Transport Reviews
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713766937

The Myth of Travel Time Saving

David Metz [a]
[a] Centre for Transport Studies, University College London, London, UK

First Published on: 20 February 2008

To cite this Article Metz, David(2008)'The Myth of Travel Time Saving',Transport Reviews,28:3,321 — 336
To link to this Article: DOI: 10.1080/01441640701642348
URL: http://dx.doi.org/10.1080/01441640701642348

Transport Reviews, Vol. 28, No. 3, 321–336, May 2008

The Myth of Travel Time Saving

DAVID METZ

Centre for Transport Studies, University College London, London, UK

(Received 29 April 2006; revised 26 July 2007; accepted 20 August 2007)

ABSTRACT *The idea that the main benefit of improvements to transport infrastructure is the saving of travel time has been central to transport economic analysis. There is, however, little empirical evidence to support this proposition. Indeed, in the long run average travel time is conserved, implying that travellers take the benefit of improvements in the form of additional access to more distant destinations made possible by higher speeds. Such a perspective, based on considerations of the value of access, has implications for economic appraisal, modelling and policy.*

Editorial note: This paper raises fundamental issues about the way in which analysis in transport is carried out as it questions the notion of travel time savings. One referee stated that: "The paper raises some very interesting points that should cause many people to at least think hard about the underlying assumptions of current best practice", whilst another said: "it does potentially stimulate debate, so as a catalyst it might be reasonable to publish". A third said: "I like this paper because it is provocative … but the bottom line is that this is an area of contested points and nuances of argument. As I said before, I would hope that if people are in some disagreement about a paper published by Metz then this would spur them on to write a 'response' paper which would make for an excellent development in the intellectual arguments in the literature". I would like to take this advice and invite any reader of *Transport Reviews* to write a response or comment on the views in the paper that follows—all views will be published with David Metz being given the final right to respond. Please could you send me an email of your intention to submit a response and when that response might be submitted

David Banister
david.banister@geog.ox.ac.uk

Introduction

Travel time saving is a central concept of transport economics, analysis and modelling. It is supposed that in general individuals would rather be doing something

Correspondence Address: David Metz, Centre for Transport Studies, University College London, Chadwick Building, Gower Street, London WC1E 6BT, UK. Email: david.metz@transport.ucl.ac.uk

0144-1647 print/1464-5327 online/08/030321-16 © 2008 Taylor & Francis
DOI: 10.1080/01441640701642348

else than travelling. Accordingly, travellers would like to diminish the number of trips, to travel to closer destinations and to reduce the travel time for a given trip. Individuals would therefore be willing to pay some amount for a travel time reduction, which implies that changes in the transport system that lead to travel time reductions would increase welfare. Such travel time reductions are quantified and valued for the purposes of social appraisal of public investments (Jara-Diaz, 2000).

Since the 1960s the valuation of travel time savings has been an important public policy issue. In Britain, for example, travel time savings have accounted for around 80% of the monetized benefits within the cost–benefit analysis (CBA) of major road schemes. Allowing for exceptions such as safety and environmental schemes, the rationale for and size of the public investment programme in roads and transport has depended critically on the social valuation of travel time saving (Mackie *et al.*, 2000).

There is, however, another important concept—that of 'access'—that has been central to transport and whose relationship to travel time savings has rarely been discussed. The purpose of transport has always been to provide access to desired destinations. Developments in technology, together with increasing personal incomes, have permitted individuals to travel faster and hence farther within the time they have available for travel. This enhances choice of employment, domicile, leisure, shopping and other activities.

Recently two aspects of access have attracted particular attention. One is the role of transport in facilitating close mutual access or agglomeration of similar and complementary economic activities. The productivity benefits of agglomeration include better matching of people to jobs and access to skilled labour, as a result of dense labour markets; better connection to suppliers and markets; and information spillovers between firms (Department for Transport, 2005; Graham, 2005; Eddington, 2006). Second, there is the importance of enhancing access for people at risk of social exclusion to employment opportunities and to everyday services (Social Exclusion Unit, 2003).

One might wonder whether indeed travellers are motivated primarily by the availability of travel time savings or by the possibility of enhanced access. This review argues that the available evidence is consistent with access as being the main motivation in the long run. Hence, new infrastructure does not result in travel time being saved to allow other activities to be carried out. Rather, travel time is conserved, allowing more distant destinations to be reached within the time available for travel. Accordingly there is a need to reconsider investment appraisal based on valuing travel time saving.

The paper is concerned with personal travel, as opposed to the movement of goods. The focus is on car-based travel, given its predominance (in Britain 85% of total personal transport is by car or van; Department for Transport, 2006b). The approach of the present paper builds upon earlier arguments (Metz, 2002, 2004a). Given the range of aspects considered, the references cited are selective and representative.

Travel Time

It should be possible to measure time saving if this is a significant part of the benefits to travellers of new investment in transport infrastructure. Travel time is measured in surveys of personal travel behaviour, typically using 7-day travel diaries. In Britain, for instance, average travel time (per person per year) has been reported since 1972/73 as one output of the National Travel Survey (NTS) (see most recently Department for Transport, 2006a). This household survey covers personal travel by residents of Britain along the public highway, by rail and by air within Britain, including walks of more than 50 yards. The most recent value of average travel time is 385 hours per person per year, or just over 1 hour per day. As indicated in Figure 1, this has changed rather little over 30 years, during which period car ownership has more than doubled and the average distance travelled has increased by 60%.

It should be noted that there have been recent changes to NTS methodology, in particular the data from 1995 onwards have been weighted to compensate for non-response bias and the drop-off in numbers of trips recorded by respondents during the course of the travel week. This has resulted in a small upward trend in average travel time as shown in Figure 1. Previous plots of NTS data showed a slope that was not significantly different from zero within 95% confidence limits (Metz, 2004b). Thus, whereas previously average travel time in Britain might have been described as 'invariant', based on the revised data one would now regard travel time as relatively conserved, compared with other changes in the transport sector over the 30-year period.

The NTS data set is almost certainly the longest series of its kind. It is based on a large sample (currently around 20 000 individuals compiling diaries) and has been subject to a quality review (Department of Environment, Transport and the Regions (DETR), 2001). There is a good deal of data on average travel time from other sources which have been reviewed by Schafer and Victor (2000), Schafer (2000) and Mokhtarian and Chen (2004), building on the seminal earlier compilation of Zahavi and Talvitie (1980). There are also Dutch studies, including a long time series from a national survey, albeit with some changes in survey methodology over the period (Van Wee *et al.*, 2006). Differences in survey methodologies limit comparisons of such travel time data, both longitudinally and cross-sectionally (Schafer, 2000). Nevertheless, what emerges from these compilations is the finding that, in broad

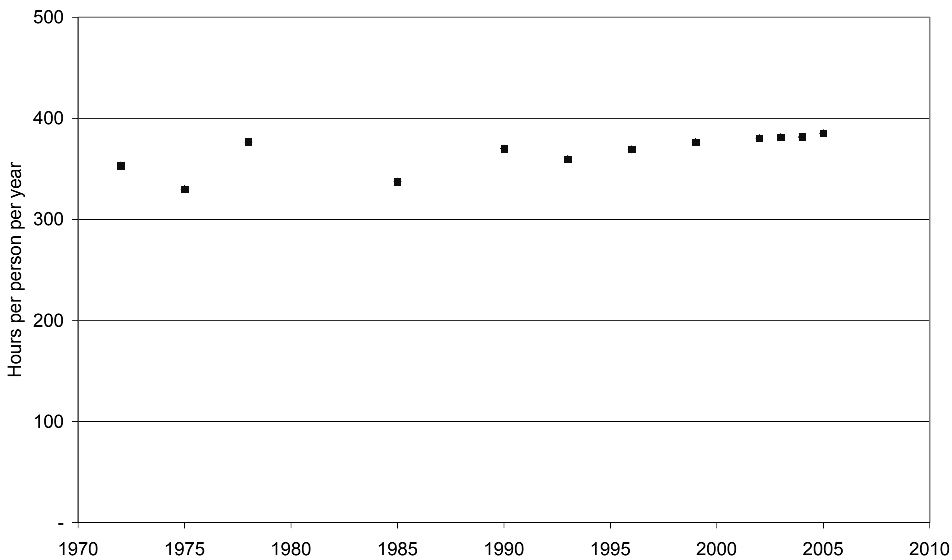

Figure 1. Average travel time (hours per person per year). *Source:* Department for Transport (2006a)

terms, average travel time holds constant across populations and over time at around 1.0–1.1 hours per day. If there is any trend over time, it is upward rather than downward, with perhaps the most marked upward trend reported from the USA, increasing annually at the rate of about 2 minutes per person per day between 1983 and 2001, albeit on the basis of only four surveys involving single-day travel diaries (Toole-Holt *et al.*, 2005). Within populations there is some variation in travel time according to gender, age, geography, income, and car ownership (Metz, 2005), and, of course, there is further variation within such subpopulations. Furthermore, over the life course of the individual travel time is likely to vary as a function of lifestyle decisions. However, these considerations are not relevant for the discussion that follows, where the author is concerned with the whole population, or with large subpopulations for which relative constancy of average travel time is a reasonable assumption, given the insensitivity of the empirical travel time data to changes in the wider economy.

These data on average travel time offer no obvious support to the idea that travel time savings comprise the dominant element of the benefits from investment in the transport system. Indeed, Figure 1 prompts the following question. What has happened to all the travel time savings claimed to justify public expenditure on British roads of around £100 billion over the past 20 years at current prices? One possible answer would be that had it not been for the time savings associated with this investment, average travel time would have been higher than it has been. The pattern of investment in road infrastructure in Britain over the past 20 years has shown marked swings in expenditure, between £3.5 and £6.4 billion per year (at constant 2004/05 prices) (Department for Transport, 2007) and, hence, in new capacity becoming available. The steady trend of travel time seen in Figure 1 shows no suggestion of a reflection of such variation in new capacity, and hence offers no support for the idea that average travel time would have been higher in the absence of new road construction.

An alternative interpretation of Figure 1 is that people take the benefit of investment in the transport system—private investment in vehicles as well as public investment in infrastructure—in the form of additional access to desirable destinations, made possible by higher speeds in the time available for travel. From this viewpoint travel time savings would be at best transient phenomena. Light might be shed on this possibility by empirical studies of travel time savings putatively associated with infrastructure investment, such as a new or widened road that has been built with the intention of generating such savings.

It is, however, remarkable that there appear to be no empirical studies of travel time savings in the literature. (In this context 'travel time saving' makes available time to be spent on other activities.) References where one might have expected to see such reports cited include Bruzelius (1979), Glaister (1981), Mohring (1994), Wardman (1998), Small (1999), Jara-Diaz (2000), Mackie *et al.* (2000), Ortuzar and Willumsen (2001), and Garrison and Levinson (2006).

There are certainly studies that demonstrate time saving for vehicles as a result of widening a link in a road network, such as the post-opening project evaluations commissioned by the UK Highways Agency (e.g. Highways Agency, 2006). And of course, the railway timetable demonstrates the speedier journeys made possible by faster trains. Such particular journey time savings would result in overall travel time saving per person per year if trip origins and destinations remained unchanged—which in general cannot be assumed. To detect travel time savings that might arise from particular investments, it would be necessary to employ travel diary techniques, as used, for instance, in the NTS. A 5-minute saving through reduced congestion on a regular two-way commuter journey would amount to a reduction of around 10% of the average overall annual travel time, which should be detectable in a suitably designed survey using travel diaries. However, the effort would not be trivial, and perhaps the supposed reality of travel time saving is so deeply embedded that no one considered this worth substantiating empirically.

The lack of direct evidence does not mean, however, that travel time savings do not exist. But given the long-term invariance of average travel time, travel time saving would necessarily be a transient phenomenon, in a context in which individuals tend to use improvements to the transport system to maximize access. One might therefore envisage the prospect of travel time savings as a short-run benefit that motivates a decision to take a new route or transport mode, when that possibility arises. Subsequently, this time saving is used for further travel, as the benefits of additional access are recognized. Therefore, the long run benefit of investment is the additional access to desirable destinations. Because the average annual trip rate has held fairly constant over time, in Britain at least (Department for Transport, 2006a), this additional access generally involves longer journeys, not extra trips.

Value of Travel Time Savings

Extensive consideration has been given to the valuation of travel time savings (e.g. Wardman, 1998; Gunn, 2000; Mackie and Nelthorp, 2001). Small (1999) argues that an extensive empirical literature, based on demand models, has established that people and firms make reasonably predictable trade-offs between travel time and other factors when making travel choices; such studies are the basis for estimating the willingness to pay for travel time savings. It might be thought that this body of work would provide substantiation for the existence of travel time saving. Conversely, it might be considered surprising that it has been possible to value a phenomenon not empirically demonstrated to exist.

There are two approaches to the valuation of travel time savings: revealed preference (RP), based on observation of alternative travel choices involving different costs; and stated preference (SP), based on hypothetical choices made by individuals of routes and modes, again involving different costs, using market research-type techniques.

Standard methods for estimating the value of travel time saving through the SP technique operate within a short-term context. Gunn (2000) has referred to the common suspicion that SP data can only give information about short-run preferences. Individuals participating in SP experiments can seemingly envisage the possibility of travel time savings and the trade-off between time and money. However, while findings from such experiments are therefore consistent with the existence of travel time savings, they do not constitute a direct demonstration.

Similarly, conventional RP analysis generally focuses on short-term situations, in which circumstances, moreover reliability of journey time, might be a confounding factor, for instance where drivers can choose between a less congested tolled road and a parallel untolled routed (e.g. Brownstone and Small, 2005). The empirical observations usually made do not reveal whether in the short run, when the 'time saving' option is chosen, the saved time is used for additional travel over the course of the week, or whether it is used for non-travel activities. The data shown in Figure 1 indicate that in the long run time saved is indeed used for additional travel. That is, these data reveal the preference of the whole population for a relatively stable amount of travel time in the long run. This implies no preference for time saving and hence a long run value of travel time saving of zero. What is actually preferred is additional travel, with the average distance travelled up by 60% over the period shown.

It is commonly stated that the value of travel time saving represents some 80% of the economic benefit of major road schemes (Mackie *et al.*, 2000). But if travel time savings have significant value only in the short run, as argued above, then it follows that the economic benefit of long-lived interventions has been misspecified. The bulk of the economic benefit of road schemes and other transport infrastructure investment is associated with making possible additional access to desired destinations. This is consistent with the concept that travel is a derived demand; that is, the demand for travel depends on the value of the activities at the destinations, which has to be sufficient to outweigh the time and money costs of the journeys.

The emphasis on travel time saving as a measure of the economic benefit of an improvement to the transport infrastructure arose in a context in which trip origins and destinations were assumed unchanged. This meant that the values of activities at trip ends could be disregarded since these would be the same in the 'do minimum' and 'do something' cases (see, for example, the pioneering papers of Coburn *et al.*, 1960; and Foster and Beesley, 1963). Subsequently, it has been recognized that travel demand might vary in response to the availability of new infrastructure, but what has generally been overlooked is the consequent need to estimate the economic benefit associated with the new destinations. In the limiting case—the long run situation discussed above where all initial time savings are used for extra travel—the entire economic benefit arises from activities at the new destinations and none from time savings (leaving aside benefits associated with accident reduction and the possible reduction in vehicle operating costs).

Implications of Additional Access

The argument developed above is that the benefit of investment in long-lived transport infrastructure is taken by travellers in the form of additional access, not time saving. A defence of current practice in investment appraisal, which focuses on valuing travel time saving, might be that such an approach is practicable and provides a conservative valuation of economic benefits—because if travellers prefer to employ such time saving to travel further, the value of the time savings must be at least as great as the value of the additional access. There are, however, a number of problems with such an approach.

The domain of transport economics has in part been defined by the value of travel time savings. The economic benefits deriving from better transport are seen as being transferred beyond the transport domain into the wider economy on the basis of this value. However, if these benefits are taken in the form of additional travel to desired destinations, then the domain of transport economics must surely encompass this extra travel.

In fact, this additional travel is already recognized as the phenomenon known as 'induced traffic', the traffic which arises from increasing the capacity of the system (Standing Advisory Committee on Trunk Road Assessment (SACTRA), 1994; Goodwin, 1996; Noland and Lem, 2002). The main responses of travellers to new road capacity are supposed to include changing route, retiming journeys, choosing a new destination for the same journey purpose, increasing journey frequency, making entirely new journeys, as well as changed land-use patterns. All these responses can result in extra traffic. Induced traffic is regarded as the additional vehicle-kilometres, comparing the 'do something' and 'do minimum' cases.

Given the conservation of average travel time, induced traffic across the network is predictable, being proportional to the increase in average speed caused by the increase in capacity (Metz, 2004a; also recognized by Noland and Lem, 2002). The magnitude of induced traffic thus predicted is at the upper end of the range of what is supposed generally to arise. The SACTRA (1994) study concluded that in the short-term about half the time saved through speed increases might be used for additional travel, while the longer-term effect was likely to be greater, with a high proportion, perhaps all, being used for further travel. Estimates of induced traffic made in the context of scheme appraisal or modelling tend to be a good deal smaller, in part because hitherto there has been no established theoretical basis for such estimation. For instance, a proposal for a bypass around the town of Newbury forecast induced traffic of only 10% on a 'worst case', whereas a detailed evaluation 5 years after the road was opened found up to twice the traffic flows predicted before construction (Highways Agency, 2006).

As noted above, average trip rate is conserved in the long run. This implies that induced traffic in aggregate does not arise from increased journey frequency, or from retiming or making entirely new additional journeys. Rather, induced traffic is generally the consequence of the choice of more distant destinations for the same journey purposes and is associated with changed land-use patterns.

This greater scale of induced traffic, arising from the conservation of travel time, has implications for detriments that are a function of traffic volume. Generally, proposals for major road schemes to be funded with public money take credit for the reduced accident rates expected when modern roads replace those of an earlier era. However, a greater volume of induced traffic would give rise to greater numbers of accidents, which would offset the expected accident savings. For a portfolio of British trunk road schemes, the economic value of the extra accidents arising from induced traffic has been estimated to be of the same order of magnitude as the value of the savings claimed for the improvements, with considerable variation from scheme to scheme (Metz, 2006a). A retrospective evaluation of the effects on road safety of new urban arterial roads showed that, for nine projects, average net induced traffic amounted to 16%, while the net reduction in the average accident rate was 18%, yielding very little net change in the expected number of accidents (Amundsen and Elvik, 2004).

As well as increased accidents, vehicle emissions would be higher on account of induced traffic than would otherwise be estimated, given that emissions are proportional to distance travelled (Stead, 1999). There would also be land-use implications of the extra travel, given that new locations become accessible such that the benefits of higher land prices can be captured by land owners (Metz, 2006b). All these aspects affect the benefits to be expected from proposed new infrastructure capacity. Accordingly, it would be desirable to base the appraisal of such schemes on the authentic behaviour of travellers, which involves their taking the benefits in the long run via additional travel, not time savings.

Value of Access

The purpose of personal travel, first and foremost, is to reach destinations at which the individual may acquire benefits—whether employment, leisure, shopping, education, visiting people, and so forth—which could not be achieved by staying at home. The further it is feasible to travel, the more choice of destinations of any particular kind, which is why higher speeds are attractive, given that travel time is constrained. All else being equal, access and choice increase with the square of speed. However, the additional benefit from access to any particular kind of location would tend to decline as choice increases—a case of diminishing marginal utility.

Consider, for instance, a road improvement that allows an individual to gain access to an additional supermarket within the time they are willing to allocate to travel. The magnitude of the benefit would depend on whether, before the improvement, there was access to one, two or more competing supermarkets. The UK Competition Commission (2000) has studied access to supermarkets, finding that 75% of consumers travel to supermarkets by car, with 90% travelling for 20 minutes or less each way. Supermarket catchment areas are based on travel time, routinely calculated when potential new stores are being evaluated. In assessing the extent of competition amongst supermarket chains, the Commission took the view that the presence of at least three stores within a 15-minute catchment area would provide consumers with adequate choice, while the presence of only one or two would be likely to limit choice, a situation which would justify intervention on competition policy grounds. The Commission concluded, in effect, that the marginal benefit to consumers outweighed the costs of regulatory intervention to ensure access to a third supermarket but not a fourth.

Most other kinds of destination exhibit similar characteristics of declining marginal utility, including employment, education, and leisure, although the appropriate scale of choice would depend on the nature of the activity—a likely desire for more choice of employment might be expected than of leisure opportunities, for instance. Choice of residence is more complex, of course, with costs and benefits associated with location, amenity, size and quality of dwelling, as well as travel time and money costs for the journeys to the workplace and to family and friends. Nevertheless, higher speeds on the journey to work permit a greater choice of residence, and diminishing marginal utility of benefits will generally apply.

There is one situation in which the access achieved through personal travel would not necessarily involve diminishing marginal utility. There are locations of a unique nature or special value, which are either scarce in some absolute or socially imposed way, or subject to congestion or crowding through more intense use (Hirsch, 1977). Examples include historic sites, waterfront properties, and Premiership football stadia. Higher speeds allow access to a greater number of such distinctive non-replicable locations. However, the benefits of such enhanced access are offset by increased crowding, as others with similar interests take advantage of the improved transport infrastructure.

In principle, the value of access to different classes of destination could be established by a willingness-to-pay approach, employing SP techniques. However, this would need to identify the value of access at the margin, for example to the second, third and fourth supermarket. It would then be necessary to allow for the fact that an improved road, for instance, permits increased access not just to shops, but to employment, educational, leisure, and other opportunities, each with their own willingness-to-pay-at-the-margin characteristics.

It would be desirable to take into account household income since what people are willing to pay in monetary terms for access must depend on what they can afford. This would point to adjusting willingness-to-pay values by some form of welfare or equity weight (Mackie and Nelthorp, 2001). Simple averaging across the population, as has been done for willingness-to-pay estimates of the value of travel time savings, means that issues of social exclusion then have to be addressed separately.

The willingness of business to pay for access to labour and other markets would need to be taken into account in investment appraisal based on the value of access. At present this is done by adding the agglomeration benefits to the standard travel time saving benefits (Department for Transport, 2005; Graham, 2005; Eddington, 2006).

An attraction of appraisal based on the economic value of access is that it would incorporate the agglomeration benefits of access naturally, and not as a supplement to an otherwise incomplete methodology. For instance, the economic justification of a new radial commuter rail route serving a central business district would identify the benefits to individuals of access to employment, etc. in the city centre, as well as the benefits for business of access to a wider labour market—the two sides of a coin.

Intrinsic Utility of Travel

It has been postulated above that the value of investment in transport infrastructure lies mainly in the additional access to desirable locations made possible and that the benefits of such access involve diminishing marginal utility. It might therefore be expected that average travel time would tend to fall over the years as the benefits to the individual of additional distance made possible by travel at higher speeds tend to decline. However, no evidence of any downward trend is seen in average travel time, as depicted in Figure 1 or in other studies cited above. This requires explanation.

The perspective of conventional transport economics is that travel is essentially a 'derived demand', that is, a demand predicated entirely on the benefits found at the trip end. However, the general finding of invariant average daily travel times has prompted suggestions that there might be benefits from travel over and above those associated with the destination of the journey, which could be a reason why travel time is conserved. Hupkes (1982) proposed that there is an intrinsic utility based on satisfaction obtained by moving; hence, the total utility of travel time is this intrinsic utility—limited by boredom, monotony, and fatigue—plus the derived utility associated with the destination. Metz (2000) suggested that there are 'destination-independent' benefits of travel—including the psychological benefits of movement, exercise benefits, and involvement in the local community—the loss of which lessen the quality of life in old age.

Mokhtarian and Salomon (2001) also argue that travel might be desired for its own sake, what they term 'undirected travel', in which the destination is ancillary to the travel, rather than the converse. On the basis of survey data, these authors have identified positive preferences for travel among a good proportion of respondents, as well as evidence that people often engage in 'excess travel', that is, travelling further than the minimum distance to reach a desired destination (taking the scenic route, for instance) (also Ory and Mokhtarian, 2005; for other relevant papers on the topic of the positive utility of travel, see Mokhtarian, 2005).

More generally, much recreational travel is evidently attractive on account of the means and style of travel, for instance sailing, horse riding, hiking, as well as motor touring in favourable circumstances (the open road amidst pleasant scenery). This intrinsic utility of mobility is likely to be experienced, to some degree, with more utilitarian kinds of journey.

As well as benefits of travel associated with mobility, another class of destination-independent benefits comprises those arising from the fruitful use of time whilst on the move. Lyons and Urry (2005) have pointed to the productive use that might be made of the time involved in travelling, particularly by rail, for instance for using a mobile phone and notebook computer, reading, listening to music, thinking, self-improvement, and so forth. Such productive uses extend to waiting time, for instance in the airport lounge, and are hence incidental to travel, whereas the benefits associated with mobility cannot be gained in such circumstances.

The evidence for the existence of an intrinsic utility to travel or mobility is suggestive rather than conclusive, largely because few empirical studies have been attempted. Nevertheless, the possibility that such intrinsic utility is material has implications for the argument, noted above, that estimates of travel time savings for an infrastructure proposal provide a conservative estimate of the economic benefits, even if travellers employ the possible time savings for additional travel/access. Taking advantage of travel time saving would reduce the benefits from the intrinsic utility of travel. Accordingly, if people take advantage of infrastructure improvements to travel farther (as they do), this is because the utility associated with the destination plus the intrinsic utility of the trip must be at least equal to the travel time saving that might otherwise been made.

To illustrate this argument, consider a recreational walk starting and finishing at home. If one has judged the distance correctly, the intrinsic utility derived from the exercise, getting out and about, etc., would equal the value of the time expended (which is travel time that might have been saved by not making this trip). If now such a recreational walk is combined with a visit to a shop, the utility associated with this destination would need to be added to the intrinsic utility on one side of the equation. Generally, the benefits of travel comprise both such destination-dependent and destination-independent components, although the relative magnitudes will vary from case to case.

Limitations of Cost–Benefit Analysis (CBA)

CBA has been important in justifying public investment in transport infrastructure. Travel time savings have been the source of the predominant part of the quantifiable economic benefit, although recently agglomeration and other benefits to business have also been recognized as benefits not captured by estimates of time savings (Department for Transport, 2005; Graham, 2005). A recent study, commissioned by H. M. Treasury and the Department for Transport, argued that road network improvements could be had having benefit–cost ratios for the best schemes of 5–10, taking account of all such benefits (Eddington, 2006).

There are, however, certain problems with CBA as presently employed to appraise transport projects. First, as argued above, justification of long-lived infrastructure based mainly on short-run travel time savings is inappropriate. The value of access at the margin should be used in place of the value of average time savings. However, the task of creating an economic methodology based on the value of access could be considerable. Second, the value of travel time savings, as currently estimated, overstates the value of access at the margin because of the contribution to the value of the trip of the intrinsic utility, as discussed above.

Third, as is well recognized, not all benefits and disbenefits are capable of monetary valuation. Although there have been some recent additions to those that can be valued—noise, local air quality, greenhouse gases, journey ambience, and physical fitness for walkers and cyclists (see Transport Analysis Guidance 3.14.1 at http://www.webtag.org.uk)—there remain many others for which this has not proved possible, despite years of effort. In consequence, decision-making involves considerable judgement, with the relative weighting to be attached to the monetarized and non-monetarized benefits unclear.

These difficulties prompt a question about whether the seemingly high benefit–cost ratios reported by Eddington (2006) might not overstate the actual attractiveness of such schemes, whether because the value of access at the margin is less than the value of time saved on average, or whether because some environmental detriments are disregarded. Eddington himself draws attention to a "conundrum" concerning transport projects in urban areas, where agglomerations in a service-based economy tend to be found. Urban road networks are heavily used and shared by a wide range of users, and moreover economic growth and congestion are disproportionately represented in urban areas. Hence, projects in urban areas might have been expected to offer very high returns. However, evidence from the Department for Transport's database of projects that have been subjected to CBA does not suggest very high returns in urban areas relative to other areas. Part of the explanation might be high land and construction costs, but Eddington suggests that there also seem to be barriers to option generation in urban areas.

Another contributing factor to this conundrum could be that the methodology currently employed for CBA (time savings plus agglomeration benefits, with limited account taken of environmental detriments) overstates the economic benefits. Schemes for new urban road construction that notionally are highly attractive in CBA terms might for good reason be judged to be much less attractive to the public authorities that would need to sponsor and finance the projects.

While CBA is used quite widely for transport infrastructure appraisal in Europe (Grant-Muller *et al.*, 2001) and elsewhere, it is by no means used universally to justify other kinds of public sector capital expenditure. In Britain, H. M. Treasury guidance advocates the use of CBA across the range of public investment (H. M. Treasury, 2003). Nevertheless, for major areas of such expenditure, including the large capital programmes in health and education, while the costs are quantified the benefits are not. It is not practicable to assess the value of the benefits of replacing an old hospital building by a new one; and likewise for school buildings. It is difficult to identify the causal relationship between the modern building and improved health or educational outcomes, as well as to value such outcomes. Hence, rather than attempt CBA, what is done is to assess cost-effectiveness in achieving policy objectives (or, in quasi-market situations where there are income streams based on activity, affordability analysis is performed).

Given the difficulties with using CBA to appraise transport projects, there would be attractions in employing instead cost-effectiveness analysis of the various means of achieving agreed policy objectives. Arguably, this would tie economic analysis more closely to policy.

Transport Modelling

The question of whether travel time is saved or conserved is relevant to the practice of transport modelling. In general, transport models, including the standard four-stage models, make the assumption that travellers minimize the 'generalized costs' of the journey, that is, the combination of money costs and time costs, summed using monetary values of travel time (this is Wardrop's equilibrium; Ortuzar and Willumsen, 2001). Minimization of generalized costs is consistent with the idea that travellers take advantage of improved infrastructure to save travel time, but is not obviously consistent with the evidence that in the long run travel time is conserved.

Also relevant here is evidence that the proportion of household income spent on transport and travel holds constant over time once the level of car ownership has reached around one per household (Schafer and Victor, 2000). In Britain, such expenditure has fluctuated around 16% for the past 25 years (National Statistics, 2004; Metz, 2005). This too does not fit well with the idea that travellers are motivated to minimize travel costs, at least in the long run.

The case for retaining the minimization of generalized costs might be defensible when modelling short-term effects such as mode choice in response to cost changes. But for longer-term modelling of supply and demand, or of transport and land use, it seems more appropriate to assume that travellers aim to maximize access, subject to time and money constraints. Or better still, that travellers value additional access at the margin and perceive intrinsic utility in travel while subject to competing demands on their time as well as a money constraint.

It is of interest to consider another class of model: micro-simulation models of traffic in which the movement of individual vehicles might be governed by three interacting models representing the vehicle following, gap acceptance and lane changing, and which, when applied simultaneously at the level of individual vehicles, aggregate to display the characteristic features of congested traffic flow (Druitt, 1998). Driver behaviour, as observed in particular locations, can be used to calibrate such a model, for instance the headway a driver will accept to change lanes (Transport for London, 2003). Such models can recognize the behaviour of individuals at a more basic level than that of route choice, mode choice, and the other standard behavioural variables of macro-level models. The analogous basic behaviour in such macro-models is the minimization of generalized cost, which seems never to have been considered as a candidate for variation to secure the better fit of the model to the observed data.

Transport Policy

The question of whether travel time is saved or conserved is relevant to transport policy. Consider the question of what, in general, to do about a congested section of an interurban trunk road. The standard policy response is to add capacity, supported by CBA that takes credit for the value of travel time savings. However, if in the long run the benefit of this extra capacity is taken in the form of longer trips to desired destinations made possible by higher speeds, then the detriments—environmental, accidents—would be higher than anticipated, while the consequences for congestion are unlikely to be significant since the additional traffic (vehicle-kilometres) would offset the benefit of additional carriageway.

More generally, what matters is the effect of the policy intervention, not the intention. If the effect is to increase speed, the long run outcome will be greater access (which is good), more substantial environmental detriment (bad), and no significant change to congestion (Metz, 2004b). A second example would the construction of a bypass to remove through traffic from a village. If, as is usually the case, the diverted traffic flows faster, the long-term consequence would be induced traffic in the form of longer trips to more distant destinations. A third example is less obvious and as yet less commonly encountered: road pricing in the form of congestion charging has the intention of reducing congestion and therefore might be expected to have the effect of increasing traffic speeds. If travel time in the long run is conserved by those choosing to pay, they will tend to make longer trips. Hence, roads pricing might be expected to result in induced traffic (Metz, 2006c).

Conclusions

Travel time saving has been the centrepiece of transport economic analysis for approaching half a century. The idea is simple: there are better things to do than travel, so if travel time could be reduced by improving the infrastructure, then there would be a quantifiable economic benefit to set against the cost of the investment. The lack of empirical evidence for travel time saving is therefore surprising. Travel time saving has the quality of a myth—a traditional story accepted as factual. It is what economists term a 'stylized fact', as opposed to an empirical fact.

Data from travel surveys show that average travel time is conserved in the long run, at around 1 hour per day. Measurement of short-run changes to travel time following an improvement which has the effect of increasing speed appears not to have been attempted. It was initially assumed that trip origins and destinations could be taken as given, so that savings in travel time when traversing a new or widened link road would translate into overall travel time savings having economic value. Subsequently, it was recognized that in general the pattern of demand would vary in response to a change in the supply of carriageway, which allows the possibility that some of the assumed time saving could be used for extra travel—hence, induced traffic. In the long run, it can be concluded that all the possible time saving is used for extra travel, consistent with the conservation of average travel time.

Nevertheless, the absence of empirical evidence for travel time saving is not evidence of absence, and travel time savings are likely to arise as a transient phenomenon. It might be supposed that the possibility of saving time would be an important factor to be considered when the choice of a new travel option presents itself. But once the new route or mode becomes part of an established pattern of daily activity, the benefit may then be perceived as an improvement in access, rather than as a time saving. With the elapse of time (months or years), the improvement in the transport system allows further access to desired destinations, within the more or less constant time people allow themselves on average for travel. Longitudinal studies of travel activity would be valuable as a means of understanding better travel time savings as a transient phenomenon.

The traditional focus on travel time savings in economic appraisal, and on the minimization of generalized costs in transport modelling, can be contrasted with the approach of 'behavioural economics', which considers the possibility that actors in the real world do not behave as the idealized utility-maximizing participants of standard economic frameworks. Behavioural economics is concerned to identify the ways in which behaviour differs from that of standard economic models, as well as to show how such behaviour matters in economic contexts (Mullainathan and Thaler, 2000; Camerer and Loewenstein, 2004). There is a developing body of transport studies that questions utility maximization as the basis for decisions by travellers (for a recent discussion, see Avineri and Prashker, 2005).

While much work in mainstream behavioural economics has focused on finance and saving, one study concerns the behaviour of New York City taxi drivers who pay a fixed fee to rent their cabs for a 12-hour shift and then keep all their revenues (Camerer *et al.*, 1997). Their work hours are flexible (they can quit early and often do) and income fluctuates because of the weather, day-of-week effects, and so forth. Many drivers say they set a daily income target (to cover the rental fee, fuel and desired take home pay) and quit when they reach that target. Drivers who set a daily target will drive longer hours on low-income days and quit early on high-income days. This behaviour is the opposite of an income-maximizing strategy over the longer-term.

The conservation of average daily travel time suggests that a similar targeting process may be at work with respect to travel time, with an upper bound determined by competition between the various uses of time within the 24-hour day, and a lower bound reflecting the benefits to the individual arising from mobility unlinked to the particular destination (Metz, 2004a). However, the question of such intrinsic utility of travel has been the subject of little investigation and deserves further study.

If travel time is conserved rather than saved, then there are implications for investment appraisal, modelling and policy as discussed above. In particular, standard CBA is not a reliable guide to the value of infrastructure investment and arguably should be abandoned; the generality of macro transport models is not based on the authentic behaviour of travellers and cannot be relied on to predict the consequences of interventions; and transport policy-makers need to recognize that interventions that have the effect of increasing speed will promote traffic growth.

References

Amundsen, A. H. and Elvik, R. (2004) Effects on road safety of new urban arterial roads, *Accident Analysis and Prevention,* 36(1), pp. 115–123.

Avineri, E. and Prashker, J. (2005) Sensitivity to travel time variability: travellers' learning perspective, *Transportation Research Part C,* 13(2), pp. 157–183.

Brownstone, D. and Small, K. A. (2005) Valuing time and reliability: assessing the evidence from road pricing demonstrations, *Transportation Research Part A,* 39(4), pp. 279–293.

Bruzelius, N. (1979) *The Value of Travel Time* (London: Croom Helm).

Camerer, C., Babcock, L., Loewenstein, G. and Thaler, R. (1996) Labor supply of New York City cabdrivers: one day at a time, *Quarterly Journal of Economics,* 112(2), pp. 407–441.

Camerer, C. and Loewenstein, G. (2004) Behavioural economics: past, present and future, in: C. Camerer, G. Loewenstein and M. Rabin (Eds) *Advances in Behavioural Economics,* pp. 3–52 (Princeton, NJ: Princeton University Press).

Coburn, T., Beesley, M. and Reynolds, D. (1960) *The London–Birmingham Motorway: Traffic and Economics.* Road Research Technical Paper No. 46, Department of Scientific and Industrial Research (London: HMSO).

Competition Commission (2000) *Supermarkets: A Report on the Supply of Groceries from Multiple Stores in the United Kingdom* (London: Competition Commission).

Department for Transport (2005) *Transport, Wider Economic Benefits, and Impact on GDP* (London: Department for Transport).

Department for Transport (2006a) *Transport Statistics Bulletin: National Travel Survey: 2005* (London: Department for Transport).

Department for Transport (2006b) *Transport Statistics Great Britain, 2006 Edition* (London: Department for Transport).

Department for Transport (2007) *Transport Trends 2006 Edition* (London: Department for Transport).

Department of Environment, Transport and the Regions (DETR) (2001) *National Travel Survey Quality Review 2000* (London: DETR).

Druitt, S. (1998) Traffic models for real people, *Traffic Engineering and Control*, 39(9), pp. 480–483.

Eddington, R. (2006) *The Eddington Transport Study: Transport's Role in Sustaining the UK's Productivity and Competitiveness* (London: H. M. Treasury).

Foster, C. and Beesley, M. (1963) Estimating the benefit of constructing an underground railway in London, *Journal of the Royal Statistical Society Series A*, 126(1), pp. 46–93.

Garrison, W. and Levinson, D. (2006) *The Transport Experience: Policy, Planning and Deployment* (Oxford: Oxford University Press).

Glaister, S. (1981) *Fundamentals of Transport Economics* (Oxford: Blackwell).

Goodwin, P. (1996) Empirical evidence on induced traffic: a review and synthesis, *Transportation*, 23(1), pp. 35–54.

Graham, D. (2005) *Wider Economic Benefits of Transport Improvements* (London: Department for Transport).

Grant-Muller, S., Mackie, P., Nellthorp, J. and Pearman, A. (2001) Economic appraisal of European transport projects: the state of the art revisited, *Transport Reviews*, 21(2), pp. 237–262.

Gunn, H. (2000) Valuation of travel time savings and loses, in: D. Hensher and K. Button (Eds) *Handbook of Transport Modelling*, pp 433–448 (Oxford: Elsevier).

H. M. Treasury (2003) *The Green Book: Appraisal and Evaluation in Central Government*, 3rd edn (London: Stationery Office).

Highways Agency (2006) *A34 Newbury Bypass: 'Five Years After' Evaluation (1998–2003)* (London: Highways Agency).

Hirsch, F. (1977) *Social Limits to Growth* (London: Routledge & Kegan Paul).

Hupkes, G. (1982) The law of constant travel times and trip rates, *Futures*, 14(1), pp. 38–46.

Jara-Diaz, S. (2000) Allocation and valuation of travel time savings, in: D. Hensher and K. Button (Eds) *Handbook of Transport Modelling*, pp. 304–319 (Amsterdam: Pergamon).

Lyons, G. and Urry, J. (2005) Travel time use in the information age, *Transportation Research Part A*, 39(2–3), pp. 257–276.

Mackie, P., Jara-Diaz, S. and Fowkes, A. (2001) The value of travel time saving in evaluation, *Transportation Research Part E*, 37(2–3), pp. 91–106.

Mackie, P. and Nelthorp, J. (2001) Cost–benefit analysis in transport, in K. Button and D. Hensher (Eds) *Handbook of Transport Systems and Traffic Control*, pp. 143–174 (Oxford: Elsevier).

Metz, D. (2000) Mobility of older people and their quality of life, *Transport Policy*, 7(2), pp. 149–152.

Metz, D. (2002) Limitations of transport policy, *Transport Reviews*, 22(2), pp. 134–138.

Metz, D. (2004a) Travel time—variable or constant?, *Journal of Transport Economics and Policy*, 38(3), pp. 333–344.

Metz, D. (2004b) Travel time constraints in transport policy, *Proceedings of the Institution of Civil Engineers: Transport*, 157(2), pp. 99–105.

Metz, D. (2005) Journey quality as the focus of transport policy, *Transport Policy*, 12(4), pp. 353–359.

Metz, D. (2006a) Accident savings overvalued in road scheme appraisal, *Proceedings of the Institution of Civil Engineers: Transport*, 159(4), pp. 159–163.

Metz, D. (2006b) Travel time and land use planning, *Town and Country Planning*, June, pp. 182–183.

Metz, D. (2006c) Time and motion: how limited travel time constrains mobility. *Traffic Engineering and Control*, 47(9), pp. 380–382.

Metz, D. (2008) National road pricing: a critique and an alternative (submitted).

Mohring, H. (Ed.) (1994) *The Economics of Transport*, vols 1 and 2 (Aldershot: Edward Elgar).

Mokhtarian, P. and Chen, C. (2004) TTB or not TTB, that is the question: a review of the empirical literature on travel time (and money) budgets, *Transportation Research Part A*, 38(9–10), pp. 643–675.

Mokhtarian, P. and Salomon, I. (2001) How derived is the demand for travel? Some conceptual and measurement considerations. *Transportation Research Part A*, 35(8), pp. 695–719.

Mokhtarian, P. L. (Ed.) (2005) *Transportation Research Part A*, 39(2–3) [Special Issue: 'The Positive Utility of Travel'].

Mullainathan, S. and Thaler, R. (2000) *Behavioral Economics.* Working Paper No. W7948 (Cambridge, MA: National Bureau for Economic Research).

National Statistics (2004) *Family Spending: A Report on the 2002–03 Expenditure and Food Survey* (London: Stationery Office).

Noland, R. and Lem, L. (2002) A review of the evidence for induced travel and changes in transportation and environmental policy in the US and the UK, *Transportation Research Part D,* 7(1), pp. 1–26.

Ortuzar, J. and Willumsen, L. (2001) *Modelling Transport,* 3rd edn (Chichester: Wiley).

Ory, D. and Mokhtarian, P. (2005) When is getting there half the fun? Modeling the liking for travel, *Transportation Research Part A,* 39(2–3), pp. 97–123.

Schafer, A. (2000) Regularities in travel demand: an international perspective, *Journal of Transportation and Statistics,* 3(3), pp. 1–31.

Schafer, A. and Victor, D. G. (2000) The future mobility of the world population, *Transportation Research Part A,* 34(3), pp. 171–205.

Small, K. (1999) Project evaluation, in: J. Gomez-Ibanez, W. Tye and C. Winston (Eds) *Essays in Transportation Economics and Policy,* pp. 137–180 (Washington, DC: Brookings Institution Press).

Social Exclusion Unit (2003) *Making the Connections: Final Report on Transport and Social Exclusion* (London: Office of the Deputy Prime Minister).

Standing Advisory Committee on Trunk Road Assessment (SACTRA) (1994) *Trunk Roads and the Generation of Traffic* (London: HMSO).

Stead, D. (1999) Relationships between transport emissions and travel patterns in Britain, *Transport Policy,* 6(4), pp. 247–258.

Toole-Holt, L., Polzin, S. and Pendyala, R. (2005) Two minutes per person per day each year: exploration of growth in travel time expenditure, *Transportation Research Record,* 1917, pp. 45–54.

Transport for London (2003) *Micro-simulation Modelling: Guidance Note for Transport for London* (London: Transport for London).

Van Wee, B., Rietveld, P. and Meurs, H. (2006) Is average daily time expenditure constant? In search of explanations for an increase in average travel time. *Journal of Transport Geography,* 14(2), pp. 109–122.

Wardman, M. (1998) The value of travel time: a review of the British evidence, *Journal of Transport Economics and Policy,* 32(3), pp. 285–316.

Zahavi, Y. and Talvitie, A. (1980) Regularities in travel time and money expenditures, *Transportation Research Record,* 750, pp. 13–19.