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THE VALUE OF BUSINESS TRAVEL TIME SAVINGS

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Contents

Abstract

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The value of time savings for business travellers forms a sizeable part of the benefits from trunk road, rail and air transport improvement schemes. It is therefore important to possess appropriate values to place on business travel time savings for evaluation purposes. The normal approach in practice is to adopt the wage rate of the workers in question plus an increment for overheads and non-wage payments.

In this paper criticisms of this approach are discussed and the implications of these criticisms for the development of alternative methodologies for valuing business travel time savings are considered. Data from two surveys of long distance business travellers and one survey of employers, which were carried out as part of an SERC financed project on business travel, is used to estimate values of business travel time savings for each of these different methodologies. Unlike previous studies considerable use is made of data obtained from stated preference experiments. Revealed preference data is also used to obtain value of time estimates. The results show that, for forecasting purposes, a value a little above the conventional 'wage rate plus' value may be appropriate. Although no empirical support is found for the assumptions on which present valuation conventions are based, the empirical results suggest these conventions yield values which are approximately correct, for our samples.

1. Introduction

Business travel constitutes a very important part of the long-distance travel market. According to the 1978-9 National Travel Travel Survey, journeys in the course of work (excluding those by manual workers and professional drivers) accounted for 12% of trips over 25 miles. But this greatly understates their economic significance. Because journeys in the course of work are assumed to have a much higher value of time than leisure journeys, they attract a very high weight in transport decision-taking. For instance, 26% of the average benefits from a trunk road improvement scheme are stated to come from journeys by car in the course of work, as opposed to 23% from leisure journeys by car (DOE(1976)). The high willingnes to pay for speed, comfort and convenience make business travel even more important for rail and air. It accounts for 25% of inter-city rail trips - and a higher proportion of revenue - (BR(1985)) and 60% of domestic air travel (CAA(1975)).

It is therefore important both in forecasting and in evaluation to possess appropriate values to place on business travel time savings. The normal approach in practice is to set these values equal to the wage rate of the workers in question plus an increment for overheads and non-wage payments. The research reported in this paper appraises possible alternative approaches to valuing savings in business travel time and derives empirical estimates of the values implied by these different approaches. In the course of our research we have undertaken surveys of organisations, to gather information about travel policies, and two samples of business travellers. We draw on information from these surveys to construct values of time and to illustrate our arguments.

The structure of this paper is as follows. First, we review the existing literature on valuing business travel time. This is followed, in Section 3, by a discussion of possible alternative approaches to valuing savings in business travel time. The data used to construct these values is briefly described in Section 4, and in Sections 5-7 we present evidence on employees' and employers' valuations of business travel time. In Section 8 these values are used to construct 'synthetic' values of time. Lastly, we conclude with our recommendations concerning the appropriate values of business travel time for use in evaluation and forecasting.

2. Background

The current convention in Great Britain is to set the value of business travel time (VBTT) equal to the marginal cost of labour, defined to equal the wage rate plus an increment for the overheads associated with employing labour (e.g. national insurance, fringe benefits, provision of work facilities). This we shall refer to as the wage rate approach.

It has often been suggested that the wage rate approach

overstates the appropriate value of business travel time for both forecasting and evaluation purposes, and the few empirical studies that have been undertaken in Great Britain seem to bear this out. Both University of Leeds (1971) and Universtiy of Southampton (1971) estimated values of time from revealed preference data on the choice between rail and air travel, and obtained values substantially below the wage rate. However, since revealed preferences are the product of both the constraints on choice imposed by company travel policy and the preferences of travellers themselves, it is difficult to interpret such results. RTM's (1977) study took a rather dfferent approach, following the pioneering work of Hensher (1977). Hensher departed from the wage rate approach by accounting for the following factors:

1) business travel may occur in what would otherwise be leisure time and hence, savings in travel time may accrue to leisure and not work activities. The value of these time savings then equals the employee's value of substituting travel time for leisure

2) work may be done in the course of a business trip, implying output may be lost from a saving in travel time.

3) the employee may not be indifferent between working in the office and travelling.

Both RTM and Hensher derived a value of time of about two-thirds the wage rate, although since the RTM study was a pilot study on only 60 travellers the value should not be relied upon. We believe the approach developed by Hensher to be a valuable innovatory approach to a difficult problem, and it has formed the starting point of our own research. However, we take issue with the precise method of valuation he used on a number of points.

3. Alternative Approaches to Valuation

As was mentioned in the previous section, the conventional approach to the valuation of business travel time savings is to regard them as savings of working time, and to value them at the wage rate plus the marginal wage increment.

The reasoning behind this is that in a perfectly competitive economy, profit maximizing firms will employ labour up to the point at which its marginal cost just equals the value of its marginal product. When working time is saved, it is converted into additional output, either directly, by the firm itself, or indirectly, by the release of resources for use elsewhere in the economy. Thus the 'wage rate plus' represents both the behavioural value of time (what the firm is willing to pay to save time) and its resource value to the economy.

Possible criticisms of this simplistic approach, particularly when applied to business travel, are as follows:

(a) The assumption of universal perfect competition may be too far from reality. Monopoly power in the final product market will cause firms to equate the cost of labour to its marginal revenue product, which will be less than the value of its marginal product. Monopoly power in the labour market would have the opposite effect. Monopoly power on the part of the workers may bid the wage up above the value of the marginal product if workers are also able to exact some control on the amount of labour employed. In addition, firms may have objectives other than profit maximization (Hunter and Mulvey (1981)).

(b) In the presence of large scale unemployment, it is unlikely that the working time released will be used to produce additional output. In other words, there is a strong case for shadow pricing labour, although this practice has been rejected in cost-benefit analyses conducted by or on behalf of the British government (H.M. Treasury (1982)), except when specifically advised by the Treasury to do so.

(c) The approach ignores benefits or costs to the workers themselves from the transfer of time between work and travelling. Although one might argue that, in a perfectly competitive labour market, any such effects would be transferred to the employer via adjustments to the remuneration package he was obliged to offer, they may still not be reflected ex ante in the 'wage rate plus' approach.

(d) A set of problems applies particularly to business travellers, who often do not work fixed hours or receive additional payment for overtime. (Of our sample, only 45% worked fixed hours). The result is that it is not obvious to what extent travel time savings will be converted into work as opposed to leisure. Additionally, such workers are able to undertake some work whilst travelling, depending on the mode of transport used. Thus travel time savings may not convert directly into additional working time.

These criticisms may lead one to ask why the common practice is not, as in the case of leisure time savings, to conduct behavioural studies of business travellers' willingness to pay to save time. Some such past studies have been referred to above. However, in this case, a further set of problems appears. Business travel decisions are the result of a two stage process; the determination of travel policy by the organisation, followed by the choice of the individual within the constraints imposed by that policy. In our sample, only senior management would normally be reimbursed the costs of domestic air or first class rail travel. On the other hand, within the constraints of the reimbursement policy, most individuals were free to choose their own travel mode. Thus, many business travellers are choosing between, say, car and rail, knowing that they can fully recoup the cost of the mode they choose (and, if they are using their

own car, obtain a contribution to the overhead costs of running it as well). The consequence of this is that revealed preference values are likely to reflect a combination of employers' and employees' willingness to pay (using the employers' money) to save time. While this provides values required for use in forecasting, these values are not appropriate for evaluation.

Thus, one is pushed in the direction of undertaking stated preference investigations both of the willingness to pay of employers and of employees to save travel time. That is what we have attempted in this study. Even this is far from straightforward. In the case of the employers, it is difficult to find any individual who can speak authoritatively about the circumstances in which organisation travel decisions would change. In the case of the employee, it is necessary to create a situation in which it is clear that he/she personally will bear the additional cost of a faster journey. How we set about doing this is described in Section 5.

Let us call the resulting value of time of the employee VT and of the employer VE. On one argument, VE would be the appropriate valuation, since the employer would have already reached his own conclusions on the extent to which time savings would be translated into additional work or leisure, and the effect of that change on the utility of the worker and hence on his/her required remuneration package. But this is asking a lot of what was neccessarily a very simplistic stated preference excercise.

An alternative approach is to derive a synthetic value of time along the lines of the work of Hensher (1977). Here it is necessary to first identify the potential benefits from savings in business travel time. To do this one must consider both the alternative uses of these time savings and the nature of activities carried out in the course of travel. For this purpose we categorise all activities as being either for leisure or for work. Thus travel time savings can be used for one of these two broadly defined purposes and, likewise, in the course of a journey the business traveller will be either working or engaged in a leisure activity.

The potential beneficiaries from savings in business travel time are the employer through an increase in output, and the business traveller, through an increase in utility. A travel time savings results in an increase in output if either:

I) The traveller works for longer or,

II) The reduction in travel time improves productivity.

Note that a travel time reduction may cause less work to be done whilst travelling and thereby offset some of the output increases. Next a travel time saving results in an increase in the traveller's utility if either:

III) Travel time savings are converted into leisure time

(assuming the utility from travel is less than the utility from leisure) or,

IV) Travel time savings are used for work and working (in the office or at home) yields more utility than travel.

Expressing the above ideas mathematically let,

MP = marginal product of labour

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

VW = the value to the employee of work time in the office relative to travel time

r = proportion of travel time saved used for leisure purposes

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

q = relative productivity of work done while travelling compared with in the office

MPF = value of extra output generated due to reduced fatigue.

Then the value of savings in (long distance) business travel time (VBTT) is given by:

$$VBTT = (1-r-pq)MP + (1-r)VW + rVL + MPF \qquad (1)$$

It is this expression which we would ideally like to measure, and which we call a synthetic value of time. Next we discuss, in turn, issues concerned with the measurement of MP, VL, VW, MPF, p, q and r.

MP, the marginal product of labour has generally been assumed to equal the wage rate plus an increment for overheads. We, however, propose an alternative approach to the measurement of MP in which MP is derived from VE, the employers' willingness to pay to save travel time. This is done by supposing the employer had reached his own conclusions on the extent to which time savings would be translated into additional work or leisure and the change in the utility of the worker that would need compensation through the latter's remuneration package. Because increases in the employee's utility are not subject to tax, in the employer's valuation of travel time savings the terms rVL and (1-r)VW (in equation (1)) should be inflated by 1/(1-tp) (where tp is the employee's personal tax rate) to reflect the compensation an employer has to provide an employee for travel, in terms of travel time savings rather than increased income.

The employer's willingness to pay for savings in business travel time, VE, then is given by:

$$VE = (1 - r - p)\,MP + \frac{r}{1 - tp}\,VL + \frac{(1 - r)\,VW}{1 - tp} + MPF \qquad (2)$$

This equation was used to estimate our 'stated preference' values of MP (see Section 8).

Turning next to the issue of what value to place on VL, the value of leisure time for long distance business travellers, Hensher and RTM both used values of leisure time derived from studies of commuters' mode choice decisions. There are two good reasons why these values may not be appropriate for long distance business travellers. First, business travellers have above average incomes and second, travel time savings may occur at unsocial times of the day; both of which imply that values of leisure time for long distance business travellers will be higher than those for commuters. Evidence to support this view is given in Section 6.

In Section 6 estimates of VL are obtained from a hypothetical mode choice situation in which the respondent is required to trade his/her own money against reduction in travel time. Note that if respondents' choices were made mindful of this impact on their performance at the business meeting, then VL may include MPF.

When time savings affect the utility of employees, the question arises of whether to use equity values of time or not. In Great Britain the standard practice in evaluation has been to assign all individuals the same (equity) value of time, namely the value for a traveller with an average income. This practice can be justified on the grounds that values of time increase with income because of differences in marginal utilities of income, and not marginal utilities of time. We consider these arguments to be persuasive in the case of valuing the benefits to business travellers from travel time savings, and consequently also estimate an equity value of leisure time.

Both Hensher and RTM had problems finding a value of VW, the value of working (at home or the office) relative to travelling, for their samples. Hensher made a number of arbitrary assumptions about the distribution of VW values and RTM found that although on balance their respondents preferred to work rather than travel, only 2 were prepared to attach any value to this preference. Since we can see no reliable way of estimating VW, and since it is unlikely to greatly influence our results, we have chosen to assume VW = 0 i.e. travellers are indifferent between travelling and working.

Lastly, other authors have ignored the issue of valuing MPF and so implicitly assume it equals zero. However, it is likely this factor will be included in any measure of the employers', and possibly also the employees', willingness to pay for travel time savings. In so far as this holds MPF is included in our stated

preference estimates.

Next p, the proportion of travel time savings which are at the expense of work done whilst travelling, has been assumed (Hensher and RTM) to equal the proportion of total travel time spent working and as such has been found empirically to be greater than zero. However, if not all travel time is spent working some travellers may still be able to complete their work in the shorter journey time i.e. for these travellers p = 0. Whenever this is so it is likely the overall value of p will lie between zero and p*, the proportion of total travel time spent working. This issue is re-examined in Section 8.

To measure q we asked respondents for the amount of travel time they spent working, on a particular trip, and for the time this work would have taken in the office. Here we note Hensher's finding that individuals are likely to exaggerate the amount of travel time spent working and the relative productivity of this work time, so as not to appear lazy. Thus, any estimates of p and q are likely to be biased upwards.

Both Hensher and RTM define r to equal the proportion of travel time which occurs in what would otherwise be leisure time. In Hensher leisure time is defined to be time outside normal work hours, taken to be 8.46 a.m. to 5 p.m. RTM directly asked their respondents for the fraction of travel in leisure time. In both studies r was found to be greater than 0. However, there are a number of problems with the assumption here that r, the proportion of travel time savings used for leisure, equals the proportion of total travel time which occurs in leisure time. For, although the round trip may often start or end outside normal work hours, it does not necessarily follow that time savings will accrue at these times. The business traveller may instead spend more time at the destination. This problem is most acute when travel is by public transport, for then the scheduling of services influences when time savings will occur; at the origin or at the destination of the business trip. If the latter occurs the time saving may be used for additional work at a business meeting. Also if the traveller can substitute travel out of normal work hours for work time on another day, then travel time savings can be substituted for work regardless of when the time saving occurs.

We did consider whether it would be more appropriate to use the proportion of trips starting/ending outside normal work hours as an estimate of r. This approach implicity assumes all time savings accrue at the start/end of the round trip, whereas Hensher's approach can be thought of as assuming that the probability that a time saving will be used for leisure equals the proportion of travel time outside normal work hours. Neither of these two approaches is entirely satisfactory. In the absence of any workable solution to this problem, we think on balance Hensher's approach is the more reasonable of the two.

Some support for Hensher's approach comes from the answers we

received to the following question:

> 'What would you have done with the time saved if your last business trip could have been scheduled to start 30 minutes, 60 minutes, 90 minutes later?'

The data in Table 1 shows the proportion of people who would use these time savings for work increases as their journey start time nears their normal work start time. Although we do not know what effect delaying the start time would have on work done later in the day, our results suggest r is a monotonically increasing function of the proportion of travel in leisure time.

Values of r calculated using Hensher's definition are denoted below as r*. Since for some people travel time savings will be replaced by extra work on other days, we would suggest that, on average, the appropriate value of r lies between zero and r*.

Table 1 Percentage of Respondents Who Would Work if Journey Start Time Postponed 30 Minutes

	% Work
All Respondents	
ECML	23
ORGN	30
Respondents Starting Their Journey at Least 30 Mins Before Their Normal Work Start	
ECML	7
ORGN	11
Respondents Starting Their Journey at Least 60 Mins Before Their Normal Work Start	
ECML	5
ORGN	10
Respondents Starting Their Journey at Least 90 Mins Before Their Normal Work Start	
ECML	4
ORGN	7

To summarise, we have a total of 6 different methods for valuing business travel time (Table 2). In addition, for each method we can also derive different values by travel mode. Estimates of these values are presented in Section 8.

Table 2 Alternative Valuation Methods

1. Wage Rate Approach
2. Employers' Stated Preference Value
3. Revealed Preference Approach
4. Synthetic Approach
   A. Using Stated Preference Values
   B. Using Equity Stated Preference Values
   C. Using Department of Transport Values

4. The Data

The data used to construct values of business travel time in the next 4 sections of this paper come from the results of three surveys carried out in early 1984; two surveys of long distance business travellers and one of employers of long distance business travellers. Briefly these surveys comprise:

1) A telephone survey of 311 organisations, approximately half of which were sited in South East England and the remaining half in the North East. This survey was designed so as to obtain information about the nature of organisations' travel policies, with particular reference to how these policies affect mode choice decisions. (See Fowkes and Marks (1985) for the detailed results of this survey).

2) A self completion questionnaire distributed, by agreeable organisations contacted in (1) above, to staff who had undertaken business journeys of over 50 miles (one way) in the last month. The questionnaire, which was answered by 442 people, asked for details of a recent long distance business trip. In particular, respondents were asked to provide details of each stage of their journey, and to provide information about the reimbursement for travel and the alternative modes they were permitted (by the employer) to use on the reported journey. In addition respondents were asked a hypothetical stated preference question, the answers to which are analysed in Section 6.

3) A self-completion questionnaire (almost) identical to that in (2) above, sent to respondents to BR's 1983 East Coast Main Line (ECML) survey who were then making a business trip and indicated their willingness to be further interviewed, by giving their name and address. A total of 411 ECML travellers answered this questionnaire. (See Fowkes, Johnson and Marks (1985) for the analysis of responses to this survey and that in (2) above). For convenience, we

shall refer to the sample of East Coast Main Line respondents as the ECML sample and the respondents to the organisation based survey as the ORGN sample.

Throughout the rest of this paper a long distance business trip is defined to be a journey with a round trip distance of 50 miles or more and for the purpose of conducting some business activity at the destination.

5. Employers' Stated Preference Values

As was mentioned in Section 3, it could be argued that the value of business travel time savings relevant for evaluation purposes is whatever the employer is willing to pay for these savings. This argument assumes employers take account of both the gains in output and the reduced disutility to the traveller from travel time savings. Dropping the assumption that the employer cares about the disutility of travel to the employee, one is still left with the proposition that the employer's value of time savings equals the value of the additional product generated by the employee substituting work time (possibly on a different day) for travel time, i.e. the marginal product of labour.

In our telephone survey of 311 organisations we asked respondents 1) how employees would normally make a day return trip between London and Newcastle and, 2) the following question, designed to reveal employers values of travel time:

> 'Now suppose a first class (only) premium accelerated rail service between London and Newcastle was introduced, saving one hours travel time on the round trip compared with their usual means of travel. Would senior staff be allowed to use the service if the extra cost was £5 ... was £20 ... was £50? And what about other staff?

From the answers to this question we calculated the number of establishments which were willing to pay up to £5, from £5 up to £20, from £20 up to £50 and £50 or more to save one hour of travel time. Although we did not specify at which end of the trip the time savings would have occurred, the presumption is that the shorter journey time would mean travellers could leave home later/get home earlier from their business meetings.

Plotting the cumulative frequency of responses against these 4 ranges we derived the median value of time by linear interpolation. Median values of time for different categories of establishments and by the usual travel mode are given in Table 2. Also median wage rates for senior staff in different categories of establishments are given in brackets (see Fowkes and Marks (1985) for more details). The results in Table 3 show:

(a) Time savings by senior staff are valued at approximately 2.5 times the rate for other staff. This is to be expected given the higher salaries of senior staff.

(b) Public non-commercial establishments place a lower value on their employees' time than establishments in other industrial groups.

(c) Large establishments value the travel time of their senior staff (but not necessarily their other staff) at a higher rate than small establishments. This possibly reflects the higher salaries of senior staff employed by large establishments. (We left the definition of 'senior' to the respondents).

(d) Values of travel time are correlated with the cost of travel by the mode normally used by an employee. That is as the cost of travel increases so too does the value of travel time.

(e) Values of time are, in general, positively correlated with employee's salaries. One exception to this is the case of public non-commercial establishments who pay relatively high salaries, especially to their senior staff, but place low values on savings in travel time.

(f) If one adds the standard marginal wage increment, equal to 36.5% of the wage rate, to the median wage rate for senior staff in our sample, the employers' value of time for senior staff still exceeds the cost of these employees. This difference may reflect the employers' valuation of the employees' disutility from travel, but equally it could be the result of estimation errors. Note that the value of time and wage rates for other employees do not differ greatly once the marginal wage increment has been applied to the wage rate.

Employers are clearly willing to pay considerable sums of money, particularly in the case of senior staff, to save travel time on business trips. To get a single employers' value of time savings we took a weighted average of our estimates for senior and other staff. From our organisation survey we have data on the relative proportions of senior and other staff in employment and on the average monthly trip rates for different categories of staff. Only middle and senior management were reported as normally making business trips and their average monthly trip rates were 4 and 6, respectively. Both middle and senior management comprised between zero and 20% of the staff employed by respondents (these are median values for the sample). Assuming a ratio of senior to middle management of 2 to 3 and weighting this by the trip rates for each category of staff gives a composite value of time estimate of approximately 20p/min.

Table 3 Median Values of Time (p/min)
(Early 1984, with median wage rates (p/min) in brackets)

	Senior Staff	Other Staff	Sample Size
Total Sample	27 (15)	10 (5-10)	311
BY INDUSTRY			
Public Non-commercial	15 (15)	7	26
Public Commercial	37 (>20)	17	19
Professional	30 (>20)	10	82
Light Industry	25 (13)	15	71
Heavy Industry	25 (13)	10	77
Other	22 (13)	10	36
BY SIZE OF ORGANISATION			
1 - 50 employees	22 (13)	7	136
51 - 500 "	27 (17)	14	136
501+ "	47 (18)	15	39

BY MODE NORMALLY USED*

			Sample Size Senior Staff	Sample Size Other Staff
Air	33	20	62	34
1st Rail	30	25	84	22
2nd Rail	13	18	58	110
Car	18	10	38	31
Other	8	7	8	7

* Only respondents giving a single response to the question on mode normally used were included in this analysis.

6. Employees' Stated Preference

In our two surveys of business travellers, respondents were asked using almost identical self completion questionnaires, to rank travel modes for a hypothetical long distance business trip. This was the stated preference experiment, the results of which comprise the subject of this section.

In this experiment, respondents were asked to consider a hypothetical situation in which they would make a day return trip of 300 miles each way (e.g. a journey between Newcastle and London) for the purpose of undertaking an unspecified business activity. For this trip the traveller could choose to travel by either air, first class rail, second class rail or car. Although it was expected most respondents would not regard travel by car as a viable option, this mode was included for completeness. A fixed lump sum of £100 was 'given' for travel expenses, whilst 'other' expenses were said to be fully reimbursed. If travel costs were more/less than £100 the traveller was told he/she would have to pay the extra/could keep the difference.

Each of the four permitted travel modes was described by the round trip travel cost and the journey start and finish times (see Figure 1). Differences in start and finish times between modes accounted for differences in both main mode travel times and access/egress times associated with each main mode. Given this information, the traveller was then asked to rank the 4 modes in order of preference, with a rank of 1 being associated with the most preferred mode and a rank for 4 being associated with the least preferred mode. Each respondent was asked to do 12 of these ranking exercises.

Figure 1 An Example of the Ranking Exercise

	Cost £	Leave home	Arrive home	Rank
AIR	80	07.00	18.30	____
RAIL 1st	75	06.30	20.00	____
RAIL 2nd	50	06.30	20.00	____
CAR	40	05.30	20.30	____

It was hoped that respondents would answer the ranking exercise by trading differences in cost against differences in time away from home, the inconvenience of start times and any other perceived differences between the services offered by the 4 modes. When analysing this ranked data we tried a number of different

model formulations before finding the 'best' models given in Table 4, (see Marks and Fowkes (1986) for more details). Estimations were carried out using the exploded logit technique (Chapman and Staelin (1982)) and an augmented version of the BLOGIT software (Crittle and Johnson (1980)) provided by John Bates.

For the ECML sample mode choices were best explained by a model containing the following independent variables; mode specific constants, travel cost squared (COST*COST), total journey time (TIME) and a dummy variable, E2, which takes the value 1 whenever the journey starts before 0630 (column 1, Table 4). The preferred model for the ORGN data differed slightly from that for the ECML data; the start time dummy E1 (which equals one if the journey starts before 0600), and not E2, now captures the effect of an early start time on mode choice; a linear as well as a quadratic cost term enters the model (column 2, Table 4). From the results in Table 4 one can show that time savings early in the morning (i.e. before 0630 in the ECML data, before 0600 in the ORGN data) are valued four times as much as time savings occuring later in the day.

Estimated values of time (for time savings after 0629, evaluated at the average cost level in the stated preference experiment) are 11.6 p/min and 11.8 p/min for the ECML and ORGN samples, respectively. These values are used in the construction of a synthetic value of business travel time in Section 8. In these calculations the higher value of time savings early in the morning is not taken into account. This is because over 85% of respondents reported their most recent long distance business trip started after 0629. Although in principle higher values should be attached to time savings which occur very early in the morning, because of the greater disutility to the traveller, it seems reasonable to ignore this factor given our data suggest only a small fraction of long distance business trips start at this time.

Next we investigated whether, as economic theory predicts, travellers' values of time increased with income. For the ECML data this was done by introducing, into the preferred model, different cost variables for respondents belonging to each of the following income groups; 0-£10,000 p.a.; £10,001-£15,000 p.a.; £15,001-£20,000 p.a.; £20,001 and over p.a. (i.e. there are now 4 cost variables in the model (Bates and Roberts (1986)). It was found that the cost coefficients for the two middle income groups, and the top and the middle income groups were significantly different. The effects of these differences on the value of time estimates can be seen in Table 5; values of time roughly double moving from the bottom to the top income group.

Similar strong income effects were found in estimations on the ORGN data. Here a linear relationship between income and the value of time was assumed, because computing constraints meant it was not possible to estimate a model containing 8 cost variables (created by segmenting each of the 2 cost variables by 4 income

groups). Doing this gave a significant improvement in model fit and, as can be seen in Table 5, values of time which almost treble moving from the bottom to the top income group.

The above results show clearly that (for our two samples) business travellers with higher incomes have higher values of time. It has already been argued that for evaluation purposes one should use an equity value of time, that is a value which does not vary with the traveller's income. This equity value is normally taken to be the value of time for a traveller with an average income. In 1984 the average level of full-time earnings fell within our bottom income group (New Earnings Survey (1984)) and so our estimates of equity values of time are 8.2p/min and 8.8p/min for the ECML and ORGN samples, respectively.

We also tested whether the time coefficients varied by travel mode, but did not find any significant effects. Note that the design of the stated preference experiment only allowed testing for differences between air and rail travel time coefficients; travel times for car were constant and, travel times for first and second class rail were the same. Thus, the stated preference values of time used in Section 8 to construct a value of time for evaluation purposes do not vary by mode.

Table 4 Preferred Models for the ECML and ORGN Data
(standard errors in brackets)

	ECML	ORGN
ASC - Air	1.645	1.835
	(0.123)	(0.118)
ASC - Rail 1	1.841	1.935
	(0.084)	(0.087)
ASC - Rail 2	1.535	1.287
	(0.068)	(0.080)
COST		-0.074
		(0.039
COST*COST	-0.00025	-0.00026
	(0.00001)	(0.00001)
TIME	-0.218	-0.223
	(0.040)	(0.034)
E1		-0.574
		(0.107)
E2	-0.528	
	(0.100)	
Rho-bar squared	.4258	.4082
Value of Time p/min	11.6 (2.1)	11.8 (2.5)

* These values are for time savings after 0629 and 0559 for the ECML and ORGN data, respectively, and are evaluated at the average cost for the stated preference experiment i.e. £63.25.

Table 5 Estimated Values of Time for Different Income Groups
(pence/minute)
(standard errors in brackets)

Income Group	ECML	ORGN
0-£10,000 p.a.	8.22	8.80
	(1.36)	(1.22)
£10,001- £15,000 p.a.	10.15	12.54
	(1.69)	(1.74)
£15,001- £20,000 p.a.	15.95	18.11
	(2.66)	(2.52)
£20,001+ p.a.	19.34	25.84
	(3.30)	(3.60)

7. Revealed Preference Analysis

Respondents to the ECML and ORGN surveys were asked to supply information on:

1) travel times, travel costs and other costs for a recent long distance business trip

2) how much quicker/slower and cheaper/more expensive this trip would have been using their best alternative mode

3) which modes they were permitted (by the employer) to use on the reported trip.

Using the data on cost and time differences, for both samples combined, we calibrated mode choice models for travel by car versus rail and air versus rail. There was insufficient data to model the choice between other pairs of modes. Table 6 describes the nature of the choices for respondents choosing between car and rail, and air and rail. Here we were interested in finding out what fraction of respondents faced an obvious time-cost tradeoff (i.e. for whom the faster mode is the more expensive), for these respondents provide the bulk of the information necessary to identify the model parameters. The data in Table 6 shows that less than 36% of our sample face such a tradeoff. The rest of the sample either have costs and times equal for both modes or one mode dominates the other, in the sense of being both faster and cheaper. Given this and the small sample sizes, we did not expect to obtain very accurate value of time estimates.

In the search for an appropriate model specification we started with the following model (Marks (1986));

$$\Delta U = ASC + \Delta C + \Delta OC + \Delta T \qquad (3)$$

where ΔU = utility from car/air - utility from train
ASC = mode specific constant for car/air
ΔC = travel cost car/air - travel cost train
ΔOC = other cost car/air - other cost train
ΔT = travel time car/air - travel time train

This model was then augmented by the addition of dummy variables indicating whether;

1) the trip had a London destination (DLON)
2) the traveller had access to a company car (DCCAR)
3) company policy was the reason for mode choice (DCOP)
4) more than one meeting was attended on the business trip

The preferred models for each set of mode choices are presented in Table 7. In both cases the estimated values of time are considerably higher than those obtained from the analysis of the stated preference data, although the relatively large standard errors for tthe revealed preference values mean these differences are not statistically significant. One possible explanation for

these differences is that when making mode choice decisions the respondent is spending the employers' money, while in the stated preference experiment the respondent was asked to spend his/her own money. (Note that almost all of the respondents supplying revealed preference data were permitted use of both the alternative modes.) Lastly, it is interesting to note that the values of time revealed by travellers' actual mode choices are close to the value of time estimate obtained from the analysis of employers' preferences in Section 5, namely 20p/min.

Table 6 The Nature of Choices in the Revealed Preference Data: Total Costs - Travel Time Tradeoffs

(Number of Respondents)

1. CAR VERSUS RAIL MODE CHOICE

	Car Chosen	Train Chosen	Total
Car Dominates	68	33	101
Train Dominates	5	48	53
Car and Train Have Equal Costs and Times	12	13	25
Tradeoff Possible	15	41	56
Total	100	135	235

2. AIR VERSUS RAIL MODE CHOICE

	Air Chosen	Rail Chosen	Total
Air Dominates	13	11	24
Rail Dominates	4	49	53
Air and Rail Have Equal Costs and Times	-	17	17
Tradeoff Possible	9	37	46
Total	26	104	130

Table 7 Preferred Models for the Revealed Preference Analysis (standard errors in brackets)

	Car V Rail	Air V Rail
Constant	-0.724 (0.266)	1.489 (0.358)
Δ Travel Cost (£)	-0.036 (0.010)	-0.021 (0.011)
Δ Other Costs (£)		-0.038 (0.015)
Δ Travel Time (mins)	-0.0085 (0.0015)	-0.0041 (0.0014)
DLON	-2.328 (0.483)	
DCCAR	+1.028 (0.366)	
DCOP		-2.059 (1.083)
Rho-bar Squared	.3580	.4337
Number of Observations	234	130
Value of Time (p/min)	23.5 (6.9)	19.1 (10.8)

8. The Synthetic Approach

Here we implement some of the ideas discussed in Section 3 and summarised by equation (1). To recap, this equation defines the value of business travel time (VBTT) as;

$$VBTT = (1-r-pq)MP + (1 - r)VW + rVL + MPF$$

As we are assuming VW equals zero and MPF either equals zero or may enter the equation implicitly when stated preference values of VL and MP are used, equation (1) reduces to;

$$VBTT = (1-r-pq)MP + rVL \qquad (4)$$

Using the data from our surveys we have evaluated each of the items in equation (4). The two samples of business travellers were asked to record, amongst other things, a log of their most recent long distance business trip, how much time they spent working on this trip, their normal work hours and their salary. From this data we have calculated the values of r^*, p^* and MP presented in Table 8. We also asked how long the work done while travelling would have taken in the office and from this have calculated estimates of q.

The data in Table 8 shows that a greater proportion of car travel, as opposed to travel by rail or air, takes place in normal work hours, presumably reflecting the shorter length of car journeys. Predictably rail and air travellers spent a greater fraction of their travel time working than car travellers. That over 95% of all respondents worked for less than 60% of their travel time reinforces our earlier argument that the true value of p lies somewhere between zero and p^*.

VL and MP can be valued in two different ways. First, we can use estimates of employees' and employers' values of time obtained from the stated preference experiments described in Sections 5 and 6. To derive the 'stated preference' estimate of MP from this data, the estimated value of VE, 20p/min, was substituted in equation (2) and the equation was solved for MP.

Second we adopt the current practice of the Department of Transport (DTp) and set VL equal to the recommended equity value of leisure time savings, found in past studies (mainly of commuters) to be approximately 25% of the wage rate of all travellers, and MP equal to the wage rate of business travellers plus a marginal increment (to cover overhead costs and fringe benefits etc) of 36.5% of the wage rate. Inspection of our study values and the DTp values for VL and MP (see Table 8) shows the former are in all cases greater than the latter. This implies estimates of VBTT, constructed using the synthetic approach, will always be greater when our study values, as opposed to the DTp values, are used.

The difference between the estimates of VL, derived from the stated preference experiment, and those used by the Department of

Transport is particularly large. There are at least 3 possible reasons for this;

1) leisure time savings for the long distance business travellers in our SP experiment accrue at unsociable hours and so are valued highly

2) time savings which occur after a full days work and a lot of travelling can be expected to be valued more highly than time savings for shorter commuter trips

3) the incomes of business travellers are much higher than travellers on average.

This third reason of course loses its force when equity considerations are taken into account. Our 'equity' values of leisure time are nevertheless still four times the Department's values. Reasons (1) and (2) above may explain these differences.

In Table 9 we present estimates of VBTT calculated for our samples using the wage rate approach, employers' stated preference values, revealed preference values and the synthetic approach pioneered by Hensher. The VBTT estimates calculated using Hensher's methodology are all considerably less than the corresponding estimates calculated using the wage rate approach. This agrees with Hensher and RIM's work in which VBTT estimates were 50% and 60% respectively, of values calculated using the wage rate approach for their samples. The (equity) values of business travel time constructed from our stated preference data (the first two rows of 4 (B) in Table 9) are, by contrast, slightly below the wage rate approach values. Estimates for car travellers tend to be nearer the wage rate approach values and this is because a smaller proportion of travel time on car journeys, as compared with journeys by rail or air, falls outside normal work hours.

Table 8 Data for VBTT Components

	ECML SAMPLE			ORGN SAMPLE		
Variable	Car	Rail	Air	Car	Rail	Air
r*	0.293	0.452	0.453	0.355	0.395	0.396
p*	0.029	0.210	0.170	0.037	0.196	0.114
q	1.072	0.935	0.983	0.959	0.966	1.004
Values of Time p/min						
VL:						
Stated Preference	11.6	11.6	11.6	11.8	11.8	11.8
Equity Stated Preference	8.2	8.2	8.2	8.8	8.8	8.8
DTp Equity Value [1]	1.9	1.9	1.9	1.9	1.9	1.9
MP:						
Stated Preference [2]	20.2	20.6	20.6	20.1	20.3	20.1
DTp Value [3] (Marginal wage increment)	18.5	17.4	20.4	15.8	15.5	19.4

1. This value was obtained by inflating the Department of Transport's value, in 1979 prices, (Department of Transport (1981)) by the change in average hourly earnings of full-time employees between 1979 and 1984 (New Earnings Survey).

2. These values were calculated adjusting for time savings devoted to leisure i.e. $r = r^*$, $p = 0$. An average personal tax value of 40% was assumed.

3. This equals the median wage rate multiplied by 1.365. Wage rates were calculated by dividing the annual salary by 46 times normal hours worked per week.

Table 9 Estimates of Values of Time for Long Distance Business Travellers (p/min, 1984 prices)

		ECML			ORGN		
		Car	Rail	Air	Car	Rail	Air
1. WAGE RATE APPROACH		18.5	17.4	20.4	15.8	15.5	19.4
2. EMPLOYERS' STATED PREFERENCE		20.0 (108)	20.0 (115)	20.0 (102)	20.0 (102)	20.0 (127)	20.0 (103)
3. REVEALED PREFERENCE		23.5 (127)	23.5/ 19.1 (110-135)	19.1 (94)	23.5 (149)	23.5/ 19.1 (123-152)	19.1 (98)
4. SYNTHETIC APPROACHES (see Equation (1))							
(A) USING SP VALUES							
$r = r^*$	$p = 0$	17.7 (96)	16.5 (95)	16.6 (81)	17.2 (109)	17.0 (110)	16.8 (87)
	$p = p^*$	17.1 (92)	12.5 (72)	13.1 (64)	16.5 (104)	13.1 (85)	14.5 (75)
$r = 1$	$p = 0$	11.6 (63)	11.6 (67)	11.6 (57)	11.8 (75)	11.8 (76)	11.8 (61)
(B) USING EQUITY SP VALUES							
$r = r^*$	$p = 0$	16.7 (90)	15.0 (86)	15.0 (74)	15.8 (100)	15.9 (103)	15.6 (80)
	$p = p^*$	16.1 (87)	11.0 (63)	11.5 (56)	15.1 (96)	12.0 (77)	13.3 (69)
$r = 1$	$p = 0$	8.2 (44)	8.2 (47)	8.2 (40)	8.8 (56)	8.8 (57)	8.8 (45)
(C) USING DEPARTMENT OF TRANSPORT VALUES							
$r = r^*$	$p = 0$	13.6 (74)	10.4 (60)	12.0 (59)	10.9 (69)	10.1 (65)	12.5 (64)
	$p = p^*$	13.1 (71)	7.0 (40)	8.6 (42)	10.3 (65)	7.2 (46)	10.3 (53)
$r = 1$	$p = 0$	1.9 (10)	1.9 (11)	1.9 (9)	1.9 (12)	1.9 (12)	1.9 (10)

9. Conclusion

In this paper, we have presented the results of a number of different approaches to the valuation of business travel time savings. Whilst we find good reason to suppose that much of the time savings in our sample would be devoted to leisure, we still find that these time savings are valued highly by employers and employees alike. Perhaps this is not surprising; the reason why we expect time savings to be used for leisure is that they accrue in (often extremely) unsocial hours.

Thus for forecasting purposes we suggest, that a value a little above the conventional 'wage rate plus' approach may be the most appropriate. For evaluation purposes, the issue is less clear cut. The value of time savings has been shown for our samples to vary significantly according to the valuation methodology adopted. Although we do not possess sufficient evidence with which to decide unequivocally on the most appropriate to use, we believe that the lowest values that it would be reasonable to contemplate are those which assume that all time savings would be devoted to leisure activities but that any work undertaken en route would still be done, and which use employees' stated preference values adjusted for equity considerations. This gives values in the range of 40-57% of the wage rate approach values. Only a modest use of time savings for work purposes is needed to obtain values close to the wage rate approach value; for instance assuming that the proportion of time savings devoted to work equals the proportion of travel time in normal working hours will do this. In short, although we find no empirical support for the assumptions upon which the present valuation conventions are based, our empirical work suggests these conventions yield values which are approximately correct. There remains one important proviso, that it is assumed that current levels of unemployment do not justify shadow pricing this type of labour.

Finally, a word of warning. This study was undertaken on a sample of travellers which was far from randomly selected, and was deliberately confined to long distance trips for which a realistic choice of modes could be assumed to exist. In examination of data from the Long Distance Travel Survey we found the ORGN, though not the ECML, sample appeared to be representative of very long distance business travel, namely of trips with a one way distance of over 100 miles (Marks (1986b)). We have estimated that trips of this length account for roughly 25% of the total mileage for business trips as a whole. For shorter business trips one would expect more travel time to fall within normal work hours and employees' to place less value on travel time savings (Wardman (1986)). It is unclear, however, what the net effect of these changes would be on value of time estimates.

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