimes asserted that the MPL and MPF terms in (2.2) represent the benefit to the employer, and that the VW and VL terms the benefit to the employee. It would be more accurate to say that in a competitive environment the first two terms refer to the benefit to the economic system, since the proximate gain to the employer will be passed through into lower prices. In practice, the distribution of benefit from VW will depend on the characteristics of the wage payment system as shown in section 3.2.

Equation (2.2) is not explicit about the tax regime. We think it would be consistent with Green Book and WebTAG principles if MPL proxied by $w+c$ is valued gross of tax whilst the remaining terms are interpreted as accruing to the individual and are valued net of tax since they rely on lambda, the marginal utility of net income.

It is useful at this point to consider a few examples of business travel stereotypes within the Hensher framework and to relate them to the CSA benchmark which says that $VBTTS=w+c$.

Case 1: The Professional Driver

In this case, we hypothesise that a reduction in expected journey time between A and B is monitored by the firm and triggers a change in the schedule. Labour is either used to help expand firm output or is released into the market and rehired at the going market wage rate. In this case, *p* and *r* can both be taken to be zero. Since travelling and working are the same activity, *MPF* and *VW* are assumed zero. In this case, the Hensher equation collapses to the CSA benchmark, i.e. **VBTTS=w+c.**

Case 2: 'Have laptop, hands free etc and can do most work activities while travelling'

In this case, *p*>0, so **VBTTS<w+c.**

Case 3: 'I can do work tasks while travelling but my employer would get more value out of me back at base'

In this case *p*>0 and *q*<1, so **VBTTS<w+c but by less than Case 2.**

Case 4: 'A faster journey simply enables me to get home earlier. My productivity is not monitored.'

Travel time does not displace work at all, and travel time savings go into leisure. In this case *r*=1 and only *VL* is relevant. Normal expectation would be **VBTTS<w+c.**

Case 5: 'As Case 4 but my employer and I place high value on avoiding extended days because this affects productivity and morale/commitment long term.'

In this case time ceases to be fully fungible because of diurnal constraints, work/life balance considerations etc. The value of an extra half an hour in bed at 6am or of getting home in time to see the children is higher than the general value of *VL*. So in this case *r*>0 and *MPF*>0. **VBTTS could equal or exceed w+c.**

Case 6: 'A faster journey enables me to spend more time at the destination transacting business of exceptional value to my employer.'

In the Hensher model, it is assumed that the MPL is constant at all relevant times and locations. But in this case, scheduling constraints exist which mean this assumption is invalidated. Where a travel time saving enables a scheduling constraint to be overcome, there is the potential for **VBTTS>w+c.**

These cases have been presented as 'straw men', changing one component of (2.2) at a time. In reality various combinations are to be expected. Also there are issues about short run and long run. For example, if in Case 4 work becomes more or less onerous over time, is this ultimately a trigger for a change in the work task or in the wage bargain? Does the individual perceive *r*=1 as a short term phenomenon while in the longer run *r* reverts to zero?

Estimating the full Hensher expression is quite onerous, involving finding values for half a dozen terms in addition to relying on the same assumption as the CSA namely *MPL=w+c*. As a consequence, very few attempts have been made to estimate (2.2) during the quarter century of its existence and more restricted versions have been adopted. In all cases, *MPF* has been ignored, but different assumptions have been made about *VL* and *VW*, namely:

$$VBTTS = (1 - r - pq)w + rVL$$
(2.4a)

This assumes that *VW*, the relative disutility of working and travelling, is zero. This certainly makes the problem more tractable. In many cases assuming *MPF* and *VW* to be zero may be acceptable, but the assumption should not be forgotten or glossed over.

Alternatively:

$$VBTTS = (1 - r - pq)w + VP$$
(2.4b)

where *VP* is the **average** value of time for the employee, assumed to make allowance for whether the saved time would be returned to work or leisure. This approach was used by Algers *et al* (1996) and in Hague Consulting Group et al. (1999). In subsequent sections of this report we will refer to (2.4a), (2.4b) and other similar formulations, which add to the MCS approach but fall short of the full Hensher implementation, as Modified Cost Savings (MCS) approaches.

Overall, the Hensher expression is a framework within which a range of cases can be depicted, some with *VBTTS* less than gross employment costs, others greater. We cannot know from any theoretical reasoning what proportion of the business travel market corresponds to any case typology. This suggests that a combination of theory and evidence is likely to be useful.

Figure 2.1: Schematic Diagram Illustrating Workings of Hensher Equation

SCHEDULING OF ACTIVITIES

Business travel

Business travel time — Business travel time

Effective work & leisure

Effective leisure time — Effective work time — Effective leisure time

Contracted work & leisure

Leisure time, given work contract — Contracted work time — Leisure time, given work contract

0:00   6:00   9:00   12:00   18:00   21:00   24:00

24 HOUR TIME PROFILE
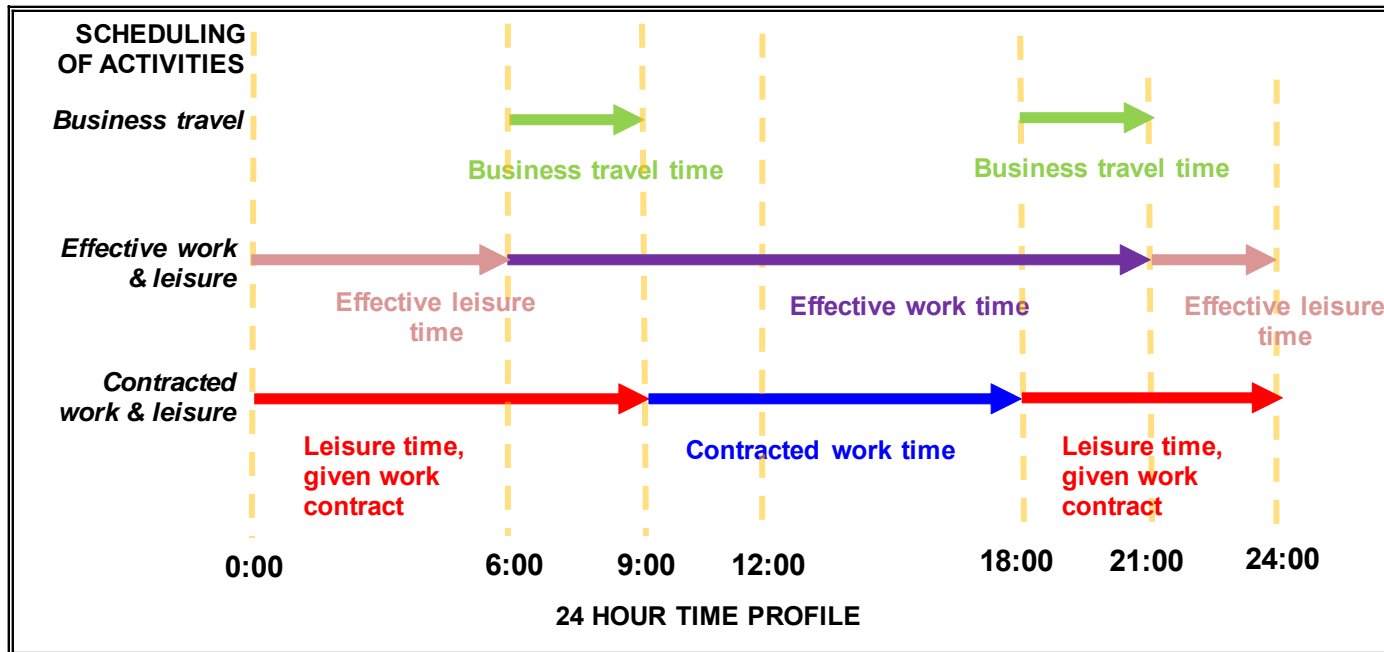
Example:

Consider an employee whose **contracted work time** is 9 hours per day, which is usually scheduled between 9:00 and 18:00. For expositional simplicity, we shall assume that no lunch break is taken (but such breaks could be admitted without substantive complication). Given the work contract of 9 hours, **leisure time** accounts for the residual time of 15 (i.e. 24-9) hours per day.

On a particular working day, the employee is required to travel to London to meet a client. In practice, this entails a 3 hour journey at each end of the day, giving total **business travel time** of 6 hours. Once in London however, the employee is expected to perform the normal contracted work time (e.g. he/she is expected to undertake a full schedule of meetings, thereby maximising the benefit of the journey), such that **effective work time** is 15 hours, and **effective leisure time** is 9 hours.

Since business travel is, in this case, undertaken outside of contracted work time, the proportion of business travel time that takes place in leisure time is 1 (i.e. $r^*=1$).

Figure 2.2: Schematic Diagram Illustrating the Workings of Hensher equation
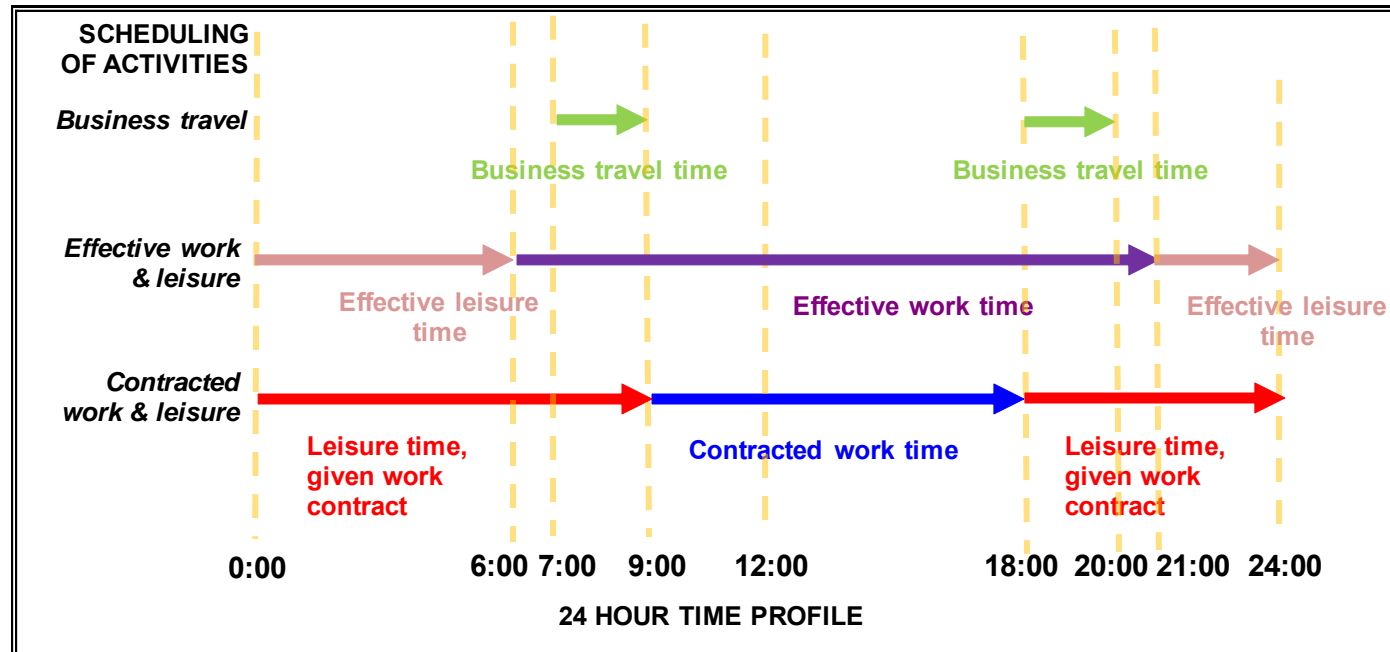
Example:

Now suppose that travel time to London is reduced by 1 hour in each direction.

In terms of the Hensher equation, we are interested in the allocation of the 2 hour saving in total **business travel time**, which could be:

1) Retained for work at home or at the normal workplace, such that **effective work time** is the same as Figure 1 (possibly to the benefit of the employee if working at home or the normal workplace is preferred to travel, and possibly to the benefit of the employer if productivity is enhanced via p^* and q). This is the outcome shown in Figure 2 above.
2) Returned to leisure, such that **effective leisure time** increases by 2 hours, as compared with Figure 1 (again to the benefit of the employee, but to the loss of the employer as productive output is reduced).
3) Split between work and leisure, such that the final outcome is intermediate between 1) and 2).

2.5 International Appraisal Practice

When looking at international appraisal practice it is important to recognise that in many countries no firm guidelines are provided. The requirement on the transport analyst is to use best practice methods. In a 2005 survey of appraisal practice in the EU plus Switzerland, Odgaard, Kelly and Laird (2005) found that 'national guideline values' which are used in almost all appraisal circumstances only exist in 10 of the 27 countries surveyed. Seven of the countries have no guideline values whatsoever and the remaining countries have guideline values but there is no requirement to use them. In fact, for four of the latter group of countries, the guideline values are only rarely used (Odgaard, Kelly and Laird, 2005 Table 5.1).

Looking at the ten EU countries where guideline values are provided and used in almost all circumstances, we find that three different valuation methods for business travel time savings are in use . As shown in Table 2.5 the cost saving approach for valuing business travel time savings is the most popular method.

Table 2.5: Approaches to Estimating Business Values of Travel Time Savings (for Surveyed Countries/Organisations with Appraisal Guidelines)

Method	Countries	
Cost saving approach	Europe:	Denmark, Finland, France, Germany, Ireland, Norway, UK, European Investment Bank, EC
	Non-Europe:	Australia, New Zealand, USA, World Bank
Modified cost saving/Restricted Hensher	Europe:	Sweden, Netherlands
	Non-Europe:	---
Full Hensher model	Europe:	---
	Non-Europe:	---
Willingness to pay	Europe:	---
	Non-Europe:	---
Other	Europe:	Switzerland
	Non-Europe:	

Source: Odgaard, Kelly and Laird (2005) updated to 2012 and to include Australia, New Zealand, Norway, USA, World Bank and EIB with authors' own work.

Modified cost saving/restricted Hensher models have been estimated in Sweden (Algers, Hugosson and Lindqvist Dillen, 1995), and the Netherlands. (HCG, 1998). Norway used to use an modified cost saving/restricted Hensher method (Ramjerdi et al., 1997), but in 2010 reverted back to using a cost saving approach. Switzerland is unique in that it factors up the non-working time savings value using a value derived from international studies; Bickel *et al.*, 2005 p118). The European Investment Bank (EIB, 2005) and the EC (Bickel et al., 2006) also advocate the cost saving approach.

Outside of Europe we find that the cost saving approach also dominates. In the United States, business values of time are based on wage rates with no mark up for labour related overheads (Belenky, 2011). In Australia the cost saving approach is also used (Austroads, 2011), as it is in New Zealand (Melsom, 2003). In New Zealand, occupations and industries are taken into account when calculating wage and non-wage costs by mode (BCHF, 2002 Chapter 8). The World Bank also advocates the cost saving approach, though wage rates should be adjusted for the shadow price of labour (Mackie, Nellthorp and Laird, 2005 TRN-15). **No country that we have surveyed uses either a (full) Hensher model or values derived from direct elicitation of willingness to pay by employers.**

The content of appraisal guidelines, whilst interesting, does not necessarily reflect the state of the art in valuation methods. This is because a pragmatic balance between data collection efforts and need often has to be struck during development of the guidelines. Issues of equity also influence the methods adopted and the level of disaggregation in the values.

Furthermore, guidelines also have to be developed for the full spectrum of potential stakeholders, and recognition therefore has to be made in the guidelines for the practical realities of the modelling and evaluation methods that will be employed. There have therefore been a plethora of studies that have examined willingness to pay by business travellers for travel time savings, often with a demand forecasting perspective, that are more sophisticated in their valuation methodology than the cost saving approach (Shires and de Jong, 2009; Abrantes and Wardman, 2011; Hensher, 2011). Where these studies are informative to the question being asked in this study they comprise part of the literature review/meta-analysis reported in Chapter 3.[5].

Patterns and trends in these empirical studies of the value of business travel time savings are presented in Annex 2 of this report. However, given that ultimately we are interested in amending national appraisal guidelines, we briefly examine case study Scandinavian practices and how they have changed over time. This is presented in Figure 2.3.

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[5] The majority of these studies do not compare the stated/revealed willingness to pay against the wage. Fowkes et al. (1986) is one of the few studies that makes this explicit comparison.

Figure 2.3: Valuation of Business Travel Time Savings in Scandinavian Appraisal Guidance

Current practice

Sweden and Norway have used the Hensher formula (or variants of it) since the mid 1990s, but have both recently changed to a (modified) cost savings approach. Denmark has always used a cost savings approach. Sweden changed to a pure cost savings approach in 2008, after using Hensher-type formulas since the early 1990s. As of 2012, a modified cost savings approach is used. Here the VBTTS for train is reduced by 15% to account for productive travel time (see below). Norway changed to a pure cost savings approach in 2010, after using a Hensher-type formula since (at least) 1997. Sweden and Denmark do not differentiate the VBTTS with respect to mode or trip distance, whereas Norway has a higher VBTTS for air trips due to higher average wage rates for air travellers. In Sweden's case, it is acknowledged that the VBTTS should in principle be differentiated with respect to mode and travel distance due to wage rate differences, but the available data have been too unreliable for this.

Principles for "cost savings" calculations

All three countries use the wage rate plus overhead costs as an indicator for marginal labour productivity (MPL). The question whether wages are a good enough approximation of MPL arises regularly, but no specific alternative has been suggested.

Another discussion is how to define overhead costs. Sweden currently uses only indirect labour taxes (social security charges and the so-called "employer tax"), but no other overhead costs, such as costs for office rents, administrative support etc. The Danish and Norwegian practices seem to be the same, although this is not absolutely clear.

Motivations for adopting the modified cost saving approach

In both Sweden and Norway, the crucial argument for abandoning the Hensher-type formula was that in the long run, it was expected that workers would not transfer saved time to leisure, but would instead transfer it to increased work. That is in the Hensher formula r was argued to be zero. The motivation for this has been that spending some time on work-related travel outside normal working hours is part of the agreement between employer and employee. This argument has been supported by the observation that despite substantial increases in travel speeds over several decades, there are no indications that business travellers nowadays spend less of their leisure time on business trips; hence, there seems to be no indication that some of the travel time savings have been converted to leisure time.

The debates in both countries seem to acknowledge that it is not enough to try to measure how a travel time saving would be divided between the employer and employee in the very short-term, such as focusing on a particular trip. The attempts at doing this during the 1990s are hence now viewed as misdirected, and that an understanding of the r parameter needs to be based on the long-run effects.

Neither Denmark nor Norway adjusts the VBTTS for productivity during the trip, although the Norwegian debate acknowledges that this should be done in principle. During the period 2008-2012, Sweden likewise had no productivity adjustment, although this was based on the misunderstanding that consumer surplus could not be calculated when values of time were different on different modes. Once this misunderstanding was corrected, it was decided to adjust for productivity during the trip in the 2012 recommendations. However, the current Swedish recommendation of 15% productivity during train trips is rather arbitrary. During the decision process, two sources were used (Fickling et al. 2008; Lyons et al. 2007). The 15% productivity figure does not directly relate to either of these studies and is the outcome of a judgement that p in the Hensher equation probably lies between 0 and 0.3 for rail travellers.

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3. REVIEW OF EMPIRICAL EVIDENCE ON BUSINESS TRAVEL TIME SAVINGS

This section provides a summary review of the empirical evidence relating to the value of business travel time savings. It is supplemented with Annexes 3, 4 and 5 which provide more detail. The evidence we review relates to:

- Briefcase Travellers (in section 3.1);
- Professional Drivers (in section 3.2);
- The Labour Market (in section 3.3).

People using the transport system for employer's business purposes fall into various loose and overlapping categories. At one end of the spectrum is the person travelling on behalf of his employer to a business meeting inside or outside the firm, or to meet a client or secure a contract. Travel is purely a means to an end and the traveller may be able to work or think during the journey. These people are frequently labelled briefcase travellers. At the other end of the spectrum are professional drivers. Their prime task is to drive the vehicle to its destination, load or unload and document receipt of the goods. For them, work is travel. In between we have the categories of travelling salesmen, service engineers and others for whom travel is an essential input to their job. These people may be able to undertake limited tasks while travelling, for example calling ahead to check the customer is at home or the part is available etc, but their main work task is at the locations they visit. We discuss this intermediate category in section 3.2 below.

3.1 Briefcase Travellers

3.1.1 Introduction

This section is concerned with reviewing existing evidence, whether UK or elsewhere, regarding the value of business travel time savings for so-called briefcase travellers, that is, those who are travelling as part of their job but who are not professional drivers. Hence such briefcase travellers might be attending a meeting with a client, collaborator or at a branch office, attending a seminar or making a delivery. We are particularly concerned with how the evidence fits with various theories and practices regarding the valuation of business time savings, along with evidence on parameters that can be used to deduce valuations and methodologies for estimation. This review of briefcase traveller empirical evidence has four themes:

- Review of evidence relating to the Hensher equation, set out in section 2.4.2, and the implications that adopting this approach would have for appraisal;
- Review of willingness to pay (WTP) evidence;

- Specific key insights and issues raised across numerous studies
- Summary of findings and recommendations for appraisal and research

More detail is provided in Annex 3, which summarises 20 British studies and a dozen international studies that provide evidence relevant to the valuation of business travel time savings, supplemented by data sets assembled for meta-analysis purposes which cover many additional studies.

3.1.2 Review of Hensher Equation Evidence

The Hensher equation has considerable intuitive appeal but has found only limited use in official appraisal practice. As Table 2.5 shows, it is only currently used in a restricted form in official recommendations in the Netherlands and Sweden and it has been used in Norway. In the UK it was investigated in 1986, but found to give valuations closely spread around the traditional cost savings approach value, depending on the assumptions made (Fowkes et al., 1986). Since the evidence base for such assumptions was meagre, the study recommended that the cost savings approach should continue for official appraisal forecasts, a conclusion that was accepted by the Department for Transport. That advice was repeated, for road scheme appraisals, by a more recent review for the Department (Fowkes, 2001; Mackie et al, 2003) and again accepted. Nonetheless, there are now a significant number of studies that provide evidence on the parameters of the Hensher equation and which also assess the implications for appraisal of using the approach compared to the conventional cost saving approach.

The Hensher equation has been operationalized in different ways across different studies. We have placed everything on a consistent basis by casting all the appraisal implications in terms of the modified cost savings (MCS) approach specified in section 2.4.2 as:

$$VBTTS = [(1 - r - pq)MPL] + rVL$$

To serve as a reminder here, the key parameters are:

> r is the proportion of travel time saved that is used for leisure (and $r*$ is the proportion of total travel time which occurs in leisure time)
> p is the proportion of travel time saved that is at the expense of work done while travelling (and $p*$ is the average amount of time spent working during a journey)
> q is the productivity of work done while travelling relative to at the workplace
> MPL is the marginal product of labour, as in the cost savings approach[6]
> VL is the value to the employee of leisure time relative to travel time
> [] is the portion of VBTTS that is associated with the employer, the remainder is associated with the employee.

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[6] This is here taken as the wage rate plus labour related costs

Ten studies provide evidence on the Hensher parameters (Hensher, 1977 [Australia]; Fowkes et al., 1986 [UK] ; Algers et al., 1995 [Sweden]; Hague Consulting Group, 1990, 1998 [Netherlands]; Ramjerdi et al., 1997 [Norway]; Hague Consulting Group et al., 1999 [UK]; Beca Carter Hollings and Ferner et al., 2002 [New Zealand]; VSS, 2009 [Switzerland] and Mott Macdonald et al., 2009 [UK]), and all but three (Hensher, 1977; Beca Carter Hollings and Ferner et al., 2002; VSS, 2009) estimated VL rather than rely on private leisure values from elsewhere.

In general, it is p^* rather than p that has been used in studies[7]. Fowkes et al. (1986) speculated that p will be considerably less than p^* and in the two studies where both figures were collected this turned out to be the case. A notable feature of the literature has been that there is little attempt to provide a detailed account let alone a quantitative explanation of how p, q and r vary across studies. The exceptions here are the UK 1994 value of time study (Accent et al., 1999) and the Mott MacDonald et al., 2009) Study into the Productive Use of Rail Time (SPURT) where one-way tabulations of p, q and r were provided.

Generally, there is little comparison of the Hensher equation with other methodologies. One study (Fowkes et al., 1986) compared it with the cost savings approach, an employers' (SP) valuation, an employees' SP valuation (as part of the Hensher equation) and an employees' RP valuation whilst Hensher (1977) compared it with an employers' (SP) valuation and Algers et al. (1995) compared it with the findings of an employee SP exercise where respondents were instructed to follow company guidelines and policy. Of course, since MPL (gross wage rate) enters the Hensher equation then it is always possible to compare its outcome with the conventional cost savings approach.

It is worth reporting here in detail the Fowkes et al. (1986) findings not only because of this study's uniqueness in comparing different methods but also because of the impact of this pioneering study on UK government policy. Table 3.1 below sets out the values of time from the different methods considered in that study.   Note that the Hensher results sometimes exceed the cost savings approach, due to the MPL used in the former being greater than 'gross wage rate plus'.

Table 3.1: Fowkes et al. (1986) UK Business VoT Study (£/hr 1985 prices)

Method	Car	Rail	Air
Cost Savings Approach	10.3	9.8	11.9
Employers' Stated Preference[1]	12.0	12.0	12.0
Revealed Preference	14.1	12.6	11.5
Synthetic (Hensher)			
$r = r^*$ $p = 0$	10.4	10.1	10.0
$r = r^*$ $p = p^*$	10.1	7.7	8.3

The results do show a reasonably high degree of similarity across methods. Fowkes (2001) stated that, "it is easy to see why [Table 3.1] was not thought to give any great support to calls for a move

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[7] The precise questions asked are contained in Annex 3.

away from the current approach towards use of the Hensher formula". It is our understanding that its findings influenced the Department for Transport's retention of the cost saving method in the light of possible shortcomings of the assumptions underpinning the cost saving approach.   The latter went on to state in the context of briefcase travellers, "On the other hand, there are a number of empirical questions which are in principle capable of resolution. For instance, what values of time do individuals travelling in the course of work reveal on the basis of their travel choices. And what use is likely to be made of time savings".

SPURT (Mott MacDonald et al., 2009) reported that around 80% of rail business travellers in Spring 2008 were now working during a train journey, with 82% working on the outward leg and 77% on the return journey. This is contrasted with an estimate of 52% from what they term the "last comparable data set" of the National Passenger Survey (NPS) of 2004, and is facilitated by more power points on trains and more Wi-Fi connectivity. This was over a period of only 3½ years and is therefore a large increase. Although not undertaken on a comparable basis, since the NPS did not reveal the actual amount of time spent working, it was estimated that 30% of journey time was spent working in 2004 increasing to reported levels of 57% in 2008. The Dutch studies have also witnessed an increase in $p*$ over time for rail.

A novel feature of this study is in providing insights into how p, q and r varied across rail travellers. Although the vast majority of the data covers trips of less than 90 minutes, it is interesting to observe how the various parameters vary with journey length. These are set out in the summary table below, along with some variations by journey duration identified in the UK 1994 VoT study (HCG et al., 1999).

Both p and q (and $p*$) might be expected to be influenced by crowding levels. As far as we are aware, this study provides the first and only insights into how crowding impacts on the Hensher parameters, although there is a considerable amount of evidence on how crowding impacts on valuations of travel time (Wardman and Whelan, 2011). Unfortunately though, and similarly to the examination of distance effects, the analysis of the crowding issues was hindered by small samples in the more crowded categories. However, business travellers may well take measures to avoid the problems of crowding by booking seats, travelling first class or taking less crowded trains.

It was only at load factors over 90% with some standing that the study identified that relative productivity was impacted. At that level q falls from around 1 to around 0.9. We can only speculate that it would be very much lower when standing is involved but further research is required on this issue.

Even if we accept that q does not vary greatly with load factor providing it is possible to be seated, we would expect the ability (or indeed willingness) to work during the journey to fall with the load factor. The results with regard to crowding and productivity are not conclusive, but it appears that at 75%-90% load factor 50% of the journey was spent working (i.e. $p* = 0.5$). At load factors over 90% (without standing) it was 38%. In the absence of better information, we take this as 60% of the

time spent working at 70% load factor, 50% of the time spent working at 80% load factor, 40% at 90% load factor and 30% at 100% load factor. Taking $p*$ to be unaffected up to 70% load factor, would indicate ratios applied to p of 0.83 at 80% load factor, 0.67 at 90% and 0.50 at 100%.

For passengers who are forced to stand, the SPURT evidence denotes that $p*$ might be halved. We take this as 0.25, being 50% of that achieved seated at 100% load factor

Drawing firm results from what is the only evidence of its kind is not easy, and in part this is due to limited variations in crowding levels. The study itself stated that, "the conclusion remains that work activity is affected by whether one can sit all the time or not, but further insights are desirable" and "the effect of crowding, and/or seating availability, needs therefore to be explored further".

It is useful to summarise the evidence relating to p, $p*$, q, r and $r*$, not least because it can be expected to vary across modes, distance and over time. This is done in the Table 3.2 below.

We observe in the two instances where both p and $p*$ are estimated (NZ, SPURT) that p is less than $p*$, as expected. In general, it is $p*$ that has been estimated, and for car it is generally low to the extent that it could be claimed that the productive use of travel time saved is not an issue. The New Zealand and Norwegian studies find $p*$ to fall with distance for car, although there is no effect in the results reported for the UK VoT study. The figures for air, with the exception of the very first study, indicate that little productive use is made of time and the same is generally true of bus. These findings are not surprising.

This clearly is not the case for rail where the p and $p*$ values tend to be substantial. Inspection of the Netherlands' figures indicates that $p*$ might have been increasing over time, as might be expected, and this is evident from comparing the two $p*$ values for UK rail. There is also evidence from the UK that p for rail falls with distance which is backed up in the Norwegian $p*$ figures although not the Swedish.

As for q, the evidence strongly supports a value around 1. The noticeable exception is Norway and it is not clear why these figures are so low.

The r figures are invariably large. On average, air has the highest values and this is presumably because these longer than average journeys tend to be more often made out of normal office hours. This will also explain the distance effects apparent in the UK rail evidence, in Norway for all modes and to a lesser extent the UK car evidence. The figure for car is lowest throughout and is noticeably low for New Zealand where the journeys tend to be relatively short. Presumably car journeys have a greater proportion of journeys, such as for delivery/pickup, where the saved time would simply mean more work time whilst the distances will also tend to be shorter.

Netherlands' evidence suggests an increase in *r* over time for all modes and this is also apparent in UK evidence for rail and car. It may be due to changes in work practices, such as shorter working hours, or increasing reluctance to convert saved time into work time in our ever busy world.

Suggested values of *p*, *q* and *r* on the basis of this evidence are set out in section 3.1.5 below.

Table 3.2: Summary of *p*, *p**, *q*, *r* and *r** Evidence

Study	Year	Mode	*p*	*p**	*q*	*r*	*r**	Comment
Hensher	1977	Air		0.36	0.61		0.55	Domestic journeys and average of out and return
UK Business Travel Study	1986	Car		0.03	1.01		0.32	Long distance travel
		Train		0.20	0.95		0.42	
		Air		0.14	0.99		0.42	
UK VoT Study	1994	Car		0.04	1.02	0.46		
		10-30min		0.03	1.11	0.47		
		31-60min		0.04	1.01	0.41		
		61-121min		0.05	1.00	0.43		
		> 120min		0.05	1.01	0.54		
Netherlands VoT Study	1988	Car		0.02	0.90	0.34		
		Train		0.11	0.89	0.53		
		Bus		0.03	0.93	0.48		
Netherlands VoT Study	1997	Car		0.04	0.90	0.45		
		Train		0.16	0.89	0.63		
		Bus		0.03	0.93	0.65		
Sweden VoT Study	1995	Car		0.14	1.01	0.54		
		Car Self		0.10	1.20	0.66		
		Air		0.13	0.97	0.84		
		Air Self		0.11	1.02	0.85		
		Train Inter		0.28	1.03	0.78		
		Train Self		0.23	1.08	0.75		
		X2000		0.28	1.04	0.79		
		Train Reg		0.18	1.15	0.82		
		Bus Inter		0.13	0.93	0.85		
		Bus Reg		0.17	1.26	0.86		
		Comp Car		0.19	1.11	0.47		
Norway VoT Study	1997	Car Inter		0.03	0.32		0.57	
		Air		0.07	0.28		0.64	
		Train Inter		0.18	0.39		0.72	
		Bus Inter		0.06	0.20		0.74	
		Ferry		0.03	0.19		0.63	
		Car Urban		0.21	0.02		0.39	
		PT Urban		0.30	0.07		0.43	
New Zealand VoT Study	2002	Car	0.03	0.22	0.93	0.28		88% car or van. q averaged 1.07 without capping at 1.
Swiss VoT Study	2003	Car, Rail, Bus	0.64		0.98	0.51		
SPURT	2009	Rail	0.41	0.46	0.97	0.52		
		< 45min	0.60		0.98	0.48		
		45-89min	0.35		0.97	0.51		
		90-149min	0.28		0.98	0.56		
		150min+	0.22		0.96	0.65		

Since the application of the Hensher formula requires the gross wage rate, which in the conventional cost savings approach is taken to be the value of business travel time savings, it is a straightforward matter to determine the implications of the Hensher approach relative to the conventional approach. This is done in the Table 3.3 below for all 10 studies.

Table 3.3: Impact of Modified Cost Saving (MCS) on Cost Saving (MPL) Value of Time

Study	Year	Mode	MPL	MCS	WTP	Comment
Hensher	1977	Air Dom Air Int	5.10 $/hr 6.64 $/hr	3.47 (68%) 1.99 (30%)	4.36 (86%)	Employer WTP (SP)
UK Business Travel Study	1986	Car Train Air	£10.26/hr £9.84/hr £11.94/hr	10.1 (98%) 7.7 (78%) 8.3 (69%)	14.1 (137%) 12.6 (128%) 11.5 (96%)	Long distance travel. In MCS, $r=r*$ and $p=p*$. WTP is employee RP
UK VoT Study	1994	Car	£18.54/hr	10.7 (58%)		Includes the r weighting on VL absent in original report
Netherlands VoT Study	1988	Car Train Bus	44.69 f/hr 36.52 f/hr 28.46 f/hr	37.6 (84%) 23.1 (63%) 17.2 (60%)		$p*$. Includes the r weighting on VL absent in original report
Netherlands VoT Study	1997	Car Train Bus	50.97 f/hr 51.41 f/hr 37.57 f/hr	37.0 (73%) 23.8 (46%) 19.7 (52%)		$p*$. Includes the r weighting on VL absent in original report
Sweden VoT Study	1995	Car Car Self Air Air Self Train Inter Train Self X2000 Train Reg Bus Inter Bus Reg Comp Car	195 SEK/hr 138 SEK/hr 207 SEK/hr 184 SEK/hr 171 SEK/hr 178 SEK/hr 181 SEK/hr 160 SEK/hr 128 SEK/hr 129 SEK/hr 189 SEK/hr	118 (60%) 99 (72%) 107 (51%) 108 (59%) 70 (41%) 77 (43%) 75 (41%) 62 (38%) 87 (68%) 59 (46%) 110 (58%)	150 (77%) 223 (108%) 201 (118%) 201 (111%)	For consistency, we have here recalculated the figures using the original q values, setting VW to zero and weighting VL by r. WTP is an employee SP "according to company guidelines and rules".
Norway VoT Study	1997	Car Inter Air Train Inter Bus Inter Ferry Car Urban PT Urban	185 NOK/hr 201 NOK/hr 153 NOK/hr 132 NOK/hr 161 NOK/hr 170 NOK/hr 131 NOK/hr	181 (98%) 267 (133%) 116 (76%) 75 (57%) 130 (81%) 137 (81%) 106 (81%)		
New Zealand VoT Study	2002	Car PT	23.4 $/hr 21.2 $/hr	19.2 (82%) 16.1 (76%)		VL is leisure value. Values km weighted except PT
Swiss VoT Study	2003	Car, Rail, Bus	66.5 CHF/hr	21.4 (32%)		$p*$ used
SPURT	2009	Rail	39.09 £/hr	13.76 (35%)		Include the r weighting on VL absent in original report

Note: Figures in brackets represent the MCS and the WTP figures as a proportion of MPL

Recall that we have placed everything on a consistent basis, weighting the employee's valuation (VL) of transferring time to leisure by the proportion (r) that time saved accrues to the traveller. We take MPF to be zero, as is customary, and VW to indicate indifference between working while travelling and working in the normal workplace. Note though that we are often using p^* not p.

Table 3.4: Comparison of Valuations

	Year	Mode	SP VL v MPL	VL v Private VoT	Comment
UK Business Travel Study	1986	Car	0.68		Strong income effects in VL.
		Rail	0.71		Long distance travel.
		Air	0.59		
Netherlands VoT Study	1988	Car	0.47	1.91 – 2.44	Uncongested and congested
		Train	0.38	1.75	car time
		Bus/Tram	0.39	1.83	
Netherlands VoT Study	1997	Car	0.47	2.39	
		Train	0.37	2.14	
		Bus/Tram	0.31	1.35	
UK VoT Study	1994	Car	0.21	1.72	
Sweden VoT Study	1995	Car	0.53	1.28	
		Air	0.57	1.34	
		Train Inter	0.61	1.41	
		X2000	0.63	1.11	
		Train Reg	0.50	1.14	
		Bus Inter	0.77	1.51	
		Bus Reg	0.62	1.60	
Norway VoT Study	1997	Car Inter	1.00	2.15	
		Air	1.56	2.02	
		Train Inter	0.77	2.19	
		Bus Inter	0.45	1.23	
		Ferry	0.63	1.23	
		Car Urban	0.51	2.23	
		PT Urban	0.61	2.76	
SPURT	2009	Rail	0.46	-	

Note: The two columns of figures respectively denote the ratio of VL to MPL and the ratio of VL to the private value of time.

It can be seen that the modified cost saving (MCS) valuations are generally somewhat less than the MPL. The effect is largest for rail, given that p^* tends to be large, and for longer distances where r tends to be larger. Note however that the impact would be less if p rather than p^* were used. In section 6, we report on sensitivity analysis of the impact of different Hensher parameters on the resulting value of time in relation to MPL.

Most of the studies covered estimated VL[8], the valuation of time saved during a business trip that is converted to leisure, and they also provide direct estimates of the value of time saved on leisure trips. We would expect VL to be less than the wage rate and as can be seen below this is almost

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[8] Those that did not use the value of time for non-work trips

always the case although with a large spread. We would also expect VL to exceed the private value of time for leisure on the grounds that business travellers have above average incomes. Again this is apparent in the Table 3.4 and again there is quite a spread in the ratios.

The final summary table, covering much less evidence than the above tables, is a comparison of WTP evidence both from the employer and from the employee where these might be taken to proxy company values. These are either RP evidence or SP results where the respondent has been instructed to follow company guidelines. There have been, as far as we are aware, only three studies that covered both the Hensher and WTP approaches.

A clear pattern of results is apparent in Table 3.5. The WTP evidence roughly approximates the values applied in the conventional cost saving approach (MPL), exceeding them in some cases. This contrasts with the relationship between the WTP and MCS valuations, where the former always exceeds the latter and often by a considerable margin.

Table 3.5: Within Study Comparison of WTP and MCS Methods

	Year	Mode	WTP/MPL	WTP/MCS	Comments
Hensher	1977	Air	0.86	1.26	Employer SP
UK Business Travel Study	1986	Car	1.17	1.19	Employer SP
		Rail	1.22	1.56	
		Air	1.01	1.45	
		Car	1.37	1.40	Employee RP
		Rail	1.28	1.64	
		Air	0.96	1.38	
Sweden VoT Study	1995	Car	0.77	1.27	Employee SP "according
		Air	1.08	2.08	to company guidelines
		Train	1.11	2.68	and rules"

Note: The two columns of figures denote the ratio of the WTP value to the level of MPL and the ratio of the WTP value to the value obtained from the MCS.

3.1.3   Review of WTP Evidence

There is a wealth of important evidence relating to willingness to pay (WTP) to save travel time in the course of work, from either RP or SP studies, and the review of this is summarised here, with an emphasis on how it relates to the wage rate. We have covered three separate sets of evidence:

- A data set covering UK and mainland European values of time assembled as part of a recent meta-analysis (Wardman et al., 2012)[9];

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[9] Whilst this data set covers out-of-vehicle time, reliability terms and departure time shifts, it does not cover crowding values. We therefore cover these in the next section.

- Evidence from a recent large scale study in Japan;

- Evidence from high speed rail studies on business travel.

We have at our disposal some large data sets that have been assembled for the purposes of meta-analysis, as detailed in Annex 3. Although business travel represents a relatively small proportion of the records, around 14% of the 3109 monetary values and 9% of the 1389 time multipliers, there is nonetheless sufficient data to support meaningful analysis and to obtain interesting insights.

Our UK data does not include SP studies, as far as we are aware, where the value of time on business travel was explicitly a personal valuation (VL) and covered in the previous section. In the other European studies, personal values have been estimated in order to calculate Hensher type business values. The latter are contained in our data set but can be separately identified.

Our SP values are certainly not explicitly personal values, but are derived from SP exercises offered to those making business trips. We therefore contend that there is a degree of ambiguity as to what they represent. Our impression is that most studies have lacked a degree of rigour in this respect as they do not specify what the respondent should assume in terms of company policy and who pays and who benefits. It would have been a large task to go back to each study and determine this information, and in some cases the studies do not report the questionnaire. The values are therefore dependent upon how respondents interpreted the SP exercises presented to them, although we can presume that company policy has a significant, even if not entire, bearing on RP based valuations.

UK Evidence

The UK values of business travel time in our data set are reported in Table 3.6. These are expressed in 2010 prices and incomes, and an income elasticity of one has been used to allow for income growth over time and put the observations on a comparable basis.

In 2010 prices and incomes, the official UK (WebTAG) transport appraisal values of time for business travel were £33.74 per hour for car drivers and £47.18 per hour for rail travellers.

The average value of time from our dataset based on RP data is £34.7 per hour, which is at the lower end of the official values although admittedly based on only six observations. Of these 6 values, four are inter-urban. The urban values relate to choices between rail and car and the inter-urban choices cover rail, car and air.

Although RP valuations do not necessarily reflect company policy, the results here are more in line with the values used in the cost saving approach than with methods that might reduce such valuations on the grounds of productivity and/or the use to which the saved time is put.

Table 3.6: UK Business Values from Meta-Analysis Data Set (£ per hour, 2010 prices and incomes)

	RP	SP
IVT	34.7 : 9.4 : 6	21.9 : 1.7 : 165
WALK AND WAIT	-	25.1 : 4.1 : 21

Note: Figures are mean : standard deviation of the mean : observations.

Whilst the SP figures are lower than the RP, they are sufficiently high compared with the gross wage rate, taken here to be the WebTAG values, we conclude they must reflect a significant element of company policy (given that the official value of time for leisure purposes is £5.7 per hour and £6.5 per hour for commuting). We return to this issue below when segmenting by mode and distance.

Stated Preference values could be lower than Revealed Preference values because the full company effect has not been taken into account. This might be because of ignorance or else a personal preference to avoid time savings if that would mean work would have to be done elsewhere or overtime payments were reduced. An offsetting effect would be that travel time saved converted to personal leisure time might exert an upwards influence. Another factor is that we might expect SP values to be lower than RP from a methodological perspective. In our most recent meta-analysis of UK values (Abrantes and Wardman, 2011), which is dominated by non-business evidence, the RP values were found to be 22% larger than SP values. This is presumably due to bias in SP responses. If this was also apparent for business travel, then the difference between the RP and SP values would be reduced by 38%. However, this would still indicate that the full effect of company policy based around cost savings would be absent from the SP responses.

Our review has not uncovered any RP based valuations of walk and wait time. The SP values of walk and wait do exceed their corresponding IVT values but the difference is not significant. We return to the time multipliers below.

The SP samples are sufficiently large that we can segment them by both the mode used and the mode to which the value relates and we do this in Table 3.7 below, with the additional segmentation by distance. All these factors potentially provide insights into the relevance of the cost saving approach.

Table 3.7: UK SP Values of IVT Split by Mode and Distance from Meta-Data (£ per Hour)

Car Valued Urban	8.6 : 1.4 : 18	Car User Urban	10.5 : 1.7 : 25
Car Valued Inter Urban	13.0 : 1.5 : 39	Car User Inter Urban	11.8 : 1.2 : 37
Rail Valued Urban	6.5 : 3.03 : 2	Rail User Urban	10.6 : 4.5 : 3
Rail Value Inter Urban	28.3 : 2.9 : 76	Rail User Inter Urban	26.1 : 2.3 : 63
Air Valued	61.6 : 29.0 : 4	Air User	119.7 : 21.4 : 4

Note: Figures are mean : standard deviation of the mean : observations. There would have been more observations in each category except for values often covering a mixture of modes.

Whilst some of the samples are small, there are some clear patterns. Firstly, these SP values are low for urban car and rail. These are more in line with personal values of time. Secondly, whilst the inter-urban car and rail figures are larger, they remain some way off the wage rate figures of £33.74 per hour for car and £47.18 per hour for rail. Thirdly, it is only where the values relate to air (used and valued) that the wage rate is exceeded. This is a small market, with well above average incomes, but it indicates that without these the SP values on average would fall shorter of the wage rate than is apparent in the average SP values previously presented. Finally, and importantly, the findings are inconsistent with other approaches to the business values of time in two important respects:

- This pattern of results provides no justification for lower values for rail as a mode as would generally be implied by the Hensher equation.
- Positive distance effects are apparent, and that for rail is over and above that which would be expected purely on the basis of income; this casts doubt on the cost saving method to business time valuation if not the cost saving values themselves.

Given there have been increased opportunities to use travel time productively, it could be argued that there will be a tendency for the value of time to fall over time, or at least for it to increase by less than the growth in income. In order to determine whether there is any trend apparent, we need to isolate the income effect, since the two will be highly correlated, and again an income elasticity of one is used. Table 3.8 indicates that, overall, there has been a substantial reduction in the value of time between pre 2000 and the later years.

Table 3.8: UK Values by Time Period from Meta-Data (£/hour, 2010 prices and incomes))

	RP	SP
PRE 2000	34.7: 9.4 : 6	25.6 : 2.9 : 91
2000 AFTER	-	17.3: 1.6 : 74

Note: Figures are mean : standard deviation of the mean : observations.

However, we have seen that there are modal and distance effects and it turns out that these are possibly confounding. The earlier time period has a mean distance of 91 kilometres with 52% (59%) rail used (valued) and 24% (24%) car used (valued). The more recent time period has a mean distance of 74 kilometres with 24% (32%) rail used (valued) and 52% (47%) car used (valued). On the basis of the preceding results, we would expect some tendency for values to fall.

We therefore regressed the 171 income adjusted business valuations (in logarithmic form) on the logarithm of distance, a time trend and other key dummy variables. Models with coefficients having t ratios exceeding one are reported in Table 3.9.

Table 3.9: Regression of Adjusted Value on Relevant Variables

	I	II
Intercept	2.171 (6.0)	2.106 (6.3)
Trend	-0.003 (0.4)	-
2000 and after	-	0.047 (0.4)
Log Distance	0.351 (8.2)	0.353 (8.2)
SP1[10]	-0.467 (1.6)	-0.530 (1.9)
SP2	-0.410 (1.3)	-0.483 (1.6)
SP3	-0.747 (2.3)	-0.814 (2.6)
Train User	0.290 (1.7)	0.315 (1.8)
Air User	1.339 (4.4)	1.346 (4.4)
Toll Numeraire	-0.630 (4.1)	-0.646 (4.3)
Adj R^2	0.47	0.47

Note: t ratios in parentheses

Model I contains a time trend which is found to be far from significant, although the distance effect is apparent as are other previously observed effects from user and SP type. There was also an effect apparent from whether the cost coefficient used in the calculation of the valuation was based on sensitivity to toll charges (Toll Numeraire). This would reduce the value of time by around a half, presumably reflecting a protest response. However, we would not expect the toll protest to be a company policy effect. The SP coefficients show such values to be somewhat lower.

Model II replaces the trend with a simple dummy denoting whether the value related to 2000 and after. Its coefficient is also far from significant. In summary, this analysis of the inter-temporal variations in values of time in our meta-data set does not point to trend reductions in valuations over time.

The findings are therefore not consistent with the Hensher equation to the extent it would imply lower values over time, independent of income, as p increases.

Mainland European Evidence

We now turn to evidence in our data set for the rest of Europe. These figures, in Table 3.10, are expressed in € per hour and have also been adjusted using an income elasticity of one. In place of the official business value of time used for the British evidence, the reference case is the average labour cost in each country. We additionally here provide figures for the MCS approach whose valuations enter our data set.

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[10] See Annex 3 for definition of SP1, SP2 and SP3

Table 3.10: Non UK European Values from Meta-Data (€ per hour, 2010 prices and incomes[11])

	RP	SP	MCS
IVT	35.4 : 4.1 : 32	32.3 : 2.8 : 81	40.7 : 4.6 : 14
LABOUR COST – IVT	29.2 : 1.5 : 32	25.0 : 1.3 : 81	35.2 : 1.5 : 14
WALK and WAIT	48.8 : 16.2 : 4	50.5 : 3.8 : 6	-
LABOUR COST – WALK and WAIT	30.8 : 6.3 : 4	34.5 : 2.9 : 6	-

Note: The labour costs reflect the gross costs of employment across all workers and were sourced from Eurostat. The labour costs vary between IVT and walk and wait and between data type because they relate to the specific studies from which the values were obtained. Figures are mean : standard deviation of the mean : observations.

Although the mean RP value of IVT of €35.4 per hour is similar to that for the UK, at £34.7 per hour for broadly similar incomes[12], what we observe for the European values is a much closer degree of correspondence between the RP and SP values. On average the SP values are €32.3 per hour, less than 10% lower than the RP values and hence a difference that could be accounted for by bias in responses rather than any fundamental difference in what the SP values represent.

The European values all, on average, exceed the average labour cost. This is not surprising since business travellers will have salaries higher than average. Nonetheless, it would be difficult to argue on the basis of these findings that the valuations are significantly lower than the gross wage rate.

Given that the labour costs differ little between the walk and wait sample and the IVT sample for the RP valuations, the difference in valuations can be attributed to whether there is a premium valuation of walk and wait time. It turns out that the walk and wait values do attract a premium, and are 38% larger, somewhat less than typically the case for non-business values. The walk and wait time values are significantly different to the IVT values but the SP results are clouded by income differences and hence we return to a more controlled examination of time multiplier below where there are no confounding income effects.

As with the UK evidence, we can segment by mode and distance to obtain further insights. However the RP data does not support detailed segmentation. For the 32 observations of RP values, the mean value for 21 urban trips was €31.7 per hour with a standard error of 4.0. The 11 inter-urban values average €42.6 per hour with a standard error of 8.4. As with the UK data, an income effect might be in operation, and additionally there may be variations across countries, but equally longer trips involve more travel in unsocial hours which companies might be willing to pay more to reduce.

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[11] The exchange rate used was 1 € equals £0.88

[12] RP Business valuations were obtained for Denmark (16%), France (10%), Germany (6%), Greece (6%), Netherlands (28%), Norway (6%), Poland (3%), Portugal (3%), Spain (13%) and Sweden (6%). The mean GDP per capita is €36700 compared to €30120 for the UK. The SP valuations follow a broadly similar pattern and imply a mean GDP per capita of €34987.

Unlike the UK data, there is no support for a distance effect for car valued, and this is also the case looking at car users. The rail samples are small but they do support the findings of the UK studies that rail values increase with distance with air values the highest. Also in line with the UK evidence, the values are in stark contrast to the Hensher equation which would assign relatively low values to rail because of the productive use of time and increased likelihood of travelling out of normal office hours.

Table 3.11: Non-UK Values Split by Mode and Distance from Meta-Data (€ per hour, 2010 prices and incomes)

Car Valued Urban	28.9 : 4.6 : 22	Car User Urban	25.1 : 4.4 : 15
Car Valued Inter	23.9 : 4.3 : 26	Car User Inter	20.5 : 3.4 : 27
Rail Valued Urban	44.8 : 12.3 : 7	Rail User Urban	44.4 : 14.9 : 2
Rail Valued Inter	63.1 : 20.8 : 4	Rail User Inter	42.5 : 20.7 : 2
Air Valued	32.3 : 10.0 : 2	Air User	75.8 : 29. : 3

Note: Figures are mean : standard deviation of the mean : observations.

Time Multipliers

Time multipliers express the value of an attribute of a trip, such as walking to or between stations in equivalent units of in-vehicle time on the basis that people experience greater disutility from such elements of the trip. For example, the walk time multiplier is commonly taken to be two and hence valued at twice the value attached to in-vehicle time.

We now investigate a variety of time multipliers and compare them across data sets and purposes. The RP evidence for business travel is very limited and it is difficult to draw any conclusions although we might conjecture that changing departure times is more important than for the non-business RP evidence, and this might be a function of travelling more in unsocial hours, and perhaps that non-business travellers regard the disutility of congested time more highly.

Across the six observations covering out-of-vehicle time and congested time (set out in Annex 3), the RP values average 1.56 with a standard error of 0.24. In contrast, the 111 RP valuations of the same attributes for non-business average 2.02 with a standard error of 0.09.

Turning to the SP based values in Table 3.12we observe a remarkable degree of consistency between the business and non-business valuations (where the EB values have more than a few observations). This applies for walk time, departure time shift, congested time, headway and access time, whilst the values of the standard deviations of travel time are not that different.

Given the SP values for mainland Europe are broadly in line with the RP values, and that we have argued that the UK values seem to contain some influence of company policy, we therefore conclude that this similarity between business and non-business values is not simply because

business travellers have responded purely in terms of their own preferences but because this is what the company permits because it values it.

Table 3.12: Time Multipliers (All European Evidence)

	RP		ALL SP	
	EB	Non-EB	EB	Non-EB
Walk	0.94 : 0.00 : 1	2.05 : 0.19 : 33	1.62 : 0.28 : 6	1.64 : 0.04 : 300
Wait	1.87 : 0.50 : 2	2.24 : 0.15 : 36	1.32 : 0.45 : 3	1.63 : 0.07 : 95
Search	-	3.06 : 0.92 : 3	2.41 : 0.00 : 1	1.64 : 0.19 : 20
Late	1.75 : 0.00 : 1	4.23 : 1.52 : 4	2.61 : 0.51 : 3	4.32 : 0.51 : 29
Dep Shift	1.21 : 0.34 : 4	0.82 : 0.18 : 4	0.92 : 0.12 : 32	0.99 : 0.06 : 187
Congested	1.32 : 0.35 : 2	1.56 : 0.19 : 6	1.59 : 0.14 : 13	1.57 : 0.08 : 54
Headway	0.40 : 0.15 : 2	0.61 : 0.11 : 22	0.76 : 0.08 : 35	0.72 : 0.03 269
Intch Wait	-	2.03 : 0.31 : 2	1.28 : 0.0 : 1	1.84 : 0.11 : 23
Access	2.04 : 0.00 : 1	1.87 : 0.16 : 36	1.63 : 0.17 : 16	1.61 : 0.08 : 91
Std Dev	-	-	1.11 : 0.30 : 4	0.89 : 0.11 : 41

Note: Figures are mean : standard deviation of the mean : observations.

Recent Japanese Evidence

A major three year value of time study has recently been conducted in Japan, covering RP analysis of motorists' route choices, SP analysis and a meta-analysis of a large number of Japanese values of time. The study did not major on the value of business travel value of time savings but nonetheless it provides some insights.

The RP analysis was based on the 2005 Road Traffic Census and examined motorists' choices between ordinary roads and an alternative that included ordinary roads and a tolled expressway (Kato et al, 2013). Separate models were estimated for business travel, commuting and other.

The large sample sizes, (including over 12000 for business travel) allow for precise estimates of the coefficients, with t ratios of over 25. The value of time per person for business travel of 33.9 Yen per minute is not far off the average wage rate, which at the time was 37.2 Yen per minute, but note that the distance elasticity was estimated to be 0.77 and most evidence was for shorter distance trips which would presumably have somewhat lower values. The commuting and other values were 24.5 Yen per minute and 21.0 Yen per minute respectively, less of a discount than typically seen in Europe.

Kato and Tanishita (2013) report a meta-analysis of 261 Japanese values of time obtained from 68 papers between 1979 and 2003. The business values average 158 Yen per minute in 2000 prices (from 15 observations), contrasting with 40.9 for home to work (from 40 observations) and 55.8 for leisure (from 30 observations). Note that the business values are largely inter-urban and hence a

distance effect may have influenced the results, as implied by the elasticity of 0.77 above, whilst all 15 values were from RP studies[13] which were found to lead to somewhat higher values. Indeed, removing the air studies, with average values of 177 Yen per minute, leaves a very much lower average value of 83 Yen per minute although still very much larger than the then average wage of 30 Yen per minute.

The meta-model itself obtained a very low income elasticity of 0.31 and therefore we do not regard it to be a reliable means of predicting absolute values of time.

SP surveys were conducted in 2010 and based upon motorists' route choices. The results based on a web survey obtained very high values for commuting (87.4) and very low values for business (11.1) which appear quite implausible. The paper based questionnaire obtained more reliable evidence, with a business value of 51.9 Yen per minute, falling to 45.5 when estimated to both RP and SP data combined in a single model. The official business value of time in 2008, based on the wage rate, was 44.0 Yen per minute.

This raft of Japanese evidence would, if anything, support the valuation of business travel time savings in the conventional manner in line with the wage rate.

High Speed Rail Evidence

Whilst this study is not primarily concerned with rail, this aspect of the study relates to briefcase travellers and rail is an important mode for this market segment. Given this, and the fact that high speed rail projects are of interest because they offer large time savings and briefcase travellers are likely to be an important element of any high speed rail economic case, we here review the WTP evidence that relates to high speed rail of which we are aware. This evidence is summarised in Table 3.13 below with more detail provided in Annex 3. It provides for each study the proportion of the wage rate implied by the value (%MPL), the ratio of out-of-vehicle (OVT) and in-vehicle (IVT) time values, the ratio of the business to leisure values, any known specific instructions in the SP exercise and comments providing further detail.

The evidence from this raft of high speed rail studies is that the values derived from the cost saving approach are broadly supported, and a strong case could be made for using a premium valuation at least for this market segment. It would be difficult to make a case in favour of the Hensher approach on the basis of these findings given that the latter would, in contrast, most likely imply values somewhat lower than the wage rate. Having said that, the sort of business travellers involved are likely to be more senior and to be travelling long distances and these would tend to inflate the values although not necessarily their relationship to MPL. The large time savings on offer might also

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[13] 5 are route choice, 8 are mode choice and 1 is destination choice. Air travel is the focus of 3 route choice and all of the mode choice studies and these can be expected to be large values.

have a bearing but the studies provide little insight into how the unit value of time varies with the size of the time saving.

Table 3.13: Summary of High Speed Rail Evidence

Study	%MPL	OVT/IVT	Business/ Leisure	SP Instruction	Comment
Bates (2012)	1.4	1.2-1.4	2.66		Removes log cost of Burge et al. (2010) and easier to interpret.
SDG (2009)	0.8 0.6 0.8 0.7 0.6 0.7	0.88 & 0.45 1.16 & 0.59 0.97 & 0.50 1.21 1.53 1.26	1.57 1.29 1.03 1.20 1.27 2.09	No specific	Air and Rail Users: Rail Air and Rail Users: HSR Air and Rail Users: Air Car Users: Rail Car Users: HSR Car Users: Car Rail MPL value used for air
González-Savignat (2004a)	5.0	0.4	1.49	Unknown	Air Users. Wage rate figure expected to be too low for air users.
González-Savignat (2004b)	1.2 1.1	- -	1.75 1.74	Unknown	Short Long Car Users
Wardman et al. (1992)	1.4	-	-	Consider company policy	Rail user official value used for MPL
Atkins (2002)	1.4 & 1.0[1] 1.2 & 0.8[1] 1.2 & 0.8[1] 1.4 & 1.0[1]	1.08 1.30 1.30 1.08	1.80 2.02 2.02 1.80	No specific	Air Car Rail HSR
Wardman and Murphy (1999)	1.58 3.18	0.73 0.81	2.39 1.82	Consider company policy	Rail Users Air Users Official value for rail users
Halcrow Fox (1998)	1.45	n.a.		No specific	Air users. Rail user valuation used as base
Gunn et al. (1992)	2.49 2.27	- -	- -	No specific	Air Car
Speedrail	1.86 0.74		4.8 1.8	Unknown	Sydney-Canberra Intermediate
Yao and Morikawa (2005)	2.39 2.31	0.77 0.80	2.79 2.69	Unknown	Rail and Air Car and Bus Japanese evidence

Note: [1] First figure is Car MPL denominator and second is rail MPL denominator

3.1.4 Review of Key Insights

Our reviews above have largely covered the p, q and r evidence relating to the Hensher equation and WTP evidence, both with an emphasis on comparison with the conventional cost saving approach. However, this misses some of the other important insights that the reviewed studies provide and these are summarised here. These cover:

- Who pays for the time saving and who benefits
- Self-Employed and Employees
- SP and company policy
- Distance Effects
- Crowding, Comfort and Soft Factors
- RP and SP

Who Pays and Who Benefits?

There is some uncertainty as to what WTP values represent and what the respondent is considering when undertaking an SP exercise. Some might disregard the cost, on the grounds that the company would 'stump-up' for the journey, whilst others might answer as if they were paying themselves. Yet others might try to conform to what they think the company would do and even then they could be wrong.

This uncertainty also to some extent applies in the case of RP evidence and the extent to which implied willingness to pay reflects company and personal preferences. The greatest control in SP exercises occurs when VL is being estimated, but even then the amount of detailed investigation either before the main survey, in the form of exploratory research, or post-SP debriefing, has been somewhat lacking.

The Netherlands 1988 study (Hague Consulting Group, 1990b) found the cost coefficient, denoting sensitivity to cost variation, for public transport business travellers to be 37% lower where the employer reimbursed some or all of the cost even though respondents were told to assume that they would themselves have to pay for all costs directly. It was concluded that, "the results above indicate that this approach has not been entirely successful".

In the 1994 UK VoT study (Hague Consulting Group et al., 1999) instructions to some respondents in the SP exercise about a fixed cost reimbursement had no significant effect on the cost coefficient in the business model whilst those who were reimbursed had a lower cost coefficient by around 20 to 30%. It was concluded that, "Overall, the effect of cost reimbursement is not as strong as one might expect". In distinguishing additionally between whether it was the employer's or the respondent's time, and relative to a base of respondent's time and money, business travellers for whom it was their own time and their employer's money had a 26% higher value of time, reflecting the slight effect above of reimbursement. When it was the employer's time, the value was 11% lower when it was the respondent's money and 11% larger when it was the employer's money. These variations exist despite the valuations supposedly being personal ones.

In a further SP exercise, business travellers were told that they should take into account employer reimbursement when making their choices. It was found that the toll coefficient would not be zero even for those who had the entire toll reimbursed. Similarly, in a study of motorists' route choices between the M6 Toll road and the M6 (Wardman et al., 2008), no specific instructions regarding

reimbursement were given to business travellers but it turned out that those who would be reimbursed the toll had a cost coefficient at most only 30% lower.

These findings add to the evidence from comparing RP and SP business values that there is an element of uncertainty as to what SP business values represent and it is important to collect appropriate supplementary information in order to interpret SP results.

SP and Company Policy

The issue of company policy is one that has challenged those investigating the freight market and to mitigate this issue study interviews with relevant managers in haulage and distribution companies are not uncommon. However, we are only aware of two studies, (Hensher 1977; Fowkes et al., 1986) where there have been attempts to obtain employers' values directly. The attitude to business travellers presented with SP exercises has tended to be quite cavalier. Respondents are often not provided with instructions as to what to assume, with the notable exception of when VL is being estimated, whilst there is no use of 'de-brief' questions investigating what motivated the respondent when making choices. Important questions might include: Do companies have a travel policy and are business travellers aware of it? Do they make choices as agents operating in the best interests of their company? Do they assume that the company will pay 'whatever the cost'? Have they freedom of action or are travel arrangements made on their behalf? The outcomes of their real or hypothetical decision making can be expected to be influenced by these issues.

There has, however, been little detailed examination of company policy in the context of behavioural analysis for value of time estimation. The only detailed study of which we are aware of business travel decision making in the context of company policies and guidelines is that conducted by Accent et al. (1989). Although now more commonplace, the study commenced with qualitative research , in this case with in-depth interviews with company personnel responsible for overseeing corporate travel and booking arrangements as well as on-train interviews with business travellers. Two computer-assisted SP exercises were then conducted with business travellers (as opposed to those responsible for company policy and travel arrangements). The first SP exercise (SP1) offered pairwise choices between two options characterised by ticket type, ticket price and journey time.

<u>After that</u>, a large number of questions were asked about company travel policy, booking arrangements, reimbursement, awareness issues and the impact on actual decision making.

The second SP exercise (SP2) then offered pairwise choices between rail and other modes of travel but in addition to the discussion of travel policy issues (which had <u>not</u> preceded the first SP exercise but <u>did</u> precede the second SP exercise), respondents were now also reminded of business travel policies in the instructions regarding the second SP exercise. This was termed the 'company policy overlay' and had a clear impact as is apparent below. As can be seen from Table 3.14, in all but one case the SP values were lower when there was a greater incentive to account for company policy.

The study concluded that, "In summary, company travel policy (and potential changes in policy) seems to be strongly related to their responses under the hypothetical choice scenarios. In fact, this relationship appears to be stronger than that obtained for more conventional indicators such as income, profession, company size and type, etc" and also that "the differences between the Game 1 and Game 2 results indicate that the overlay effectively brought company policy and cost constraints into the picture".

Table 3.14: Implied Valuations by Company Policy Overlay (£ per hour, 1989 prices and incomes)

	SP1	SP2	SP2/SP1
First Class			
Swindon	31.2	13.8	0.44
Cardiff, Manchester, Newcastle	54.0	16.8	0.31
Standard Class			
Swindon	6.0	9.6	1.60
Cardiff	18.0	13.8	0.77
Manchester	18.0	12.0	0.67
Newcastle	18.0	12.0	0.67

These results can be regarded as a salutary lesson to the many studies since that have taken, for whatever reason, a much less rigorous stance regarding business travel decision making within SP experiments.

In the 1995 Swedish value of time study (Algers et al., 1995), an SP exercise was conducted where employees were explicitly asked to respond as if they were following company guidelines. The values obtained for car, air and rail were 150, 223 and 201 SEK per hour respectively. Relative to the MPL for car, air, inter-urban train and the X2000 train, these form 77%, 108%, 118% and 111% of the MPL respectively, thus very much in line with the values from a cost savings approach and somewhat larger than for the Hensher approach which, for these four alternatives, provided values which were 60%, 51%, 41% and 41% of the wage rate.

The issue of company policy is critical to the willingness to pay approach based around SP data, and is also of relevance to RP approaches. Thus far the evidence presented here has not received the attention it merits.

Self-Employed and Employees

Given the uncertainties surrounding the status of WTP values, a potentially fruitful avenue of research is to compare values for the self-employed with those for employees, on the grounds that in the former case issues surrounding company policy and who pays/benefits are internalised.

Algers et al. (1995) contained a particular focus on self-employed business travellers whose values of time were compared with those obtained from employees. The table below reports the values for self-employed and employed business travellers which can be interpreted as VL since they are private values for those business travellers saving time during a trip but paying themselves. For

completeness, we also report the behavioural values (Behav) bearing in mind company guidelines and policies.

Table 3.15: Self-Employed and Employed Values from Swedish 1995 National VoT Study (SEK/hr)

Income	Car			Inter City Train			Air			X2000 Train		
	Self	VL	Behav	Self	VL	Behav	Self	VL	Behav	Self	VL	Behav
-100	80	81		74	83		89	91		126	90	
101-200	73	94	161	67	97	147	81	106	227	115	104	296
201-300	112	101	182	103	104	166	124	113	258	176	112	336
301-400	138	139	213	128	143	195	154	156	303	218	154	395
401-		144	206		148	189		161	293		159	381

Note: 'Self' denotes self-employed values, VL are personal values for those on business trips and 'Behav' denotes behavioural values based around what company policy and guidelines were perceived to allow.

We note two things. Firstly, that the Self and Emp values are little different. If the self-employed values were driven by the cost saving approach then we would expect then to be larger than the employee private values. It could be that the self-employed have borne in mind the productive use of travel time and the use to which the time saved would be put. The Hensher equation for the self-employed yields SEK per hour values of 99 for car, 77 for inter-city train, 108 for air and 75 for X2000. With the exception of the latter, there is a high degree of correspondence between the self-employed value and the Hensher value. Secondly, the self-employed willingness to pay is far lower than the behavioural values based around what company policy and guidelines would allow.

We can draw two conclusions from these findings. The first point suggests that the cost saving is not the basis for the self-employed values of time. The second point suggests that SP exercises based on perceptions of company policy might deliver inflated values.

González-Savignat (2004a) used SP to examine choices between rail and air between Madrid and Barcelona. For business travellers separate coefficients were reported for the self-employed and employees. It was found that the cost sensitivity was twice as large for the self-employed. These findings are in line with the Swedish findings in implying lower values for the self-employed.

HCG et al. (1999) stratified by whether the business travellers were self-employed. After accounting for income and other socio-economic and trip related factors, their values were 17% lower in an SP exercise in which the instructions were directed at obtaining personal values. This would suggest that those instructions were followed. The final SP exercise stated that they should follow their employer's reimbursement policy and there was here no difference between the self-employed and employees. This is consistent with employees following company policy in line with the self-employed. However, the value of time is low, at around £4.8 per hour, far less than the wage rate would imply.

There is a view[14] that examining the specific market of self-employed business travel might be a fruitful avenue since the individual and the company are one and the same. However, it is important to conduct more detailed analysis aimed at identifying exactly what lies behind the decision making and implied values of self-employed business travellers and the reasons for any differences between their values and the values obtained for employees.

Distance Effects

Karlström and Eliasson (2007) have shown that the business value of time should in fact increase with the generalised cost of the trip, that is, it should increase the longer and more expensive the trip is. This is also borne out by considerable empirical evidence. The intuitive reason is that "expensive" trips are only undertaken if the time spent at the destination is highly valued. They argue that this would explain a substantial part of the observed difference between willingness to pay and the cost saving/Hensher approaches. So far, this result has not affected practice.

There might be other reasons for distance effects, such as the greater likelihood of paying overtime, less time with clients or at meetings, the expense of stopovers, the generally greater inconvenience of travelling early in the morning or late in the evening, and more senior staff generally making the longer distance journeys.

Values of time based on the cost saving and Hensher equation will contain distance effects to the extent that the MPL varies with distance. In addition, the Hensher equation will imply a distance effect in line with variations in p, q and r by distance. We might speculate that p falls with distance, as well as the efficiency of the work done, whilst r will increase as more travel time is spent in own time. These are, of course, offsetting effects

Bates (2012) in re-analysis of the SP data collected for the long distance model[15] obtained an elasticity of Value of Time with respect to distance of 0.9. It is difficult to find this credible since the implied variation in values would be very large; the value of time for a business trip from Newcastle to London would be nearly seven times larger than a trip from Luton to London.

We have seen from inspection of the WTP evidence that a distance effect is apparent. The most recent UK meta-analysis (Abrantes and Wardman, 2011) specifically examined whether the distance elasticities varied by purpose and recovered a figure for business travel of 0.45. Nor do we find this lower elasticity entirely credible. The Newcastle to London business value of time would be 2.62 times higher than a trip from Luton to London and we harbour concerns that this is picking up an income effect which acts to inflate the pure distance effect

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[14] For example, expressed widely at the seminar held as part of this study on 9 November 2012

[15] RAND Europe (2011), Modelling Demand for Long-Distance Travel in Great Britain: Stated preference surveys to support the modelling of demand for high-speed rail, (Peter Burge, Chong Woo Kim, Charlene Rohr), TR-899-DFT, 31st January 2011

We have reported in Table 3.2 variations in *p* and *r* with distance whilst it is an empirical matter whether the MPL varies with distance. These variations will influence the estimated business values of time based on the Hensher equation and the cost savings approach.

Crowding, Comfort and Soft Factors

We have seen that valuations exist for a wide range of time related journey attributes for business travellers. In addition to in-vehicle time, these include walk and wait time, departure time shifts, headway and reliability. However, our meta data set does not cover some important journey aspects such as crowding and interchange, both of which are relevant to rail travel. Nor does it cover a range of what are commonly referred to as soft factors, such as comfort related attributes or en-route facilities.

Crowding levels will impact on the ability to use time productively (*p*) and how productive that time is (*q*). We considered the limited evidence that exists, obtained from the SPURT study (Mott MacDonald et al. 2009a) in section 3.1.2. There is, however, somewhat more evidence for the impact of crowding on the value of time.

SPURT finds a fairly strong effect on VL from crowding above the 75% occupancy level. This is consistent with other crowding evidence that load factor seems to have an effect at this sort of level even prior to standing occurring (Wardman and Whelan, 2011). However, SPURT only examined crowding up to a level of 100% of seats taken and even then it is unclear at that level whether the respondent would have found a seat or would have had to stand. The Passenger Demand Forecasting Handbook (PDFH) provides multipliers for seating time values up to 100% load factor and for seating and standing beyond 100% load factor according to passenger per square metre (ATOC, 2009) but it does not segment by purpose. A study by MVA (2008) that underpins the crowding multipliers in PDFH provided a thorough analysis of crowding but only one of its models distinguishes journey purpose and this was not part of the final recommendations.

Table 3.16: Crowding Multipliers for PDFH and Meta Analysis

Load Factor	Seating Meta	Seating PDFH	Standing Meta	Standing PDFH
60%	1.02	1.00		
80%	1.11	1.03		
100%	1.20	1.07	1.84	1.89[1]
120%	1.29	1.13[2]	2.00	2.01[2]
150%	1.45	1.19[3]	2.27	2.11[3]

Note: [1], [2] and [3] – These are at 0.0 pass/m^2, 0.5 pass/m^2 and 1 pass/m^2.

In a review conducted for the Department for Transport, Wardman and Whelan (2011) cover 20 years' UK evidence and develop a meta-model that provides forecasts of load factor dependent

multipliers for seating and standing for business travel. The implied multipliers for business travel are given below and compared with PDFH. There are some differences for the seating penalties.

Another key variable for business travellers as far as rail is concerned is whether interchange is required. This is widely regarded to be an important factor in determining demand for rail travel. A number of studies have estimated such effects for business travellers (Steer Davies Gleave, 1981; MVA, 1985, 1989, 1991; Wardman and Shires, 2000; Wardman et al., 2001; Burge et al., 2010) with penalties generally being 20 minutes or less[16].

There is also a wealth of evidence that business travellers value comfort-related factors. Much evidence for this is summarised or referenced in PDFH (ATOC, 2009). With regard to car travel, a number of studies have considered attributes other than IVT (HCG et al., 1999; Beca Carter Hollings and Ferner et al., 2002; Wardman et al., 2008).

A key issue here, as before, is whether the valuations and time multipliers obtained for a range of attributes other than IVT for business travellers represent travellers' own personal valuations or include an element of what the company would be prepared to pay. It is only in the case of studies that have estimated such values alongside VL, as with WiFi and crowding in the SPURT study (Mott MacDonald, 2009a) that we can be sure that the valuation relates solely to the individual.

RP versus SP

In general, there are relatively few direct comparisons of values of time obtained from RP and SP models, and this is true also for business travel. When compared across different studies, as in meta-analysis, SP valuations tend to be lower, presumably the result of strategic bias/protest response with regard to cost variations, and Abrantes and Wardman (2011) found the RP values to be 22% larger than SP values. We have already observed that the UK RP values for business travel exceed the SP values and the same is true of the mainland European values.

The UK 1994 VoT study (HCG et al., 1999) and the Dutch 1988 VoT study (Hague Consulting Group, 1990a) both developed RP and SP models for business travel. Whilst the RP values turn out to be higher, the results are clouded by the lack of precision associated with the RP estimates.

Whilst there does seem to be an indication that the SP based business valuations are less than the corresponding RP valuations, it is unclear to what extent this is due to protest response/strategic bias, as might exist with non-business values, or due to SP business valuations not fully representing company valuations.

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[16] Note that the interchange penalties in PDFH are generally somewhat larger but they also account for the absence of premium weighting of interchange time whilst a distance effect has been introduced to offset the generalised journey time (GJT) property that a fixed penalty will have a somewhat lower demand effect for longer distance and hence higher GJT journeys.

3.1.5 Conclusions Regarding Briefcase Traveller Evidence

The evidence we have reviewed does not tell an entirely consistent story. On the one hand, the Hensher equation implies that in some cases, and particularly for rail, significant reductions on the value of time estimated via the traditional cost savings approach. On the other hand, the WTP value of time evidence is more in line with the values of the costs savings approach. Multiplier evidence indicates that some premium should be attached to out-of-vehicle time and crowding.

We have 10 observations from 3 studies that provide both WTP and Hensher equation evidence and in all three cases the WTP value exceeds the Hensher value and on average it is around 50% larger. Within the WTP evidence there is some variation between RP and SP valuations and an element of ambiguity as to the status of these values, particularly for the SP findings.

Summary of Hensher Equation Evidence

There are 10 studies, as far as we are aware, that provide evidence on the Hensher parameters, although this is relatively modest given the significance of business travel to appraisal and relative to the wealth of evidence on private travel.

p Evidence

The *p* evidence often relates to *p**, the average rather than marginal amount of time spent working, and in the two cases where both are reported the former is less than the latter. There is evidence to indicate that *p* falls with distance and, at least for rail, is increasing over time. As might be expected it is somewhat lower for car and air than for rail.

If we were to select a representative figure across all the evidence, then for *p* we would recommend:

- A value of zero for car, given that the *p** figures are very low.
- A figure of 0.10 for air, discounting the relatively high Hensher (1977) figure[17].
- A value of zero for bus travel. Bus has low *p** values which tend to be similar to car when covered in the same study and hence a value of zero seems appropriate. In any event, it is a minor mode for business travel.
- A value of 0.25 for *p** for rail. The picture for rail is mixed. The older evidence, of which there is quite a lot, indicates a figure of around 0.25 for *p**. This might increase over time (but then it is *p** not *p*). We have opted for a figure for *p* of 0.25 overall given that *p* is expected to be less than *p** but upward trends in the average value (*p**) will exert upward

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[17] There may well be unpublished results from airline research that we are unaware of. We might speculate that *p** at least is larger for international trips although the Hensher (1977) evidence in the Annex does not bear this out.

pressure on the marginal value (*p*). On the basis of the overseas evidence we suggest 0.2 for urban trips and 0.3 for inter-urban trips

However, in the context of figures to use in UK appraisal, then those reported by SPURT (Mott MacDonald et al., 2009a) for rail and the 1994 UK Vot Study (Accent et al., 1999) should be considered not just because they are UK specific but also because of the level of detail provided and in particular the variation by distance.

With regard to crowding, we suggest taking *p** to be unaffected up to a 70% load factor, and then to apply the ratios of 0.83 at 80% load factor, 67% at 90% and 50% at 100%. However, this is based on the evidence of a single study. That study also denotes that *p* might be halved for those who have to stand. We take this as 25%, being 50% of that achieved seated at 100% load factor

There is no evidence of how *p* varies under walking and waiting conditions, although a low value could reasonably be expected.

q Evidence

The evidence on *q* strongly supports a value around 1, that is, work while travelling is as productive as work in the normal workplace. This does overlook the possibility that the value of the work done while travelling may be lower than work in the normal workplace which might be an important consideration although currently, limited evidence exists to make an assessment.

At crowding levels above 90% but with passengers able to obtain a seat, there is support for a lower *q* parameter of 0.9. This is, however, based on a very limited evidence base both in terms of studies and context.

There is no evidence on the value of *q* for walking and waiting time but again a low value would appear likely.

r Evidence

The *r* figures are invariably large, and they mainly relate to *r* rather than *r**. Labour market equilibrium considerations would imply these to be short run values. On average, air has the highest figures and this is presumably because these longer than average journeys are more often made outside of normal office hours. This would also explain the distance effects that are apparent.

There is some evidence that *r* is increasing over time across all modes of travel. This may be due to a change in work practices, such as shorter working weeks, or an increasing reluctance to convert saved time into work time. For *r*, and again taking a view across all the evidence, we would recommend (at least in the short term):

- A value of 0.60 for air and rail *r*
- A value of 0.40 for car as an average across a reasonably consistent evidence base

In the UK context, we again recommend that particular thought be given to the evidence presented in the SPURT and 1994 UK VoT Study, for rail and car respectively, both because of their level of detail and direct relevance to the UK.

VL Evidence

The VL evidence suggests, as expected, higher than national average leisure time values, averaging around 75% higher presumably due to income effects. It is also, as expected, less than the MPL, averaging around 60% of the latter.

Summary of WTP Evidence

The UK RP evidence, whilst suggesting values lower than the cost savings approach, is more in line with that technique than with the Hensher equation that implies values somewhat less than MPL. The UK SP evidence provides, as expected, lower values. They are clearly larger than private values but there remains an ambiguity about precisely what they represent. Even accounting for strategic bias as best we can, the UK SP do not lend support to the cost saving approach.

Matters are different for the mainland European evidence where there is a greater degree of consistency between the RP and SP values and the estimated values, on average, exceed the labour cost. Whilst business travellers are expected to have higher salaries than the average, it would be difficult to argue on the basis of these findings that the valuations are significantly lower than the gross wage rate.

The WTP evidence from Japanese studies and from high speed rail studies tends to support the values implied by the cost savings approach as would WTP studies based on employers or on employees who have been instructed to follow company policy and guidelines.

The WTP evidence does not indicate lower values for rail than car, as would be implied by the Hensher equation, and nor is there support for reductions in the value of time over time. However, distance effects do appear to exist and these would seem to be larger than could be accounted for purely by income differentials. If the estimated values correctly reflect the total of employer and employee WTP, then these findings would seem out of line with the Costs Savings Approach values to the extent that the variation with distance is greater than would result from segmenting the Cost Savings Approach with different wage rates by distance.

There is a strong degree of similarity between the out-of-vehicle time multipliers for business and non-business trips. Given that the SP values for mainland Europe are broadly in line with the RP values, and that we have argued that the UK values seem to contain some influence of company

policy, we conclude that this similarity between business and non-business values is not simply because business travellers have responded purely in terms of their own preferences but because there is some company valuation of it. Again this does not accord exactly with the Cost Savings approach.

There is a large amount of evidence on time multipliers. The evidence would seem to support a premium valuation of walk and wait time of around 1.5. This is backed up by a recent meta-analysis of time based multipliers (Wardman, 2013) in which the figures output from the model for rail business travellers vary between 1.6 and 1.4 depending upon distance, although they were around 2.0 for car walk time.

As for crowding penalties and valuations, distinct from the effects on p and q, we suggest the use of the business travel multipliers from the Wardman and Whelan (2011) meta-analysis and illustrated in section 3.1.4.

A key issue here is the uncertainty over the extent to which the WTP values, particularly those obtained from SP data, reflect company policy and hence the status of these valuations.

Summary of Insights Evidence

There is some uncertainty as to what the SP values represent, and indeed this might also apply to the RP data, although it does seem that the RP values are larger than the SP values. Whether this difference between RP and SP values is because of response bias or because company policy has not been fully taken into account is unclear. What is clear though is that company policy does seem to have an additional influence on decision making when it is raised, and this observation has not yet received the attention that it merits. The limited variation in values in SP exercises according to who pay and who benefits also raises concerns as to what the SP values represent.

For the self-employed, company policy is internalised and hence they might serve as an interesting benchmark for employee based valuations although the evidence suggests they might behave in a different and incomparable fashion to employees. Different behaviour by employees of, say, small companies and large multinationals, or private and public sector employers, might also be anticipated.

A distance effect seems to exist on WTP values, and will also exert an influence on the Hensher equation parameters insofar as p, r and MPL vary with distance. However, we do not have sufficient faith in the distance elasticities estimated from the WTP evidence to present appropriate values.

Not only does crowding influence p and q but there is also evidence that crowding leads to a premium valuation being placed on time spent in such conditions. Whilst it is not altogether clear to what extent this includes an employer as well as employee effect, we have argued that SP responses do contain an element of company willingness to pay and that walk and wait time should have a

premium valuation in contrast to the cost saving rationale. It remains unclear what the employer willingness to pay is, if anything, is for improvements in walking, waiting, crowding and other journey attributes.

Summary: Empirical Support for and Challenges to the Valuation Methodologies

We have summarised the *p*, *q* and *r* evidence that underpins the Hensher approach. Table 3.17 below sums up how this evidence is consistent with what we regard to be the three primary approaches to the valuation of business travel time savings namely:

- The traditional Cost Savings Approach (CSA)
- The Willingness to Pay (WTP) Approach
- The Hensher Approach

The summary evidence takes different forms, distinguishing between the understanding provided by specific studies, the outcomes of reviewing numerous studies alongside each other and the insights obtained from detecting patterns in valuations. The common purpose is to cast light upon whether particular valuation methods or their values as derived are consistent with the empirical evidence.

For each category of evidence, we briefly specify the outcome and then highlight the implications for valuations of travel time savings, in terms particularly of consistency with the current convention and the robustness of the evidence base. We set out whether the findings provide any guidance for the appropriateness of particular methods. As is clear from the table, and our preceding discussions, the evidence is by no means consistent in its implications as to the most appropriate basis for valuing travel time savings for briefcase business travellers. It clearly indicates that further research in the area is warranted.

Table 3.17: Summary of Evidence

Evidence	Outcome	Implications for Values	Implication for Method
UK Business Travel Study 1986	Most extensive comparison of methods. Similar valuations from employers' Stated Preference, Revealed Preference, Hensher equation and Cost Saving Approach	*Values*: Consistent with CSA *Quality of evidence*: Dated and conditions will have changed	Indicated that all three approaches provided broadly similar results
Modified Cost Savings Studies	With r≠1, on average rail 51% MPL, air 76% MPL, Car 76% MPL and Bus 63% MPL. Evidence falling over time as p increases and some increase in r. With r=0 (and q=1) on average, rail 79% MPL, Car 92% MPL, Bus 88% MPL, Air 84% MPL.	*Values*: Lower than CSA, particularly for modes where productive use of time. *Quality of evidence*: Concerns on over-reporting of p and q, and use of average rather than marginal p	Suggests WTP and CSA valuations are generally too high
WTP Studies in Modified Cost Savings Studies	Employer based values average 107% of MPL. Employee values based on perceptions of company policy average 104% of MPL	*Values:* Consistent with CSA *Quality of evidence*: Few studies and dated. Employer surveys small scale	Supports CSA and suggests Hensher values too low
UK RP IVT	Values 86% of average of MPL for car and rail.	*Values:* Broadly Consistent with CSA *Quality of evidence:* Only 6 values	Supports CSA
UK SP IVT	Higher than personal values of time but 54% of average of MPL for car and rail.	*Values*: Less than CSA *Quality of evidence*: Do values represent company policy?	Support for Hensher valuations
European RP IVT	20% higher than gross labour costs but average labour costs lower than business travel market	*Values*: Consistent with CSA or a premium *Quality of Evidence*: Large number of values	Supports CSA and suggests Hensher values too low
European SP IVT	30% higher than gross labour costs but average labour costs lower than business travel market	*Values*: Consistent with CSA or a premium *Quality of Evidence*: Many values	Supports CSA and suggests Hensher values too low
OVT Evidence	UK walk and wait values 15% larger than IVT values. European values for RP are 158% wage rate and 38% larger than IVT. SP values are 146% wage rate and 56% larger than IVT. Business and Non-Business multipliers remarkably similar for non-trivial samples	*Values*: Different from CSA approach and Hensher approach *Quality of Evidence:* Limited number of values but consistency with non-work values.	Evidence challenges CSA and Hensher approaches
Time Trend	No evidence of a (negative) time trend that would be apparent under Hensher approach	*Values*: Consistent with CSA relative to Hensher *Quality of Evidence:* Large evidence base	Some challenge to Hensher approach
Mode and Distance Effects	Values not lower for rail as Hensher approach would imply. Positive distance effects exceed what might expect from income variations	*Values*: Different from both Hensher approach and CSA *Quality of Evidence*: Large Evidence base	Evidence challenge to Hensher and CSA
Japan Evidence	RP, SP and meta-analysis evidence, largely relating to car travel	*Values*: Broadly consistent with CSA values *Quality of Evidence*: Lot of studies and good quality RP evidence but mainly car	Supports CSA.
High Speed Rail	SP evidence generally obtaining values in excess of the gross wage rate.	*Values:* Consistent with CSA values or a premium. *Quality of evidence*: Solely SP and some dated	Supports CSA and challenges Hensher approach
Self Employed	Relatively low values	*Values*: Lower than CSA approach *Quality of Evidence*: Few studies and SP based	Challenges CSA but could support Hensher

Recommendations for Further Hensher Equation Research

We here set out what we regard to be the necessary requirements for further research were the Hensher equation to be implemented. Section 5 contains broader research recommendations.

A noticeable feature of the studies that provide evidence on p, q and r is a lack of detailed analysis of how p, q and r vary across different circumstances. Exceptionally, the UK 1994 study (HCG et al., 1999) provides one-way tabulations for p, q and r across a number of useful dimensions whilst the SPURT study (Mott MacDonald et al, 2009a) also provides some breakdowns[18].

We would expect p, q and r to be influenced by a number of factors, and indeed we can observe this in the <u>inter-study</u> comparisons presented above. However, as far as we are aware, there have been no serious attempts to provide a comprehensive <u>intra-study</u> quantification of how the parameters vary across different situations. We would therefore recommend that any further research in the area develops models based on data collected specifically with the purpose of quantifying the effects on, as appropriate, p, q and r, of factors such as:

- The size of the journey time change
- Whether the time change is a gain or a loss
- Mode of travel, including sub-modes such as type of train, car or plane and in-journey facilities
- Journey length, time of travel and direction of travel, being clear what stage of the journey p, q and r relate to
- Purpose of business meeting
- Occupation, seniority, employment contract, and remuneration basis
- Interactions between p (and $p*$), q and r (and $r*$)
- Estimates of these parameters have changed over time
- Crowding and comfort levels, both seated and standing and the proportion they form of the journey
- Walking and waiting time
- Short and long term response, including examining say a weekly time dimension and the transfer of activities across a longer timeframe than just a single journey
- What, when asked, are the (other) factors that explain why travellers devote a particular amount of time to work, or indeed do not work, and would take a specific amount of time as leisure time
- What is the impact of using $p*$ and $r*$, and if easier to operationalize, what is the relationship between p and $p*$ and between r and $r*$
- The survey method, such as during the journey or afterwards, interviewer or self-completion
- The particular wordings of the questions used to elicit the parameters.

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[18] Indeed, there might be scope for further empirical analysis of the Hensher parameter evidence within these data sets.

In addition to the relative productivity of q, further investigation of the value of the work done on the train is needed and indeed it would have been useful to address the question of whether the work would in any event have been undertaken at some other time without crowding out some other work related activity.

Given the long recognised issue of respondents overstating the amount of time they spend working on the train, some kind of observational means of verification of p^* estimates, or indeed p would seem to be warranted. This might involve monitoring of behaviour after a journey time variation as well as CCTV or other observation of behaviour. Concerns that q might be overstated also need to be addressed. We might question whether q is around 1 as is indicated in the evidence. It is difficult to envisage the journey being a more productive environment than the office and for some or indeed many it will be less productive.

Previous research has focussed on employees' perceptions of their own productivity and what they would do with time saved. Given that future research might cover employers, the opportunity of interviewing employers about their perceptions of p, q and r might in part serve as some form of verification. This might cover longer term uses of time saved and indeed provide some indication of whether the Hensher equation is 'intuitively' the model that companies are following.

There is a need for some informed research on how values might vary over time, for example, as the ability to work varies or as companies increasingly require their employees to make productive use of travel time.

There needs to be empirical support for variations in MPL, not only by employment type but by the productivity of the activity which drives the business trip.

In the long run, there is a reasonable expectation that r equals zero, that is, in the long run all travel time savings are converted to working hours. The motivation for this has been that spending some time travelling outside normal working hours is part of the agreement between employer and employee. This argument has been supported by the observation that despite substantial increases in travel speeds over several decades, there are no indications that business travellers nowadays spend less of their leisure time on business trips; hence, there seems to be no indication that some of the travel time savings have been converted to leisure time.

The debates in Norway and Sweden about the Hensher equation seem to acknowledge that it is not enough to try to measure how a travel time saving would be divided between the employer and employee in the very short-term, such as focusing on a particular trip. Hence it can be argued that the attempts at doing this during the 1990's were misdirected, and that an understanding of the r parameter needs to be based on the long-run effects.

Nonetheless, empirical evidence, based around the experiences and expectations of employers and employees, would seem to be warranted in order to test the extent to which this hypothesis is true.

Although not a major issue, studies that have estimated VL have not explored it in as much detail as for private travel. Thus segmentations by factors such as mode, distance, income, occupation type and employment sector would add value.

Recommendations for Further WTP Research

Our view is that the two central most important issues that need to be grappled with are:

- What are companies prepared to pay for travel related improvements for their employees
- Given the prominence of the WTP method, what is the status of values obtained from SP data and more importantly how far can employee-based data provide an accurate indication of the value of business travel time savings?

There is clearly a need for some kind of employer based exercise, ideally including an RP element as well as the more obvious SP element and supplemented by a detailed investigation of company policy. This should cover more than just travel time and also be extended to cover the possibility that the MPL at the event generating the business trip is higher than usual and that walk and wait time savings might be more highly valued than IVT savings if only because the employer recognises there is more 'dead time' with walking and waiting time than IVT. It is some considerable time since such research was last conducted in the 1980s and new survey and analytical methodologies have emerged.

Employee based RP evidence is clearly valuable, provided that robust and familiar choice contexts can be obtained. Nonetheless, even this needs to be backed up with questions which seek to determine the key factors that have influenced decision making.

Given the attractions of SP methods, there would seem to be merit in using this to provide estimates of company valuations. However, the status of such evidence needs to be unambiguous. On the one hand, respondents can be instructed to follow what they perceive to be company policy, with de-briefing questions exploring what that policy is. On the other, they might not receive any instructions but be asked directly about what influenced their decision making and indirectly about reimbursement policies and time use which are of use in interpreting the data. The key is that company travel policies are transient and reflect current price relativities. Rail First Class travel is allowed, or not allowed, at different points in time as the gap between their fares change. If First Class fares were to be set at £1 greater than Standard Class fares, then all companies would allow all their employees to use First Class on business trips. What is required, to determine the employers' values from employee SP surveys is that the respondents act within the spirit of the company travel policy rather than by current rules.

Any analysis of RP and SP data needs to be able to isolate the company and personal valuations and to avoid obtaining some mix of the two[19]. Moreover, challenges to the cost saving approach, which might arise from premium valuations of walk and wait time or variations in valuations either by mode or by distance need to be clearly identified as hypotheses to test and then these tests given the firmest possible basis.

In particular, we feel it is important to conduct further research into distance effects for two main reasons. Firstly, we do not find the existing evidence relating to distance elasticities to be entirely convincing, although we do believe there is a distance effect. Secondly, Karlström and Eliasson (2007) contend that distance effects might be able to explain a substantial part of the differences between the WTP and Hensher approaches.

Prior to all these sets of research (and for the Hensher equation research as well), it is essential that appropriate exploratory work, using focus groups and more in-depth methods, is used to clarify, both for employers and employees, company policy issues and how these are or might be accounted for in methods aimed at estimating values. To what extent do companies actually follow some kind of Hensher approach to valuation, to what extent do market imperfections exists and who is responsible and/or aware of policy, and to what extent would company preferences actually be out of line with a strict interpretation of the cost savings approach, say, by paying more than the MPL of senior managers to save time, policies relating to class of travel and company attitudes to walk and wait time?

As a benchmark, there is some value in a sub-set of this analysis exploring the willingness to pay of the self-employed in considerable detail. Is there here a correspondence between the expressed willingness to pay and the Hensher equation or are there other, perhaps less rational, factors underpinning behaviour?

3.2   Professional Drivers

3.2.1   The Classic Case

Our definition of Professional Drivers (PDs) will be 'persons who are employed specifically to drive a vehicle and carry out associated duties which cannot be performed while actually driving'. Examples of PDs are:

- train drivers, who can do no more than communicate (eg. by phone) while driving, but have associated procedures (eg. systems tests) to follow when stationary;

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[19] Although the latter might be important for forecasting purposes.

- commercial vehicle drivers, who might be expected to help with loading/unloading and filling in paperwork, but who can do little while actually driving;

- bus drivers, who take fares and inspect tickets at stops, but cannot carry out other work while driving.

For PDs, as defined above, any travel time saving will allow more driving to be done within the working day. If the work initially involves overtime working, the saving to the employer might be considerably more than the normal wage rate for that person. If the driver is working fixed standard hours, it may be the case that the freed up time cannot be used, for example, if there is not time for a further trip within the standard hours.

Often, it will be sensible to ignore that complication by relying on the threshold effect argument, which says that with standard hours there must be an amount of unusable time in the starting position that will occasionally be sufficiently large that the new time saving allows an extra trip to be fitted it. With a few non-contentious assumptions, it can be mathematically proven that that occasional gain balances exactly with the zero gains when the freed time cannot be used, to give an average gain equal to the amount of time actually saved.

There is a case where that argument does not hold, and that is when there is a 'peak vehicle requirement', or here more exactly a 'peak driver requirement'. That arises where it is never possible for a driver to make two peak runs and where standard working agreements mean that there is already a surfeit of drivers available at other times, so that no useful work can be undertaken in any time saved, and an increased journey time would just reduce the surplus of unused drivers off-peak. Many employers can, however, vary working hours to avoid that situation.

Overall, it appears that any time saving will be worth, on average, to the employer the employee's gross wage plus on-costs. That is not exact, even for this quite narrowly defined group, and there is no proof, but the consensus has been that this is the correct way to value travel time savings for this group and we are not aware of serious challenge to this position.

3.2.2 An 'Intermediate' Group

Having discussed the classic case of professional drivers, we turn now to consider what we term an intermediate group, lying between Briefcase Travellers and PDs as defined above. This 'middle' group includes people such as travelling salespeople, service engineers and such like.

Travelling Salespeople

Travelling salespeople, who are not primarily employed to drive but for whom driving is an essential part of the job. A travel time saving should permit an equivalent amount of time, on average, to be added to the working time that day, if only by the threshold effect whereby it will sometimes be

possible to fit an extra call or travel leg into the working day making VBTTS equal to the gross wage rate plus on-costs seems sensible.

Service Engineers

Those who are service engineers, plumbers and such like are not PDs but they need to travel as part of their job. They might be able to do a limited amount of 'phoning ahead' while driving, but that would not be reduced by a travel time saving, There might be more than one person travelling together, say in a van, and one may be able to progress paperwork while travelling, such that a Hensher equation approach might seem indicated.

However, many such travellers may be self-employed, which complicates the picture. A further complication is that a significant proportion of these people may be travelling in overtime, especially in case of emergency call-outs. Overall, on average, the assumption of gross wage rate plus seems to fit these people too.

3.2.3   Conventional Valuation Approach

The conventional approach to valuing travel time savings to PDs and the 'intermediate' group is the cost saving approach, taking an hour's saved time to be valued at the gross wage rate, plus on-costs. Alternatives have been considered, and we have been informed that New Zealand considered a Hensher equation approach for these groups. In our view there might be a slight overestimation by setting the value of business travel times saving equal to the 'gross wage rate plus' for this group, but it is unlikely to be large.

3.2.4   Alternative Valuation Approach

A further approach would be to survey employers to find their Willingness To Pay (WTP) to save scheduled journey time for a vehicle carrying such persons, but there are complications with that approach that we need to consider:

Firstly, obtaining WTP responses from employers is very difficult. The first difficulty is in finding a suitable person to answer the questions that is willing to do so. Even if willing to respond, such persons have limited time and might be unwilling to undertake enough Stated Preference exercises to cover all dimensions of interest, e.g. staff type, staff salary, trip length, trip duration.

If it is not possible to get each respondent to cover all these dimensions, it might be suggested that we just increase the sample size. The problem is that for acceptable accuracy for future use in appraisal, the required sample size would exceed the population size, regardless of whether everyone would be willing to engage with the experiment. The same would apply to Adaptive Stated

Preference, which obtains much more information from each respondent, but a cut-down experiment with, say, 100 respondents would be possible.

A second complication is that there may be more than one employee in the vehicle. Here the WTP sought from the employer might relate directly to the **vehicle**, thereby capturing WTP for all persons carried. However, this raises difficulties. Firstly, we might wish to establish the WTP relating to each individual, so as to be able to generalise to other combinations of persons carried. Secondly, the persons carried might be "employed" in different ways to each other. For example, a Train Operating Company (TOC) would directly employ the driver, senior conductor, and ticket inspection staff, but might only employ the catering staff indirectly; so asking the WTP of speeding the train up would give an ambiguous answer on these grounds alone.

Thirdly, there may be the possibility of reducing fleet size if travel times were speeded up. Returning to the WTP of speeding up a train example, a major gain to a TOC will be that it may need less 'train sets' to provide a given level (frequency) of service. The same applies to speeding up a van carrying a 2-person repair team; the employer's WTP will include an allowance for potential greater use of the van (with backing from the 'threshold effect'). This would be both non-linear and complicated to account for.

Fourthly, there may be value in having the "load" at destination earlier (given all constraints), thereby realising a scheduling benefit above and beyond a travel time benefit. For freight movements, this will at least include interest charges on the working capital tied up in the load being moved. We have encountered container loads said to be valued in the millions of pounds, in which case the interest payments per day may well exceed drivers' wages. Other loads are perishable and/or "use by" dated, so that gaining or losing half a day could have enormous value to the shipper.

Finally, we want a medium to long run response to changes in travel time, that is, values that would be used in planning and scheduling decisions, as opposed to short run reactions to variations in travel time on a day-to-day basis. Planning decisions would cover the hiring of additional staff if required, whereas the short term reaction to an unexpected delay might be an overtime payment or a compensation payment of some kind. The state of the art in thinking on these matters is to refer to the medium/long run decision as a 'value of time' leading to an estimate of VTTS, while we refer to the short run decision as a 'value of reliability' leading to an estimate of what we might label the value of a travel time reliability saving (VTTR).

3.2.5   Summary for Professional and Intermediate Drivers

We conclude that for all these professional drivers and drivers for whom travel is a significant part of their duties, the CSA retains a strong appeal as a basis for valuing travel time savings. Of course it assumes the market for drivers is competitive. Reliability benefits need to be handled through a willingness to pay approach so care is needed to avoid double counting. We re-iterate that we have

not encountered reasoned objection to the use of the CSA for the categories discussed in this section.

3.3 The Goods/Services Market and the Labour Market

3.3.1 Context

In this sub-section, we review UK labour market conditions and their implications on the valuation of the business value of time for use in cost benefit analysis. The issue of the use of time whilst travelling (i.e. the productivity of travel time) is discussed in section 3.1 and also in considerable detail in Annexes 3 and 4.

Such a review is necessary as the different valuation methods require competitive labour and product markets to give robust valuations. By assuming a competitive labour market the marginal product of labour can be taken to be the observed wage rate plus non-wage costs. In this review we firstly focus on whether market failures in the goods and labour markets drive an empirical wedge between the wage and the marginal product of labour, and secondly examine whether the shift to more flexible working has any bearing on the value of business travel time savings. These issues are discussed in more depth in Annex 5 dealing with labour market conditions and implications for the valuation of business travel time savings. Given the HM Treasury's preference to account for employment effects elsewhere in the appraisal (HM Treasury, 2003), rather than to shadow price labour in the presence of high unemployment, such an approach is not discussed further here, although a brief discussion is provided in Annex 5.

3.3.2 Imperfectly Competitive Markets

Imperfect Goods/Product Market

There are two relevant goods/product market failures: indirect taxation and imperfect competition arising through for example product differentiation or geographic monopolies. Appraisal methods account for both of these market failures in that any surpluses additional to user benefits are estimated in the cost benefit analysis (DfT, 2011; 2012b). The average rate of indirect taxation in the economy is 19.0% (DfT, 2012a), whilst marginal costs are taken to be 20% lower than shop prices (DfT, 2005 p49). The evidence reviewed by DfT (2005) however shows that this 'average' mark-up disguises tremendous variability by industry with a range from 0% to mark-ups in excess of 40% in some sectors.

There is also ample evidence at an international level that perfect competition does not prevail. For example for 10 EU countries Badinger (2007) estimates mark-up factors of price above marginal costs of approximately 1.3 for manufacturing and construction and 1.37 for services for the late 1990s. Christopoulou and Vermeulen (2008) also find evidence that rejects the perfect competition

hypothesis with price-marginal cost factors of 1.37 in 8 Euro area countries and 1.31 in the US. In addition, they find that the price-marginal cost margins are not uniform, with significant variation by industry and country lying behind these headline numbers.

In both situations the market failure reduces output below that which would occur under competitive conditions. Employment levels are therefore lower in the presence of either indirect taxes or imperfect competition than they would be under perfect competition. Whilst the firm is a wage taker (and the labour supply curve it faces is perfectly elastic) these market failures can operate at an economy wide level. As the labour supply curve for the economy as a whole is elastic, there then exists a gap between the wage and the marginal product of labour (with a competitive labour market). This is because the firm equates the wage to the marginal revenue product of labour. Therefore with an imperfectly competitive goods market and a competitive labour market the value of the marginal product of labour is greater than the wage. The situation of an imperfectly competitive labour market is discussed below.

Imperfect Labour Market

Income taxes distort the labour market by driving a wedge between the wage faced by employers and that received by employees. This restricts employment to levels below that associated with fully competitive conditions. This distortion generates welfare benefits (equivalent to the increased tax take) additional to user benefits when employment expands or wages increase (e.g. through agglomeration impacts) (DfT, 2005; Venables, 2007; DfT, 2012b). Departmental guidance recognises these additional welfare benefits. From a business VTTS perspective an income tax in an otherwise competitive economy does not prevent the gross of tax wage equalling the marginal product of labour. There is therefore no need to shadow price labour due to the presence of an income tax in a transport cost benefit analysis.

Whilst the pervasive view is that labour markets in developed economies are competitive[20], this view faces a number of challenges (Manning, 2011). One of the central criticisms is that the competitive labour market model regards firms as wage takers, where if the wage rate was lowered by 1 penny the firm would lose all its employees. This is clearly a simplification. From the perspective of transport policy cost benefit analysis, the issue is not what causes the imperfections but whether any market imperfection leads to the wage departing from the marginal product of labour. This is because we are interested in whether the market wage needs to be adjusted (i.e. shadow priced) in some way to reflect the actual marginal product.

In an imperfectly competitive labour market rents are derived from the employment relationship either by the employer or worker or both. If an employer gets rents the marginal product is above the wage, whilst if a worker gets the rents then the wage is a good indicator of the marginal product of labour. Manning (2011) in reviewing the evidence on the size of such rents in the labour market

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[20] A labour market can be competitive even when the product market is not competitive.

concludes that rents in the region of 15% to 30% are plausible. There is however a lot of variation and enormous uncertainty in these estimates. The limited evidence that does exist suggests that most of the rents accrue to workers – implying wages are close to marginal product.

Evidence that imperfect competition exists in the labour market can also be found through a joint transport sector labour market analysis. With imperfect competition in the labour market commuting costs will not be fully compensated if firms have more market power than workers. Manning (2003) shows that this is the case for the UK, whilst Rouwendal and Van Ommeren (2007) demonstrate that it is the case for the Netherlands. Whilst these averages suggest that on the whole labour markets are imperfectly competitive, arguably the level of competitiveness will vary with labour market segment.

Mobile workers, typically high skilled and the primary wage earner in a household, arguably would face a competitive labour market as the household may move or migrate in response to changing employment opportunities. Workers in lower skilled occupations, women and ethnic minorities arguably face restricted geographic search areas and high mobility/migration costs (Madden, 1981, 1985; Zax, 1991; Ihlanfeldt, 1992; McQuaid, Greig and Adams, 2001) and therefore are more likely to face an imperfectly competitive labour market. Laird (2008) finds evidence for varying degrees of imperfect competition by labour market segment. Following the work of Manning and Rouwendal and Van Ommeren, in a Scottish context, he finds that the level of compensation for commuting costs varies by labour market segment: urban, rural, gender and skill level. The implication is that the market wage is likely to be a good estimate of the marginal product for 'mobile' workers.

Synthesis of Market Imperfections

The lack of evidence in this field makes it difficult to give recommendations on the size of any gap between the wage and the marginal product of labour for business travellers. On the basis of what evidence there is it would seem that the gross wage is a reasonable approximation for the marginal product of labour for business travellers, despite the prevalence of market imperfections. This is because firstly a lot of business travel is conducted by 'mobile' workers, and secondly that what evidence there is suggests the rents accrue to workers. That is, there is no need to shadow price labour as a consequence of market imperfections. Further research is needed to confirm this due to the weak evidence base.

3.3.3   Flexible Working

The cost saving approach was devised at a time when it could be argued there was a high degree of rigidity in the labour market. So the distinction between employer's business time and non working time was relatively clear cut. In such an environment the opportunity cost of travel time was clearly lost production and this pointed towards the wage as a good indicator of the marginal value of business travel time savings. The question that arises is whether a shift to a more flexible working

environment has altered this. The discussion here complements that regarding the use of travel time in Annex 4.

The evidence clearly points towards a very different labour market today than that of forty or fifty years ago. The structure of the economy has altered and with it the need for flexibility in working patterns. Average weekly hours of a manual worker have fallen from 53 hours in 1943 to 43.5 in 1987 (ONS, 2003). This trend has continued, with average hours worked having fallen by 4.7% since 1991 (ONS, 2011). This is attributed to a "mixture of structural changes in the economy, and more flexibility in the hours chosen by employees or offered by employers (including more part-time working)". While part-time working is obviously a key component of flexible working, with part-time workers forming 27% of the UK workforce (ONS, 2011), flexible working extends beyond working part-time. In 2003 some 6 million workers (27% of women and 18% of men) are estimated to have had working patterns that differed from the standard pattern (Hibbet and Meager, 2004)[21]. Such variability arises from flexitime, term-time working, annualised hours, job sharing, nine-day fortnights and zero hour contracts.

In addition to these types of variability in working patterns some 5% of the workforce also engages in telework[22] (White *et al.*, 2007). Such workers typically are the higher income workers holding senior positions who use computers and telephones as part of their daily jobs. These workers are typically judged on the outcomes they produce rather than the hours of work they give to the firm – that is, they are not specifically compensated for their overtime. The nature of teleworking also means that manual workers and customer-focused workers typically do not telework. The move away from the formalised working week in today's economy is also evidenced by the importance of weekend working (some 29% of workers usually work on Saturdays, whilst 21% usually work on Sundays) and by the fact that 35% of the workforce sometimes work either paid or unpaid overtime[23].

Whilst flexible working has undoubtedly increased over time, the above evidence highlights the fact that fixed hours contracts with no overtime still remain the dominant working pattern. However, the increased prevalence of flexible working arrangements may mean that specific treatment of those who work unpaid overtime may be necessary at times. From a business value of travel time savings perspective different employment models are relevant to different workers and therefore business trips:

(i) Workers with fixed hours contracts with paid overtime. Here travelling time will displace time at the workplace no matter what time the trip occurs.

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[21] This includes part-time and full-time workers – though being part-time itself does not constitute flexible working.
[22] Telework is a work arrangement in which employees do not commute to a central place of work
[23] Source: Quarterly Labour Force Survey (April – June 2012). Accessed via the Economic and Social Data Service Nesstar Catalogue (accessed October 12 2012)

(ii) Workers with flexi-time contracts with ability to re-coup overtime through days off. Again travelling time will displace time at the workplace no matter what time the trip occurs.

(iii) Workers with contracts with unpaid overtime and the self-employed
   a   *Travelling during normal work hours. Here business travel would be expected to displace work.*
   b   *Travelling outside normal working hours. Here travelling for business may displace leisure time as well as work time. Employees would require compensation through the wage at a rate depending on how onerous the travelling is compared to leisure. A reduction in travelling time would lead in the long run to a reduction in the level of wage compensation required.*

For workers with paid overtime or flexitime (i.e. (i) and (ii) above) business travel will only displace work activities. That is, the *r* term in the Hensher formula will be zero or close to zero, though this should be tested empirically.

For workers working unpaid overtime but who travel during normal work hours (i.e. (iii)a. above) business travel displaces work and leads to an increase in unpaid overtime. Travel time savings would therefore lead to a reduction in unpaid overtime.

For workers who are not paid overtime and travel outside of normal working hours (i.e. (iii)b above) business travel could displace both work and leisure time. For these workers, (iii)a and (iii)b, the *r* term will be greater than zero. It is an empirical question as to how important this group of workers are to specific policy interventions (e.g. rail interventions).

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4.   PRACTICAL APPLICATION ISSUES

This section addresses some issues in practical application which were specified in the Request for Proposal. These are all in the context of the current Cost Savings Approach. We here discuss:

- Updating of the Cost Savings Approach (in section 4.1)

- Disaggregation and Segmentation Issues (in section 4.2)

- Consistency of Treatment of Modelling and Appraisal (in section 4.3)

- Modal Transfer Issues (in section 4.4)

4.1   Updating the Input Values and Parameterisation

The cost saving method sets the value of time savings equal to the marginal gross cost of labour including labour related overheads.   Internal DfT memos set out the approach used for implementation. In essence the DfT's approach has been to:

- Use NTS data[24] to derive distance weighted annual incomes by mode of travellers. As the NTS only collects banded income data – the mid-point of the income band is used.

- Calculate hourly incomes by dividing average annual incomes by an estimate of the total hours worked by an average worker in a year (sourced from the New Earnings Survey).

- Use the New Earnings Survey to estimate hourly wage rates for professional drivers including commercial vehicle drivers and occupants.

- Use the Labour Cost Survey to estimate average non-wage labour costs. On average non-wage labour costs add 21.2% onto the wage cost

- Uprate average hourly estimates by a factor of 1.212 to give estimates of the gross cost of labour plus labour related overheads.

- Adjust estimates to adjust unit of account and price and value base.

The current values in WebTAG unit 3.5.6 (DfT, 2012a) were derived from survey data in 1999/2000. They have been updated to 2010 prices and values by reflecting changes in GDP per capita and

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[24] Note that the National Travel Survey excludes professional driver mileage.

inflation. Since these values have been derived, the New Earnings Survey has been superseded by the Annual Survey of Hours and Earnings (ASHE).

Effectively the approach is a two staged approach. The first stage estimates the hourly distance weighted wage of travellers, and the second estimates the nonwage labour costs. We comment on these stages separately.

4.1.1   Deriving the Hourly Wage

Over time the labour market alters and the way that different modes of transport are used by different sections of the business community may also change. The fact that the current average modal business time saving values by mode were derived from 1999 to 2001 NTS data raises some issues. Even if the existing approach is maintained, there is a need to update the current values using more recent travel survey data.

Given that the cost saving method, and alternatives such as the Hensher model, require an estimate of the hourly wage, ideally a dataset that is robust in earned income data should be used. The NTS is not such a dataset. This is for three reasons. Firstly, the personal gross annual income reported in the NTS is from all sources (earnings, benefits, pensions, savings, self-employed, multiple jobs, etc.). Secondly, the survey does not record the number of hours worked by individuals, and thus one cannot obtain a robust estimate of an hourly wage rate. Finally, the income data is only banded. More appropriate datasets for deriving hourly incomes would be the Annual Survey of Hours and Earnings (ASHE) and the Labour Force Survey (LFS). These form the basis of ONS' estimates of earnings. The challenge of course is to link these more robust estimates of hourly earnings to observed travel behaviour, in order to derive distance weighted estimates of the value of business travel time savings by mode.

The current approach could bias the values. Firstly, total annual income exceeds earned income. We have not been able to identify a data source to show this clearly at the personal level, but it can be illustrated at the household level. The Family Resources Survey (DWP, 2012 Table 2.3) indicates that earned income comprises on average about 85% of total income for households with a head of household aged between 25 and 59. Thus using total income as an approximation to earned income overestimates earned income by about 18% (on average across the workforce). Secondly hours worked vary significantly by occupation. Managers and senior officials work about 15% more hours than the average worker, as indicated in Table CAS040 of the 2001 Census. As workers in these occupations also travel the most (see Section 2) then using average hours worked by the average worker risks introducing an upward bias to the estimated hourly wage rate of those travelling on employers' business. Furthermore, as travellers will self-select between modes, any upward bias will vary between modes and will be largest for modes used by those who work the longest hours (i.e. modes preferred by managers, senior officials and professionals). Ultimately, how significant any biases are is an empirical question needing further analysis before drawing conclusions.

An alternative approach to estimate the distance weighted hourly wage by mode would be to use each dataset to its full strength. Therefore the NTS would be used to describe the types of business travellers using each mode (in terms of distance weighted proportions by occupation and potentially industrial sectors[25]), and the LFS or ASHE would be used to derive hourly wage rates for each of these categories of business travellers. ASHE is a survey of employers, and responses are based on documentary evidence, whereas responses in LFS are based on individual recollection, sometimes by proxy respondents and sometimes without reference to payslips. ASHE is therefore generally considered more reliable (Ormerod and Ritchie 2007). The ASHE sample is also considerably larger than the LFS, although not as representative of low-paid workers, does not include unpaid overtime hours, and does not cover self-employed, which the LFS does: we discuss the self-employed below. The LFS is therefore arguably the better dataset from which to derive hours worked, whilst the ASHE is considered the best dataset to describe earned income. Such an enhanced approach is similar to that used in New Zealand (BCHF, 2002 Chapter 8).

Ultimately the question of whether the existing methodology for calculating distance weighted average hourly earnings per mode is a good approximation to a more sophisticated approach is an empirical question. We have raised a number of issues that would suggest that biases exist in the current methodology. However, the significance of these biases is an empirical question that needs further analysis before any conclusions can be drawn.

4.1.2 Non-Wage Labour Costs

Our discussions with the ONS indicate that the Labour Cost Survey is the best comprehensive dataset for non-wage labour costs in the UK. It is re-compiled every four years by the ONS as part of on-going commitments to Eurostat. Partial annual updates are also made. The latest survey relates to 2008. A 2012 survey will also be undertaken, which should become available in 2014 once Eurostat has published it. The Labour Cost Survey is not a survey in the strictest sense, but is in fact an analysis of existing datasets – the main ones of which are the ASHE, the LFS and the Annual Business Inquiry (ABI). The main sources of non-wage labour costs are employers' national insurance and employers' pension contributions. Other non-wage labour costs are also estimated, including paid annual leave, paid maternity/paternity leave, training costs, sick pay, benefits in kind, etc. Mark-up factors from employee wage costs to gross labour costs to the firm per hour of employment are available for the economy as a whole and by industrial sector.

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[25] The NTS contains National Statistics Socio-economic Classification (NS-SEC) data that gives broad occupational data. It also contains data on standard industrial sector (SIC). These are also contained in the LFS and ASHE. If disaggregating by mode, NS-SEC and SIC sample sizes are likely to be small giving imprecise estimates of both distance weighted proportions (from the NTS) and possibly earned income from the LFS or ASHE. Some aggregation of the NS-SEC categories and SICs will be necessary. Additionally it may be necessary to pool several years of the NTS data to obtain reliable estimates of mileage weighted proportions at whatever level of disaggregation NS-SEC/SIC is chosen. Another estimation issue that may arise is that if business related travel is a function of income rather than job function than an income/mileage distribution may arise within any specific NS-SEC/SIC sample segment. Arguably business travel should be a function of the job undertaken by the worker and not income – however there may be whether there is sufficient data in the NTS to identify job functions accurately enough and some correlations with income/wage may still be present.

The current non-wage labour costs are based on the 2000 Labour Cost Survey. The existing business values of time could therefore be updated to be consistent with the 2008 survey (the latest available survey). The proportion of non-wage costs varies by industry with skilled service sector industries incurring higher non-wage costs than agricultural, construction, manufacturing and low skilled service sector employment. As travel behaviour (distance travelled and mode choice) varies by income and job type, there is an argument that the non-wage mark-up should also be allowed to vary by mode. This would require an analysis of the NTS to indicate the industrial sectoral split by mode. Such an enhanced approach is similar to that used in New Zealand (BCHF, 2002 Chapter 8).

4.1.3   Professional Drivers

Employed professional drivers would be treated the same as other employees in this revised methodology – in the sense that the ASHE or LFS would be used to derive their hourly wage.

4.2   Issues Relating to Disaggregation and Segmentation

Regarding the most appropriate level of disaggregation and segmentation, we need to consider two related issues of practicality. The first considers the most appropriate level of disaggregation for surveying or estimating the value of business travel time savings and the second relates to the most appropriate level for use in appraisal. The two may differ in that the practicalities of appraisal may require compromises to be made. Taking each in turn.

4.2.1   Disaggregation and Segmentation When Estimating VBTTS

The discussion in the previous chapters has identified that VBTTS will vary by:

- Wage: e.g. by occupation, industry, skill level, age/experience, etc.;

- Non-wage benefits (e.g. pension, company car, etc.): e.g. by industry and occupation;

- Form of contract between employer/firm and employee: primarily whether overtime is paid or not, and whether travelling out of normal work hours constitutes overtime;

- Whether the worker is self-employed or not;

- The ability to work whilst travelling and the productivity of that work: i.e. by comfort, overcrowding and quality of work space whilst travelling;

- The timing of the trip: does the trip fall wholly or partially within the normal working day?

- The disutility of travel: journey length, early start/late finish, crowding, walking, waiting, seated/standing; etc.

Many of these attributes vary systematically by mode. Mode can therefore act as a proxy, but ideally one needs to isolate the behavioural mechanisms that underpin the valuation of business travel time savings. Similarly the attributes above will vary systematically with whether the business traveller is a professional driver or their assistant, a 'briefcase' traveller, or non-briefcase traveller (e.g. a manual worker).

4.2.2 Disaggregation and Segmentation of VBTTS for Appraisal

Work values of travel time savings are currently disaggregated by mode (DfT, 2012a). The valuations by mode are intended to reflect distance weighted averages of travellers' hourly earned incomes marked up for non waged labour costs (as discussed in section 4.1). This is in contrast to non-working values of time where an equity value is used (i.e. a national average mileage weighted value for all modes). The principal disaggregation options for appraisal are (i) no disaggregation (i.e. an equity value); (ii) disaggregation by mode as in the existing guidance with further disaggregation by journey length, time of day of trip; and (iii) disaggregation by income with a similar level of further disaggregation, though modal specific factors (e.g. issues relating to comfort and productivity would need to be introduced). These options are illustrated in Table 4.1.

Table 4.1: Options to Disaggregate/Segment VBTTS for Appraisal

	Average	Potential disaggregation			
		Journey length	Time of day	Modal factors (walking & wait time, comfort)	Productivity during travelling (pq)
(i) Equity value	Single national value for all modes and all trips	N/A			
(ii) Mode	As existing guidance (DfT, 2012a)	Urban/short distance or inter-urban/long distance	During or outside of work hours	N/A	Quality of work environment, overcrowding, walk and wait times (to access main mode)
(iii) Earned income (wages)	By say income quintile	Urban/short distance or inter-urban/long distance	During or outside of work hours	walking & wait time, comfort, overcrowding	Quality of work environment/ overcrowding

The level of disaggregation most consistent with how VBTTS varies is disaggregation by earned income (wages). This level of disaggregation is also consistent with the position adopted in Mackie *et al.* (2003) with respect to the disaggregation of non-working time. It is also comparable to the approach adopted in the Netherlands (Odgaard, Kelly and Laird, 2005). One of the practical advantages of disaggregating by income instead of by mode is that the issue of average incomes on each mode altering after a transport intervention becomes irrelevant (see Section 4.4). Against these positives, disaggregation by earned income may seem unpalatable due to the equity issues that arise if the MPL is supplemented by employee benefits (as in the case of the Hensher equation). However, it should be noted that disaggregating by mode is in effect a form of income disaggregation by proxy, so there is little difference from an equity perspective between disaggregating by mode and by earned income. Arguably though disaggregating by earned income is more transparent.   However such an approach would increase the modelling complexity substantially – which may not be appropriate for the many appraisals that are undertaken. Another issue with disaggregating by income is that there is little data on the proportion of business travellers by earned income quintile (say) available to practitioners. Some guidance on earned income split proportions based on NTS analysis would need to be given to practitioners to support the adoption of business values of time disaggregated by income.

4.3   Consistency Between Treatment of Modelling and Appraisal

The discussion about the difference between VTTS for modelling and appraisal goes back to MAU Note 179, where three separate functions for 'generalised cost' were distinguished. There was 'behavioural cost' ("those costs which when used in appropriate models give the best empirical fits to observed behaviour") to be used for modelling, and two types of cost for appraisal – those perceived by society, and the true resource costs. This led to the standard formula, which in essence still survives, whereby user benefits are measured in perceived cost terms, and subsequently adjusted for indirect tax and other considerations (the "resource cost correction[26]"). Paragraph 2.2.7 of the 1980s VTTS study (MVA/ITS/ TSU) noted: *"Ideally, in both modelling and economic applications, these three quantities would converge. However,...we do not live in such a world…"*

For **non-business** purposes, the prevailing methodology has always been that appraisal values should be based on WTP, and, to ensure consistency between appraisals, codified so that the same values apply to all schemes. This may be taken as implying that behavioural values could be different, and could vary between studies, and this probably has been the case in the past. However, with the advent of WebTAG, and the increasing requirements for "WebTAG-compliance", there has been a notable tendency (whether or not this is in fact encouraged by WebTAG) to use the recommended appraisal values (Unit 3.5.6) as behavioural values as well.

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[26] Note that, following the 1999 Sugden review, there has been a change of units from resource or "factor costs" to "market prices" (see WebTAG Unit 3.5.4, §3)

Note that this raises some interesting issues when additional demand segments are distinguished beyond the three purposes for which VTTS is differentiated in Unit 3.5.6 (Business, Commuting, Other). For example, Unit 3.12.2 (Modelling Road Pricing) encourages income segmentation in the demand model, and suggests how the VTTS might vary. In this case, the variation is (more or less) compatible with the average values in Unit 3.5.6, so that, **provided the time saving is the same for all income groups**, the disaggregated benefits will be consistent with those obtained from using a single ("standard") VTTS. However, this will no longer be the case when different income groups make different choices between differently priced options (which is of course precisely the reason for the variation), as in the case of tolled roads for example. More generally, it is not necessary to take a particularly extreme case to produce a result whereby a positive user benefit using disaggregated VTTS becomes a disbenefit using a single VTTS. Unfortunately, the only way to avoid this is to insist that the appraisal values are the same as the behavioural values. This raises the perennial issue of equity, and here we have nothing to add to the reasonably extensive discussion in §8.5 of the 2003 report (Mackie et al., 2003) .

In the case of Business VTTS, there has never been any presumption that the appraisal value should coincide with the behavioural values (though we have questioned this in this study), since the appraisal value is grounded in theory, not behaviour. In addition, the basic rationale for the VBTTS, that time saved was previously being unproductively spent, means that no distinctions between different types of time (walking, crowding etc) are relevant for appraisal, though they might be considered important for behavioural issues such as route choice. In spite of this, the same issues about "WebTAG-compliance" (and perhaps, as well, the avoidance of the same kind of inconsistencies just discussed) have led to a more or less universal tendency to use the appraisal values for behavioural modelling here as well, though in this case they are only applied to in-vehicle time, with standard "multipliers" (generally in line with PDFH for rail) used for other components. It may be supposed that this practice would continue even if the method of deriving the VBTTS changed.

While the prevailing practice may be doing some (currently unquantified) damage to modelling, it certainly has the virtues of consistency. It is therefore likely to continue unless robust evidence can be adduced not only that the recommended appraisal values are in conflict with credible behavioural values (i.e. values derived from a rigorous estimation process using reputable data), but also that the forecasts are as a result seriously contradicted by actual outturn evidence.

Given this position, the discussion about the possible disaggregation of non-working behavioural values applies to working values as well. Nonetheless, inasfar as the recommended business appraisal values are not based on WTP, there are some additional issues. For example, there is some empirical evidence from SP studies that – as is the case for non-working VTTS – values rise with distance, and this might therefore improve the forecasting models. However, such variation in distance is at odds with the use of the MPL, which would **not** vary with distance (apart from any effect whereby higher income travellers make longer trips).

Overall, as the previous (2003) study concluded for non-work values, we would see the equivalence of appraisal and forecasting values as a practical "second best" option, which will run into problems from time to time with quasi-commercial appraisals such as rail investment and toll roads. This remains, in our view, an unresolved issue, as the remarks about equity, above, imply.

4.4   Implications for Appraisal of Modal Transfer

The benefit calculus for modal transfer is not inherently different from that relating to any other choice process: the "rule of a half" [RoH] approximation can be construed as saying that for those who change their travel choice, the allocated benefit is equivalent to half the cost change attributed to their former choice plus half the cost change attributed to their latter choice. While this may at first glance appear counter-intuitive, it can be demonstrated to be mathematically correct (as long as the RoH approximation is valid). It is also consistent with the general modal division of the TEE table, where the convention is that the allocation is by the "source" of the benefit (eg an improvement of highway time) rather than the "users" of the mode.

This means that there are no inherent complications in allowing the VTTS to vary by mode – the only caveat is that the VTTS on both modes (in the case of a mode switcher) should be appropriate for the travellers switching. This also implies that where modal characteristics and user characteristics vary (over time), WebTAG will need to be revised.

In practice VTTS has not traditionally been different between modes for commute and leisure travel, so this requirement is in that case automatically met. For VBTTS, however, it has been traditional to calculate separate VTTS by mode and, as §4.1 makes clear, this is done in relation to the mean income of travellers currently on each mode. Potentially, therefore, a problem could arise in respect of the caveat in this case.

In fact, while MAU Note 179 recommended a single VTTS for non-working time, for working time it was merely noted that "account may be taken of variation in wage rates, insofar as different groups can be identified". It is not clear at what stage this was explicitly aligned with "mode" in DfT-recommended values.

The 2003 report discusses modal VTTS in some depth (§8.3): however, the arguments are more specifically directed towards non-working VTTS. In this respect, an important principle is enunciated: "If values are taken direct from existing *users* of each mode (as in the Bus-Bus, Underground-Underground, Rail-Rail and Car-Car columns of Table 22), then inconsistencies will arise in the CBA because bus time benefits will be valued in accordance with the average income level of bus users, whilst car benefits will be valued in accordance with the average income level of car users. On this basis, "switchers" between modes will be treated anomalously."

However, although this was in the context of non-working time, it is hard to see why this should not apply to VBTTS as well (paragraph 1.2.6 of WebTAG 3.5.6 suggests that the issue is not really a problem unless the number of mode switchers is high compared to the number of existing users.)

Pulling this all together, there is no *a priori* argument against allowing VTTS to vary by mode, and this applies equally to working and non-working time values. However, this variation should reflect the characteristics of the mode (comfort, the opportunity for doing work, etc) and not the characteristics of the users. The only logical exception to this would be where no (or minimal) mode switching is envisaged, and where it is considered important to recognise the income levels of the travellers on different modes (as is allowed for, in the case of VBTTS, in current Guidance).

The corollary of this is that if we move away from the Cost Saving approach to include some variant of the Hensher formula, there is no intrinsic problem in allowing some or all of the elements (p, q, r etc) to vary by mode, provided these are recognisably attributes of the mode rather than the travellers.

It is worth noting that the variation in VTTS by mode to reflect comfort etc. can logically be extended to variations **within** mode (e.g. crowding on public transport). In this case, however, there is a presentational complication. The "time" elements in the current TEE Table can be interpreted as the product of the average number of users *times* the time saving *times* the (modal) VTTS. However, if there is no single modal VTTS but it depends on the network conditions, then the benefit is no longer interpretable in terms of (pure) time savings but rather "savings in quality weighted time". In mathematical terms, the change in benefit associated with time changes can no longer be written as $-v.(T'-T) = -v.\Delta T$ (where the prime indicates the "after" situation) but as $-(v'.T'-v.T)$.

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5. FUTURE OPTIONS

5.1 Aims

The purpose of this section is to set out, on the basis of the review work reported in the previous sections, the credible and feasible future options that we believe are open to the Department with regard to the decisions it makes concerning the valuation of time saved during business trips.

Some of these options need to be supported by fresh empirical research and where this is so we specify the form that such research might take, along with an indication of the likely timescales and resources required and the key risks[27]. Other options can be based upon existing evidence or information and where this is so we set out what these might be.

It is not the purpose of this section to provide recommendations as to the way forward, even though previous sections have provided summaries of evidence and advice on sensitivity tests regarding parameters, values and practices for use in appraising business values of travel time savings. Rather we here set out the options in an objective, evidence based fashion, enabling the Department to make informed choices as to the best way to proceed in this matter.

At the outset, we point out that the alternatives to the cost saving approach proposed here relate only to so-called briefcase travellers. We are not aware of any credible challenge to the cost savings approach for professional drivers, although it could still be updated. The options that we here evaluate are:

- Do Nothing – Maintaining the Current Cost Savings Approach;
- Update the Cost Savings Approach;
- Hensher Equation and Existing Evidence;
- WTP and Existing Evidence;
- Hensher Equation and New Evidence;
- WTP and New Evidence;
- Triangulation.

The WTP and New Evidence option also distinguishes employer based WTP and employee based WTP whilst further distinctions can be made according to whether the WTP is based on Revealed Preference (RP) or Stated Preference (SP) evidence.

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[27] We have not been required to provide cost estimates of the research associated with each of the options set out below. However, we should point out that the timescales here suggested do not include the time required to implement any research findings into guidance.

A final section considers additional research not specific to any particular option but which might usefully contribute to the Department's decision making processes.

5.2   Option 1: Do Nothing - Retain Current Cost Saving Approach

Description

The WebTAG values would continue to be rolled forward on the same basis as currently. This is the baseline option against which to consider the other options.

Justification

This option would not affect the set of appraisals currently in the pipeline and would cause minimal disruption. However, it is difficult to ignore the age of the base calculations underpinning the current values and the number of years of formulaic updating, combined with the materiality of business travel time to the economic case for many transport schemes.

Method

Not applicable

Resources

Not applicable

Timescales

Not applicable

Risks

A number of previous reviews, such as the Leitch report, have recommended regular review and updating of key appraisal values. The risk is that if the basis for automatic updating from the 2001 baseline differ from actual trends in GDP per head, or if the marginal overhead costs of employment have changed then the values will be wrong even if the CSA is retained as the basis for valuation. This would not be good practice.

5.3   Option 2: Update Current Cost Saving Approach

Description

This is a 'do-minimum' option which is to give a thorough spring clean to the values derived within the current CSA method. This work would also be required to progress options 3 and 5 below since both of those make use of the MPL that is the basis of the CSA. The key components of this option are:

- A recalculation of the annual wage income of EB travellers in their relevant categories considering alternative data sources and probably comparing their results and assessing robustness

- A recalculation of the annual hours of work of EB travellers in their relevant categories and income bands.

- A recalculation of the on costs (NI, pension and other employment related marginal costs) relevant to the Department's EB traveller categories.

- Updating the mileage-weightings used to derive the Department's values for EB traveller categories using recent NTS data (e.g. 2006-10). Note that NTS does not cover professional drivers and so will need to be supplemented to cover that.

Slightly outside our terms of reference there is a policy question about whether WebTAG guidance is sufficient in relation to traveller categories, variation with journey length and appraisal treatment of contexts such as tolls and premium fares where traffic needs to be split. This could affect the specification of Option 2 and therefore should be considered.

Justification

Relative to Option 1, the justification is that such a material component of the appraisal should be reviewed and updated regularly, in our view at least every ten years. This is particularly the case where economic circumstances have changed as dramatically as they have in the last decade. Relative to the options below, it is useful to distinguish between professional drivers and travellers on employers business (so-called briefcase travellers but in fact covering a range of activities).

In the case of professional drivers of trucks, delivery vans and coaches, we have encountered no challenge based on principle or evidence to the use of the CSA. In saying that, the Green Book assumption of full employment of the relevant class of labour has been taken as given. We therefore think that Option 2 is also an appropriate option for the appraisal treatment of professional drivers. The practical question will be whether a clear distinction can be drawn between professional drivers and other EB travellers. It may be that an acceptable and practical proxy is to assume that all truck,

van and bus and coach drivers are professional drivers while all EB car drivers and travellers on public transport are 'other EB'.

In the case of the Other EB category, we note first of all that many countries have actually stuck with the CSA despite the limitations and doubts discussed above. The DfT might decide that the costs, risks and likely robustness of results from the options set out below were such that they could not be justified. Or it might decide that the outcome of such a study was unlikely to produce results which deviated significantly from the CSA for certain modes or traveller categories.

Method

This would be a data driven study requiring an appreciation of the quality of the relevant data sets and their use for this purpose. It would probably be useful to have advisors or peer reviewers with good knowledge of the data sources and their limitations.

Resources

This piece of work could readily be carried out separately from and independently of the work required for Options 3 and 5 below. Desirably, it should precede and help to input to the work programme below. It could be carried out wholly or largely in-house (as in 2001) or let to a suitable outside contractor. It would be an important but not particularly large or time-consuming piece of work.

Timescales

We would envisage this being a 3 to 6 month piece of work from contract start date to delivery and acceptance.

Risks

The risk of the work not producing usable results is low. There are two main sources of risk. The first is that this piece of work produces unexpectedly large changes in values which then have to be managed within the system, with agencies etc. In our view, that risk needs to be recognised and accepted. The second is that this option may not on its own be sufficient since it fails to address the key critiques of the CSA, namely that for some types of traveller, journey length and mode, p and r are non-zero, or that willingness to pay approaches produce different results, or that the current method deals inadequately with walk, wait and crowding time on business trips. The evidence review presented in Section 3.1 should be considered to assess whether alternative methods would lead to values different from the cost saving approach. To cover this second category of risk, more radical options would need to be considered.

5.4 Option 3: Hensher Equation and Existing Evidence

Description

We prescribe the modified cost savings approach set out in section 2.4.2 and equation 2.4a. This is to us the more acceptable form of the broader Hensher equation, setting as it does VW and MPF to zero along with weighting of VL by *r*.

Justification

From a theoretical perspective, the Hensher equation offers a flexible and defensible framework for measuring the value of business travel time savings, and deals with the principal critiques of the cost savings approach. It has long been regarded as an intuitively appealing means of estimating the value of business travel time savings, has been investigated in most of the national value of time studies, and in some form or another has, at various times, been the basis of official appraisal guidance in the Netherlands, Norway and Sweden.

This particular option of using existing evidence, as in our understanding is the Swedish approach for rail, is a cost-effective means of implementation.

Method

Existing evidence is here used and hence there are no new issues of a methodological nature. There are however choices to be made as to the values of *p*, *q* and *r* to use, along with VL.

Section 6 sets out recommended *p*, *q* and *r* values to be input to a Hensher equation to serve as a sensitivity on the current cost saving approach. We believe these values, based on a comprehensive review of the literature, would provide a suitable basis for implementation of the Hensher equation. In the longer term, there is a strong argument that r should be zero, as in Sweden.

A Delphi survey might be conducted on the values of *p*, *q* and *r* whilst the findings of the recently completed Dutch national study should be evaluated when it is published in early in 2013.

Values for VL could be taken from evidence on non-business travel time savings but for the higher income levels and relevant distances characterising business travel markets.

Resources

Given that a comprehensive literature review has here been conducted of the Hensher parameters, it would therefore be a straightforward matter to calculate new official values based on this option. Indeed, section 6 covering sensitivity analysis effectively does this and with an extension to cover crowding and walk and wait time.

Further analysis of the *p*, *q* and *r* data collected for car in the 1994 UK VoT study (Hague Consulting Group et al., 1999) and in the SPURT study for rail (Mott MacDonald, 2009) might be considered. It would be useful to have a more detailed understanding of how *p*, *q* and *r* vary with various relevant factors.

Timescales

This option would benefit from updated MPL figures under option 2 but other than that could be implemented within 3 months.

Risks

There is the risk that the values obtained from previous studies are not appropriate, not least because of variations over time and also because much of the evidence relates to *p** and not *p*. Transferability would be improved if there had been more quantification of what impacts on *p*, *q* and *r* and by how much, as well as allowing a finer degree of segmentation in appraisal.

Concerns may remain about the validity of the figures whilst an element of uncertainty is introduced by, as is apparent in section 3.1.2, the variability of the evidence base. Do people overstate the amount of time spent working and the efficiency of that work relative to work at the normal workplace? Is *r* in the long run zero, as the Swedes accept, and if so what is the path of adjustment from the reported short run *r* figures to the long run zero? Is the MPL of important business trips adequately reflected in a wage rate that reflects average MPL?

There is also a significant risk, as is evident from the review of empirical evidence and summarised in Table 3.17, that this method, regardless of its intuitive appeal, somewhat understates the amount that companies are actually prepared to pay to reduce the travel time of their employees. The values could therefore be readily subject to challenge from a large amount of WTP evidence.

5.5   Option 4: WTP and Existing Evidence

Description

Adopt business values based on the available WTP evidence.

Justification

It can be argued that it is difficult to object to this method on theoretical grounds; it offers a clear, simple and unambiguous measure of the value of business travel time savings. What companies are prepared to pay to save their employees' time is a direct measure of its value to them.

The option of using existing evidence is a cost-effective means of implementing a WTP based approach.

The WTP approach does not require the MPL and hence any assumptions and approximations involved in taking the labour costs to represent MPL and in calculating labour costs are avoided.

Method

Existing evidence is used here and hence there are no new issues of a methodological nature. There are however choices to be made as to which evidence to use.

Section 6 sets out some values which we recommend for sensitivity analysis upon the current approach. We believe these values, based on a comprehensive review of the literature, would provide a suitable basis if it were decided to implement a WTP approach based on existing evidence. The findings and recommendations of the recently completed Dutch national study should also be evaluated when it is published early in 2013.

Resources

Given that a comprehensive literature review has here been conducted of WTP evidence, implementation of this option would require minimal resources.

Timescales

This option could be implemented within 3 months.

Risks

There are several sources of evidence and they do not tell an entirely consistent story. The employer based evidence would support retention of the current values but it is limited and dated. The UK employee based evidence provides values lower than the wage rate, with the exception of high speed rail evidence where a premium would be supported which is also the case for the European WTP evidence.

There is a risk that the non-employer evidence which forms the vast majority does not accurately reflect company WTP. In the UK at least, it indeed seems that SP evidence does not fully reflect company policy but then even the RP evidence, limited as it is, might reflect a blend of company policy and personal preference.

Unless the results of meta-analysis were adopted, which are based on analysis of a mix of business and non-business values but predominantly the latter, the existing evidence is not particularly informative with regard to mode and distance or indeed other segmentations. In any event, WTP values can be expected to vary, perhaps more so, with a range of factors other than mode and

distance, such as the importance of the business trip, the category and income of staff involved, and the extent to which journeys are made outside of normal hours, amongst other things. Existing evidence does not provide any insights here.

5.6 Option 5: Hensher Equation and New Evidence

Description

As Option 3 but populated with fresh evidence on the Hensher parameters.

Justification

If the Hensher equation is an appropriate basis for the business value of time, up-to-date parameters are needed and, ideally, parameters that can be made specific to a particular context.

Deficiencies with existing evidence need to be addressed, such as a more flexible MPL allowing for the importance of the activities undertaken, and p, q and r parameters that cover a wider range of issues and are robust to over-reporting of p and q and under-reporting of r. Ideally evidence is required on whether all the benefits of times saving accrue to the employer in the long run and some insights into how p and q might vary over time.

Method

Prior to any survey that attempts to determine p, q and r, we feel it would be sensible to conduct some exploratory research with respondents about working during the course of a journey, how that information might be best collected and indeed validated, how things have changed over time, and what influences it. Whilst prudent to conduct such research before a large scale survey, given that concerns surround the collection of p, q and r data, we do not see this as a particularly challenging or time consuming task.

Our review was based on drawing conclusions from variations in p, q and r across studies. We here propose that the emphasis is on a more controlled examination of variations in p, q and r within a study. The factors that should be examined, as set out in section 3.1.5, are:

- The size of the journey time change and whether the time change is a gain or a loss

- Mode of travel, including sub-modes such as type of train, car or plane and in-journey facilities

- Journey length, time of travel and direction of travel, being clear as to what stage of the journey p, q and r relate to

- Purpose of business trips (i.e. activities undertaken at the destination)

- Occupation, seniority, employment contract, and remuneration basis

- Interactions between p (and $p*$), q and r (and $r*$)

- Estimates of how these parameters have changed over time

- Crowding and comfort levels for rail, both seated and standing and the proportion they form of the journey, and also walking and waiting time

- Short and long term response, including examining say a weekly time dimension and the transfer of activities across a longer timeframe than just a single journey

- What, when asked, are the (other) factors that explain why travellers devote a particular amount of time to work, or indeed do not work, and would take a specific amount of time as leisure time

- What is the impact of using $p*$ and $r*$, and if easier to operationalize, what is the relationship between p and $p*$ and between r and $r*$

Given the long recognised issue of respondents overstating the amount of time they spend working on trains, some kind of observational means of verification of $p*$, or indeed p, would seem to be warranted. This might involve monitoring of behaviour after a journey time variation as well as CCTV or other observation of behaviour. Similarly, convincing verification of previously high values of q would be desirable.

There is a need for some informed research on how values might vary over time, for example, as the ability to work varies or as companies increasingly require their employees to make productive use of travel time.

There needs to be empirical support for variations in MPL, not only by employment type but by the productivity of the activity which drives the business trip.

In the long run, there is a reasonable expectation that r equals zero, that is, in the long run all travel time savings are converted to working hours. This argument has been supported by the observation that despite substantial increases in travel speeds over several decades, there are no indications that business travellers nowadays spend less of their leisure time on business trips; hence, there seems to be no indication that some of the travel time savings have been converted to leisure time.

Research might be conducted to determine whether this holds true, particularly for relatively small time savings. Firstly, cross-sectional evidence could compare those who have experienced a time saving (e.g. Eurostar users, travellers in Kent to London) with those who have not. Secondly time

series evidence could examine how companies (and employees) responded to the time saving. Thirdly, employer expectations and intentions might be examined. Finally, employees themselves could be asked what would happen in the long run.

As far as we are aware, nobody has tried to estimate VW and MPF as we have here defined them. We do not believe it would be sensible to commit to a large scale piece of work to estimate them given there are reasons why they may be approximately zero. We would therefore propose as part of any exploratory research that respondents are probed on these issues. Should it then emerge that they might be significant factors, more detailed quantitative research could be pursued.

Updates to the valuation of VL, particularly for car, are necessary.

Resources

SPURT obtained a rail sample of almost 1700 observations whilst the relevant part of the 1994 UK VoT study achieved a sample of 1364 car users. To cover a broader range of distances and crowding levels and to support more detailed analysis, we suggest a sample of 2500 for each of car and rail.

We envisage that this information can be obtained by self-completion questionnaire but this might be the subject of testing at the exploratory stage.

The resources needed to address the long run level of r, which will make a large difference to the implications for the Hensher formula for value of time, would be significant. Employer surveys tend to be expensive even if the set of questions posed is not large whilst a large sample of travellers would be needed to detect statistically significant differences in the amount of leisure time spent on business trips between those who have experienced a time saving and those who have not. The cheaper options would be to contact those such as Eurostar travellers who have experienced a time saving. This can probably be done through on-train surveys but it is questionable whether self-completion will be adequate: if not, an interview approach is needed. Asking employees what they would expect to happen can be done as part of other surveys.

Of the cheaper options, large samples of, say, Eurostar users can be obtained at modest cost whilst asking employees about expectations is very cost effectively conducted as part of this or related surveys.

A relatively straightforward SP exercise is required to update VL for car. This might involve a sample of 500 self-completion based questionnaires. Consideration should be given to extending to cover air users and rail. The SP exercise should cover all attributes of possible relevance and not just IVT.

Timescales

We believe that the exploratory research and development of the p, q and r models from purpose collected data could be achieved within 9 months.

Although other aspects of the study can run concurrently, if MPF and VW were to be investigated then it would make sense to increase the timescale to a year given the novelty of such analysis[28].

These timescales would fit with research into the long run value of *r* which could proceed as a parallel activity.

Risks

As with any data collection, there are risks involved in collecting the *p*, *q* and *r* information, and these are increased because we are proposing greater detail than previous studies. A novel issue here is the development of quantitative models and there is no guarantee that these will be as robust as desired. In particular, a key risk is that there remain concerns about the validity of the responses obtained. There remains a risk that the results would not be robust, as reflected in the variability in the evidence base in this area and by the fact that previous studies have not already answered all the questions.

Resource may be committed to exploring MPF and VW and yet they turn out to be near zero. This is why we propose 'scoping' this issue in the exploratory research stage.

There is a risk that even with large samples the results of looking at variations in work time due to travel time variations might still prove inconclusive.

There remains a risk that the Hensher approach does not provide an appropriate basis for the benefit to companies of time savings for their employees as reflected in what they would be prepared to pay for such time savings.

5.7   Option 6: WTP and New Evidence: Employers

Description

Analysis of the decisions made by companies when their employees are faced with the opportunity to save time by paying more or the identification of specific company rules/formulae.

Justification

The principle justifying such an approach is that if we wish to establish the value to companies of time savings for their employees then we should ask them. This can include observing what they do as well as putting them in the position of responding to hypothetical scenarios.

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[28] For all these Future Options, the timescales relate to conducting the research that underpins revised values but do not include evaluating the findings, consultation and implementation in guidance

Whilst the Hensher equation can be seen to represent what a rational, profit maximising company should be prepared to pay for reductions in travel time, do companies actually follow such an approach?

The first two studies (Hensher, 1977; Fowkes et al., 1986) adopted this approach but it has not been used since in the briefcase travel market. The SPURT study (Mott MacDonald, 2009) had proposed such an approach but the option was not taken up.

The WTP approach does not require as input measures of MPL and the assumptions and approximations that can be involved with this. Nor are any of the issues surrounding p, q and r relevant here.

Fresh evidence is needed to address the important issue that company WTP can be expected to vary with a range of factors, such as the importance of the trip, category and income of staff, and the extent to which journeys are made outside of normal hours, amongst other things.

Do employers value all time the same (as implied by the cost saving approach but challenged by existing WTP evidence)?

Method

We do not think it prudent to embark immediately on the quantitative phase. Given the lack of research in the area and the complexities and uncertainties surrounding company travel, we recommend an initial exploratory phase. This would involve a mixture of 'market analysis' and qualitative research.

The market analysis aspect would be aimed at establishing what companies and their employees do, the principles underpinning behaviour[29], and who is responsible for and aware of policy. Why do staff travel by different modes in different circumstances? Do companies have the same policies and support for time savings for those who (they know) work during the journey and those who do not, for valuable meetings and more routine ones, for those (they know) who are travelling outside normal time and those not, for those (they know) who are very productive when working while travelling and those who are not? Indeed, how proactive is the company in ensuring p and q are maximised and r is minimised?

The qualitative phase would be aimed more at informing and pre-testing the quantitative methods and survey approach.

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[29] For example, it would be illuminating to establish the resonance of the cost saving approach and the Hensher equation. What are company views on and responses to p, q and r?

The two previous studies of employers' WTP were both based on SP approaches. Given the number of employers that can realistically be contacted, amongst other reasons, an SP approach is inevitable

We envisage this being face-to-face interviews with relevant company managers who are offered the possibilities to save travel time in a manner consistent with how their company operates. This might see company policy evolving in the light of possibilities or else the use of established procedures. Detailed interviews should be avoided, but details still noted, with companies who have no travel policy or where it is so prescribed/formulaic that it can be reported by other means.

The SP exercise might be based around real-world choice contexts, such as modes or routes, or around choices between unlabelled alternatives that bear no resemblance to a real-world choice context. Generally the latter is preferred on the grounds of avoiding extraneous influences that might distort the estimated degree of time-cost trading but it would not reflect actual business travel choice contexts. We would see it as an important feature of the exploratory research to determine which is more appropriate.

We see no reason why RP information cannot be collected. The only obstacle to conducting worthwhile analysis would be to obtain sufficient data. From this perspective, it might be helpful to collect RP information for different journeys and different categories of staff. It would be particularly useful to focus variations in (eg mode) decisions across different journeys and to understand the reasons behind the different decisions. Such information might be obtained through a 'follow-up' questionnaire.

A sample large enough to segment by the key elements of the standard industrial classification and standard occupation classification is required.

Resources

The resources required here would be significant. The exploratory work in itself is not a trivial exercise and could take up to three months.

As for employer based interviews, the common currency is that at most two interviews can be done in a day, and then by staff more experienced than would be employed to conduct, say, on-train surveys. Given the significance of the subject matter, and to support some detailed segmentation, we would recommend 500 completed surveys.[30]

It would also be sensible to ensure that any SP exercise obtains choice responses for each scenario that relate to different occupational categories within the company, thereby increasing considerably

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[30] Note that the recent Dutch freight VoT study, which is of relevance in the sense of employer interviews, had a target of 520 interviews.

the data set and essentially leaving 500 across company observations to explore the standard industrial classification issues given that the standard occupation classification has been addressed.

Timescales

Surveying 500 companies is likely to be a 6 month data collection task with an added 3 months of prior exploratory research. Given set-up, analysis and reporting, we would say that 15 months should be allowed for such a project[31].

Risks

The empirical challenges of implementing the method are far from trivial, and it has been rarely attempted in practice. Data collection is not straightforward; company surveys are time-consuming and the relevant staff must be identified. Risks of cost overrun or not achieving the required sample must be recognised.

The approach is essentially centred around the SP approach and hence issues of 'non-commitment bias' arise. We might expect the incentive to strategic bias/protest response to be less for companies than when individual travellers are faced with hypothetical time-cost trade-offs, but the exercise for companies is more artificial and surrounded with a greater degree of choice uncertainty. It is possible that there is an impact on the implied value of time, as well as the precision with which it is estimated.

Obtaining a representative mix of different business organisations is a challenge, and there are risks that there are wide variations in valuations, such as between private and public sector, small companies and large multinationals and by industrial sector, that make generalisation of the results difficult.

5.8 Option 7: WTP and New Evidence: Employee Revealed Preference

Description

Discrete choice analysis of business travellers' actual choices when faced with real and clearly apparent opportunities to save time.

Justification

This is much more cost effective than employer based studies yet it has a basis in real decisions and hopefully in large part reflects company policy.

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[31] But as we commented earlier, with considerable additional time to incorporate findings in guidance

Arguably it provides a firmer basis for forecasting than an employer SP exercise since it is based on what employees actually do.

The values of time can be readily linked to a range of relevant factors, including questions relating to the business traveller's motivations when deciding.

Method

This would be based on purpose collected data where business travellers are aware of a real time-cost trading opportunity. This is crucial if we are to base the modelling and implied valuations on what travellers perceive (report), which drives their actual decisions, rather than the common practice of imputing times and costs to alternatives which might bear no resemblance to the perceptions underpinning choices[32]. Given that the perceived values are a more appropriate basis for explaining choices and valuation, it is therefore essential that the choice contexts underpinning any empirical research are chosen judiciously.

Within mode choice contexts tend to be those where travellers are most familiar with the opportunity to save time and the precise trade on offer.

For rail users this might be route/operator choice. There are numerous examples, such as Kent High Speed versus MainLine, Chiltern and London Midland versus Virgin, Chiltern versus Great Western, and between Exeter/Southend/Peterborough and London where time savings can be obtained at the cost of a higher priced route or operator. The competition provided by Hull Trains and Grand Central might also be examined. Other trade-offs might exist across the network, particularly casting light on multipliers for crowding, interchange, walk and wait time.

For car users, the clearest trade-off is when a toll can be paid to save time. However, the problem with this approach, and one that has arisen in the past, is that in any specific context the toll is the same for all drivers and hence is indistinguishable from any other route specific effects. RP route choice studies have provided valuable insights when the toll has been variable[33]. The way to get around this problem in the UK is to survey at different sites, so that across the sampled choices the toll level varies.

We would not rule out the analysis of mode choice but such 'less controlled choice contexts' might not be necessary given the mode specific exercises above

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[32] This is a particular problem where the specification of alternatives is not obvious, such as when there is a choice of different tickets with somewhat different prices. But regardless of that, people make choices based on perceptions not on the outputs of network models!

[33] In Italy (Dawson, R. and Everall, P. (1972) The Value of Motorists' Time: A Study in Italy. TRRL Report LR 426, Crowthorne, Berks), in Japan (Kato, H., Oda, T. and Sakashita, A. (2013) Valuation of Travel Time Saving with Revealed Preference Data in Japan. Paper to be presented at 13th WCTR Conference, Rio de Janeiro) and in the United States (Brownstone, D. and Small, K. (2005) Valuing Time and Reliability: Assessing the Evidence from Road Pricing Demonstrations. Transportation Research A (39), pp.279-293)

A less conventional approach would be to examine how business travellers vary their choices across different situations and understanding why variations in choice occur and the influence company policy has on this. The aim of this would be to identify 'trigger points'. Such data could be obtained at low marginal cost given other surveys of travellers.

Finally, we feel there is merit in enquiring whether business travellers have faced situations where they were in a position to save time by spending the company's money. So for example, when were there opportunities to take a taxi to save time and was the option taken? Again this might be useful valued added information.

For each respondent, it is critical to determine that they are aware of the real world choice. They are then asked to describe the time and cost characteristics of the chosen and alternative options. The key to success is the judicious selection of choice context <u>and</u> traveller.

It is practical that SP questions are then asked of these business travellers and there are clear synergies from collecting both RP and SP data in the same exercise.

Resources

Given the significance of the market, and that much of this can be done with self-completion exercises, we would propose final, fully usable, samples of 1500 respondents for each of:

- Within-mode car specific exercises
- Within-mode rail specific exercises
- Choice contexts that provide information on walk time, wait time and crowding related variables, amongst other relevant factors

Timescales

This task on its own could be completed within 6-9 months.

Risks

Basing valuation models on perceived levels of times and costs is preferred because these underpin individuals' decisions and are asked about. However, there are concerns as to whether respondents correctly perceive the costs of the **alternative** options and particularly modes. This is why transport models often use engineered costs.

Should the issue of cost misperceptions be serious, this can be mitigated by obtaining a sufficiently large sample so that analysis can be conducted on a sub-set of those who either report that they are confident with their reported values or else network data indicates that their responses are accurate.

There are risks that the respondent is not making choices in terms of company policy. Thus the model would be appropriate for forecasting but not reflect the true value to the company of the saved time. . A particular case is the principal/agent problem where a traveller makes choices that are quite clearly not in the company interest, such as being influenced by loyalty schemes or other privileges.

There might be 'self-justification' bias, whereby respondents report the chosen option to be more attractive than it is and/or report the rejected options as less attractive than it is perceived. The exaggerated difference justifies the choice made.

Whilst we have proposed very careful selection of familiar and clear-cut real-world choice contexts, it may still be the case that the actual choices are influenced by extraneous factors and constraints, such as say reliability, comfort or the need to be somewhere for a specific time. These can lead to biased value of time estimates.

It is widely regarded that there are greater chances of not being able to develop robust RP models than of not being able to recover robust estimates in SP models. In particular, RP models have much inferior levels of precision of coefficient estimates than do SP models.

In summary, we are reliant on obtaining unbiased estimates of the respondent's values and that these values reflect company benefits.

5.9   Option 8: WTP and New Evidence: Employee Stated Preference

Description

Offering business travellers SP exercises and eliciting responses that reflect what their company would permit.

Justification

A cheaper alternative than both employer SP and employee RP with an ability to obtain a large sample. It would provide a degree of insurance against other methods failing to deliver satisfactory results.

Other attractions are increasing the precision of estimates, being able to examine socio-economic and trip characteristic effects in more detail, and covering attributes not amenable to investigation with RP data.

Method

The study should commence with exploratory research, with an added emphasis on how respondents do consider or can be made to engage with company policy and how we can detect whether they have done so or not.

There are two options here. One is to offer choices between two unlabelled alternatives (A and B), as was done in the 1994 UK Value of Time Study. The other is to base it around a real choice context, such as those proposed for the RP approach.

When the purpose of an SP study is valuation, there is generally a preference for 'abstract choice' SP exercises based around unlabelled alternatives. This is because it avoids the SP responses being 'unnecessarily polluted' by extraneous influences. However, business travellers are here being asked to make choices in the context of company policy. It can be argued that abstract choices, by definition, do not exist in the real world and hence the challenge of ensuring that the SP responses are based around company policy might be made greater.

On balance we would prefer to see the SP exercises based upon real world choices for the purposes of realism in the context of company policy, but this is something to test at the exploratory stage. A further attraction of this approach is that the SP exercises could be based around the RP choices contexts and hence direct comparisons made.

Debrief questions would collect information on relevant issues such as reimbursement, the use of time saved, awareness of company policy and compliance with it to support the interpretation of the results.

Those who are self-employed would provide an interesting benchmark, given that for them the company policy issues are 'internalised', and we recommend that a part of the study is devoted to a sufficient sample of this category of traveller.

In addition to the main SP exercises, supplementary exercises should be considered to ensure that full benefit is obtained from the survey in terms of covering the complete range of relevant variables. Some might cover issues surrounding departure times, class of travel, stopovers, use of taxis, and on-board facilities.

Resources

Given the significance of the study, and the cost effectiveness of collecting this form of data, we would propose large samples to support segmentation by industrial and occupational classification. Samples of 1000 of each mode would seem appropriate, particularly if data can be collected by self-completion means. Customisation would require a computer based approach, increasing the costs of data collection somewhat.

Timescales

There would though be benefits of running this in tandem with the RP study and indeed basing some of the SP exercises on the same real world choice contexts. As a stand-alone piece of work, we see no reason why this could not be conducted within a year inclusive of the detailed exploratory phase.

Risks

There is a chance that respondents do not fully account for company policy and that there is a degree of ambiguity as to what the values represent. Some respondents might feel that the company would pay whatever was needed to make the journey, leading to inflated values, whilst others might respond as if paying themselves and hence result in deflated values. Others might genuinely respond in terms of their perceptions of company policy but may be misguided as to what that is. The principal/agent problem might also arise here, whereby individuals pursue selfish interests that conflict with the employer's best interests.

As with any SP method, respondents are not committed to behave in accordance with their stated preferences, although they are perhaps less likely to protest against higher costs when it is not their own money. Other response biases might be apparent, such as justifying the actual choice made, affirming with the perceived aims of the study or breaking of the habit effects that would exist in the real world.

5.10 Option 9: Repeat of Fowkes et al. Study/Triangulation

Description

Using at least three different methods to provide estimates of the value of time.

Justification

As far as we are aware, the Fowkes et al. (1986) study provided the most extensive comparison of different approaches. That study was well received and we believe it is timely to repeat it given it is over 25 years since it was done.

This triangulation approach is often favoured in the social sciences. Convergence of at least two methods is deemed desirable and is felt to allow more confidence to be placed in results. If three methods conflict, then the investigator needs to re-formulate the research. Unless there is one outstanding candidate method, knowing that the different approaches yield different valuations is an important finding.

Adopting any of the single method approaches set out in sections 5.3 to 5.9 in isolation implies that that method is preferred. This could be regarded to be a controversial preference given that our review evidence throws up some quite disparate findings.

Coverage of different methods places more emphasis on:

- Identifying what drives how companies value and benefit from time savings for their employees

- Recognising that there might be differences across companies

Methods

One method would simply be the cost saving approach, with suitable disaggregations by key relevant variables such as distance, mode and occupation.

The other methods are:

- The Hensher Approach

- Employer WTP

- Employee RP

- Employee SP

The Hensher approach is an obvious candidate within the triangulation approach[34] whilst it is difficult to overlook the employer based WTP approach given it is their benefits that are being estimated.

The employee RP and SP methods could be combined within a single data collection exercise approach and should be adopted as further possibilities.

Our review of the literature has demonstrated differences based on existing evidence. We must also recognise that different companies might value business travel time savings in different ways. It is therefore essential that measures are taken to try and identify <u>how</u> companies value travel time savings as well as by <u>how much,</u> so as to be in a position to identify a preferred approach and how this varies across companies.

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[34] Ideally this would be the full Hensher approach but a restricted version would be acceptable

Resources

The resources involved in this approach would be significant, but 'economies of scale' might be expected. For example, the Hensher surveys could be conducted as part of the RP and SP data collection exercise. It might not be unreasonable to expect that the required resources for a single triangulation study would be around 75% of the combined resources required for each study separately, including the further work aimed at unravelling company decision making processes.

Timescales

Although there is synergy between tasks and the possibility to run tasks concurrently, we would see such a major piece of research as realistically being undertaken over an 18 month period. Indeed, the original study, although on a smaller scale than that proposed here, was undertaken over a two year period. Nonetheless, we would expect a more concentrated resourcing to be possible whilst avoiding the need to address some of the exploratory and methodological challenges facing the original. The analysis stage would still be significant as would the extra effort in ensuring co-ordination of the three approaches.

Risks

The Fowkes et al. (1986) study was well received, and no doubt a contributory factor in that was the similarity of the results across different methods. However, there is a risk that conflicting results might emerge from the three or more methods used and that these cannot be explained. Indeed, our review of previous evidence indicates that there is a reasonable possibility of this occurring. Whilst we have advocated research to identify the means by which companies value time savings, allowing for differences across companies, we must recognise that there remains a possibility that the results are inconclusive.

With the exceptions of the suitability of the technique, the risks are essentially the same as for the individual approaches, although it would be highly unlikely to experience simultaneously serious difficulties with all of them.

Close control needs to be maintained of the overall 'experiment'; we see significant risks attached to parcelling up different aspects of the triangulation as separate pieces of work.

Table 5.1: Summary of Future Options

OPTION	DESCRIPTION	PROS	CONS	RESEARCH TIMESCALES
1	Retain Current CSA	Cheap and simple!	Values are out of date Method lacks credibility in some quarters with theoretical concerns	
2	Update Current CSA	'Do-Minimum' Option. Input values can be updated Can introduce a distance dimension. In principle suitable for professional drivers, but in practice NTS excludes professional driver mileage.	Possibility of unexpectedly large changes and inability to explain these changes. Does not address concerns with CSA for briefcase travellers.	3-6 months
3	Hensher using Existing Evidence	Intuitively appealing approach. Allows for productive use of time and different travel conditions. Straightforward and cost-effective to implement	May be inappropriate method. Lack of detail in parameter estimates. Are parameters valid and up-to-date? Values challenged by large amount of WTP evidence.	3 months
4	WTP using Existing Evidence	Intuitively appealing approach. Straightforward and cost-effective to implement. Allows for different types of time. No need for MPL estimates	Concerns over evidence – little for employers, ambiguity for RP and especially SP values. Evidence not entirely consistent.	3 months
5	Hensher New Evidence	Intuitively appealing approach. Allows for productive use of time More (very) detailed, reliable and up-to-date parameters	May be inappropriate method Is r zero in long run? Resources needed for new study. Are new parameters robust?	9 months
6	WTP New Evidence: Employers	Based on what employers would pay. Up-to-date and does not require MPL measures	Largely based on stated not actual behaviour. Expensive, time-consuming and risky data collection	15 months
7	WTP New Evidence: Employee RP	Based on actual behaviour. Up-to-date and does not require MPL measures	Significant survey costs. Need to identify well-defined and familiar choice contexts. Is company policy followed? What about personal values of time?	6-9 months
8	WTP New Evidence: Employee SP	Large sample sizes at modest cost. No need for MPL and yields up-to-date figures	Is company policy followed? Response bias - not based on actual behaviour. Exploratory research needed.	12 months
9	Triangulation	Intuitively appealing approach. Potential to instil more confidence in results. Emphasis on different companies are different.	Different methods yield different results. Most expensive option – significant resources needed.	18 months

5.11   Summary of Options

Table 5.1 summarises the pros and cons of each of the options that we have put forward and indicates the timescales that we feel would be involved.

5.12   Additional Research Issues

As part of this research undertaking, we have identified a number of issues that are felt to warrant further research. It is worthwhile recording these ideas, so that the Department can consider the merits of pursuing them, and we here set them down. Less attempt has been made, however, to elaborate upon the basic idea than has been done with our identification and discussion of the 9 Future Options set out in sections 5.2 to 5.10.

Definitive statement regarding who, where, when and how people travel on employers business.

Incredibly, no one seems to have done this:

- Who: occupation, industry, hours worked, contractual arrangements re: overtime payment
- Where: journey length (short/long), urban/inter-urban/international
- When: time of trip start, time of trip end. Does the trip lie in normal working day?
- How: mode(s) of travel

The method would involve analysis of NTS data, noting though that NTS does exclude some kinds of business travel. A four dimensional matrix along the above four points is needed here.

This might well be suitable for a masters dissertation. Given there can be issues of sample size with NTS data for some segments, supplementary data sources should be sourced.

It is also important to determine how all this varies over time. Whilst technologies that support work while travelling are changing over time, the very nature of the business traveller population and the type of work they are engaging in can also be expected to be vary over time.

Implications on business values of time from using the LFS and ASHE to derive hourly wage rates and the NTS for distance weighted proportions of occupations/industries by mode?

This is the most extreme version of what was proposed in our review of data sources. Given the need to look at three datasets it might be too large for an masters dissertation, but maybe some sort of reduced form of this just focusing on say the NTS is feasible. Our understanding is that the Department are already exploring this.

'Futures' Work

Given the significance of both the ability to work while travelling and its efficiency on the business value of time, there should be some futures work to examine how and to what extent the information age might further advance in ways that affect what people do and where and when they can do it.

Can workers convert business time savings into leisure?

Ex post work on behaviour of business travellers to changes in travel time. This need to consider how individuals react and how firms react. Noting that some individuals may spend less time travelling but that the business may re-balance inputs so that on the whole more business travel is engaged in. It will be hard though to find an appropriate location to case study.

A related issue is exploring why some people during all or part of their journey do not work when it is practical for them to do so, linking to the concept of 'who owns the time?'. Why is the value of time linked to journey purpose when it is what people are doing with their time while they travel that dictates whether that time is valuable to their employer or to them personally.

Are business travellers compensated through the wage for onerous travel conditions during the course of work?

This work is concerned with the debate on whether the value of r is zero for all trips. If workers are compensated at below the wage rate then the value of $r >0$. The research would utilise a wage study on otherwise equivalent workers who travel different amounts during the course of work. This is equivalent to wage studies on the value of a statistical life. It would probably require an internet survey with a large response. An alternative approach could be to use SP to ask employees to trade off increased/reduced business travel against the wage.

It might be suitable for a PhD, though the survey would need to be funded externally, or as a freestanding piece of work.

Destination Utility

The point has been made that the time savings might be valued above MPL if they allow more highly productive time to be spent at the destination. Standard modelling assumes that the 'destination utility' is not dependent upon travel time, and so it can be ignored in appraisal. There is a need here to develop the standard theory to deal with long distance travel.

Gap between MPL and wage

In the longer term (12 months plus) the Department could commission research to better identify the gap between the wage and the marginal product of labour. Some of the problems related to the

Hensher/cost-savings method arise because worker wages and costs are used as a proxy for the increased output obtained from marginal increases in available working time, but wages deviate from marginal product for all the reasons discussed. An alternative potential approach which circumvents many of these problems is to obtain estimates of the productivity of work time directly using firm micro-data, with information on firm outputs and labour inputs. Better still is to link these data to worker level data with detail on worker characteristics wages and hours. Recent research in labour economics has developed methods for working with this type of linked employer-employee data (Abowd and Kramarz, 1999), and a growing body of literature provides empirical applications. Detailed firm/plant level data and individual worker data that can merged together by workplace identifiers is increasingly available, and the Annual Respondents Database (ARD) firm data and Annual Survey of Hours and Earnings provides the potential for this analysis for the UK. Although not without its problems, both in terms of data set up and analysis, direct measurement of the marginal product of working hours from firm level data provides an alternative strategy which could be used to provide a point of comparison with wage-based estimates of the value of business travel time savings. The size of these datasets also allows scope for analysis by occupational, industrial and geographical groups to provide greater insights into the heterogeneity, both in marginal product of work time, and on the deviation between marginal product and wages. Some papers have already looked explicitly at the correspondence between wages and the marginal product of labour using these kinds of data, both in the US (Hellerstein, Neumark and Troske 1999) and for Britain (Galindo-Rueda and Haskel, 2005; Haskel et al., 2005) and provide potential prototypes.

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6. APPLYING EMPIRICAL EVIDENCE TO TRANSPORT APPRAISALS

6.1 Background

One of the aspects of this study was to advise the Department for Transport on the application of the evidence review conducted here on the business values of time to relevant transport appraisals in the short-term pending any future long-term analytical work in this area.

This will allow the Department to test the robustness of appraisals to different assumptions regarding the business value of time (or, conversely, to determine what VBTTS would be needed to realise a given BCR). It inevitably means suggesting tests based on secondary evidence, making use of the extensive review we have undertaken, along with the use of some judgement.

On the basis of our review we see three appropriate frameworks for evaluating the business value of time and suggest tests based around these and the evidence they have yielded. The frameworks are:

- The Current Cost Savings Approach

- The Hensher Equation

- A Willingness to Pay Approach

The Cost Savings Approach as currently implemented in WebTAG is widely regarded to be in need of updating the data that underpins it. This in itself is not a sensitivity test, but rather the adoption of the most appropriate and up-to-date figures, although our suggested segmentations by journey distance could be regarded as sensitivities.

Journeys made in the course of business should distinguish those made by so-called briefcase travellers and those made by professional drivers whose job it is to spend time travelling. This work distinguishes between these two categories.

We first summarise in section 6.2 the value of time sensitivities that we have proposed. The remaining sections provide more detail and justification for the value of time sensitivities that we have proposed.

6.2   Summary of Evidence

6.2.1   Professional Drivers

We are inclined towards the argument that since, as far as we are aware, there is no substantive challenge to the Cost Saving Approach, no sensitivity testing is required in respect of drivers' time, although rebasing is necessary.

The Department for Transport has often considered 'missing' components of the total logistics value, as in the NATA Refresh (Department for Transport, 2007) but frankly we do not think these are likely to be large and are more relevant to reliability than pure time savings.

Sensible sensitivities around the central Cost Savings Approach values might be:

- Use the Hensher approach to derive the value of time. This might usefully develop a 'middle way' distinguishing between those who travel as part of their job, such as plumbers and salespeople, and those who are professional drivers. This was discussed in section 3.2;

- As recommended by the 1994 UK Value of Time study, add the driver's valuation to the employer's valuation;

- Examine the outcomes of the Dutch study when published.

However, we are not suggesting that these can be readily implemented in the short term.

6.2.2   Briefcase Travellers

Sensitivities on the current Cost Savings Approach for briefcase travellers can be constructed using the Hensher equation or by adopting willingness to pay findings.

Hensher Equation

The Hensher approach requires estimates of the amount of time saved that would otherwise have been spent working while travelling (p), the productivity of working while travelling relative to productivity at the workplace (q), the proportion of time saved devoted to leisure (r) and the employee's valuation of travel time saved when on company business that accrues to them (VL). Based on a review of international evidence, three sets of p, q and r parameters are recommended for testing, as set out below in Table 6.1.

Note we base the Hensher approach here on the restricted version of equation 2.4 where MPF and VW are both set to zero.

Table 6.1: Suggested Hensher Parameters

	p	*q*	*r*
Hensher 1			
Car	0	n/a	0.44 (<120 mins)
			0.54 (>120 mins)
Rail	0.60 (<45 mins)	1.0	0.48 (<45 mins)
	0.30 (45-149 mins)		0.53 (45-149 mins)
	0.20 (150 mins+)		0.65 (150 mins+)
Hensher 2			
Car	0	n/a	0.2
Rail	0.2 (urban)	1	0.4 (urban)
	0.3 (inter-urban)		0.35 (inter-urban)
Hensher 3			
Car	0	n/a	0
Rail	0.60 (<45 mins)	1	0
	0.30 (45-149 mins)		
	0.20 (150 mins+)		

Willingness to Pay (WTP) Approach

On the basis of the relationship between a large amount of mainland European evidence and corresponding labour costs, backed up with evidence from a large number of bespoke high speed rail studies, a sensitivity of a 25% increase on current values is suggested.

6.3   Implications for Business Values

6.3.1   Overall Values

We report in Table 6.2 below values of time for briefcase car and train travellers based on the three approaches mentioned. The cost savings figures are from webTAG Unit 3.5.6 whilst the Hensher equation uses the *p*, *q* and *r* set out above which split by distance band. We then consider distance and crowding effects and suggest sensitivities for walk and wait time.

Table 6.2: Business Values of Time: Current Official Values and Sensitivities (£/hr 2010) [35]

	Car Short	Car Long	Rail Short	Rail Medium	Rail Long
WebTAG	33.74	33.74	47.18	47.18	47.18
Hensher 1	22.63 (0.67)	20.10 (0.60)	5.05 (0.11)	17.76 (0.38)	19.02 (0.40)
Hensher 2	28.69 (0.85)	28.69 (0.85)	26.22 (0.56)	22.95 (0.49)	22.95 (0.49)
Hensher 3	33.74 (1.00)	33.74 (1.00)	18.87 (0.40)	33.03 (0.70)	37.74 (0.80)
WTP	42.18 (1.25)	42.18 (1.25)	58.98 (1.25)	58.98 (1.25)	58.98 (1.25)

Note: Figures in brackets express values relative to webTAG

6.3.2 Distance Effects

There are here distance effects included in the Hensher equation, although they are not all the same direction. These distance effects are related to variations in p and r by distance band.

We are also recommending a distance segmentation on the marginal product of labour (MPL) which will work through into a distance effect in the Hensher equation and indeed the Cost Savings Approach. Such a distance effect on MPL is something we cannot advance here but is something the Department should consider going forward.

The WTP data also indicates that these values exhibit a distance effect. However, we find the distance elasticity to be on the high side and are unable to offer a credible, evidence based distinction between urban and inter-urban trips.

6.3.3 Implications for Business Values with Crowding

Time spent in crowded conditions typically attracts a premium for non-work travel. Under the Cost Savings Approach, time is considered to be the same regardless of whether it is walk time, wait time, time spent in uncrowded conditions or time spent in crowded conditions. However, under the Hensher approach, both p and the employee's valuation will vary with crowding.

Our recommended sensitivities under the Hensher approach use values from both the Passenger Demand Forecasting Handbook (PDFH5) and meta-analysis (Wardman and Whelan 2011) for the crowding multipliers, and SPURT (Mott MacDonald 2009) for the effects on p and q. Table 6.3 below contains currently used 'official' rail crowding penalties based on PDFH (although not specifically for business travel) and sensitivities based around meta-analysis evidence[36]. It should be recognised though that implementing values adjusted for crowding in modelling is far from straightforward, not

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[35] Of course, the figures in the table will be different if the webTAG figures are rebased (or indeed if they are split by distance)

[36] The meta-analysis figures are given as a sensitivity on the official PDFH values since the latter are not specifically for business travel but the former are.

least because of feedback effects on demand of increased crowding which in turn impacts on crowding and variations in crowding levels across a journey.

Table 6.3: Load Factor Impacts on Seating Multipliers and Hensher Parameters

Load Factor	Seating Meta	Seating PDFH	p Factor	q Factor
60%	1.02	1.00	1.00	1.0
80%	1.11	1.03	0.83	1.0
100%	1.20	1.07	0.50	0.9
120%	1.29	1.13[1]		
150%	1.45	1.19[2]		

Note: [1] and [2] are at 0.5 pass/m^2 and 1.0 pass/m^2 respectively

Table 6.4: Business Values <u>with Crowding</u>: Current Official Values and Sensitivities (£/hr 2010)

	Rail Short		Rail Medium		Rail Long	
	PDFH	Meta	PDFH	Meta	PDFH	Meta
WebTAG	47.18		47.18		47.18	
60% 80% 100%	47.18 (1.00) 48.60 (1.03) 50.48 (1.07)	48.12 (1.02) 52.37 (1.11) 56.62 (1.20)	47.18 (1.00) 48.60 (1.03) 50.48 (1.07)	48.12 (1.02) 52.37 (1.11) 56.62 (1.20)	47.18 (1.00) 48.60 (1.03) 50.48 (1.07)	48.12 (1.02) 52.37 (1.11) 56.62 (1.20)
Hensher 1 60% 80% 100%	5.05 (0.11) 10.13 (0.21) 21.23 (0.45)	5.22 (0.11) 10.83 (0.23) 27.38 (0.47)	17.76 (0.38) 20.46 (0.43) 26.23 (0.56)	17.96 (0.38) 21.24 (0.45) 27.49 (0.58)	19.02 (0.40) 20.98 (0.45) 25.05 (0.53)	19.26 (0.41) 21.94 (0.47) 26.60 (0.56)
Hensher 2 60% 80% 100%	26.22 (0.56) 28.05 (0.59) 31.93 (0.68)	26.37 (0.56) 28.64 (0.61) 32.88 (0.70)	22.95 (0.49) 25.55 (0.54) 31.18 (0.66)	23.07 (0.49) 26.06 (0.55) 32.02 (0.68)	22.95 (0.49) 25.55 (0.54) 31.18 (0.66)	23.07 (0.49) 26.06 (0.55) 32.02 (0.68)
Hensher 3 60% 80% 100%	18.87 (0.40) 23.68 (0.50) 34.44 (0.73)		33.03 (0.70) 35.43 (0.75) 40.81 (0.87)		37.74 (0.80) 39.35 (0.83) 42.93 (0.91)	
WTP 60% 80% 100%	58.98 (1.25) 60.75 (1.29) 63.11 (1.34)	60.16 (1.28) 65.47 (1.39) 70.77 (1.50)	58.98 (1.25) 60.75 (1.29) 63.11 (1.34)	60.16 (1.28) 65.47 (1.39) 70.77 (1.50)	58.98 (1.25) 60.75 (1.29) 63.11 (1.34)	60.16 (1.28) 65.47 (1.39) 70.77 (1.50)

Note: Figures in brackets express value relative to webTAG. Crowding multipliers applied to webTAG figures for completeness.

On the basis of the evidence covered in section 3.1, we take p*[37] to be unaffected up to 70% load factor, but we apply the ratios of 0.83 at 80% load factor, 0.67 at 90% load factor and 0.50 at 100 load factor. The values we suggest are supported by the evidence when crowding is involved are set out in Table 6.4.

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[37] Although it is p not p* that is most relevant.

We recommend for walking and waiting values sensitivities of:

- A *p* value of 0; or
- A *p* value of 0.2 and a *q* value of 0.9

In both cases, we also recommend:

- A weight of 2.0 attached to VL
- A weight of 1.5 attached to willingness to pay values
- Values of r as for in-vehicle time (IVT)

Table 6.5 sets out the business valuations for walk and wait time based on the recommended parameters set out above.

Table 6.5: Business Values of <u>Walk and Wait Time</u>: Official Values and Sensitivities (£/hr 2010)

	Car Short	Car Long	Rail Short	Rail Medium	Rail Long
WebTAG	33.74	33.74	47.18	47.18	47.18
Hensher 1 *p*=0	26.36 (0.78)	24.68 (0.73)	42.18 (0.90)	41.66 (0.88)	40.41 (0.86)
p=0.2 *q* = 0.9	20.28 (0.60)	18.61 (0.55)	33.69 (0.71)	33.17 (0.70)	31.91 (0.67)
Hensher 2 *p*=0	30.38 (0.90)	30.38 (0.90)	43.01 (0.91)	43.53 (0.92)	43.53 (0.92)
p=0.2 *q* = 0.9	24.31 (0.72)	24.31 (0.72)	34.52 (0.73)	35.04 (0.74)	35.04 (0.74)
Hensher 3 *p*=0	33.74 (1.00)	33.74 (1.00)	47.18 (1.00)	47.18 (1.00)	47.18 (1.00)
p=0.2 *q* = 0.9	27.67 (0.82)	27.67 (0.82)	38.69 (0.82)	38.69 (0.82)	38.69 (0.82)
WTP	63.26 (1.88)	63.26 (1.88)	88.46 (1.88)	88.46 (1.88)	88.46 (1.88)

6.4   Detailed Background to Hensher Application

6.4.1   Employer Element

We have conducted an extensive review of the values of *p*, *q* and *r* that have been recovered in previous studies. This leads us to suggest three applications based around different interpretations of the empirical evidence. Our synthesis of this evidence is provided below and could, in the longer term, be tested in a Delphi survey:

- Hensher 1: based on what might be deemed the most appropriate UK evidence - SPURT for rail (Mott MacDonald, 2009) and the 1994 UK VoT study for car (Hague Consulting Group et al., 1999);

- Hensher 2: this is a combination of what the review evidence overall (including non-UK evidence) is telling us and reasonable judgment;

- Hensher 3: setting *r* to zero on the grounds that in the long run all time savings will accrue to the employer and setting *p* to best evidence. This is essentially the Swedish approach.

Hensher 1

The recommended parameters for the Hensher equation based on what we regard to be the most appropriate UK evidence are set out in the Table 6.6 below.

Table 6.6: Recommended Hensher 1 Parameters

	p	*q*	*r*
Car	0	n/a	0.44 (<120 mins)
			0.54 (>120 mins)
Rail	0.60 (<45 mins)	1.0	0.48 (<45 mins)
	0.30 (45-149 mins)		0.53 (45-149 mins)
	0.20 (150 mins+)		0.65 (150 mins+)

The (mean) values of *p**[38] for car in our review are low. It is expected that *p* is less than *p**. We find it likely that the few productive activities generally undertaken by car will continue to be undertaken in the event of a time saving.

The *p* values for rail are taken from Table 8.8 of Mott MacDonald et al (2009). They tend to be higher than other evidence for rail but then they are somewhat more recent, more detailed, and relate to *p* not *p**.

Our review evidence broadly supports a *q* value of one; it covered international evidence from 10 studies and only two (Hensher, 1977; Ramjerdi et al., 1997) provided results that materially diverged from a *q* of one.

The *r* values for rail are taken from Table 8.8 of Mott MacDonald et al., (2009). Whilst high, similarly high values for rail are supported in other, largely overseas, studies, as is evidenced in our review.

The *r* values for car are taken from the 1994 UK VoT study (Hague Consulting Group et al., 1999). There is not a great deal of difference according to reported segmentations by business purpose, road type and distance band. The figures are broadly supported by overseas evidence.

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[38] Fowkes et al. (1986) pointed out that the proportion of travel time spent working, which they term *p**, is not the same as the *p* of the Hensher equation that relates to the proportion of saved time that would have been spent working.

VL is taken from the 1994 study for car and is £8.48 per hour in 2010 prices and incomes. The VL for rail is taken from SPURT and is £18.38 per hour. Not only is there an element of consistency in using these studies as the sources of VL, given they also here provide p, q and r, but they did explicitly value time savings that accrue to business travellers in the course of a business trip.

MPL is the valuation from the cost savings approach valuation, which at market prices from Table 1 of webTAG Unit 3.5.6 August 2012 is £33.74 per hour for car and £47.18 for rail in 2010 prices and incomes.

Hensher 2

We would expect a large range in r depending upon:

- whether employees are contracted to provide input hours or deliver outputs
- whether travel is undertaken in normal hours or not
- if travel is undertaken outside normal hours whether overtime payments are made, and
- how the use of time saved is directed/monitored.

Unfortunately, the detailed evidence base to support such distinctions does not exist and further work on the Hensher approach would need to be conducted to address this evidence gap.

The suggested numbers therefore involve an element of judgement and expectation, largely related to these r parameters, and are set out in Table 6.7.

Table 6.7: Recommended Hensher 2 Parameters

	p	q	r		
			Between AM and PM Peaks	Peaks and other times of day	All day
Car	0	n/a	0	0.5	0.2
Rail	0.2 (urban) 0.3 (inter-urban)	1	0	0.8 (urban) 0.7 (inter-urban)	0.4 (urban) 0.35 (inter-urban)

From the literature, p is essentially zero for car. For rail, looking at the evidence as a whole, a figure of 0.2 could be justified, with some evidence that it is higher for longer distance trips. These patterns are apparent in our review of the evidence.

Turning to r, we might expect it to be highly time period dependent, since during 'normal' work hours most travellers would in the medium to long run transfer travelling time saved to extra work. For the purposes of a second set of Hensher parameters, it is useful to try and reflect this variation by time period. Therefore if we make the assumption that all workers, who travel during the course of work, are working between the AM and PM peaks (i.e. between say 9am and 4pm) then r would be zero at those times of the day.

At other times of the day we would expect r to be greater than zero on average, particularly if the traveller is travelling outside of normal hours and is not paid overtime. There is no specific evidence regarding this group of travellers. When applying this to appraisals it is therefore necessary to make some further assumptions. For car we take an r value of 0.5 for trips made outside of the core working day, as this value is at the upper end of the observed range. We suggest values at the upper end of the observed range to reflect that we are dealing with a time period that is out of normal working hours. Of course, a lot of the business car travellers at this time will be on fixed hours contract which is why r is a long way from 1. As rail business rail travel is dominated by white collar workers in high level occupations we assume for the purposes of this test that they work unpaid overtime. We also assume that if they work during the trip (even outside of office hours) then if they did not make the trip or they experienced a time saving they would still undertake the 'extra' work either at home or in the workplace.

These two assumptions then imply that all time savings, aside from time spent working (p), savings come out of leisure - hence r = 1-p. These give us r values for rail (outside of the core working day) of 0.8 for urban and 0.7 for inter-urban. These values are quite similar to the Swedish values, which recovered figures of 0.78, 0.79 and 0.82 for inter-urban, express and regional trains respectively. r values for the all day averages, in the absence of any other data, are estimated by using a 60:40 split in the above values for car and a 50:50 split for rail based on the start time of trips reported in section 2.

The same figures are used for VL as for Hensher 1.

Hensher 3

This test assumes in the long run all time savings accrue to the employer and hence r=0. The proposition is that, in the long run, the working hours of executives, including travel time in the course of work, do not change as a result of travel improvements or that if they do change, this is reflected in the wage bargain. This is also the assumption used in Sweden on the same grounds. Any future analytical study should attempt to shed more empirical light on this issue, but pending that we think this continues to be a reasonable view.

The values of p used in Hensher 1 are those which are the most detailed and up-to-date figures for rail and consistent with the available evidence for car so they are also applied to this test. The same figures are used for VL as for Hensher 1.

6.4.2   Employee Element

The value to the employee of leisure time relative to travel time (VL) is typically estimated using SP exercises that require the business traveller to pay any increases in cost themselves or to pocket any reductions in cost. Our recommended Hensher approaches are based on the VL estimated using such methods in SPURT for rail users (Mott MacDonald et al., 2009) and the 1994 UK study for car users (Hague Consulting Group et al., 1999

Given the artificial nature of such SP exercises and uncertainties as to what the time saved is used for, an alternative would be to use valuations derived from more conventional SP exercises but allowing for the income and distance bands relevant for business travellers.

For example, a suitable test would be to use the models contained in the Bates and Whelan re-analysis of the 1994 UK VoT study's data for leisure travel (Mackie et al., 2003) with appropriate income and distance levels entered. This though is not a trivial task and was beyond the scope of this study.

6.4.3   Implications of the Hensher Sensitivities

Table 6.8 provides the webTAG values for car and rail and then the revised values based on the Hensher equation, the values for p, q and r specified in the three sets of sensitivities , the VL figures specified and assuming MPF and VW to both be zero. MPL is given by the webTAG evidence[39].

Table 6.8: Business Values of Time: Current and Sensitivities (£/hr 2010)

	Car Short	Car Long	Rail Short	Rail Medium	Rail Long
WebTAG	33.74	33.74	47.18	47.18	47.18
Hensher 1	22.63 (0.67)	20.10 (0.60)	5.05 (0.11)	17.76 (0.38)	19.02 (0.40)
Hensher 2	28.69 (0.85)	28.69 (0.85)	26.22 (0.56)	22.95 (0.49)	22.95 (0.49)
Hensher 3	33.74 (1.00)	33.74 (1.00)	18.87 (0.40)	33.03 (0.70)	37.74 (0.80)

Note: Figures in brackets express value relative to webTAG.

6.4.4   Crowding and the Hensher Equation

Time spent in crowded conditions typically attracts a premium for non-work travel. Under the Cost Savings Approach, time is considered to be the same regardless of whether it is walk time, wait time, time spent in uncrowded conditions or time spent in crowded conditions. However, under the Hensher approach, both p and the employee's valuation will vary with crowding.

Crowding and p and q

With regard to the impact of crowding on the productive use of time, as far as we are aware SPURT (Mott MacDonald, 2009) is the only source of evidence. In addition to exploring p and $p*$, SPURT also enquired as to the impact of crowding on productivity levels. Where a passenger was still able to obtain a seat it found different levels of crowding had little impact on their productivity. Crowding levels that required passengers having to stand did have a large impact.

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[39] Of course, the figures in the table will be different if the webTAG figures are rebased (or indeed if they are split by distance)

At 75%-90% load factor, 50% of the journey was spent working (i.e. $p^* = 0.5$). At load factors over 90% (without standing) it was 38%. We would expect crowding levels to impact on productivity.

In the absence of better information, we take this as 60% of the time spent working at 70% load factor, 50% of the time spent working at 80% load factor, 40% at 90% load factor and 30% at 100% load factor. Taking p^* to be unaffected up to 70% load factor, we apply the ratios of 0.83 (0.5/0.6) at 80% load factor, 0.67% (0.4/0.6) at 90% and 0.50 (0.3/0.6) at 100%.

For passengers who are forced to stand, the SPURT evidence suggests that p might be halved. We take this as 0.25, being 50% of that achieved seated at 100% load factor.

At crowding levels over 90% but still seated, there is support within the study for a lower q parameter of 0.9.

We suggest these as sensitivities in the Hensher equation in crowded circumstances.

Crowding and VL

SPURT finds a fairly strong effect on VL from crowding above the 75% occupancy level. This is consistent with other crowding evidence that load factor seems to have an effect at this sort of level prior to standing occurring (Wardman and Whelan, 2011). However SPURT in its SP exercise only examined crowding up to a level of 100% of seats taken and even then it is unclear at that level whether the respondent would have got a seat or had to stand.

PDFH provides multipliers for seating time values up to 100% load factor and for seating and standing beyond 100% load factor according to passenger per square metre. However, it does not segment by purpose.

As a sensitivity on the PDFH approach, there are two options. The MVA work (MVA, 2008), which underpins the demand modelling recommendations incorporated in PDFH, provides a thorough analysis of crowding but only one model distinguishes journey purpose. In a review conducted for the Department for Transport, Wardman and Whelan (2011) cover 20 year's of UK evidence and develop a meta-model that provides forecasts of load factor dependent multipliers for seating and standing for business travel.

We recommend that the Wardman and Whelan (2011) meta-model be used to underpin analysis. The implied multipliers for business travel are given in Table 6.9 and compared with PDFH. There are notable differences for the seating penalties.

Table 6.9: Load Factor Impacts on Seating and Standing Multipliers

Load Factor	Seating Meta	Seating PDFH	Standing Meta	Standing PDFH
60%	1.02	1.00		
80%	1.11	1.03		
100%	1.20	1.07	1.84	1.89[1]
120%	1.29	1.13[2]	2.00	2.01[2]
150%	1.45	1.19[3]	2.27	2.11[3]

Note: [1], [2] and [3] – These are at 0.0 pass/m^2, 0.5 pass/m^2 and 1.0 pass/m^2 respectively.

6.4.5 *Walking and Waiting and the Hensher Equation*

As with crowding, given that the Hensher equation admits an employee valuation, then it is necessary to allow for any premium valuation of walking and waiting time whilst the levels of *p* for walking and waiting also need to be determined.

We are not aware of any evidence on the value of *p* for walking and waiting. However, there are analogies here with car travel. Not only might we expect the values of *p* to be low for walking and waiting, but if there are important activities to undertaken at this time (such as urgent phone calls) then it could be argued that these will continue to be undertaken even after the saving in walking time or waiting time.

On the other hand it is possible to think, converse with colleagues and make mobile phone calls while walking and waiting. Annex 4 provides further discussion of such issues. In the absence of other evidence, and given that the 'travel conditions' for walking and waiting have parallels with crowding, we would suggest a halving of the *p* value along the lines recommended for crowding that requires standing.

As for *q*, we might regard it to be lower when walking and waiting in line with crowding.

As sensitivities on the values of *p* and *q* in the Hensher equation, we suggest:

- A value of *p* of zero
- A value of *p* of 0.25 and a value of *q* of 0.9

In terms of the valuation of walk and wait time to the employee, conventional wisdom applies a weight of around 2 to 2.5 to these attributes, and this is WebTAG guidance for non-work travel.

The meta-analysis evidence would suggest that a multiplier of 1.5 on VL would form a suitable basis for sensitivity testing.

6.5 Detailed Background to WTP Based Recommendations

6.5.1 Employer Studies

We understand that there have only been two employer studies, both of which were conducted over 25 years ago (Hensher, 1977; Fowkes et al., 1986), although such approaches are more common in the freight market. The values they obtained were consistent with the values derived from the cost savings approach. Hence no test is suggested.

6.5.2 WTP Approach

The WTP approach has to rely on the evidence that is available. Sensitivities could be derived from RP and SP based findings, both with and without broader European evidence. Alternatively, bespoke evidence might be used, such as evidence from high speed rail studies informing high speed, Light Rapid Transit (LRT) studies for LRT schemes, and evidence from toll road studies for toll roads. We return to the bespoke evidence below.

Our review of evidence made use of a meta-data set recently updated to include mainland European evidence (Wardman et al., 2012) to supplement the UK evidence that has been amassed over many years and most recently analysed by Abrantes and Wardman (2011). The values collected cover the period 1960 to 2011. For the UK, there are only 6 RP observations for IVT but 165 SP observations. The corresponding figures for Non UK evidence are 32 and 95. As for walk and wait times, there is no UK RP evidence for business travel but 21 SP observations. In mainland Europe, there are 4 RP values and 6 SP values.

Our UK meta-data set yields business values of £34.68 per hour from RP studies and £21.9 from SP studies across all modes. These contrast with official values of £33.74 per hour for car and £47.18 for rail. If anything these would suggest a reduction compared to current recommendations, although the relationship can be expected to differ under rebased values and the SP values might not fully reflect company policy. However, there is support for a value in excess of the wage rate:

- The mainland European evidence suggests values of travel time savings 21% higher than labour costs when considering RP evidence, increasing to a 29% premium for SP evidence;
- The WTP values in some studies, notably the employer based values of Fowkes et al. (1986), exceed the wage rate;
- Our review of 11 high speed rail studies showed that the valuations were on average 50% larger than the gross wage rate, and 40% larger for the 6 UK studies.

The UK and mainland European evidence indicates that walk and wait time are valued 50% higher than in-vehicle time for business travel. Indeed, this is backed up a recent meta-analysis of European

wide time multipliers (Wardman, 2013) in which the figures derived from the model for train business travellers varied between 1.6 and 1.4 depending upon distance.

In addition, the convention of weighting walk and wait time at twice IVT is one of the oldest and most widely used in transport planning. This could form the basis of a test on VL.

The WTP evidence relating to crowding was extensively reviewed by Wardman and Whelan (2011). PDFH crowding multipliers are also based on WTP evidence.

We suggest the following applications:

- On the basis of the broader WTP evidence, insights from specific WTP studies and a review of a significant number of high speed rail studies, a 25% mark-up on current wage rate based values

- The empirical evidence would seem to warrant a premium attached to walk and wait time. A weight of 1.5 would seem to form a suitable basis for applying willingness to pay values

- Official rail crowding multipliers are already contained in PDFH, although not specifically for business travellers. As a test, we recommend using the business crowding multipliers implied by the Wardman and Whelan (2011) meta-model.

The WTP evidence is also in a position to indicate distance effects. It is clear from our examination of the UK and mainland European evidence that distance effects are apparent. However, the most recent UK meta-analysis (Abrantes and Wardman, 2011) specifically examined whether the distance elasticities varied by purpose and recovered a figure for business travel of 0.45. We do not find this entirely credible. The value of time on a business trip from Newcastle to London would be valued 2.62 times higher than for a trip from Luton to London, and we believe this margin of difference to be too large. Nonetheless, it is not as high as the 0.9 figure obtained from the Bates (2012) re-analysis of the long distance model SP data.

We therefore are not in a position to recommend distance elasticities based on the WTP evidence.

6.6   Professional Drivers

Our view is that there is a strong feeling that the cost savings approach is an appropriate means of valuing the time of professional drivers, although it is essential that the figures underpinning recommended values are as up to date as possible.

We are inclined towards the argument that since there is no substantive challenge to the cost saving method, no testing is required in respect of drivers' time. If further work was desired in this area, our view is that the imminent Dutch study may provide some helpful insights. The DfT has often

considered 'missing' components of the total logistics value (Department for Transport, 2007) but frankly we do not think these are likely to be large and are more relevant to reliability than pure time savings.

Sensible sensitivities around the central Cost Savings value might be:

- Use the Hensher approach to derive the value of time. This might usefully develop a 'middle way' distinguishing between those who travel as part of their job and those who are professional drivers;

- As recommended by the 1994 UK Value of Time study, add the driver's valuation to the employer's valuation;

- Examine the outcomes of the Dutch study when published.

However, we are not suggesting that these sensitivities can be readily implemented in the short term.

6.7 Bespoke High Speed Train Values

As part of our review of the empirical evidence, we have covered 11 high speed rail studies, all based on SP evidence. Of these 6 were UK studies. More detail is provided in relevant part of Section 3.1.3

The ratio of the value of time to the gross wage rate varied from around 0.6 to over 5, although excluding an outlier the maximum was 3.18. The evidence does seem to support a business valuation in excess of the wage rate. Indeed, across the central values for each study, the value of time was on average around 50% larger than the gross wage rate, and across the 6 UK studies it was 40% larger. This could of course be the result of offering large time savings, and the studies are largely silent on this. In addition, the studies will probably have contained more senior business travellers while the wage rate is an average for all business travellers.

Nonetheless, taken along with the mainland European evidence, we suggest a test that is 25% larger than the current values.

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