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The Wider Value of Rural Rail Provision

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In the context of recent plans for public sector expenditure, the value for money provided by rural public transport is an important issue in Britain as elsewhere, and one aspect of this is the option and non-use value placed on public transport by residents. Whilst there are a small number of studies which have estimated option and non-use values, they rest largely on contingent valuation methods which are subject to dangers of bias, and concentrate on commuter services into cities rather than truly rural services. This paper seeks to overcome these problems by conducting a Stated Preference (SP) experiment in rural communities, which values the provision of rail services and compares this against Post Office provision. We believe that using this approach, and allowing respondents to compare willingness to pay for rail services with that for another important rural service subject to threatened cuts, should produce more reliable results; moreover we achieve this using self completion questionnaires rather than much more expensive interviews. Our results show much lower values for rail than previous studies, though this is to be expected in truly rural areas where the likelihood of commuting by rail is much lower. Other non-use values are greater than option values in this context.

1 Introduction

1.1. Background

The value to be placed on maintaining rural public transport services has been an important research issue for at least 50 years. In Britain, following the release of the Beeching Plan in 1963 (Beeching, 1963) which led to closure of a third of the rail network, there was much debate about the social need for rail services against the cost of providing them and the then relatively new science of Cost Benefit Analysis was used in a number of cases, notably the work by the MoT (1969), Else and Howe (1969) and Richards (1972). Hillman and Whalley (1980) extended the debate beyond pure CBA to look at social issues. At a time when government spending cuts are leading to the withdrawal of many local bus services, and the recent McNulty review (McNulty, 2011) questioned the value for money provided by many

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regional rail services, the need for thorough and reliable methods of appraising spending on rural public transport is acute, in Britain as elsewhere.

1.2. Option Values

Traditionally appraisals have considered time and cost savings to users and the benefits of diverting traffic from road, in terms of reduced congestion, accidents and environmental externalities. More recently the concept of option values has been applied to public transport, although it has been examined within the field of environmental economics over a longer period (Pearce and Turner 1990).

An option value can be defined as "the value that economic agents are willing to pay above and beyond their expected value of consuming the good, to have the option of consuming that good at some point in the future." (Laird et al. 2006).

The basis of an option value is a situation where a person does not currently use a particular mode for certain journeys, but may have cause to in the future. At the most short term level this may relate to the use of public transport at times of poor weather when car use might be felt to be unsafe. A longer term example might be the opportunity to move home or occupation in the future and for which public transport would then become a more attractive mode than car use or walking/cycling.

The maximum size of an option value is likely to be no more than the cost of the highest price alternative option, for example, the use of a taxi if neither car nor public transport was available. This leads us to expect high option values where journeys would otherwise be frequent or very expensive. Where there is no alternative that the user could afford, the option value will represent the cost attached to having to give up the activity in question; for instance in the case of the journey to work, being unable to work.

Various studies have taken place on option values and transport. Bristow et al. (1991) examined the potential withdrawal of bus services in two contrasting areas, the first being a deprived area of Leeds, the other a more affluent area in Cheshire. Non-users gave a value of £1.50 a week to retain the services while the value of bus users was only £0.50 per week over and above consumer surplus. It should be noted that these non-use values also include the option values. One of the explanations for this difference was that non-users tended to be more affluent and therefore had the ability and willingness to pay (WTP) to keep the services.

Bristow et al. (1991) also concluded that self completion surveys are not a suitable method for the collection of data in this area because of the complexity of the issue and the poor response rate. An additional complication was that as this was an early study of the matter there were likely to be issues with knowing what the range of option values were making the surveys more difficult to design.

Geurs et al. (2006) estimated option values based on an internet based SP survey regarding two regional railway links in the Netherlands. Their approach disaggregated option values, non-use values and consumer surplus from total economic value via three different experiments. They estimated option values for regular train users of around €240 per year for users, and €168 per year for non-users. However, these values are potentially unrealistically large as they offered no alternative public transport service. In reality it is unlikely public transport services would be withdrawn completely, as even without public support, some level of service is likely to be commercially viable.

Humphreys and Fowkes (2006) compare different levels of service and different modes. The service they report on is primarily a commuter route (North Berwick – Edinburgh), and they report option values of £150 for users, and £172 for non-users for the rail service as against the existing bus service

The only non European study of option and non-use values of which we are aware is Ian Wallis Associates (2011) in New Zealand, which also examines rural rail services, though in a very different socio economic and geographical context.

Laird et al. (2004) describe four methods for extracting option values: contingent valuation, stated preference, the travel cost method and hedonic pricing. However, of the studies cited, all had used contingent valuation, with Humphreys and Fowkes (2006) and Geurs et al. (2006) supplementing this with stated preference methods.

1.3. Non-Use Values

Non-use values are a value held by an individual unrelated to their own use or future use of a service, in contrast to option values. They can be divided into three main types according to Geurs et al. (2006); existence values; altruistic values and indirect user benefits.

Existence value "refers to a WTP to keep a good or service in existence in a context where the individual expressing the value has no actual or planned use for him/herself or for anyone else". Whilst Humphreys and Fowkes (2006) suggest that a transport use value could exist due for example to "the scenic quality of a (railway) line", they state this is unlikely to be relevant to transport infrastructure.

Altruistic values exist when people "are willing to pay to preserve a service that benefits others." (Geurs et al. 2006). These values could be seen to hold a parallel with charitable giving.

Indirect user benefits are described by Geurs et al. (2006) as "benefits that individuals derive indirectly from the use made of a public transport service by others", this might be from the lack of congestion affecting a car user.

There is a strong distinction between non-use values and option values, with option values covering potential future use in the case of a change in lifestyle, and non-use values covering more altruistic issues of both an inter-generational and intra-generational nature and subjective personal benefit valuations. It should be noted that there is scope for significant overlap between aspects of non-use values and user benefits or externalities already accounted for in a standard appraisal.

Humphreys and Fowkes (2006) report non-use values of £17 per year for users and -£27 for non-users, (they do not explain the negative value, which is a feature of their best performing model, but Laird et al. (2009) describe the result as counter-intuitive). Geurs et al. (2006) report annual non-use values for users of €308 and between €193 and €229 for non-users. So it appears that there is much more uncertainty about the level and relevance of non-use values than option values.

1.4. Motivation for Study

While a number of studies, discussed above, have examined the field of option and non-use values there remains considerable need for further research. Laird et al. (2009) review the evidence and examine the case for the inclusion of option and non-use values in transport appraisals. The point is made that the effect of including these values in an appraisal is very much dependent on the context and the relative strength of the user benefits/costs. This defines the areas where such values are of most importance, "typically lines with relatively infrequent levels of service and low levels of demand". They also mention the problem of obtaining reliable valuations, with the current available research producing a very wide range of values and from a very small number of studies (five) and which mostly have small sample sizes. This latter point is an area which it is important to remedy, although, because of the relatively complex nature of obtaining these results and the difficulties obtaining samples from people who do not use public transport, it may be that the quality and detail of results would have to be compromised to collect very large samples. In spite of the problems mentioned the authors did find some consistency across the studies, reporting that "the upper end of the range reflects a high quality train service linking a community to a large employment and service centre", "in the middle of the range we find values associated with high quality bus services", "at the lower end of the range we find lower quality bus services and potentially lower quality rail services" and concluded by saying that "the need to build up the existing evidence base forms the future research agenda for this field."

Partly this is because of the need for larger sample sizes, and for studies which address deep rural areas, where the risk of closure is much more acute, rather than solely commuting into large cities. A student project with a very small sample size (Crockett, 1992), is the only study to examine rail in deep rural areas to our knowledge and does not provide separate estimates of option and non use values. Painter et al. (2002) also look non use values of rural bus networks but do not report option values.

But also there are methodological issues. When dealing with sensitive issues such as service closures, there is a danger that contingent valuation methods may be subject to strategic bias. We try to guard against that by using a stated preference design in which another rural service subject to controversial closure proposals, Post Offices, is introduced. Post Offices are seen as a vital lifeline for rural communities as they provide communication, retail, finance functions whilst often performing a social role, reducing the feeling of isolation in these areas - the UK Government's minimum access criteria stipulates that 95 per cent of residents in rural areas must be within three miles of their nearest post office outlet.

Whilst Humphreys and Fowkes (2006) and Geurs et al. (2006) used stated preference methods, their analysis did not make use of the most up to date techniques for estimation, which can lead to bias in parameter estimation. This is another shortcoming in the existing literature which is addressed in our work.

We also examine whether service valuations differ by distance from the railhead, an issue highlighted by Laird et al (2009) as little considered in previous studies.

A further issue we examine is the relative size of the various elements of willingness to pay. Only two studies (Humphreys and Fowkes (2006) and Geurs et al. (2006)) actually provide distinct estimates of option and non-use values. In order to eliminate double-counting from estimates of non use value, it is necessary to go further and identify the size of the various elements leading to this value..

With the above in mind it was decided to carry out surveys of residents living comparatively close to rail services operating in rural areas across the north of England.

This article is structured as follows. Section 2 describes the data collection exercise, Section 3 the methodology, Section 4 the results of the stated choice exercise and the disaggregation of the resulting values. Section 5 concludes with a discussion of the implication of the results.

2. Data collection

2.1 Survey method and scope

Self completion questionnaires incorporating a stated preference survey were distributed to residents. This approach was used as, despite the problems that Bristow et al. (1991) found with self completion surveys, they were the only viable way of obtaining a large sample from across a very large geographical area, at reasonable cost.

Two rail routes were chosen to base the surveys around, as discussed below and illustrated in Figure 2.1:

Leeds – Skipton – Lancaster (NW route): Settlements between Skipton and Lancaster (exclusive) were surveyed. The route traverses the southern edge of the Yorkshire Dales, running into north Lancashire, an area with a mixture of villages and small towns. The rail service that currently operates does so at a very low frequency (five services per day) using poor quality rolling stock. There is however very little competing public transport operating along the route.

Leeds – Skipton – Settle – Carlisle (S&C route) : Settlements between Settle and Carlisle (exclusive) were surveyed. This route runs from the West Yorkshire conurbation through some of the most remote areas of the north of England, before joining the Eden Valley to run into Carlisle. The route has now become reliant on local traffic and tourists for its passenger revenue, although the line has in recent years become more important for freight traffic. While the service and rolling stock used is superior to that on the Leeds – Lancaster line, the timetable represents a trade off between tourism requirements and the needs of those who live in the area, as evidenced by the use of spare stock from urban areas to form services in the off peak which need to be returned by the evening peak in the urban areas. Due to the topography of the area, the line has almost no direct public transport competition; indeed the road network in the area operates in a more convoluted way as the rail service crosses valleys on a significant number of viaducts and tunnels.

Figure 2.1: Diagrammatic representation of key stations on survey routes

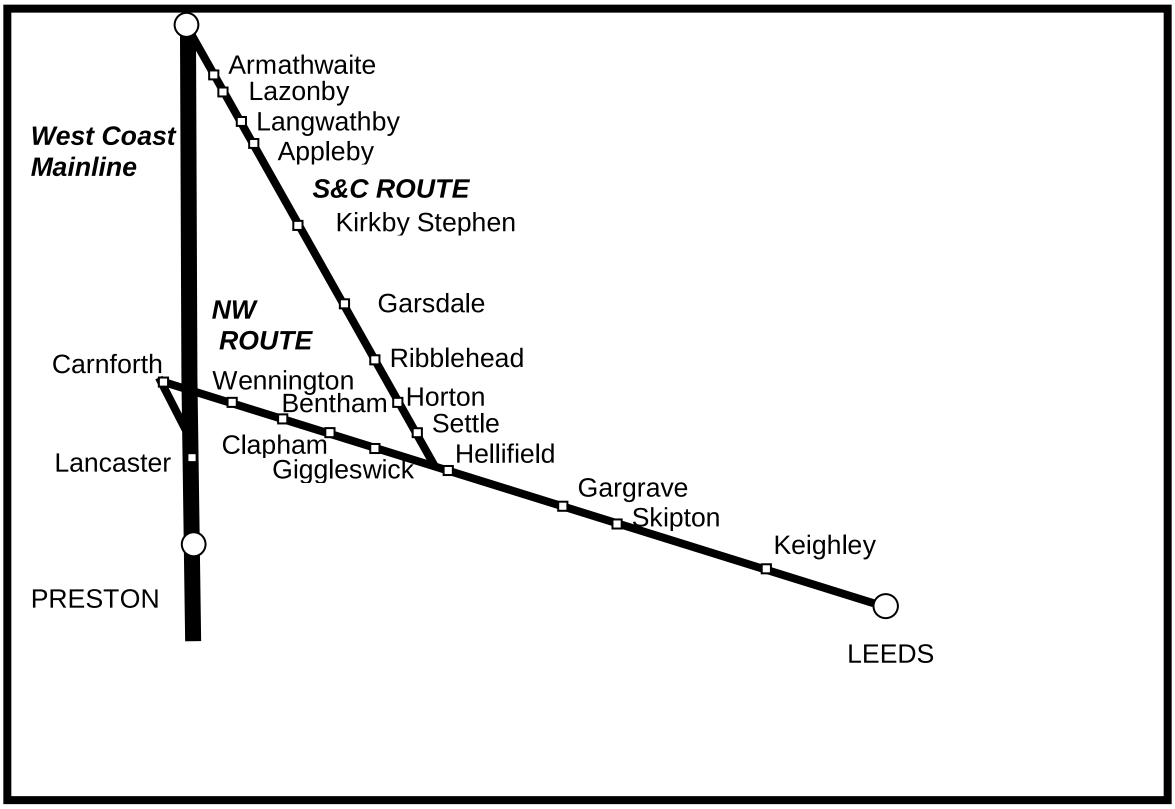

Table 2.1 below summarises some of the characteristics of the stations that the lines serve.

Table 2.1: Example Study Station Characteristics

Station	Route	Passengers (2009-10) (ORR)	Population (2001 Census)
Settle (Giggleswick)*	S&C(NW)	121,720 (10,926)	3,831
Bentham	NW	19,162	3,573
Wennington	NW	3,222	102

Ribblehead	S&C	18,606	0[4]
Appleby	S&C	61,984	2,500

* Settle has two stations, Settle and Giggleswick on separate lines

2000 surveys were distributed across various settlements in the area, with 1000 allocated to each line. Of the 14 settlements, 8 were served directly by the rail service while the remainder were not directly served and were up to 5km from the rail routes in question. Around one third of questionnaires were distributed to the latter, which are termed "catchment" settlements, and the rest to the former, described as "station" settlements. The purpose of this was to try and examine the issue of the tapering of values as distance from the service was increased.

2.2 The Questionnaire

The surveys started with a range of background questions about access and use of services, to try and attract individuals who may not use the rail service frequently and therefore might have discarded the survey. After background questions that allowed the grouping of individuals during the analysis process, a Stated Preference (SP) survey formed the main part of the survey. The technical details are discussed further below, however it contained three attributes which were public transport (incorporating mode and three levels of headway), Post Office (incorporating three levels of days and hours of opening), and Council Tax change expressed in pounds per month. This mixture of attributes was used as it allowed an analysis of the effect of bus substitution of rail services as well as comparisons with another public service (Post Office). At this time a programme of Post Office closures was taking place across the country, and it was felt that the incorporation of this into the survey might help stimulate the response rate and to reduce strategic bias. Council Tax change was used as the cost attribute as it was the only charge which all householders would be likely to pay or be aware of, and could be more reasonably seen to be related to the provision of local services. This use of Council Tax was based on the method employed by Humphreys and Fowkes (2006).

2.3 Stated Preference Design

The basis of the design used in the final survey was the result of two previous pilot surveys, and was a non trivial task because of the difficulty in estimating where the values would be

[4] Ribblehead is essentially a tourist destination near the Ribblehead viaduct, so has no resident population

likely to lie because of the relative paucity of evidence, particularly when considering the valuation of Post Offices. However, an attempt was made resulting in the final design presented in Table 2.2 below.

Table 2.2: Final SP design example

Choice Pair	**Headway**		**Council Tax Change per month (£)**		**P/O Hours per month**		**Mode**	
1	60	120	3.5	3	192	112	Coach	Train
2	120	180	1	-1	192	112	Coach	Train
3	60	180	5.5	-2	112	192	Coach	Train
4	120	60	-3	6.5	192	60	Coach	Train
5	120	180	6	2	60	192	Coach	Train
6	180	60	2	3.5	60	192	Coach	Train
7	60	120	3.5	3.5	112	60	Coach	Train
8	180	120	5	2	60	112	Coach	Train
9	180	60	-1.5	3.5	112	60	Coach	Train

The design was facilitated by the use of boundary rays, developed by Fowkes (2000), which helped to visualise the implications of altering the designs. Boundary rays are a collection of boundary values (points of indifference) for different values of time for each pair of choices.

The design was subject to simulations with random data to ensure they could accurately accommodate as wide a range of likely monetary values as was likely to occur. The simulations provided satisfactory results.

2.4 Data collection

An overall response of 20% was achieved, given that this was a postal survey such a response rate was quite acceptable. However, of that 20%, only around half completed the stated preference question well enough for it to be analysed which gave a total sample to be used for modelling of 223 (11%). This is a considerably larger sample than Humphreys (2003) who used less than 91 respondents. The response rate is equal to Bristow et al. (1991) results, but much larger in absolute terms. Only Geurs et al. (2006) has succeeded in obtaining a larger sample, but their methodology was an online survey, which cannot be expected to get an unbiased response, particularly in rural areas. An interesting feature of our sample was the consistency of response rates across all settlements, regardless of their proximity to the rail service. This tends to suggest that setting the public transport questions within the context of wider public services, and distributing it at a time when other rural public services were in the public mind contributed to the improved overall response rate.

Of the final 223 returns, 30% (66) were from the catchment areas. Table 2.3 gives the frequencies and percentages of the four different respondent categories.

Table 2.3 Disaggregation of sample by public transport use and location type

Respondent Category	Number of Respondents (% in brackets) N=223
Users, Catchment area	15 (7)
Users, Station Settlement,	96 (43)
Non-Users, Catchment area	51 (23)
Non-Users, Station Settlement,	61 (27)

3. Methodology

3.1 Analysis of SP data using Multinomial Logit

The key objectives of the SP exercise were to estimate option and non-use values for users of the two study routes, as well as estimate respondents' WTP for different levels of Post Office service and headway. In addition it was important to look at the effect of residents' distance from the nearest station, the difference in values of rail (as against replacement coach) held by users and non-users of the service as captured by segmented Mode Specific Constants (MSCs).

The model is specified as follows:

$$U(i,j) = \alpha_c Cost_j + Mode\,(\alpha_{us}\, UseSet_i + \alpha_{ns}\, NUSet_i + \alpha_{uc}\, UseCat_i + \alpha_{nuc}\, NUCat_i) + \alpha_{hl} HeadLo_j + \alpha_{pl} POLo_j + \alpha_{pm} POMed_j \quad (3.1)$$

where:

U (i,j) is the utility of respondent *i* from choice alternative *j*;

Cost is Council Tax change (pence per month) associated with alternative *j*

Mode is the MSC capturing respondents' underlying preferences for Train over Coach;

UseSet is the User station settlement dummy;

NUSet is the Non-user station settlement dummy;

UseCat is the User station catchment area dummy;

NUCat is the Non-user station catchment area dummy;

HeadLo is an average headway between services of 180 minutes, with the base being the current level of service of 120 minutes;

POLo represents the lowest level of Post Office Hours provision (5 days, 9am-12noon);

POMed represents a 'medium' level Post Office provision (4 days, 9am-4pm), as against a possible maximum of 6 days, 9am-5pm.

Interactions of cost (i.e. Council Tax change) and the MSC with age and income did not contribute significantly to the predictive power of the model so were dropped. Segmentation of headway by route and of Post Office opening hours by high was also examined, to capture any differences in sensitivities amongst respondents for differing levels of existing provision, but again these impacts were not significant so were dropped. Segmentation of cost by existing public transport availability was also investigated but not found to have a significant impact on the results. Effects of non-car ownership were found to be insignificant due to the extremely small numbers of respondents with no access to a car (under 5%). A higher level of headway of 60 minutes was dropped from the model as the resultant dummy coefficient was insignificantly different to that of the base level of 120 minutes.

The model presented principally measures the difference in utility between a rail service and a replacement coach service. Realistically it is unlikely that if the existing rail service was withdrawn it would not be replaced by some form of coach or bus service, therefore the difference between coach and rail is the important value to uncover.

Models were estimated using BIOGEME[5]. as standard fixed coefficients Multinomial Logit model (MNL). From these coefficient estimates, WTP values for changes in particular attributes can be derived by taking ratios of the coefficient on the attribute with the cost coefficient.

3.2 Direct estimation of WTP values using Mixed Logit

For the final specification, a Mixed Multinomial Logit model (MMNL) form of the model is estimated as outlined in equation 3.2 below. The mixed logit model returns estimates of not only the mean of the parameters, but also the standard deviation, allowing us to capture the effect of unobserved heterogeneity on the model results. Standard logit models assume unobserved factors are uncorrelated over time, for each choice the person makes, leading to possible biases in coefficient estimates. Using the Revelt and Train (1998) specification, this heterogeneity is assumed to vary across but not within respondents, which generally leads to improvements in model fit and a greater ability to retrieve taste heterogeneity. In the mixed logit modelling, all attributes are estimated as random parameters.

[5] Open source freeware designed for the estimation of discrete choice models, **biogeme**.epfl.ch

A non linear specification of the model allows rail service, Post Office hours and service headway to be estimated in willingness to pay space, rather than in preference space such that the mean coefficient represents the average willingness to pay and the standard deviation represents the distribution of the willingness to pay. As shown by Train and Weeks (2005), the estimation in WTP space avoids difficulties in estimation of willingness to pay values when derived from two separate distributions (i.e. of headway or Post Office hours and cost) which may require extensive simulation (see Mabit et al. 2006), instead the WTP estimates are recovered directly from the model. To implement this we re-cast the model in WTP space as follows:

$$U(i,j) = (\alpha_c + v_{ic}) * Cost_j + Mode\,((\alpha_c + v_{ic}) * (\beta_{us} + v_{ius}) * UseSet_i + (\alpha_c + v_{ic}) * (\beta_{ns} + v_{ins}) * NUSet_i + (\alpha_c + v_{ic}) * (\beta_{uc} + v_{iuc}) * UseCat_i + (\alpha_c + v_{ic}) * (\beta_{hl} + v_{ihl}) * HeadLo_j + (\alpha_c + v_{ic}) * (\beta_{hh} + v_{ihh}) * HeadHi_j + (\alpha_c + v_{ic}) * (\beta_{pm} + v_{ipm}) * POMed_j + (\alpha_c + v_{ic}) * (\beta_{pl} + v_{ipl}) * POLo_j \qquad (3.2)$$

where β_x, an estimate of the value (WTP) for a change in attribute x, is obtained directly from the data and v_{ix} a randomly generated individual level disturbance associated with this attribute. BIOGEME estimates the parameters defining the mean and standard deviation of the (normal) distribution from which the values of v_{ix} are sampled. Each estimated parameter is a product of cost and attribute coefficients, so the signs will be opposite to those estimated in preference space in equation 3.1.

4. Results

4.1 Discrete Choice Modelling Results

Table 4.1 presents the coefficients and t-statistics for the different attributes examined, taken from models estimated separately for the two routes in M1 and M2, and then pooled in M3.

Table 4.1 MNL model coefficients and t statistics

Model	M1: MNL Model - NW Route		M2: MNL Model – S&C Route		M3: MNL Model – NW & S&C Pooled	
Individuals / Observations	111	999	112	1008	223	2007
Rho-square:	0.167		0.195		0.178	
Adjusted rho-square:	0.156		0.183		0.172	
Log Likelihood (model)	-576.6		-562.5		-1143.3	
Attributes:	**Coeff (μ)**	***t-stat***	**Coeff (μ)**	***t-stat***	**Coeff (μ)**	***t-stat***
'High' Post Office hours (Base)						
'Medium' Post Office hours	-0.589	-5.48	-0.758	-6.85	-0.668	-8.70
'Low' Post Office hours	-0.469	-3.22	-0.654	-4.34	-0.558	-5.35
MSC (users, settlement)	-1.020	-8.90	-0.858	-7.37	-0.936	-11.52
MSC (non-users, settlement)	-0.458	-3.48	-0.667	-4.73	-0.555	-5.78
MSC (users, catchment)	-1.120	-3.12	-0.929	-3.70	-0.981	-4.80
MSC (non-users, catchment)	-0.006	-0.04	-0.038	-0.26	-0.020	-0.20
Cost (£ per month)	-0.114	-4.52	-0.132	-4.97	-0.122	-6.70
'Low' Headway 180 mins	-0.386	-3.40	-0.230	-1.97	-0.309	-3.82
120 Headway (Base)						

All models show decreases in Post Office opening hours were associated with significant decreases in utility and lower probabilities of choosing an option. However, the effect of reduced days of operation seems confounded with total hours, as the 'Low' provision (5 half days) has a smaller (but insignificantly so in each model) negative coefficient than the 'Medium' provision (4 full days). Increases in Council Tax (ie Cost) have a significant negative impact on utility and choice probability. The negative signs on the segmented constants indicate a preference, ceteris paribus, of rail over replacement coach.

The similarities in the sign and size of the coefficients across models M1 and M2 indicate that pooling the two routes, as in M3, is appropriate. This yields a model with more robustly estimated coefficients and is our preferred model of the three.

As explained above, we then estimated the pooled model in WTP space to directly derive the monetary valuations and associated t-statistics, and also to explore the impact of random parameters. These results are presented in Table 4.2. The MSC for non users in catchment areas was dropped from subsequent estimation as insignificantly different from zero, suggesting that non-rail users from the wider station catchment area have no innate preference of rail over coach. Model M4 yields more robustly estimated coefficients than M3 and has a better fit, as evidenced by the higher adjusted rho-squared of 0.246 compared to 0.172 for M3. Overall, M4 is our preferred model, but we also report valuations from M3 for comparison.

Table 4.2 Mixed Logit WTP coefficients and t statistics

Model	M4: Mixed Logit WTP Model (Pooled)			
Individuals / Observations	223	2007		
Rho-square:	0.256			
Adjusted rho-square:	0.246			
Log Likelihood (model)	-1015.362			
Attributes:	**Coeff (μ)**	***t-stat***	**Coeff (σ)**	***t-stat***
'High' Post Office hours (Base)				
'Medium' Post Office hours	4.18	5.73	-3.95	-6.46
'Low' Post Office hours	2.75	3.2	3.34	5.25
MSC (users, settlement)	7.36	6.18	-7.44	-6.46
MSC (non-users, settlement)	3.87	3.18	6.40	5.11
MSC (users, catchment)	8.17	2.92	-7.76	-3.28
Cost (£ per month)	-0.335	-6.15	-0.203	-4.30
'Low' Headway 180 mins	1.82	3.55	-3.72	-4.52
'Medium' 120 mins (Base)				

4.2 Monetary Valuations

Valuation of Rail Services

The valuation of rail services is key to the success of this model. Table 4.3 below gives WTP values for the avoidance of coach substitution for models M3 (MNL) and M4 (mixed logit, WTP), expressed as £ per year (whereas in Model M4, as reported in Table 4.2, WTP estimates were expressed as £ per month as in the questionnaire).

Table 4.3: WTP to maintain rail over a replacement coach service (£ Council Tax year)

User Group	M3	M4
User, Settlement	98.53	88.32
Non-user, Settlement	58.42	46.44
User, Catchment	103.26	98.04
Non-User ,Catchment	*2.12*	-

Note: valuations in italics are insignificant at the 95% level

It is clear from the resulting monetary values, that respondents who use the service hold a very strong valuation of the existing service. Values for non-users are around 40% lower than for users in the case of those living in the station settlement. The lower values for non-users are not at all surprising as this group should hold no current use valuation, in addition they may not be aware of the quality of the existing service and so hold a lower altruism value as well as holding a lower insurance and future personal use value.

Lower values for those travelling further distances to access rail are to be expected, as the disutility of travelling to the station would reduce the overall value of the service.

As a whole the results for the catchment area settlements are at variance with the results found in Humphreys and Fowkes (2006) in the North Berwick area where valuations increased with distance from stations. However, the catchment area used here is much greater than that in the earlier study (5km compared to 2km). It is also possible in the Humphreys study that those passengers living further away were higher income commuters or knew such people.

Overall the monetary results for public transport are considerably lower than in the North Berwick study; this produced aggregate valuations of option and non-use values of £195 and £298 for users and non-users respectively, for a service with a headway of 30 minutes - the figures for comparable headways are less clear but are still in excess of values found in our study. We believe that the reason for the difference lies in the differing nature of the study areas; in the North Berwick study the area is more urbanised and there is likely to be more dependence on public transport for accessing Edinburgh on a frequent basis, where as in this study respondents will be likely to use the service less often, and know fewer people who do use it frequently, and therefore will value the service less. In the North Berwick study the alternative would have been a service bus, while in this case it was a dedicated replacement coach, which in general might be deemed to be more acceptable.

By way of comparison with other similar UK studies combined option and non-use values, Bristow et al. (1991) obtained an average value of £104 per year for bus services, while Crockett (1992), studying Settle, obtained an average value of £59 per year, all at 2002 prices (Laird et al. 2009). The reported values here sit comfortably within the range of those in the literature.

Valuation of Headway

Due to insignificantly differing coefficients, high and medium headways were treated as the same base group in the estimation, so valuations for headway are difficult to interpret.
Compared to the combined base group, significant values of WTP for service level improvements from 180 minutes to the base group derived from Models M3 and M4 of £30 and £21 respectively suggest a strong aversion to low levels of frequency (ie around 180 minute headway). Given that 120 minutes is the current level of service, this also suggests individuals are more concerned about cuts in service from the current level than increases.

Post Office Valuations

The valuation of Post Office attributes is a useful comparison with the public transport aspects of the model to try and establish the relative importance of different public services. The Post Office attribute is divided into three levels, comparing days and hours of opening. As the majority of locations had very high opening hours this was used as the base.

Table 4.4: WTA for reductions in Post Office provision (£ Council Tax year)

Post-office valuations WTA £ per year	M3	M4
112 (vs 192) hours per week	65.70	50.16
60 (vs 192) hours per week	*54.89*	33.00

Note: valuations in italics are insignificant at the 95% level

Table 4.4 shows, using the preferred model (M4), that individuals are willing to accept compensation of £50 per year for a reduction in opening hours from 192 per week to 112 per week. However, it also indicates that they would accept less (£33) to compensate for a greater reduction in opening hours to 60 per week. However, these hours were spread over 5 days whilst the 112 hours were spread over 4 longer days. This indicates individuals value the presence of the service spread evenly and predictably over the week.

The magnitudes of these values are comparable to the base valuation of rail against coach. However, it has not been possible to find any precedent for the work on Post Offices.

4.3 Disaggregation of Option and Non-Use Values

Introduction to the Procedure

While the figures presented previously are useful, it is necessary for appraisal purposes to disaggregate them further into different categories of economic value specifically; current use value, option value, non-use values, and finally double counting within the non-use valuation needs to be split from the aggregate non-use value. Double counting in this context refers to areas of economic value which are already accounted for in a broader appraisal, which would include environment and congestion issues, as well as user benefits. Post Office valuations do not have implications for environment and congestion so are exempt from such categories. This disaggregation was achieved in a similar approach to Humphries and Fowkes (2006) by asking respondents to rate the importance of different distinct issues to them when they were answering the stated preference question. These issues represented different aspects of total economic value (TEV) which measures the maximum value of a good or service, and here were presented in such a way that it was possible for the four key areas mentioned above to be disaggregated. The different issues and the elements of TEV they represent are in Table 4.5 below.

Table 4.5. Proxies for TEV used in disaggregation procedure

Proxy	**Aspects of Option/Non-Use value**	
	Public Transport	**Post Office**
Current use of service	User Benefit	User Benefit
Unanticipated future use	Option Value	Option Value
Insurance mode	Option Value	Option Value
Use by future generations	Non-Use, Altruism	Non-Use Altruism
Benefit to friends/family	Non-Use, Altruism	Non-Use Altruism
Benefit to elderly	Non-Use Altruism	Non-Use Altruism
Concerns re environment	Non-use, Double Count	N/A
Concerns re congestion	Non-use, Double Count	N/A

McConnell (1997), reported in Laird et al. (2009), states that those aspects of non-use values which are pure altruism on the part of the holder can be counted in an appraisal. Three categories have been identified in Table 4.5 above that meet this criteria. The current use of the service is also a form of double counting as the user benefits of the rail service would be accounted for elsewhere.

Weighting Procedure

To estimate the weighting applied to each aspect of the user and option/non-use values the scores for the proxies above were calculated in the following way:

1. For all of the categories of benefit, mean of the scores given to them by respondents was produced
2. The total of the means of scores within the same category of TEV was taken
3. The total of the mean score for each category, as a proportion of the total of the mean scores for all categories, was taken as an estimate of the proportion of the willingness to pay attached to that category of benefit.

The results have been disaggregated into user and non-user groups as well as being split by distance from station.

Each of the categories is presented in Tables 4.6 and 4.7 below with their grouping and the individual and grouped score.

Table 4.6. Components and weighting of TEV for Public Transport

Description	**Score**				**Grouping**	**% of Final Value**			
	User	**NU**	**User**	**NU**		**User**	**NU**	**User**	**NU**
	Settlement		**Catchment**			**Settlement**		**Catchment**	
Current Use	6.0	4.0	5.8	4.9	Current Use	10.6	8.4	9.7	9.0
Unanticipated Use	7.6	5.6	8.1	6.6	Option Valuation	24.8	25.3	26.0	24.2
Insurance Mode	6.5	6.4	7.6	6.6					
Future Generations	7.7	6.4	8.7	7.5	Non-Use Valuation	39.3	41.0	42.0	41.7
Friends/Family	6.9	5.9	7.9	7.0					
Elderly	7.8	7.1	8.8	8.2					
Environmental	7.2	5.9	7.2	7.1	Non-Use Double Counting	25.4	25.3	22.3	25.1
Congestion	7.3	6.0	6.3	6.5					

An apparent anomaly that appears in this data is how a respondent can hold a use valuation while being classed as a non-user of the service. This is a result of the classification of non-users being those people that use the service every six months or less. A proportion of the sample will still hold a current use value of the service, hence the presence of this value. These values are kept in the calculation and used in the model as to remove them would distort the results.

The weightings in Table 4.6 are used to divide up the SP results into groups, including the removal of the double counting valuations. The same process was applied to the Post Office results, presented in Table 4.7.

Table 4.7 Components and weighting of TEV for Post Offices in Station Settlements

Description	Score				Grouping	% of Final Value			
	User	**NU**	**User**	**NU**		**User**	**NU**	**User**	**NU**
	Settlement		**Catchment**			**Settlement**		**Catchment**	
Current Use	7.7	8.3	6.5	7.5	Current Use	19.5	20.4	17.1	18.6
Unanticipated Use	8.1	8.5	6.9	7.9	Option Valuation	20.4	20.9	18.1	19.5
Future Generations	7.8	8.0	8.4	8.4	Non-Use Valuation	60.2	58.7	64.7	61.9
Friends/Family	7.3	7.5	7.1	7.9					
Elderly	8.7	8.5	9.2	8.7					

4.4 Discussion of the Weighted Monetary Valuations

Using the weightings presented above and the results of the SP experiment it is possible to produce disaggregated valuations of the different aspects of option and non-use values. It is these values that would be used in an appraisal.

The aggregate valuations presented for each user category are split up into the different categories of value according to the weighting presented in Tables 4.6 above, and those parts that can be treated as double counting are then discarded. Table 4.8 below presents the results of this process.

The useable option and non-use value can be defined as:
Aggregate Value – (Current Use + Double Counted NU Value)

Table 4.8 Weighted monetary values for Rail vs Coach Replacement

		User Settlement	NU Settlement	User Catchment	NU Catchment
Monetary Values (£ per Council Tax Year)	**Aggregate Value**	88.3	46.4	98.0	0
	Current Use of Service	9.3	3.9	9.5	0
	Option Value	21.9	11.8	25.5	0
	Non-Use Valuation	34.7	19.0	41.2	0
	Double Counted Non-Use Value	22.4	11.8	21.9	0

Table 4.8 presents the weighted monetary values of the disaggregated components of the aggregate value. The areas shaded in grey are regarded as option and non-use valuations excluding all double counting, and therefore can be included as additional benefits in appraisals. The figures show how a large proportion of the aggregate value obtained from the model has to be discarded and, therefore, how important it is to at least attempt to remove these parts.

Table 4.8 shows there is a clear difference between option and fully disaggregated non-use values, implying that in general terms respondents rate their own possible use less than the current and future use of others.

Table 4.9 below presents some results from the work of Humphreys (2003) by way of comparison. Of the limited number of option and non-use studies available this is the most readily comparable with this work. In this example Humphreys division of TEV has been converted into the categories used in the table above and the figure converted from 2002 to 2008 values. The values are for a 30 minute headway service.

Table 4.9 Monetary values of Rail Service (2008 £ per Council Tax Year) from Humphreys (2003)

Group	User	Non-user
Aggregate Value	395	360
Current Use of Service	56	0
Option Value	207	249
Non-Use Value	34	6

Double Counted Non-Use Value	98	105

The aggregate values for the North Berwick study are far in excess of the values found in this study. The bulk of this difference lies in the option values category which is substantially bigger than in our study. The variation in the study areas has been mentioned previously as a source of difference and this must again be the case. The population of more rural areas obviously believe that they have a much lower probability of using the service than those in the hinterland of Edinburgh.

Double counted non-use value is also a source of the difference and this is again a function of the characteristics of the areas, peak time congestion and air pollution issues will be a much more identifiable problem around Edinburgh than it is in the Yorkshire Dales for example. It is also likely that respondents will have considered the externalities as being issues that affect, not their settlement, but their trips into regional centres. The regional centres in this study, for example, Skipton, Carlisle and Lancaster, are not nearly as large as Edinburgh and the number of people travelling in by rail at peak times will be proportionately lower. Respondents may well have been aware of this and will have judged that the marginal effects of congestion and air pollution of the withdrawal of rail services would be very low.

The size of the non-use value is broadly comparable across the two surveys, which suggests that respondents are equally altruistic in each area, and infers that respondents weight the importance of a service to those with no alternative mode equally, irrespective of service level or locations served and therefore do so purely on the basis of the existence of the service.

Another interesting effect in this study is that users have a higher option value than non-users while the reverse is true of the North Berwick study. The quality of the service and the importance of the destinations served is likely to be the source of this as the higher quality rail service in Edinburgh will be more likely to meet the future needs of the local population. In this study area the headway of services combined with the range of locations people might want to travel to makes it less probable that respondents will be able to use the service for future trips.

The importance of the main rail served destinations is likely to influence the non-use values as well. The implication of this is that option/non-use values will be likely to taper not just with the proximity to the local station but also the distance from major regional centres and the number of competing regional centres in the area that are or are not accessible by rail. This point will be less likely to apply in very rural locations, for example, the far north of Scotland as one regional centre (Inverness) will dominate the whole of the region, because of its size relative to the other settlements.

5. Conclusion and Discussion

Overall the results and analysis presented in this paper have addressed a number of issues both in relation to the nature of rural rail and public service valuations but also the success of methods for collecting and estimating them. We have shown that self completion questionnaires can be used, permitting much greater sample sizes, and have reduced the risk of strategic bias by using stated preference methods in which another important public service subject to the threat of closures, local post offices, has been introduced. Previously it has been felt by researchers, such as Bristow et al. (1991) that self completion surveys are not appropriate for use in this area of work, as the mixture of issues being contemplated are quite complex and therefore the results of the survey would be of a poor quality and receive a poor response rate. This study has demonstrated that it is possible to obtain quality data through the use of self completion questionnaires. In terms of the response rate to the surveys (11% completed the SP question), it should be considered that it would be more difficult and expensive to get a similar sample through interview surveys, and it is likely that similar forms of response bias would be exhibited.

We have also estimated valuations based on more up to date discrete choice modelling techniques than in the existing literature, yielding models with better fit and robust coefficients.

A key finding of this paper has been the conclusion that the location of a respondent combined with their use of the rail service can heavily influence the valuations of the service. For those respondents who live some distance from the station and are users the valuations are almost the same as those people who use the service and live close to the station. In stark contrast those who do not use the service and live further from the station hold almost no value at all. This shows that the decline of non-use values over distance is extremely rapid; this is quite a significant finding for the research in this area. It would also indicate that altruism within this context is highly localised with little perception amongst non-users in catchment areas that other people in their area might be reliant upon a rail service some distance away for long distance trip making.

The converse of this is that it is clear that non-users who live close to a station do hold a value for the service, after disaggregation, of around 30% lower than for users of the service. This is an important result as it suggests that proximity to and knowledge of the service, which will be greater close to stations, influences respondents' valuations.

Overall the values have been considerably lower in this study than the main comparator in the form of the Humphreys study (2003), and show a greater importance of non-use values relative to option values. This is almost certainly because of the differing nature of the study areas. In the Humphreys example the line served a major national centre and was more outer suburban in context and service provision than the lines featured here. Aside from the small scale Crockett (1992) study no other studies have attempted to capture option and non-use values on routes of the type shown here. On these lines, it is less likely that people would finds themselves dependent on the train to get to work than on commuter lines into cities; on the other hand, alternatives to the train for those without a car available are scarce.

It was most surprising to find that local residents value the rail service similarly to the Post Office, despite them using Post Offices more often. This might be the result of some sort of strategy on the part of respondents particularly with respect to altruistic non-use values. They may feel that if rural services are in decline then it is important to maintain links to larger centres to make up for this loss. This would apply as much to other services, such as shops, as to Post Offices.

This study provides further evidence on the relevance of option and non use values for the appraisal of rail subsidy decisions. Option values already feature in the standard British approach to appraisal, but their assessment is largely qualitative; they are not often considered elsewhere. However, the finding of much lower values for rural lines than previously found for more city commuter oriented services suggests that careful disaggregation of service types will be necessary if more quantitative valuation of these effects is to be introduced into appraisals. The study also provides evidence that option values and non use values are relevant not just for public transport services but also for facilities such as rural post offices, where a case for subsidy will also exist.

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