

Review of the value of time assumptions for business travellers on HS2

Summary

This note sets out the main evidence on the valuation of business time savings for rail travellers. Current appraisal guidance assumes that business travellers are unproductive whilst travelling by train, and that all time savings are used productively. A number of HS2 consultation responses have challenged this methodology on the basis that it is unrealistic to assume business travellers do not work on the train. Academic studies have attempted to estimate the coefficients needed to adopt a more sophisticated approach. However, if the appraisal of HS2 is to allow for the possibility of work being undertaken during journeys, it would also be necessary to consider the impacts on the valuation of benefits that accrue from crowding reductions. At present there is insufficient robust evidence to inform a more sophisticated treatment of this issue in appraisal, but further sensitivity testing should be undertaken to enhance DfT's understanding of the risks of the current approach.

This note sets out the main evidence on the valuation of business time savings for rail travellers

To support DfT's scrutiny of the economic case for HS2, the Strategy Unit has been asked to provide an assessment of the latest evidence on the valuation of business travel time savings.

Current appraisal guidance assumes that business travellers are unproductive whilst travelling by train, and that all time saved is used productively

As explained in webTAG unit 3.5.6¹, the value of time for business journeys is based on the 'cost savings' (or 'wage plus') approach which considers the benefit of time savings purely in terms of cost savings to the employer. A reduction in travel time leads to an increase in productive time (travel time itself is considered unproductive) or to reduced costs (a reduction in direct wage costs and variable non-wage labour costs, such as taxes and pension contributions). This implicitly assumes that changes to travellers' welfare have no impact on wages.

Fowkes *et al.*² note that the current assumption is consistent with a perfectly competitive economy, in which firms employ workers up to the point where their marginal cost is equal to their marginal product. When time is saved, it is either converted directly into additional output by the firm, or frees up resources for use elsewhere in the economy. The same paper describes the current appraisal approach as "simplistic" and highlights a number of potential criticisms, including that the economy is unlikely to be perfectly competitive in reality; that time savings are unlikely to translate into additional work when the economy is operating at less than full employment; and that the welfare of workers should be taken into account. Fowkes *et*

¹ <http://www.dft.gov.uk/webtag/documents/expert/unit3.5.6.php>

² Fowkes, Marks and Nash (1986) *The value of business travel time savings*, working paper 214, Institute for Transport Studies, University of Leeds.

a/ also note that travellers may work during a journey, a point highlighted in a number of the HS2 consultation responses (see below).

Attaching an economic value to the time savings that accrue to business travellers when rail services are improved is a complicated matter. They may or may not use any time savings for productive work: if a journey starts or ends at home, some proportion of the time saved may translate into increased leisure, at least in the short run. Even if the allocation of time savings was fully understood, it may be unclear how to value them. Business travellers on high-speed rail are likely to have incomes in excess of the national average and time savings may accrue early in the morning or late in the evening. The value of any additional leisure time freed up for long-distance travellers could therefore be greater than suggested by the standard approach to appraisal.

The situation is further complicated by the impact of crowding on business travellers' productivity. It can be difficult to work on a crowded train, so if HS2 reduces crowding on existing rail services, it could increase the amount of productive time available to travellers on those services.

Although it is possible to observe the increased use of mobile technology when travelling, there is currently insufficient evidence to address all of the uncertainties above and determine their combined effect. The adoption of a simple assumption about the degree to which travel time is used productively, without addressing the issues of crowding and potential conversion into leisure time, would result in a biased assessment of the economic impact.

The current webTAG guidance, written with all modes in mind (including, for example, car driving and cycling), is based on a simplifying 'cost saving' assumption that travel time is unproductive and that all time saved from journey time reductions is used productively. Although it does not separately capture the effects set out above, it has the advantage of providing a practicable approach that can be applied consistently to all modes of travel. DfT will continue to monitor emerging evidence to determine if the existing approach provides a reasonable valuation of business traveller time savings.

Consultation responses highlight two main challenges to the current approach

i) It is unrealistic to assume time spent on a train is unproductive

Casual observation suggests this to be the case. Data on wi-fi usage also provide some support: for the most recent period for which data are available, 13 per cent of passengers on East Coast services logged into the onboard wi-fi service³ (although not all of these users would have been business travellers). By the time HS2 enters operation, technological progress is likely to have made it even easier to work remotely on a train.

ii) The value of rail business traveller time in the appraisal guidance is in itself too high

Current webTAG values are based on 1999-2001 National Travel Survey (NTS) data, and so are ten years old. A number of consultation responses suggest that the value used may be too high, and some suggest the value used equates to an income of

³ East Coast Wi-Fi performance report - period 11 2010/11

around £70,000 per year. One potential derivation of this estimate is set out in a recent paper by the RAC Foundation⁴.

This report is concerned with point i) above. DfT will assess the second issue separately and provide commentary in its consultation response.

Alternative approaches to the valuation of business travel time savings take into account a broad range of factors

The ‘Hensher equation’ 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 Hensher equation⁵

$$\text{VBTTs} = \underbrace{[(1 - r - pq)\text{MP} + \text{MPF}]}_{\text{Employer value}} + \underbrace{[(1-r)\text{VW} + r\text{VL}]}_{\text{Employee value}}$$

Where:

VBTTs is the value of business travel time saving

MP is the marginal product of labour

MPF is extra output due to reduced travel fatigue

VL is the value to the employee of leisure time relative to travel time

VW is the value to the employee of work time at the workplace relative to travel time

r is the proportion of travel time saved used for leisure

p is the proportion of travel time saved at the expense of work done while travelling

q is the productivity of work done while travelling relative to work done at the workplace

There are two main differences between the ‘cost savings’ approach described on page 1 and the Hensher approach above:

- the Hensher approach takes into account that working on the train may be less productive than working at the workplace; and
- the cost savings approach assumes the benefits from travel time savings accrue entirely to the employer. The Hensher approach allows for the possibility that benefits may also accrue to the employee in the form of increased leisure time and/or reduced travel fatigue.

It may be argued that the second point above is relatively short term in nature. In the long term, faster and more pleasant journeys might lead to lower wages and higher profitability (that is, the employee value component would eventually accrue to the employer via reduced wages). Alternatively, it might be argued that workers are prepared to dedicate a fixed amount of time to work-related activity each week, at a given wage rate. Any journey time savings that free up leisure time could, therefore, be translated back into additional off-train working in the long run.

⁴ Castles, C. and Parish, D. (2011) *Review of the Economic Case for HS2*, RAC Foundation, available at: http://www.racfoundation.org/assets/rac_foundation/content/downloadables/hs2_review-castles_parish-281111.pdf

⁵ From MVA Consultancy (2009) *Understanding the Passenger, Valuation of overcrowding on rail services*.

A number of academic studies have attempted to estimate the coefficients of the Hensher equation

Using the equation above, Hensher (1977)⁶ estimated the value of time savings to be around two-thirds of the wage rate. Other studies have concluded that it is too difficult to estimate the coefficients to implement the Hensher equation⁷ with any degree of confidence. This section of the report summarises the evidence in this area. This is not intended to be a comprehensive literature review, but highlights the main pieces of evidence that might usefully inform an assessment of the approach to business time savings taken in the HS2 appraisal.

The value of business travel time savings (1986)⁸

Based on a range of stated and revealed preference approaches, Fowkes *et al.* suggest that a value of 40 to 57 per cent of that implied by the wage rate approach is likely to represent a plausible minimum value for business traveller time savings. These values are based on the assumption that all time savings are used for leisure, and include a valuation of work undertaken during journeys. The authors further note that it is necessary to assume that only a small amount of the time savings need to be used for work purposes for the cost savings approach to be approximately correct.

Exploring the relative costs of travelling by train and by car (2006)⁹

This study found that 69 per cent of business travellers did some valuable work on journeys lasting between one and three hours. For 41 per cent of business travellers, work was the activity on which they spent most time. These percentages are slightly lower for shorter or longer journeys.

Study of the Productive Use of Rail Travel time (SPURT) (2009)¹⁰

This work studied the amount of time spent working on trains by UK rail business travellers, and estimated the net impact of journey time savings on their productivity. The main findings were as follows:

- around 80 per cent of business rail travellers worked during their journey. For those who did work, 57 per cent of their time was spent working. So on average 46 per cent (80 per cent x 57 per cent) of business travel time on rail was used productively;
- the productivity of 34 per cent of business travellers would be unaffected by journey time reductions; 17 per cent would undertake less work if their journey time was reduced (they would work less on the train and not work in the saved time); 20 per cent would work more overall; of the remaining 29 per cent of travellers reporting an uncertain impact, the overall effect was a slight gain in working time. Overall, a 10 minute reduction in journey time would increase the average time spent working by business travellers by 0.75 minutes in the short-term;
- working on the train is 97 per cent as efficient as working on similar tasks in the office; and,

⁶ Hensher (1977) *Value of business travel time*

⁷ Hague Consulting Group *et al.* (1999)

⁸ Fowkes, Marks and Nash (1986) *The value of business travel time savings*, working paper 214, Institute for Transport Studies, University of Leeds.

⁹ Kirby, Carreno and Smyth (2006) *Exploring the relative costs of travelling by train and car*, final report to Virgin Trains, Transport Research Institute, Napier University

¹⁰ Mott Macdonald *et al.* (2009) *Study of the productive use of rail travel time*

- around 13 per cent of total journey time is used to settle down or prepare to disembark. If this proportion does not vary with journey length, there are implications for the time available for useful work if journey times are shortened.

A follow-up study considered long-run implications (see below).

Value of working time and travel time savings: long run implications report (2009)¹¹

The SPURT long-run implications report recommends the value of business travel time savings should be reduced to between 65 and 50 per cent of current values. This is based on scenarios assessing impacts on net productive time, taking into account time lost working on the train, time savings used for work, and time savings diverted to leisure.

Table 1: SPURT long-run scenarios

| Scenario | All saved time used productively | Shorter journeys reduce time available for work on train | Leisure time increases for home-based trips | Leisure time increases for home-based trips (split by outward, inward, non home-based) | Employer's VoT | Employee's VoT | Total VoT |
|----------|----------------------------------|--|---|--|----------------|----------------|--------------|
| 1 | Yes | | | | 39.19 | 0 | 39.09 |
| 2 | Yes | Yes | | | 25.11 | 0 | 25.11 |
| 3 | Yes | Yes | Yes | | 10.89 | 7.07 | 17.96 |
| 4 | Yes | Yes | | Yes | 9.51 | 7.16 | 16.67 |
| 5* | Yes | Yes | Yes | | 4.69 | 17.8 | 22.49 |

*based on short-run results from SPURT survey

This report also noted the possibility that journey time savings may ultimately impact on a traveller's salary. However, the authors argue that time savings of up to 20 minutes are highly unlikely to have such effects.

How do rail travellers use their time? A comparison of National (Rail) Passenger Survey findings between 2004 and 2010 (2011)¹²

Lyons *et al.* (2011) analysed National Passenger Survey results for 2004 and 2010, and identified that significant proportions of business travellers work during their journey and assess this time as worthwhile: 34 per cent reported working for most of their journey in 2010, almost unchanged from 35 per cent in 2004.

Robustness of evidence

Caution is required when interpreting the findings above. In particular, many of the studies are based on people reporting how they spend time (stated preference), which may differ from how they actually spend time. Two of the studies compliment the stated preference evidence with observational evidence of how passengers actually spend time (revealed preference). Table 2, below, compares the methodologies of the studies considered above.

¹¹ Mott Macdonald *et al.* (2009) *Value of working time and travel time savings: long run implications report*

¹² Lyons, Jain, Susilo and Atkins (2011) *How do rail travellers use their time? A comparison of National (Rail) Passenger Survey findings between 2004 and 2010*, Centre for Transport and Society, University of the West of England, Bristol.

Table 2: research approaches

| Study | Stated Preference | Revealed Preference | Other |
|---|-------------------|---------------------|---|
| Fowkes et al (1986) | x | x | |
| Kirby, Carreno and Smyth (2006) | x | | Applied a statistical process, based on probabilities, to the SP data to estimate the percentage of journey time that is productive |
| Mott Macdonald et al, SPURT (2009) | x | x | |
| Mott Macdonald et al, Long Run Study (2009) | x | | Scenarios created from SPURT data |
| Lyons et al (2011) | x | | |

Hensher¹³ found that travellers exaggerated the amount of travel time spent working and the relative productivity of this work to avoid seeming lazy. The SPURT report asked business passengers how much work they completed on their journey and the results are therefore likely to suffer from this upward bias. The size of this effect is uncertain although a counter-argument to this point is that even when they are in their normal workplace, workers may not spend 100 per cent of their time productively. The authors of the SPURT long-run implications report themselves note that their findings are speculative and recommend a more detailed research programme.

An assumption that business travellers use time on trains productively would have more than one impact on the HS2 appraisal

1) A reduction in the value of business travel time savings

The studies outlined above provide a range of estimates for the degree of reduction in the value of business travel time savings that would be needed to move from a simple 'cost-saving' approach to a more sophisticated calculation that can account for work completed during a journey and impacts on employee welfare. Whilst many of these studies rely heavily on stated preference evidence which may be open to challenge, there is a degree of consistency in their findings. Reducing the value of business traveller time savings to somewhere between one half and two-thirds of their current value would appear to provide a reasonable approximation suitable for use in sensitivity testing.

There are two further complications:

- i) the value of time savings may be non-linear. That is, time savings may be more valuable on longer-distance trips. In his evidence to the Transport Select Committee¹⁴, Peter Mackie noted that countries such as the Netherlands and Sweden recommend higher values for time savings on long distance trips. This approach is based on evidence such as that from the national Swedish value of time study, which suggested a much lower value of time should be applied to time savings on shorter trips; and

¹³ Hensher (1977) *Value of business travel time*.

¹⁴ Transport Select committee inquiry into the strategic case for High Speed Rail (2011), *written evidence from Professor Peter Mackie (HSR 101)*

- ii) approaches that capture the employee value element of time savings require a suitable valuation of leisure time. The standard approach in appraisal would be to adopt an 'equity' value based on average incomes. Fowkes *et al.*¹⁵ note that since business travellers on rail are likely to have incomes in excess of the national average, and because time savings may accrue early in the morning or late in the evening, the value of leisure time for long-distance travellers could be higher than the standard approach would imply. The identification of a suitable value for the leisure time component represents a further difficulty with the adoption of a Hensher-type approach. Of course, this issue is not problematic if one takes the view, described on page 3, that increased leisure time is translated into additional off-train work in the long run.

2) An increase in the value of benefits from reduced crowding on existing services

If appraisal is to incorporate the possibility that work may be undertaken during rail journeys, then it must also take into account that the productivity of such work is likely to diminish in crowded conditions. Passengers forced to stand may be unable to perform many types of work; whilst a standing traveller might make a phone call, they will find it difficult to write a report on their laptop.

The HS2 appraisal recognises that the new service could generate benefits by reducing crowding levels on existing services. However, these benefits are calculated on the basis that time spent on trains is unproductive. The value of these benefits could increase substantially if it is assumed that time on existing services could be used more productively once crowding levels are reduced.

There are counter-arguments to this perspective, however. Certain consultation responses note that the productivity of rail travellers can be protected by pre-booking, or making more inter-city services reservation-only (as would be the case on HS2). SPURT¹⁶ identifies that productivity does fall on more crowded services, but remains relatively high. The authors suggest this may be because business travellers tend to secure seats.

In short, there is a lack of evidence to inform what may represent a suitable factor for adjusting HS2 appraisal results to take into account the impact of crowding on a traveller's productivity during their journey.

3) An increase in the value of benefits from shifting from other modes

Under the current appraisal approach, both car and rail passengers are assumed unproductive during their journey. If appraisal allowed for the possibility of productive work during a rail journey, the gain from switching modes could be much greater than in the current approach. For a traveller switching from car to train, say, it would be necessary to value the time saving, plus the fact that work could now be undertaken during the whole of the journey. The 2011 HS2 Demand and Appraisal Report¹⁷ notes that the implications of this for the 'rule of a half' principle that underpins standard transport appraisal are unclear. Indeed, such an approach could lead to unrealistically high values for time savings that are inconsistent with observed evidence on the

¹⁵ Fowkes, Marks and Nash (1986) *The value of business travel time savings*, working paper 214, Institute for Transport Studies, University of Leeds.

¹⁶ Mott Macdonald (2009) *Study of the productive use of rail travel time*

¹⁷ MVA Consultancy and Mott MacDonald (July 2011) *HS2 London - West Midlands Consultation, Demand and Appraisal Report*, available at: <http://www.hs2.org.uk/assets/x/78304>

proportion of travellers switching mode. This effect should therefore be treated with caution until its theoretical and empirical implications are more fully understood.

There is insufficient robust evidence to adopt a more sophisticated approach to the valuation of business traveller time savings, but further sensitivity testing should be undertaken to enhance DfT's understanding of the risks of the current approach

This paper has presented evidence on how the valuation of business time savings might change if the current 'cost saving' approach was replaced with a more sophisticated methodology.

Simple observation and a range of academic studies confirm that some of the time spent on trains by business travellers is used productively. Most of the formal evidence relies on surveys in which travellers report their own behaviour, which may be subject to substantial bias. The current appraisal approach should therefore be seen as a necessary simplification in the absence of robust evidence to underpin a more sophisticated approach.

Criticism of the current approach tends to focus on whether travellers work on trains, which has led some stakeholders to propose reductions to the value of business time savings in the appraisal of HS2. In isolation, this adjustment would represent an incomplete treatment of the issue. If the appraisal of HS2 is to allow for the possibility that work may be undertaken during journeys, it is necessary to take into account all of the associated impacts on the appraisal results, including a potential uplift in the value of de-crowding benefits, and potentially the increased productivity impact of shifting modes. There is considerable uncertainty about how to value these effects.

In light of these uncertainties, it is not possible to identify a single alternative approach to the valuation of business time savings in the appraisal of HS2 that would offer an unambiguous improvement on the current central scenario. Nonetheless, given the scale of the proposed investment, it would be prudent for DfT to enhance its understanding of the impact of alternative approaches on the economic case for HS2 through the application of a broader range of sensitivity tests. Potential additional sensitivity tests are proposed in Table 3, below. It is proposed that the individual tests are run separately to understand the impact of individual factors, and that results are also combined to provide a plausible range of net outcomes.

Table 3: potential additional sensitivity tests

| Effect | Evidence | Assumption in previous HS2 Ltd sensitivity tests | Options for future sensitivity tests |
|--|--|---|--|
| 1) A reduction in the value of business travel time savings | Although there are concerns about robustness, the evidence reviewed suggests there may be a case for reducing business traveller time savings to between 40 and 65 per cent of their current values | Business value of time reduced by 50 per cent | Test the impact of the full range of reductions suggested by the literature |
| 2) An increase in the value of benefits from reduced crowding on existing services | Lack of evidence on the extent to which business travellers are affected by crowding or how much crowding affects their productivity. Intuition suggests there should be some reduction in productivity in crowded conditions, but this may not be significant if a high proportion of business travellers obtain a seat | Crowding penalty increased to PDFH 4 value | Test no change in crowding penalty to reflect the SPURT finding that crowding has little impact on productivity Test the impact of using PDFH 5 crowding values |
| 3) An increase in the value of benefits from shifting from other modes | No firm evidence, but it is possible that if those switching to rail can use their journey productively, mode shift could have much greater benefits than previously assumed | Full value of business time savings from modal shift and crowding penalty increased to PDFH 4 value | Insufficient evidence to propose an alternative approach - further consideration of underlying theory required |

Note: Another sensitivity test was run using behavioural values of time in place of standard WebTAG values. This resulted in a broadly unchanged cost benefit ratio. However the values used were based on small scale studies from 2001 and there is insufficient evidence to recommend any alternative sensitivity tests of this type.