NOTES AND COMMENTS

THE VALUE OF COMMUTER TRAVEL TIME SAVINGS

Some Clarifications

By Allan P. Layton*

This paper draws attention to some interpretational problems associated with the empirical analysis by Hensher (1976b and 1978) of the value of commuter travel time savings.

In his rejoinder to a comment by Small (1978), Hensher (1978) presented the following regression equation (p. 93):

$$C_u + TP_c - C_a = \underset{}{6{\cdot}362} - \underset{(-1{\cdot}98)}{0{\cdot}0783\,(t_u - t_a)} - \underset{(-13{\cdot}72)}{1{\cdot}1888}\left[\frac{(t_u - t_a)^2}{t_u}\right] \tag{1}$$

The theoretical model on which this was based was:

$$C_u + TP_c - C_a = a_o + VTTS(t_u - t_a) \tag{2a}$$

$$VTTS = b_0 + b_1\left[\frac{t_u - t_a}{t_u}\right] \tag{2b}$$

$$C_u + TP_c - C_a = a_o + b_0(t_u - t_a) + b_1\left[\frac{(t_u - t_a)^2}{t_u}\right] \tag{2c}$$

where
$C_u + TP_c - C_a$ = the net monetary benefit (NMB) of mode choice
TP_c = the transfer price – a measure of consumer surplus
C_u = cost of usual (present) modal choice
C_a = cost of alternative mode
$t_u - t_a$ = usual trip length – alternative trip length
= travel time savings (TTS)
a_o = a measure of *"psychic attachment"* to the usual mode
$VTTS$ = value of travel time savings.

A key hypothesis of Hensher was that $VTTS$ was composed of two com-

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ponents: a constant (b_0) and a component dependent on the size of the time saving:

$$b_1\left(\frac{t_u-t_a}{t_u}\right)$$

With this in mind, a cursory glance at equation (1) indicates a problem with its interpretation. The quantity,

$$\left(\frac{t_u - t_a}{t_u}\right)^2$$

will always be positive, and will increase if there is an increase in travel time savings (TTS) of the usual modal choice over the alternative. This increase in TTS should (according to the hypothesis) be associated with a rise in the NMB of the modal choice. As is evident, this may not follow from equation (1) in its present form.

In other words, the estimated version of (2c) above should produce a positive result for b_1. This is clear from the theoretical model embodied in (2a) and (2b). An increase in TTS will be reflected in a more negative value for (t_u-t_a). If there is to be a concomitant rise in NMB (as predicted by the hypothesis), *VTTS* in (2a) must be regarded as negative. It follows from (2b) that if *VTTS* is to be always negative b_0 must be negative and b_1 positive.

Thus, whereas Small (1978) was concerned to see the statistical significance of b_1 "before Hensher can claim to have shown that value of time is a function of either amount of time saved or trip length" (p. 88), it is just as important for b_1 to have the appropriate sign. Theoretically this sign should be positive rather than negative.

A related point of confusion arises in the original paper by Hensher (1976b). The various values of *VTTS* for differing trip lengths and TTS are given in the body of his Table 1. Hensher indicates that these values were calculated by the equation:

$$VTTS = 60\left[-0{\cdot}0783 - 1{\cdot}188\left(\frac{t_u-t_a}{t_u}\right)\right]$$

or, in cents per minute, by:

$$VTTS = -0{\cdot}0783 - 1{\cdot}188\left(\frac{t_u-t_a}{t_u}\right)$$

This apparently is the empirical verstion of (2b) above. However, as already noted, the only sensible empirical version of (2b), consistent with (2a) and (2c), is one in which b_0 is negative and b_1 is positive. That is:

$$VTTS = -0{\cdot}0783 + 1{\cdot}188\left(\frac{t_u-t_a}{t_u}\right)$$

If we take the negative of this,

$$-VTTS = +0{\cdot}0783 - 1{\cdot}188\left(\frac{t_u-t_a}{t_u}\right)$$

which will always be positive.

In fact it is the last expression which (after multiplying by 60) yields the values in Table 1 of Hensher (1976b).

In summary, the following points in Hensher (1976b and 1978) need clarification:

1. In (2a) it should be made clear that the coefficient of $(t_u - t_a)$ should be a negative quantity.
2. In (2c) one should expect b_0 to be negative and b_1 positive. In particular, further clarification is needed of the sign of b_1 in the regression results. Given that Hensher's empirical analysis yielded a negative result for this parameter estimate, the statistical evidence seriously undermines the theoretical model.
3. The values in Table 1 of Hensher (1976b) were actually based on the expression:

$$+0{\cdot}0783 - 1{\cdot}188\left(\frac{t_u - t_a}{t_u}\right)$$

which is the negative of *VTTS* as employed in equations (2a) and (2b).

A Rejoinder

By David A. Hensher†

The timing of Dr. Layton's comments coincides with the renewed interest in the value of time savings, and in particular with the evaluation of techniques having some or no elements in common with the traditional revealed preference approach (see Hensher and Truong (1983) and MVA Consultancy (1983) for examples).

The study published in 1976 (Hensher, 1976a) reports empirical research completed in 1972. In the last 13 years there have been a number of critiques of the transfer price (TP) approach by Daly *et al.* (1973) and MVA Consultancy (1983). However, the main interest of these reviews and of further empirical work was in using the TP in a model form such as (2a), in which no explicit consideration was given to functional specification of the relationship between value of time, trip length, and amount of time saved. Layton's comments relate, not to

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the TP approach itself, but to the particular specification of a model, as proposed by Hensher (1976b). Bruzelius has since shown that extending the TP approach in the way I did to handle the amount of time saving relative to trip length is not consistent with a framework that assumes neo-classical utility-maximising behaviour (Bruzelius, 1979, pp. 184-185).

Thus in replying to Dr. Layton's observations I must make it clear that the interchange does not change the value of the TP approach itself.

If the empirical results do not reflect the theoretical model, the concern in this particular instance should be with the measurement design for TP. I and others (e.g., MVA Consultancy, 1983) have done much work since to indicate that it is extremely difficult to get reliable measures of TP in the way we did it. Consequently, the theory may not be truly testable till we have the correct measuring instrument. I would not use the statistical evidence to suggest that the theoretical model is undermined before we have got the measurement instruments correct.

Dr. Layton says "This increase in TTS should . . . be associated with a rise in the NMB of the modal choice". It is stated quite clearly on page 93 of Hensher (1978) that the value attached to amounts of time saved is only meaningful in relation to the total trip length. $(t_u - t_a)/t_u$ is not TTS but TTS relative to trip length. Layton should say "a component dependent on the size of the time saving in relation to the current trip length". Since it is a proportion, the interpretation should be made in this light.

On the signs of coefficients: it is true that some individuals will have $t_u > t_a$, others $t_a > t_u$ and some (maybe) $t_u = t_a$. The mean of $t_u - t_a$ for the 301 observations is 8.8 (positive). (This is given in Hensher (1976a), page 127). This datum includes only traders (in the Beesley definition). It is interesting that when I included traders and non-traders in the models in Hensher (1976a) the signs were as proposed for Layton's (2a). If I were to redo the work, I should use all observations (traders and non-traders).

We have a sample in which the individuals are, at the mean, predominantly time sacrificers (see p. 118 of Hensher (1976a) for breakdown). Thus to apply the model *at the aggregate*, as I have done, one must be sensitive in estimation to the data context. If $t_u - t_a$ is 8.8, then switching to the *alternative* will save 8.8 minutes on average. Now we are proposing that $t_u - t_a = 5$ minutes, so switching to an alternative will save 5 minutes. The predominance of time sacrificers/cost savers means that to save time one must switch to the alternative. It might be said that it is unfortunate that in 1971 a sample of Sydney commuters were more money conscious than time conscious. In recent work (Hensher and Truong, 1983), I have used an experimental design approach which permits unique coefficients for each individual; thus the distribution of travel times can be explicitly accounted for in calculation of a *mean* value of time. This also has the measurement problems common to all approaches which obtain data responses on hypothetical situations.

Since the model is not set up as a choice model with each mode defined specifically as car, train, etc. (rather than usual and alternative), the signs are very sensitive to the distributions of $t_u - t_a$ and $c_u - c_a$. A way round this is to use an experimental design data base, but then one has a totally different model.

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