The 'multi-modal approach' to user benefits in new mode contexts: a rejoinder

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This rejoinder responds to the peer review by John Bates on the 'multi-modal' (MM) user benefit methodology, recommended in our 'Rail Openings Appraisal' (ROA) research for 'new modes'.

The central argument

In his review, Bates' central argument is that "*any method proposed to deal with "new modes" must also have validity in the more general case*" (p.3). That is, any method for appraising new lines and stations should also be applicable to the generality of rail interventions. It would seem that, according to Bates, our proposed method is not applicable in the 'generality', and he has therefore dismissed our proposed method on that basis. However, the whole reason for the ROA study is that the existing 'general' methodology has been consistently shown to be inappropriate in the case of new modes, suggesting that what is needed is a bespoke method. Of course, it stands to reason that a bespoke method may not necessarily be applicable to the generality of schemes.

A critical aspect is how the question of 'validity in the general case' is framed. Bates' concern is that, in developing the MM approach, "*the authors have not developed the theory in line with general discrete choice analysis*" (p.3). On this basis, Bates assesses whether the MM approach could be derived from the standard discrete choice model (DCM). This DCM is taken to represent 'generality' in Bates' view, because "*its output can be directly used in conjunction with the standard appraisal guidance using the so-called Rule of a Half [RoH]*" (p.2). Whenever our proposed model deviates from this DCM model, Bates treats this as a flaw in our model. Bates acknowledges that it is very difficult to use the standard DCM for new modes because we do not have the data it needs, but does not draw the conclusion that we need a model with a different set of assumptions. We should stress that 'different' does not necessarily imply 'less true to reality' or invalid.

Indeed, our proposed MM approach is based on different assumptions to DCM, but these assumptions follow the precedent of notable researchers in the field – namely Foster & Beesley (1963) and Sugden (1972). It is not, however, derived from a DCM. Alternatively, if one were to take Bates' view that reconciliation with DCM is a practical requirement for CBA – a view we do not share and which does not appear to be shared by TAG[2] – then it would in any case seem possible to develop a different form of DCM that is tailored to the 'new mode' context. For example, DCM and the MM approach are reconcilable where 'public transport' is treated as one mode. In seeking 'validity in the general case', Bates' review focuses on the general case of a *rail improvement* – and unfortunately not on the *new rail* context.

Discussion

We should highlight that the MM approach is in fact a particular form of RoH. The RoH was first deployed in transport CBA by Foster and Beesley (1963, p.77), for the case of the Victoria Line (i.e. a new mode scheme to some extent). Authors of subsequent influential work, including formalisations of the RoH approach (Neuburger, 1971) and linkages to demand modelling (Williams, 1977), recognised that the RoH could be applied at different levels. Applying the RoH at the level of 'a trip by mode *x*' was convenient for the general case: "*the selection of journeys by mode as the appropriate*

[1] We are indebted to Professor Robert Sugden for his invaluable help in developing the key points made in this note.

[2] TAG recommends DCMs as one possible modelling option, but there is no mention of discrete choice theory in TAG Unit A1.3 which presents the approach to user benefits as "*the approach advocated by Sugden (1999)"* (DfT, 2022, p.3).

economic good follows the assumption implicit in most engineering practice" (Neuburger, 1971, p.63). Applying the RoH at this level (i.e. mode-specific) soon became the preferred option, with typical mode definitions being the usual car, bus, rail, etc. This became the standard RoH in DfT guidance – underpinned by Sugden's (1999) framework ensuring a consistent approach across modes[3].

As is well established, the RoH gives a linear approximation to the change in Marshallian consumer surplus generated by transport projects. The consumer surplus of a good "*is the difference between the price paid for it and the price at which a consumer would substitute something else for it*" (Foster, 1960, p.343). In practice however, there are multiple ways of applying the RoH, depending on how 'the good' is defined. F&B (1963)'s original deployment of the RoH defined the good as 'a trip', not as 'a trip by underground'. Thus, an underground trip which, before the scheme, was instead made by bus or by car, was classed as an existing trip. The change in consumer surplus to switchers was the full benefit relative to their previous mode, and the notion of new users applied only to passengers who did not travel at all without the scheme (those passengers receiving half the benefit of switchers). Consequently, the estimation of F&B's RoH was more complex than the current TAG version of RoH, as it was based on the computation of time and cost savings for various groups of existing users (switchers), depending on their previously used mode. **This method, which is in essence our proposed 'full MM approach', was further developed and simplified for the case of railway closures by Sugden (1972), who defined the good as 'a trip by public transport'. Sugden's RoH approach corresponds to our 'reduced MM approach'[4]. The economic rationale for this way of measuring consumer surplus – at the trip level – is also valid for the 'generality' of schemes**. Of course, this does not mean that the approach should be used for all schemes. For most schemes, defining the good as 'a trip by rail' (i.e. the TAG definition of RoH) is clearly more convenient.

The origin of the standard TAG version of the RoH can be linked to the following consideration: when a change in the generalised cost of a rail trip is small, the mode-specific RoH is likely to be more accurate. Measuring changes in the cost of trips for a given mode is subject to less idiosyncratic variation than measuring cost differences across modes. But it requires a context of observable changes in the cost of rail to be applicable. Since most transport schemes are incremental (e.g. improvements to existing lines/routes which bring small cost changes), appraisal guidance has benefitted from this convention, as it has simplified the analytical burden relative to F&B's RoH. Also, it readily aligns with the usual conventions of mode choice modelling.

However, the downside of adopting a mode-specific RoH in TAG is that it does not readily admit the context of new modes – in other words, TAG has focussed on the 'costs of a given mode' instead of 'costs of a given trip'. The latter would have kept the door open to a 'multi-modal' approach in new mode contexts: wherein a *smaller* change in cost can be observed between bus and rail (compared to an analysis restricted to rail, where a larger cost change must be assumed but is not in practice observed). Authors of influential work underpinning the current TAG RoH (e.g. Sugden, 1999) never intended to close that door (as noted above, Sugden was also one of the proponents of the multi-modal approach). **Both RoH approaches could have co-existed – and this is what we now advocate.**

In terms of external corroboration for the MM approach, we note that appraisal guidance in Germany follows an approach that defines 'public transport' as a mode, and then subdivides this into 'rail-based'

[3] The priority in those days was the development of a common appraisal approach suitable for the generality of transport schemes. 'New modes' appraisal was an exception and, understandably, not a priority area.

[4] The difference between the full and reduced MM approaches, is that the former assesses benefits to switchers to the new mode from all existing modes separately, whereas the latter assesses all benefits relative to the best alternative public transport option.

and ‘non-rail-based’. User benefits are then calculated on the basis of weighted costs for ‘public transport’. Whilst some of the details differ, the essence of the German approach is consistent with our proposed MM approach. Last but not least, we should mention that we have had several conversations with Prof. Robert Sugden recently, and he stands by the MM approach.

Annex: a comment on the role of DCM on CBA

It is important to distinguish between methods for predicting demand and methods for estimating benefits. The calculation of user benefits using the RoH, in any form, simply requires information on the number of trips with and without the scheme. A demand forecasting model provides this (as data). There is no specific requirement on the form of such demand model (see TAG Unit A1.3). In practice, for example, Restoring Your Railway appraisals have used a mix of models, including gravity models, trip rate models and, also, DCMs.

Discrete choice theory provides a choice paradigm that defines how passengers make transport choices, typically through a random utility model. There is no doubt of its significance in transport modelling. A lot of the complexities of any DCM (including Bates’) are necessary for predicting mode choice. In particular, the reason why DCMs need a random utility term is that if the generalised cost of each mode was deterministic, there would be no travel on the higher-cost modes. But that is not a problem for a CBA which treats predicted do-minimum (DM) and do-something (DS) trips by each mode as data. The rationale for the RoH in its various forms is not, at any point, linked to any specific underlying choice paradigm. Thus, whether the utility function incorporates an error term or not matters for modelling, but it is not part of the rationale behind the RoH. Therefore, in our view of CBA, error terms are not relevant when considering the validity of one or another application of the RoH. In other words, the measurement of consumers' surplus from given demand data does not depend on any specific method of predicting demand (see e.g. Sugden, 2003, 2023).

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