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A S Fowkes
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Tony Fowkes

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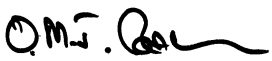
Signature	

FOREWORD

This is one of a series of papers prepared under DETR contract PPAD9/65/79, 'Revising The Values of Work and Non-Work Time Used for Transport Appraisal and Modelling'.

The views expressed in these papers are those of the authors and do not necessarily reflect the views of the DETR (now DTLR).

Working Papers 561-566 were originally prepared in May 2001 and formed the basis for Working Paper 567 which reports on the evidence and was prepared in August 2001. Working Papers 568 and 569 on policy and practicality were written subsequently.

The Study Team consisted of:-	Peter Mackie
	Mark Wardman
	Tony Fowkes
	Gerard Whelan
	John Nellthorp
	John Bates (John Bates Services)
	Denvil Coombe (The Denvil Coombe Practice).
Rapporteur:-	Phil Goodwin (UCL).

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1. OVERVIEW

There are two approaches to valuing travel time savings to business people. The first is that which has formed the basis of UK policy for about 30 years, and which is set out in Section 2. This takes the value of travel time savings on employer's business as equal to the gross wage rate plus an allowance for other costs that the employer saves. These might include such things as desk space, computer, tools, uniform, protective clothing, travel expenses. These were investigated in studies for the UK Department of the Environment around 1970 (Fullerton and Cooper, 1969; Rubashaw, Michali, Taylor and Key, 1969; Harrison, 1969; Harrison and Taylor, 1970; and Makrotest, 1970).

The underlying rationale was that if employers were actually seen to be saving a certain amount of cost (through the gross wage and these various add-ons), then this was the value to them and, subject to any taxation related adjustments, should be the value to society. The approach is sometimes called 'The Cost Saving Approach', though it is also sometimes referred to as the 'wage rate plus' approach. Clearly, it was believed by the UK government that the economy was sufficiently competitive that average wage rates, for the employment groups concerned, reflected the value to employers.

The approach can (but need not) be underpinned by appeals to the neoclassical theory of the firm and the labour market. This gives the equivalence of the marginal (revenue) product of labour to the marginal cost of employing labour, implying that a marginal minute saved will result in a marginal output increase valued at the wage rate for that minute. It is sufficient for this to be true on average, rather than for each individual employee involved. The process may also be 'indirect', such that employers receiving sufficiently big travel time savings, via their employees, might release resources into the labour market, where their value should be the marginal wage rate paid by employers for labour of this type. There is clearly room in this argument for small edge effects, but in general it does provide credible support for the Cost Saving Approach. However, its value is undermined by the possibilities it gives for objections to its assumptions, and this process ultimately leads most students of this area to at least wish to consider the more detailed 'Hensher' method to be considered in Section 3.

This note then proceeds in Section 4 to review what AHCG did. Section 5 looks at the matter from the point of view of the employer. Finally, section 6 gives our conclusions.

2. THE CURRENT UK APPROACH

The latest values of time and vehicle operating costs recommended by DTLR are set out in its Transport Economics Note dated March 2001. In the case of Working Time, Willingness to Pay values are taken to be both the Perceived Cost (presented for use in forecasting models) and the Resource Cost (presented for use in evaluation studies). The Willingness to Pay of employers has been taken on theoretical grounds to equal the gross wage rate plus non-wage labour costs "such as national insurance, pension and other costs which vary with worker hours". On the basis of data from the 1992 Labour Cost Survey, the 36.5% mark-up for wage costs, previously used, was revised down to 24.1% in the 2001 TEN note.

The current approach can be supported by labour market theory. However, several alternative sets of assumptions will do the job, and none can be defended as obviously universally applicable (other than as an approximation). Hence, if any particular set of assumptions is put forward, it is relatively easy to cite convincing cases where they might not

be applicable. Nevertheless, if the value to employers of an extra hour of labour of a particular type, whether released by travel time reductions or otherwise, is far from the gross wage rate, then there must be something wrong with the working of the labour market.

In general, when a 'buyer' buys some commodity, say a pack of six eggs, then we deduce that (unless the buyer had got mixed up and was intending to buy tomatoes) the value of the pack to the buyer was at least equal to the price paid, and most probably above it (i.e. consumer surplus). If the buyer uses eggs regularly, the same will apply to individual eggs, and the buyer may keep buying eggs until the value per egg to him/her falls to the price of an egg. However, if the buyer is not a large consumer of eggs, the restriction that they may only be brought (at that price) in packs of six may influence matters. In a given period, the marginal pack of eggs (possibly the first pack of eggs) may be purchased because its value as a pack equalled or exceeded the price of the pack, rather than that the value of the last egg in the pack was greater than the pack price divided by six. The last egg may turn out to have negative value if it goes 'off' before it is consumed.

Because employers hire labour in 'packs', typically of some 40 hours per week, it might be that the last hour each week has less value to the employer than the wage rate. It might therefore seem that a one hour travel time saving might generate another hour worth less than the wage rate. Against this we can give various arguments. Firstly, the benefit of sending business people travelling lies in time spent at the destination. Fitting in an extra hour at the destination in a day trip may be especially valuable, and speeding up travel for multi-day trips could reduce the number of days required for the trip, again at disproportionate benefit. Secondly, much labour is interchangeable, such that it is hired till the marginal package (of 40 hours or whatever) is just worthwhile. A firm with 100 managers should be able to organise them such that the 'jumps of 40 hours' indivisibility is not significant. Thirdly, the widespread prevalence of overtime working (often at premium wage rates) indicates that, all else equal, a firm with, say, 4000 hours of work to cover per week will find it cheaper the smaller the number of employees used (due to administrative costs, costs such as paid holiday entitlements which relate to the basic hours, etc). All in all, it does not seem unreasonable to assume that an hour of work time arising from travel time savings is approximately equal to the wage rate of the individual concerned.

Some people will wish to take the argument further and try to say just what the employer can produce with the extra hour of labour. This amount can be called the marginal Product (MP) or Marginal Revenue Product (MRP) if one wishes to emphasise that it is in money terms. As an approximation, the Marginal Revenue Product will equal the Marginal Physical Product (MPP) times the price of the goods produced (which for business travellers is somewhat hard to pin down). However, since the extra amount can only be sold by (ever so slightly) reducing the price, multiplying the MPP by price slightly overstates the value to the employer. To avoid this rather tedious point, we shall assume that MP is already in money terms.

Where the work being done during 'Working Time' is itself travelling, then the above approach attracts few critics. This will be the case for service engineers, delivery people, bus drivers, train drivers, lorry drivers, taxi drivers etc. These people may not be 'travelling' all the time, but they are 'out and about', and if travel conditions change to enable them to travel further in a given time, they will become more productive. In the absence of indivisibilities, if each of these people can achieve their previous travel distance in one hour less each week, then the employer gains an extra hour's productive work from each of them. If there are

indivisibilities present, for example such that a bus conductor previously fully employed cannot fit in an extra trip in the one hour, then the threshold argument (see Fowkes, 1999) says that the overall result is just the same as if there were no indivisibilities. This is because the presence of indivisibilities will mean that each employee will have a bit of spare unusable time to begin with, for example like the bus conductor without sufficient time to complete a further trip. The amount of this spare time will be uniformly distributed, between zero and the amount of time necessary to undertake a further piece of work. If a piece of work takes two hours, then the extra one hour will be useless to half of the employees, while the remaining employees will now be able to work 2 hours longer. On average therefore, each employee has gained one hour of productive work.

Many people travelling in the course of work, though, may not be in the same position as those whose work is effectively to travel. They may travel in the course of work outside normal working hours, and they may be able to carry out some 'work' while travelling, which might have to be curtailed if the journey was speeded up. The UK approach has been to treat both groups identically, ie to ignore these complications. Also ignored is the complication of whether the time saving is on the outward or return journey. If employees are presently happy to set out on a business trip at time x and return home at time y, then it might be supposed that, all else equal, this will continue to be the case and that any travel time savings will permit that much longer to be spent at the business destination. Also, if business travellers on a two hour train journey spend one hour working, there is no reason that a half hour journey time saving need reduce the time spent working. For any acceptable return arrival time, speeding up the return journey will allow longer at the destination, just as would speeding up the outward journey. While DTLR has been willing to consider evidence that has come along from time to time, it has not been convinced that there is sufficient need for an extra category of time saving, namely that for business travel. However, discussion of this has continued for a quarter of a century.

Hensher (1977) challenged the UK methodology just discussed. Following his lead, Fowkes, Marks and Nash (1986) set out four possible criticisms of the Cost Saving Approach, as follows:

(a) The UK economy is far from perfect competition. Monopolies will equate the cost of labour to its Marginal Revenue Product. This term is defined by economics textbooks, e.g. Solomon (1976), as a "measure of the extra income realised by the firm by selling the additional output (marginal physical product) it can produce from an additional unit of input". This will be less than the value of its marginal product. Conversely, monopoly power by some groups of workers may bid the wage up above the value of the marginal product.

(b) The UK economy has, since the early 1970s, operated far from full employment. For various reasons, the wage rate has not fallen (sufficiently) to clear the market. Hence any labour released into the market, due to travel time savings, might not be used to produce additional output. There is therefore a case to value labour at a 'shadow' price rather than the market price.

(c) The Cost Saving Approach ignores benefits or costs to the employees themselves from the time saving. Employees may prefer working to travelling, or vice versa.

(d) Wage rates are calculated by dividing wages by the number of hours worked, but some sorts of employees (particularly those classed as business travellers) may not work fixed work hours. Where the journey (experiencing the time saving) is outside 'normal' working hours, it may be that productive hours do not increase by the full amount of the time saving. If all travelling is to be counted as work, then the denominator (hours) used to calculate the wage rate will have to reflect that. A further complication for business travellers is that, whether or not the travelling is regarded as 'work', they may carry out productive activities while travelling. A travel time saving might reduce the time available for these.

The alternative, Hensher, approach therefore investigates the willingness to pay for each aspect resulting from the travel time saving.

3. THE HENSHER APPROACH

Hensher (1977) selected a number of hypotheses related to the valuation of business air travel time savings and subjected them to testing in a real-world setting. The starting point was hypotheses raised by the research team for the Roskill Commission's investigation into the selection of a Third London Airport Site, for which there was then no behavioural evidence available. Hensher states that he sought

> "to identify the relevance of the dichotomy between travel in the employee's own time and the employer's time, the contribution to productivity during the total six-trip-stage journey, the costs of compensating the traveller for travel in the employee's own time and the disutility cost to the employee of travel".

The context was air travel in Australia. Each journey was considered as consisting of outward and return trips, and each trip had access stages to and from the airport, hence the six trip stages. Although there are many equations in Hensher's book, there is no simple equation codifying the terms relating to the value of time that Hensher listed in the paragraph reproduced, though he does elaborate his approach in words.

Carruthers and Hensher (1976), reporting on the same work, give a rather less complicated equation. Hensher further developed his equation in the early 1980's, but did not publish a further equation until Hensher (1989), which gives (very nearly) equation (1).

$$VBTT = (1 - r - pq)\,MP + (l - r)\,VW + r\,VL + MPF \qquad (1)$$

where

- VBTT = value of savings in business travel time
- MP = Marginal Product of labour
- MPF = value of extra output generated due to reduced (travel) fatigue
- VL = the value to the employee of leisure time relative to travel time
- VW = the value to the employee of work time at the workplace 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 to the office

Of the above, Hensher (1977) omitted MPF from his calculations, no doubt because of the difficulty of obtaining suitable data. Fowkes, Marks and Nash (1986) note that Hensher made a number of arbitrary assumptions about the distribution of VW values. Hensher took p to be the proportion of TOTAL travel time spent working, and defined r to be equal to the proportion of travel time which occurs in what would otherwise be leisure time (defined as time outside normal work hours).

The UK DoT Value of Time study revisited the problem in 1981 (Lowe 1982), giving an equation similar to equation (1). There was an added complexity in the form of m, the marginal wage increment, which is added to the gross wage rate, w, to give what equation (1) has as MP. This would be particularly relevant in times of full employment, where overtime working was endemic and the only way to get further hours of labour was to lengthen overtime working at premium payments. Given the other uncertainties, this complexity is probably one too many. Other differences in the equation given, as compared to equation (1), include a negative sign to the VL term, which is presumably a typing error.

Fowkes et al (1986) also give equation (1), and introduced their own changes to the interpretation of the terms in the equation.

(1) MP was not derived from wage rates plus an overhead, but from employers' willingness to pay to save travel time, VE.

$$MP = \frac{1}{(1-r-p)}\left[VE - \frac{r}{1-tp}VL - \frac{(l-r)VW}{1-tp} - MPF\right] \qquad (2)$$

where tp is the employee's personal tax rate. Perhaps the divisor should have been (1 – r – pq), but q was estimated close to unity, and that may have been substituted here.

In this way, Fowkes et al sought to let the employer decide the extent to which time savings would be translated into additional work or additional leisure, and the extent of any change in the employee's remuneration package that might be occasioned. The tax adjustment comes about because increases in the employee's utility are not subject to tax, hence the cost to the employer of making the offsetting compensation will be inflated by 1/(1−tp).

(2) For VL, Fowkes et al rejected the previous practice of using leisure vots derived from the study of commuters' mode choice. Such values were thought to underestimate VL since business travellers on average had higher incomes than commuters, and business travel time savings were thought more likely to occur at unsocial times of day. Supporting evidence was provided. Stated preference estimates were obtained, though it was unclear whether these represented purely VL, or instead VL + MPF, since fatigue may have been taken into account when responding.

(3) For VW, Fowkes et al could see no reliable way of estimation. However, as it was felt that the effect could not be large, they set VW = 0, i.e. business travellers were assumed to be on average indifferent between travelling (working or not) and working in the office. This hardly seems satisfactory from a theoretical point of view, but might not be far wrong on average.

(4) For p, the proportion of travel time savings which is at the expense of work done whilst travelling, Fowkes et al felt that those who do work while travelling generally work for a sufficiently short time that realistic travel time savings would have no impact. So while the proportion of <u>total</u> travel time spent working has empirically been found to be greater than zero for groups of business travellers, giving the value of p used by Hensher, Fowkes et al felt that this should be called p*, with true p lying between zero and p*. Estimated values of p* ranged from 0.03 for car to 0.21 for rail.

(5) For q, Fowkes et al followed previous practice by asking how long was worked on a particular trip, and how long that work would have taken in the office. They state that, due to the expected overreporting of work done, it is to be expected that q will be biased upwards, but really it is a second bias effect affecting q that is the problem. It is not that a lot of work was done while travelling, it is more the claim that it was no less productive per minute as work in the office. For car the reported average value of q was above unity, and it is hard not to imagine that as an overestimate. For air the average was 0.98 and for rail 0.95. It is not clear what Fowkes et al actually did for q. In one place they seem to have used these values, and in another to have taken q=1.

(6) For r, Fowkes et al rejected the use of the proportion of total travel time which occurs in leisure time. Firstly it was felt that for day trips starting and ending at home, where there is sufficient work to be done at the destination, travel time savings are likely to result in more time spent at the destination, rather than a later start from home or an earlier arrival back (though this is complicated by public transport schedules). Secondly, business travellers may be able to substitute travel out of normal work hours for work time on another day. Accordingly, Hensher's value was denoted r*,

and the true value of r taken to lie between zero and r*. Values of r* found varied from 0.32 for car to 0.42 for rail and air. Fowkes et al used these values and, inexplicably, r=1. Table 1 gives their results for (r=r* p=p*) and (r=r*, p=0), together with the wage rate approach, employers' SP and an RP estimate. Setting (r = 0, p = 0) just gives the Employers' SP value, as on line 2.

Table 1 Estimates of Car Values of Time for Long Distance Business Travellers (pence per minute, 1984 prices)

	Sample 1	Sample 2	Average
1. Wage rate approach	18.5	15.8	17.2
2. Employers' Stated Preference	20.0	20.0	20.0
3. Revealed Preference	23.5	23.5	23.5
4. Hensher Formula (r=r*, p=p*)	17.1	16.5	16.8
5. Hensher Formula (r=r*, p=0)	17.7	17.2	17.5

Notes:

(i) Leisure values of time are taken from the SP survey of these business travellers on their business trip, but with a fixed budget to spend (or keep).

(ii) Sample 1 was by mail to rail travellers who had indicated they were willing to be questioned.

(iii) Sample 2 was via particular firms.

(iv) The Employers' Stated Preference was more a Stated Intention exercise. For those travellers who usually used a car the value fell to 14.4 p/min.

Source: Fowkes, Marks and Nash (1986)

As previously mentioned, Hensher (1989) gives equation (1). Nevertheless, he does not in that paper use that formula, when calculating a resource cost. Instead he reverts to the wage-plus approach, saying:-

> "At the margin it would be expected that the productivity of an employee equals his/her full wage rate. In this context the term 'full' wage rate is used to refer to the gross wage plus on-costs. The value to the <u>community</u> of an employee spending less time travelling and more time in productive work is, therefore, approximately equal to the full wage rate".

Looking at Table 1, we can see that, at the time it was constructed, using the Hensher formula, in the way he proposed, gives values of business travel time of the same order of magnitude as the wage rate approach. Relaxing some of the parameters of that formula, in this particular example, raises the VOT above the wage rate approach, on average. In passing, we may also note that Fowkes et al's Employers' Stated Preference experiment and Revealed Preference analysis, yield yet higher VOTs. Naturally, there can be more than one interpretation of the figures in Table 1. Had the gross wage rate, on line 1, been used for MP in the Hensher formula, instead of Employers SP VOT, the resulting VOT would perforce have been below the gross wage rate (the Hensher formula being an average of MP and something less). Secondly, for those approximately 10% of firms who said that their staff normally used car for long distance business travel, the Employers' Stated Preference was only three quarters of the overall value used in Table 1. Conversely, the Revealed Preference VOT for Car versus Rail (used in Table 1) was some 20% higher than the Air versus Rail

value, through this was still above the gross wage rate for those samples. Nevertheless, it is easy to see why Table 1 was not thought to give any great support to calls for a move away from the current approach towards use of the Hensher formula.

In the 1990's, Swedish and Norwegian studies attempted to calibrate the Hensher equation. The Swedish study (Algers et al, 1995) split r by whether the business traveller worked during the trip (a) or not (e). Their findings were as follows:

	ra	re	q	p
Car	0.44	0.63	1.01	0.30
Air	0.65	0.91	0.97	0.50
Long Distance Train	0.69	0.90	1.03	0.49

The Norwegian study (Ranjerdi et al, 1996) did not make that distinction. Their findings were as follows:

	r	q	p
Car	0.57	0.32	0.03
Air	0.64	0.28	0.07
Rail	0.72	0.39	0.18
Bus	0.74	0.20	0.06
Ferry	0.63	0.19	0.03

The Norwegian study constrained individual values of q to have a maximum of unity but, even so, the smallness of the results is striking. The Norwegian p values are also well below the Swedish ones. Without studying the exact questions asked, it is hard to comment further. The low Norwegian values of p strike us as more plausible than the Swedish ones. The low Norwegian values of q are a puzzle, even allowing for the adjustment, the Swedish values being similar to those found in the UK. The Swedish study however, did not accept the values reported above. In the case of q it capped individual values at unity and then multiplied by 0.65. This figure was derived from an on-train survey. That found that 90% of the work carried out on trains would have been carried out if not travelling, but that the average value of work time on board compared to work time in the office was about 60%. Furthermore, for each traveller, r was set equal to the minimum of (r) and (1-pq). In this way original results deemed not very credible were corrected.

We have reservations about these corrections made in the Swedish study. However, our major difficulty with that study is that they set VW=VL. We believe this results from a major misunderstanding. It is the equivalent of assessing zero wages, which cannot have been what was intended. The Norwegian study sidestepped the matter by using VW=VL and VW=0 as a range for sensitivity testing.

We now turn to see what AHCG actually did.

4. WHAT ACCENT/HAGUE DID

The AHCG report refers to Hensher's formula, and gives the employer's value of travel time (which we have previously called VE) as

$$VE = W (a – bc).$$

where	VE	is the employer's value of travel time changes.
	W	is the wage rate, including overheads, and so stands for MP in the previous equation
	a	is the fraction of time savings/losses which would be put into or taken out of paid work, and so equates to (l – r*) in the Fowkes et al notation.
	b	is the fraction of travel time already spent doing work, which equates to what Fowkes et al labelled p*
and	c	is the productivity of work during travel relative to being done elsewhere, which equates to what we have previously called q.

To VE is added the employee's value of time in leisure as opposed to travelling, which we previously called VL. Hence, the total VBTT is calculated as follows:-

$$VBTT = MP (l – r^* – qp^*) + VL \qquad (3)$$

Immediately we see that, compared to equation (1), the fatigue factor (MPF) has been dropped and VW has been set equal to VL. This latter assumption implies that the marginal utility to the employee of time spent in work is equal to that spent in leisure. Economic theory would only support this in the absence of wages! With any positive level of wages, for maximum utility the marginal utility of leisure (assumed positive) is equal to the sum of the marginal utility of wages (assumed positive) plus the marginal utility of working (which can be positive or negative depending on the individual). The very notion of Business Travel implies that wages are not zero, in which case VW cannot equal VL. For most business travellers, wages will be substantial and so VW will be far from VL. Originally we thought that this was an accidental mistake, but now see they follow Algers et al (1995) in putting VL = VW.

In order to estimate their a, b and c (corresponding to Fowkes et al (l-r*), p* and q), AHCG asked car travellers the following questions (these below being copied from questionnaire TB, but all questionnaires believed identical).

Q20 Suppose that the business trip that you were making had taken 15 minutes longer as a result of congestion on the roads. Would that extra time have been paid by your employer, or would it have come mostly out of your own time [or a combination of both]?

The 'combination' replies were counted as 50%, the 'employer's time' as 100%, and 'mostly own time' as 0% (despite the 'mostly'). AHCG found 'a' to be 0.537. However, I cannot see that the question has any meaning for the 22% who were self employed. Those not self employed reported 'a' as 0.64 (or r* = 0.36). The slightly higher figure of 0.655 was obtained for travellers whose employer was

paying the travel costs. This result is consistent with the r* value of 0.32 for car found by Fowkes et al.

Q21 Did you use any of the time during that trip to do work which you otherwise would have done elsewhere; for example preparing for a meeting, conversations on a portable telephone, etc? If so, about how much time?

Given that total travel time is known, this question allows us to estimate p*, the proportion of travel have spent working. AHCG called this b. AHCG found that 22.2% of respondents did do some work, the average proportion for these people being 0.195. Hence b = 0.222 (0.195) = 0.043. The Fowkes et al car value for p*, was 0.033, but this applied to long distance only, in which case the AHCG value rises to 0.052. Perhaps this reflects the increasing use of portable telephones, or perhaps 'mental' preparation was included thereby changing the definition compared to the earlier study.

Q22 Approximately how long would that same work have taken you if you had done it at your office or at your home?

This question provided AHCG with their estimate of c, and is clearly an attempt at finding q, the relative productivity of work done while travelling compared to in the office. The mention of 'or at your home' is a complication however, since it is quite possible to imagine the office being the most productive environment per minute work, followed by 'in car', with 'at home' being the least productive. In any event, values of c found were close to unity, averaging 1.02. Ignoring journeys of less than 30 minutes reduces that to 1.01. Fowkes et al found q values of 0.96 and 1.07 in their two samples of car business travellers, averaging 1.01, thereby agreeing (rather by fluke) with the ACHG long distance car figure. The agreed figure is, however, counterintuitive. How to proceed from this point is not clear. The simplest is to say that there are no grounds for taking q to be any value other than 1.00. Another approach has been to replace q values above unity by unity, on grounds of plausibility, and then recompute the average. Attempts to do this can lead to big changes in q, though the effect on VBTT is not large.

The calculation performed by AHCG was therefore as follows:

$$VBTT = MP\,(1-r^*-qp^*) + VL$$

$$= 30.9\,(0.5537-1.02\,(0.043)) + 6.7$$

$$= 21.94 \text{ p/min}$$

By carrying out the calculations at an individual level, AHCG derive a slightly lower value, namely 21.4p/min, but this figure is probably excessively swayed by rogue responses (for example, those who said they worked, very productively, for a high proportion of the time they were driving).

The first alteration we would wish to make is regarding the VL term, which we would like to see replaced by (1–r)VW+rVL, as per equation (1). AHCG claim, on p253, to be following Hensher's formula, so the onus must be on them to argue for departures from it, and this they

do not do. We note that Gunn and Rohr (1996) report that the method was used in the Dutch Value of Time Studies, dating back to the 1980's. We also accept that the Swedish National Value of Time Study (see Algers et al, 1995) followed the same approach as AHCG, but explicitly starting from equation (1). Algers et al (1996) gives the following argument:

> "In this study, the value of time to the employee was not differentiated depending on whether the time saved would be spent at work or on leisure, and it was thus implicitly assumed that the private VOT (VP) is the same in both cases, or that VW equals VL."

This leads then to eqn (4), given here in our notation.

$$VBTT = MP(1-r^*-qp^*)+VP \qquad (4)$$

Since they say that they are assuming VW=VL, it is immaterial to them whether VW or VL is used in place of VP in equation (4), and so it is to that extent equivalent to equation (3). However, it is clear that this has not been done on any theoretical basis, or as a result of any empirical findings.

The Norwegian National Value of Time Study (Ramjerdi et al, 1996) certainly considered the matter, producing separate estimates for VW=0 and VW=VL. It is not clear, from the documents I have, whether any preferred result was reached. However, it is clear from the text that the reason for considering VW=VL is that respondents may have been unclear as to whether their time saving was going to leisure or work, and so choosing to consider both VW=0 and VW=VL was to give a range. This is a different reason to that given by Algers et al. This certainly gives us no grounds for accepting the AHCG calculation, other than as a limiting case.

In consequence, our first alteration to the AHCG calculation is to replace VL with $(1-r^*)VW + r^*VL$, at which point we have to say we do not know VW either, but are fairly sure it is not far from zero. Setting VW=0 reduces VBTT to 18.34 p/min. The reason we think VW must be near zero is that travelling for business work purposes is not that dissimilar to working in an office. It certainly has nothing like the positive utility (on average) of having extra leisure time.

The next change we would like to make is to consider the VL term further. AHCG gives a very low value, 6.7 p/min, taken from their Table 88. A decade earlier, Fowkes et al (1986) had found long distance business travellers having Stated Preference VOT using their own money and time saved, of 11.7 p/min in prices then current. This is not actually inconsistent with Table 88 since a strong increase of VOT with distance is evident, unfortunately not split by whose time and money. Related to that, it is interesting that business travel time on motorways was valued three times as high as business travel time on urban roads. It could be that many of the shorter distance business travellers intercepted by AHCG were travelling as work, and not the 'briefcase' travel we are considering here. However, any change we might make would be fairly arbitrary, so we refrain at the moment, merely noting that any sensible change would increase the VBTT estimate.

The next change we will consider is to replace p^* by p and set p to a compromise value of 0.02. This is because it is unreasonable to expect the work done to fall in proportion to the fall in journey time when so little of the journey time is spent working (for those journeys

were any work is done). Our view is that there is very little evidence that p is meaningfully different from zero for car, which is all that AHGG were considering. For Rail and Air, values up to around 0.2 were found for p* by Fowkes et al (1986). From that, we might say that p values for Rail and Air might be as high as 0.1.

Regarding q, about 80% of respondents said q=1. We feel this is probably a misunderstanding, as that work might not have needed to be done at all if this person was in the office (eg a phone call to establish where they actually were). We are very reluctant to consider any q values above unity. By capping all 'business purposes' in Table 125 of AHCG at q=1, we can estimate an average q as:

$$q = \frac{1(238+551+168+177)+0.78(53)+0.98(172)}{238+551+168+177+53+172} = 0.99$$

In consequence, we feel it best to just use q=1. Our feeling is that there is no meaningful evidence to support q being set at any other value than unity.

Regarding r, we feel that many business travellers either recognise that they are being paid for their business travel time, even if out of normal office hours, or are able to take time off in lieu later. We will carry out calculations with r=0 and r=r*, which was 0.463 in the AHCG survey.

(i) r=0, q=1, p=0.02 (all time saved taken to result in extra working hours)

VBTT = 0.98MP = 0.98(30.9)
= 30.3 p/min in 1994 prices

(ii) r = 0.463, q = 1, p=0.02 (only 53.7% of time saved result in extra working hours)

VBTT = 0.517 MP + 0.463 VL

= 0.517 (30.9) + 0.463 (6.7)

= 19.1 p/min in 1994 prices

This range of values (19.1, 30.3) represents our level of uncertainty regarding the VBTT from the AHCG study using the Hensher formula, essentially driven by the choice of r. However our preference is for the higher figure (both because in (ii) r is too high and VL too low).

5. LOOKING AT IT FROM THE VIEWPOINT OF AN EMPLOYER

In this section we will list various possibilities relating to the circumstances concerning travel in the course of work, and then consider the value to the employer of a travel time reduction.

(i) Travel as Work (e.g. bus drivers, service engineers, parcel delivery persons etc.).

Following the earlier discussion, we think it is clear that, in the absence of indivisibilities and schedule constraints, if travel by such a person takes one hour less, then the employer will save one hour's gross wages. In most cases, the effect of indivisibilities and schedule constraints are negated by the threshold argument, whereby some individual workers will yield no gain, but others will now have sufficient time to complete a larger task, the average effect being equivalent to taking the gain equivalent to the gross wage rate. For this group, therefore, we feel that the benefit to the employer is near enough equal to the gross wage rate.

(ii) Employees who can take time off in lieu for travel time outside of normal working hours.

Any time saved for travel time reductions will either result in additional time spent at work directly, or indirectly due to less time taken off in lieu. Such arrangements may only work imperfectly, but we feel that the gain to the employers will be near enough the gross wage rate.

(iii) Employees who accept some out of hours travel as a condition of the job.

If we assume that the labour market is working correctly, then it must be the case that remuneration packages must be better than otherwise when there is a significant amount of out of hours travel which cannot be set against time taken off in lieu. If there are travel time savings resulting in an hour saved, then some of that may result in extra work completed and some may reduce the amount of travel undertaken out of hours. To analyse this, it will suffice to consider the two extreme cases: all in work hours, all outside work hours.

In the first case, it is clear that the benefit to the employer is most simply taken to be equal to the gross wage rate. However, particularly in the context of day trips, having three hours at the destination instead of two could be especially valuable, e.g. three productive hours in a ten hour working day instead of two. Clearly this will not apply when there is only two hour's worth of profitable work at the destination. However, it has been noticeable that as rail journey times have fallen over the years the morning business trains from provincial centres to London have arrived ever earlier and the evening return trains departed ever later. This is an indicator that day trips for business are tending to have longer at the destination.

In the second case, where the time at destination is held constant but the journey starts later and/or ends later, the employee receives the immediate benefit. For day trips there can be a considerable benefit, since extra time in bed in the early morning is particularly highly valued (according to the Fowkes et al sample), and presumably time saved late in the day (possibly a rather long

day) may also be highly valued. Given these improvements in the conditions of work, it is to be presumed that profit maximising employers will wish to take them into account when deciding aspects of the remuneration package. Our view is that the simplest assumption to make is that if employee A is spending one hour less on company duties, the employer will be able to pay that employee one hour's wage less, all else equal.

6. CONCLUSIONS

Our main conclusion is that the value to the community is approximately equal to the gross wage rate. Hensher (1989) reached the same conclusion. The desirability of allowing for the various employment related add-ons is less clear, but we do not find sufficient reason to recommend a change.

It was not the purpose of this note to decide between various methods, but rather to review what has been done. The broad alternatives are the wage - plus (or Cost Saving) approach and the 'Hensher formula'. This note has discussed the former without finding much fault with it. In contrast, the latter approach offers a more rigorous methodology but has some problems. The first major problem is that the form of the equation is not agreed. AHCG applied a form of the equation which we regard to be flawed. The second major problem is that the necessary parameter estimates are difficult to obtain. Those given by AHCG differ significantly from those we would wish to use. The exact point at which a difference over parameter estimates turns into a difference over what the parameters mean (and hence the model form) is arbitrary, and by no means self-evident in this case. However, whichever or in whatever combination, we believe the AHCG method to have effectively double counted some benefits and underestimated some others. Our provisional conclusion is that the AHCG values for Employer's Business should not be implemented as they stand. Our calculations using the Hensher formula together with the AHCG data give a range from 19.1 p/min to 30.3 p/min in 1994 prices. The width of the range is due to whether we wish to assume that travel time changes are only partially reflected in working time changes (i.e. is r equal to zero or not?). Our preference is to hold the input of 'out of hours unpaid work' for a given salary constant, so that any changes in travel times are directly reflected in work time or a change in salary. This may be because employees accept a certain amount of such travel when agreeing their employment remuneration package, or because of 'time off in lieu' or because work hours are not fixed and time sheets used to record work hours. We believe this will correctly reflect the long term 'equilibrium' position, if the labour market was fully competitive, and so is appropriate for use in Cost Benefit analysis.

We know that 'time off in lieu' schemes do not always work as advertised, and that some employers count travel time at a lower rate, but feel that these considerations are offset by considering the very high leisure time values found by Fowkes et al (1986) for time savings at the extremities of the day. Getting up at 05:00 instead of 06:00 to make a business trip has much greater disutility than an average hour transferred from leisure to travel. Furthermore, we find the Cost Saving approach inherently appealing. It is the current methodology both for business travellers and those whose work is to travel, and our recommendation is that there should be no change to the values used for evaluation. For behavioural values, the Fowkes et al Employers SP suggested that employers would be willing to pay at least the wage rate, in the context of a long distance business trip, even though the time savings were ALL outside of normal working hours. For employees, using their own money much lower values can be expected for business travel time savings.

REFERENCES

Algers, S., Dillen, J.L. and Widlert, S. (1995). The National Swedish Value of Time Study, Proceedings of Seminar F, Models and Applications. PTRC-SAM-1995, P393, pp 133-149, PTRC, London.
Algers, S, Dillen, J.L. and Widlert, S. (1996). The National Swedish Value of Time Study, paper presented to the UK DoT Easthampstead Value of Time Seminar.

Carruthers, R.C. and Hensher, D.A. (1976). Resource Value of Business Air Travel Time, in Heggie, I.G. ed. Modal Choice and the Value of Travel Time, Clarendon, Oxford.

Fowkes, A.S. (1999). Issues in evaluation: A justification for awarding all time savings and losses, both small and large, equal unit value in scheme evaluation, in AHCG, pp 341-359.

Fowkes, A.S., Marks, P. and Nash, C.A. (1986). The Value of Business Travel Time Savings, University of Leeds, Institute for Transport Studies, Working Paper 214.

Fullerton, R.J. and Cooper, D. A Pilot Study on the Effect of Road Improvements on the Marginal Wage Increment, Report to the UK Ministry of Transport from Associated Industrial Consultants (AIC) Ltd, May 1969.

Gunn, H.F. and Rohr, C. (1996). The 1985-1996 Dutch VOT Studies, paper presented to DoT Value of Time Seminar, Easthampstead.

Harrison, A.J., "The Value of Time Savings to Commercial Vehicles, Time Research Note No. 5, London: Highway Economics Unit, Department of the Environment, August 1969.

Harrison, A.J., and Taylor, S.J. "The Value of Working Time in the Appraisal of Transport Expenditures: A Review", Papers and Proceedings of a Conference on Research into the Value of Time, ed. N.W. Mansfield, London, Department of the Environment, July 1970.

Hensher, D.A. (1977), Value of Business Travel Time. Pergamon Press.

Hensher, D.A. (1989), Behavioural and Resource Values of Travel Time Savings: A Bicentennial Update, Australian Road Research, (19), pp 223-229.

Lowe, S.R. (1982), Theoretical Considerations, Value of Time Working Paper 3, DoT, London.

Makrotest Ltd. Study into the Assessment of the Marginal Wage Increment – Short Term Savings, Report to the then Ministry of Transport, London, June 1970.

Marks, P. (1986), Long Distance Business Travel – A Literature Review, University of Leeds, Institute for Transport Studies, Technical Note 180.

Ramjerdi, F., Rand, L. and Sœlensminde, K. (1996). The Norwegian Value of Time Study, Some Preliminary Results.

Roskill (1970), Commission on the Third London Airport, Papers and Proceedings. Vol. VII, Part 1, HMSO

Rubashaw, N., Michali, R., Taylor, C. and Key, R. "A Study of the Long term Marginal Wage Increment", Time Research Note No 23, London: Highway Economics Unit, Department of the Environment, May 1971.

Soloman, L.C. (1976), Microeconomics, Addison-Wesley.

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