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META-ANALYSIS OF POST-1994 VALUES OF NON-WORK TRAVEL TIME SAVINGS

Prepared for the Department for Transport

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1. Background

Recent ITS research has derived statistical confidence intervals for official value of time recommendations for non-work travel. These confidence intervals are based around the uncertainties surrounding the original value of time estimates themselves and also the uncertainties concerned with the GDP elasticity estimate that drives how the value of time for non-work travel grows over time.

There is now therefore a profile of forecast central estimates based on the best evidence on GDP growth that contains 95% confidence interval surrounding them from the original year of estimation in 1994. These figures cover the Department for Transport' (the Department)s official commuting and other non-work[1] values of time.

Whilst the Department now has a better understanding of the degree of confidence that can be placed in its official values over time, it is also concerned to examine the extent to which the value of time itself, as reflected in the large amount of UK empirical evidence, has varied over time in a manner that is or is not consistent with its forecasts.

The results of this study will contribute to the Department's evaluations of whether there is a need for a national update study which would be a significant undertaking.

2. Objectives

The two main objectives of this study, as determined by our understanding of the brief and set out in our initial proposal, are:

- To compare official value of time recommendations, for non-work travel, from 1994 to date with other British empirical evidence as represented in the ITS Leeds meta-data set.

- To examine how the income elasticity has varied over time.

We subsequently submitted a revised proposal elaborating on an idea to extend the meta-data set to cover year's post 2008. As discussed below, we embarked on such a task but did not pursue it fully for the reasons described below.

3. Content and Method

This document reports on the work ITS have conducted to support the Department in its decision making regarding the value of time for non-work travel and its updating.

This report covers the following:

- Recent Evidence on the GDP Elasticity of the Value of Time
- Updating the Meta Data Set for non-work travel
- Comparing the official values with the values in the 1994-2008 meta-data set and with the values that are implied by the meta-model estimated to that data

[1] This is referred to as Other trips.

4. Recent Evidence on the Value of Time GDP Elasticity

The GDP elasticity used in WebTAG guidance is based on meta-analysis. The most recent of these (Abrantes and Wardman, 2011) reports an overall value of 0.90 with a t ratio of 8.2.

That study also reports separate GDP and distance elasticities split by a number of factors. These are reported below. It can be seen that the GDP elasticity varies little across a number of important variables. Nonetheless, the GDP elasticity for IVT would support an elasticity larger than that now used, as would the GDP elasticities for commuting and other.

Segment	GDP (t)	Distance (t)
IVT Only	1.04 (7.7)	0.17 (6.2)
≤ 30 miles	1.02 (7.6)	0.04 (1.2)
> 30 miles	0.85 (4.4)	0.38 (6.8)
Business	0.85 (2.8)	0.45 (7.3)
Commute	1.06 (5.0)	0.08 (1.5)
Other	0.90 (8.2)	0.16 (7.3)
Car User	0.96 (6.2)	0.08 (2.5)
Bus User	0.99 (5.6)	0.01 (0.0)
Rail User	0.96 (5.6)	0.33 (6.7)
Car Valued	0.98 (5.6)	0.17 (2.0)
Bus Valued	0.70 (3.6)	0.07 (1.7)
Rail Valued	0.88 (5.1)	0.28 (8.4)

We had stated in our proposal that we would take a fresh look at how the GDP elasticity might have varied over time. However, we had overlooked that this had already been undertaken and reported in the Abrantes and Wardman (2011) paper. We report the relevant section:

> *"We tested whether the GDP elasticity was varying over time by specifying a function of the form:*
>
> $$\ln(VoT) = \alpha_1 \ln(GDP) + \alpha_2 T \ln(GDP)$$
>
> *where T is a time trend. α_2 was -0.01 with a t ratio of 0.7. We therefore conclude that the GDP elasticity is stable over time. Whilst it would be illuminating to examine the effect of specifying a disposable income index, no such consistent measure exists over the entire time period"*

Given that in the time period in question, time correlates well with amongst other things GDP, we take this result to mean that there is no variation in the GDP elasticity with the level of GDP. Of course, there could be counteracting effects operating over time that we are not here able to detect (eg, valuations could increase more or less than proportionately with income over time but fall as the comfort and productivity of travel time increase over time).

We also specified incremental dummy variable terms for each decade in the data set relative to the most recent decade and allowed these to interact with the GDP term to allow the GDP

elasticity to vary over time. This was done for the entire data set and no significant or indeed clearcut effects were apparent.

5. Updating the Meta-Data Set

As part of this study, we originally intended to extend our meta-analysis of values of time to cover evidence post 2008. Previous updates have led to significant increases in sample sizes, as is illustrated in Abrantes and Wardman (2011), and therefore we were hopeful that this might contribute to more precise GDP elasticity estimates.

Our attempt to identify further values of time evidence involved the flowing activities:

- Searching the major international journals for UK studies yielding value of time evidence;
- Examining the ETC proceedings since 2008. This has in the past been a good source of new evidence. In addition, we covered the IATBR 2012 conference, the WCTR 2010 conference and the annual UTSG conferences;
- Specific requests to academics and consultants with whom we are in regular contact;
- Inspecting the web-sites of leading University departments and consultants who are most likely to be involved in this sort of research;
- A direct appeal to a large number of transport consultancy companies, facilitated by the Department for Transport. This did not yield any studies we were not previously aware of;
- ATOC circulated an email to all PDFC members, but this did not yield anything;
- Approaching PTEG.

It turned out that we had been far too optimistic in the amount of fresh evidence that would be available, and with hindsight the recession will have been a contributory factor here.

We identified the 18 studies set out in Appendix 1, 3 of which are masters dissertations. Our view, and agreed by the Deartment, was that it was not worth committing the resource to reviewing these studies, inputting the values to the data set and conducting fresh analysis given that the impact on the precision with which the GDP elasticity was estimated would most likely have been negligible.

Whilst it would have been interesting to observe how valuations responded in times of economic downturn, the markets covered in fresh work might not have experienced the same adverse impacts as applied across the economy and this coupled with the small additional sample size would have meant that any results would have a considerable amount of uncertainty associated with them.

Nor would there have been sufficient observations per year to extend the work reported below, where we compare the official values with the values from the meta-data set for each year, to include post 2008 years. There would simply be too few values post 2008 to conduct meaningful analysis.

6. Comparing the Official Values

Previous work (Wheat et al., 2012) has developed confidence intervals for the official values of time. There is now therefore a profile of forecast central estimates based on the best evidence on GDP growth that contains 95% confidence interval surrounding them from the original year of estimation in 1994. These figures cover the Department's official commuting and other non-work values of time.

The Department is interested to examine how closely these official values and their confidence interval relate to values obtained from studies since 1994.

We ideally want to conduct this analysis on car values of time, since this forms the basis of the official values. However, this reduces the data set somewhat, and note we are only using the post 1994 values for non-work and for in-vehicle time. Also note that our data set contains a mix of modes used and modes valued. So whilst we have values of time for car from car users, we also have, say, values of time for rail from car users and values of car and bus time from car and bus users, as well as many other mixes. So focussing purely on car does restrict the number of observations available even from a data set as large as we have at our disposal.

We ideally want to make this comparison for commuting and other trips separately, but again sample size issues limit the opportunities for this, particularly when looking at individual modes. It is therefore necessary to pool the two to increase the robustness of the comparison.

Values of time vary by a number of factors, notably income and distance. We do not need to control for inter-temporal variation in income, since this will have already influenced the results for a particular year and the official values we compare against are based on the income levels relevant in that year. However, we need to control for distance insofar as in any year the average distances are somewhat different to those used to create the official values. Values might vary across studies due to cross-sectional variations in income and we return to this below.

We have used the distance elasticities ranging from 0.16 for non-car to 0.21 for car reported in the Abrantes and Wardman (2011) study to adjust for the distance effect in the meta-data. All values are 'normalised' to the 7.6 miles average distance that underpins the official values for commuting and other.

All values are expressed in 2010 prices in pence per minute and exclude values of time relating to business travel and years prior to 1994. We omit a few observations in excess of 30 pence per minute that we deem to be outliers. This reduces the overall commuting data by 9% and the overall other data by 5%.

We present below 8 sets of results that cover different modes, journey purposes and aggregation of the data:

- **Table 1:** This covers values of time for car, for both commuting and other purposes, and all values from relevant studies
- **Table 2**: Bus values of time are reported in this table, for both commuting and other purposes, and all values from relevant studies
- **Table 3**: This reports rail values of time, for both commuting and other purposes, and all values from relevant studies
- **Table 4**: This covers all modes but just for commuting trips
- **Table 5:** The values of time in this table are for other trips and all modes

- **Table 6:** This covers car values of time but an average is taken for each study rather than using each individual observation
- **Table 7:** This covers commuting trips for all modes and using an average value for each study
- **Table 8:** Values of time for other trips are here considered, with again an average value used per study.

Note that when we split by mode, we identify the value as relating to the mode user and the mode used. Thus a car value of time is from those studies which reported a value of time that related to car as a mode estimated to car users. The same applies to bus and rail. The journey purposes can then be commuting, other or a mix.

When we move to journey purpose segmentation, the values relate to either commuting or to other. However, they can relate to combinations of modes, such as car users valuing train time, or car and bus users valuing a combination of bus and train time.

For these reasons, the sample relating to mode and to purpose are not directly comparable; only a subset of observations apply to each.

Tables 1-5 are based on the total number of individual observations provided by studies whereas Tables 6-8 are based on each study providing only a single value which is the mean value where it yields more than one study.

The reason for using a single value per study is to avoid undue influence being placed on the outputs of a single study. In addition, pooling across observations in a study will tend to 'iron out' outlier effects.

We do not report simultaneous segmentations by mode and purpose since the number of observations becomes small, especially per year, and hence a greater degree of uncertainty surrounds the results. The bus and rail samples, for example, are small even without segmentation by journey purpose.

Note that where we combine values across purposes, as in Tables 1, 2, 3 and 6, we compare with the appraisal values for other. We should point out that using the commuting values would not materially alter the discussion since they are only 12% larger.

We control for journey distance as this was a strong and highly significant effect that emerged from the meta-analysis and because there is a large range of distances in our data set. It would be impractical to segment by distance bands since the resulting sample sizes would be too small.

Cross-sectional income variations might impact on values, although to some extent distance may be picking up income effects and we have accounted for this. We do not have study specific income levels but the Abrantes and Wardman (2011) meta-analysis did proxy for such by regional and geographic effects. No variations were found between rural, urban, and metropolitan values, with the exception that values for London and the South East were 27% higher. It turned out though that amongst the car values of time, the 18 (16%) observations for London and the South East averaged 9.4 pence per minute, only slightly larger than the 9.18 pence per minute for elsewhere. Whilst strong effects were detected from internet and phone data collection methods on values in the reported meta-model, the car values examined here contain just 9 (7%) that were obtained using the phone method and none from the internet. When we omit three as outlier values over 30 pence per minute, which we do in our subsequent investigations of the meta data, the remaining 6 observations are in the range 8 to 12 pence per minute. . Similarly, RP values in the meta-model were around 20% larger but relate to only 1 post 1994 value for car travel. We therefore feel that these variables do not have a large distortionary effect on the values.

Each set of results contains a table and associated graph. The tables distinguish the values from the meta data and the official values of time for each year between 1994 and 2008. For the official values, the figures reported represent the central estimate, the standard deviation of the central estimate and the lower (LCI) and upper (UCI) points on the 95% confidence interval. The summary statistics for the meta-data are the mean, standard deviation, standard deviation of the mean, the number of observations, the three year moving average and the upper and lower bounds of the 90% confidence interval. The three year moving average is calculated as the average of the observations in the three year period, as opposed to the average of the mean values for each year. An undesirable property of the latter would be that, given it gives equal weight to each year, a year with few values which were small or large would have undue influence on the moving average.

The graphs present the official value of time and LCI and UCI points on the 95% confidence interval, the actual values from the meta data along with the LCI and UCI points on the 90% confidence interval, the three year moving average and the function from regression the value on year. We have used a slightly lower level of significance for the meta-data given the generally small number of observations per year.

For the meta values of time, the standard error is generated as the square root of the estimate of the variance divided by the square root of the sample size. In generating an estimate of the variance, we chose not to do this using the standard deviation of each year because of small samples. Instead a heteroscedastic variance across years (but varying mean) is assumed so that we can pool estimates over years. This is a much more sensible way to do this than computing based on individual year standard deviations because odd results can otherwise arise, such as those years with very few observations getting a very small standard deviation estimate which yields significant differences with the estimated value of time for appraisal. Clearly this is undesirable.

The final piece of information in the table is a t test of the difference between the mean of the meta values and the central official appraisal value for each year. We do though counsel caution with this test statistic because one set of 'data' is an estimator evaluated at different GDP levels (the appraisal values) while the other data is a sample of values.

The values from the meta-data themselves have uncertainty around them since they are estimates from studies but we do not have the information for each observation that is needed to construct an error for the mean of these data.

Secondly, even if we take the individual meta values to be fixed, and therefore ignore any uncertainty in their estimation, we have the further issue that these data (or at least a sub-set of these data) are precisely the data which form the basis for the GDP elasticity estimate in the appraisal estimates. Thus when we compare the estimator of the mean of the meta data with the central value of time they are to a degree correlated (to a degree we do not know).

We are implicitly assuming independence of the mean and the appraisal estimate in conducting the t test and it is expected to struggle to detect significant differences because of the small sample sizes in some cases.

When interpreting the results presented in the tables we focus on two elements; the difference between the appraisal values and the meta data early in the series that commences in 1994, as this is when the data underlying appraisal values were collected (Hague Consulting Group et al., 1999), and the difference in how they have changed over time.
We report a large number of results here but the focus should be on Tables 6-8, as these control for studies producing multiple estimates. Of these, Table 6 is particularly important as it relates to car values, upon which the appraisal values are based.

Turning to the results in the tables below, we start with the car values in Table 1 since it is car values upon which official recommendations are based. The values of time exhibit, as might

have been expected, quite large spreads around the official values[2]. The central appraisal value in 1994 is greater than the mean of the meta-data in that year, but only by 16% and the difference is not significant at the 10% level, whilst it is only 3% larger than the moving average. The only year where the mean of the meta-data values appreciably exceeds the central appraisal value is for the large single value in 2005[3], although because it is only a single observation it cannot have a large impact on the moving average.

As for the trend, with the exception of the final year the moving average is clearly less than the appraisal central value and does not appear to be showing a trend increase. The regression trend is essentially flat and indicates divergence between the official and meta values over time. However, it should be noted that this sample includes multiple values from single studies which may be distorting the results.

Moving to the bus only evidence in Tables 2, it is very clear that the bus values are somewhat lower than official values. There are few observations early in the period but the mean meta value is significantly lower than the central appraisal value in nearly every year. The differences are striking and not altogether unexpected given that bus users have relatively low incomes yet the appraisal values are equity values. However, the trend shows the values are increasing over time, and at a faster rate than the official values. In contrast, rail users are relatively affluent, and the evidence in Table 3, both in terms of the appraisal value in 1994 and the trends, shows that the meta-data more closely reflect current recommendations, although with many of the observations lying outside the upper and lower bounds. The mean value in 1994 is not significantly different from the central appraisal value and the regression trend closely matches the central appraisal values.

Table 4 presents results for all commuters and the mean meta values are lower than the appraisal values early in the period, with a significant difference in 1996 and not far removed in 1994, 1995 and 1997. These lower values are maintained virtually throughout. However, the trend implied by the regression closely corresponds with that apparent in official values. The pattern of results is similar for the other values in Table 5 although with a greater degree of statistical significance in the differences between the meta values and the appraisal values.

The results in Tables 6-8 use an average value per study, rather than all the observations provided by each study. The aim of this is to avoid undue influence being placed on the outputs of a single study and also because taking averages might be expected to reduce the amount of randomness in the presented evidence. The mean car value in Table 6 is below the appraisal value in 1994, but not significantly so at the 10% level. The difference would be larger against the commuting appraisal values but still not significantly different. As in Table 1 the moving average essentially demonstrates little growth up to 2003 but is then a little higher for the remaining years.

The results are clouded by a large amount of variation in values across studies and some quite large variations over time in values that are not easy to explain. Given the small sample sizes in some years, the occurrence of just one study yielding atypically large or small values, even for genuine reasons, will distort the results.

There is a reasonable degree of correspondence between the regression trend and the central appraisal value. However, this correspondence should be treated with some caution as the goodness of fit of the regression is poor, reflecting the considerable amount of noise in the

[2] Some of the factors influencing this spread might be expected to be discerned by study specific dummy variables in the meta-analysis. It would have been interesting to explore the extent to which such effects reduced the spread but unfortunately they were not contained in the reported model.

[3] There were no features of this study, such as an RP study in the South East or using a phone based method of presenting the SP, that from the meta-analysis would explain such a high value.

data, and trend growth would be lower than the appraisal values, but still positive, if the single, large observation in 2005 were excluded.

What seems to be clear in Table 7, which focuses on commuting, is that the moving average and the regression trend are indicating an increase in the value of time over time and at a faster rate than the appraisal values. However, because the mean, moving average and trend are substantially below the 1994 appraisal value the mean values tend to be less than the appraisal with significant differences at the 10% level in 1996, 1997, 1999, 2003 and 2006. These results are consistent with the larger GDP elasticity of 1.06 in the meta-analysis, as reported above, which implies stronger growth in commuting values than would be apparent with the currently used 0.8 GDP elasticity. We note however that driving conditions have deteriorated over time with increased congestion in commuting periods and this might have exerted an upward pressure on the value of time.

Table 8 covers other valuations. The trend seems to follow the central appraisal value. However, as in Table 7, because the meta values are below the appraisal values in 1994, despite the similarity in trends in all but two cases the mean meta values are less than official values and around a half are significantly different at the 10% level.

Table 1: Car Values Compared with Appraisal Values for Other

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mean	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	8.1285	7.25125	1.25042	1.1111714	8	5.423373	9.079127	8.390026	0.349946	7.704146	9.075907	-0.9775	0.24741
1995	7.6464	8.71333	4.64011	0.90726765	12	7.220878	10.20579	8.574962	0.359722	7.86992	9.280004	0.14178	0.39495
1996	7.780909	5.718	1.13072	1.405533	5	3.405898	8.030102	8.755554	0.373184	8.024126	9.486982	-2.0888	0.04503
1997	5.975385	7.606	2.68618	1.405533	5	5.293898	9.918102	8.967967	0.393729	8.196272	9.739662	-0.9331	0.25814
1998	7.800769	3.68667	0.73664	1.8145353	3	0.701756	6.671577	9.205486	0.422242	8.377907	10.03307	-2.9623	0.00496
1999	9.023478	10.464	7.9308	1.405533	5	8.151898	12.7761	9.433382	0.454498	8.542582	10.32418	0.69769	0.31276
2000	9.298333	9.61067	2.93605	0.81148486	15	8.275774	10.94556	9.701035	0.497699	8.725562	10.67651	-0.0949	0.39715
2001	8.984545	6.67	1.32893	1.57143367	4	4.084992	9.255008	9.861186	0.525954	8.830336	10.89204	-1.9257	0.06246
2002	7.211111	8.94	2.83343	1.8145353	3	5.955089	11.92491	9.99801	0.551364	8.917357	11.07866	-0.5579	0.34145
2003	7.886	5.7	1.95161	2.22234281	2	2.044246	9.355754	10.24679	0.600263	9.070297	11.42328	-1.9752	0.05672
2004	10.05875	8.128	1.86285	1.405533	5	5.815898	10.4401	10.44796	0.642084	9.189496	11.70642	-1.5013	0.12926
2005	7.221739	28.43	0	3.14286734	1	23.25998	33.60002	10.56648	0.667585	9.258035	11.87492	5.55979	0.00000
2006	7.751304	6.57825	2.10095	0.49693096	40	5.760799	7.395701	10.73689	0.705285	9.354557	12.11922	-4.8201	0.00000
2007	7.617551	13	6.80935	1.405533	5	10.6879	15.3121	10.97502	0.759846	9.485751	12.46429	1.26737	0.17870
2008	12.23667	11.2825	3.01595	1.57143367	4	8.697492	13.86751	10.81934	0.723937	9.400448	12.23823	0.2677	0.38490

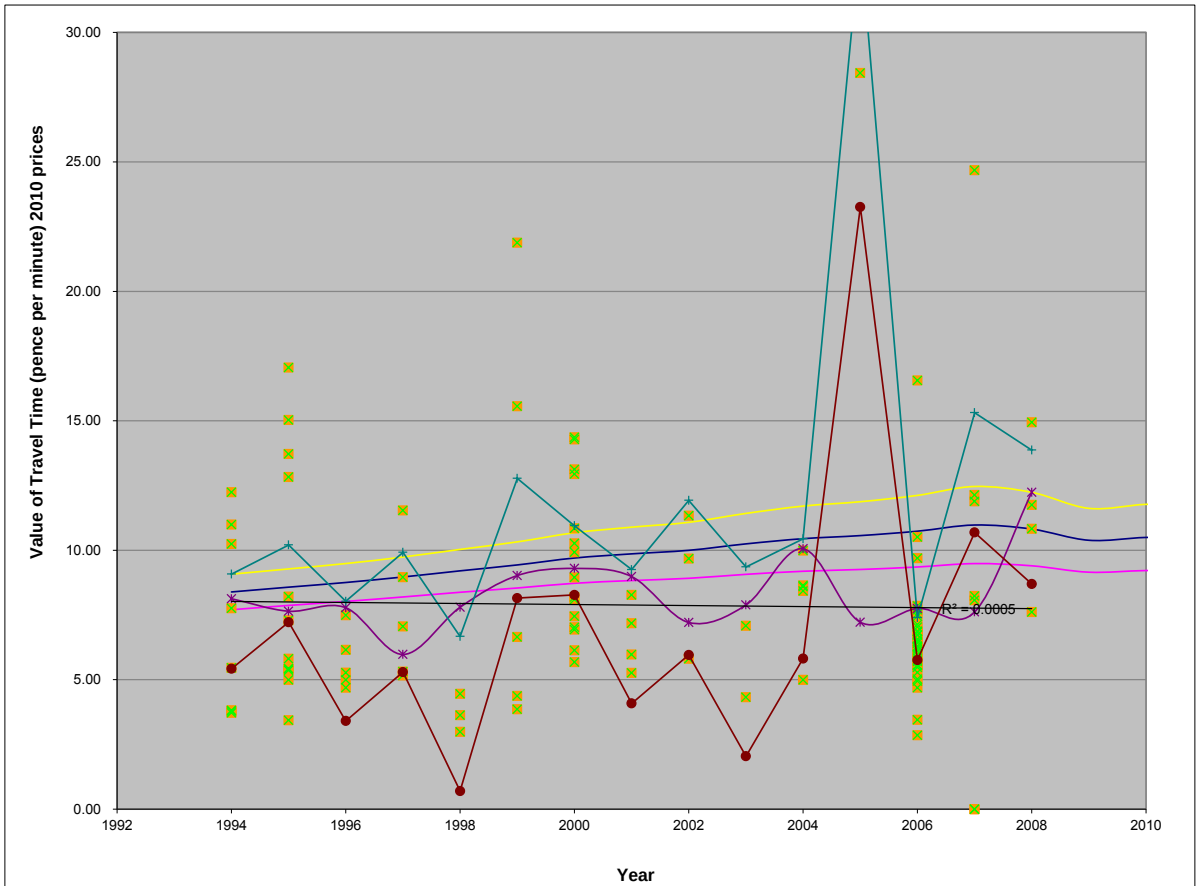


Table 2: Bus Values Compared with Appraisal Values for Other

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mea	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	1.91				0			8.390026	0.349946	7.704146	9.075907		
1995	4.685	1.91	0	1.57037	1	-0.67326	4.493259	8.574962	0.359722	7.86992	9.280004	-4.137	0.00008
1996	3.178333	7.46	0	1.57037	1	4.876741	10.04326	8.755554	0.373184	8.024126	9.486982	-0.8026	0.28908
1997	3.157143	2.425	1.08703	0.785185	4	1.133371	3.716629	8.967967	0.393729	8.196272	9.739662	-7.449	0.00000
1998	3.927857	2.47	0.29698	1.110419	2	0.64336	4.29664	9.205486	0.422242	8.377907	10.03307	-5.6697	0.00000
1999	4.539091	5.04375	2.95027	0.55521	8	4.13043	5.95707	9.433382	0.454498	8.542582	10.32418	-6.1178	0.00000
2000	4.013	4.64	0	1.57037	1	2.056741	7.223259	9.701035	0.497699	8.725562	10.67651	-3.0722	0.00356
2001	3.175	3.20636	1.43794	0.473484	11	2.427482	3.985245	9.861186	0.525954	8.830336	10.89204	-9.4037	0.00000
2002	3.232353	2.27	1.30108	1.110419	2	0.44336	4.09664	9.99801	0.551364	8.917357	11.07866	-6.2334	0.00000
2003	3.747143	3.785	0.68627	0.785185	4	2.493371	5.076629	10.24679	0.600263	9.070297	11.42328	-6.538	0.00000
2004	4.66	6.55	0	1.57037	1	3.966741	9.133259	10.44796	0.642084	9.189496	11.70642	-2.2976	0.02849
2005	5.6625	5.465	2.55266	1.110419	2	3.63836	7.29164	10.56648	0.667585	9.258035	11.87492	-3.9374	0.00017
2006	5.366667	5.17	0	1.57037	1	2.586741	7.753259	10.73689	0.705285	9.354557	12.11922	-3.2338	0.00214
2007	8.3775							10.97502	0.759846	9.485751	12.46429		
2008	9.446667	9.44667	1.76755	0.906654	3	7.955221	10.93811	10.81934	0.723937	9.400448	12.23823	-1.1831	0.19813

Figure 2: Bus Values Compared with Appraisal Values for Other

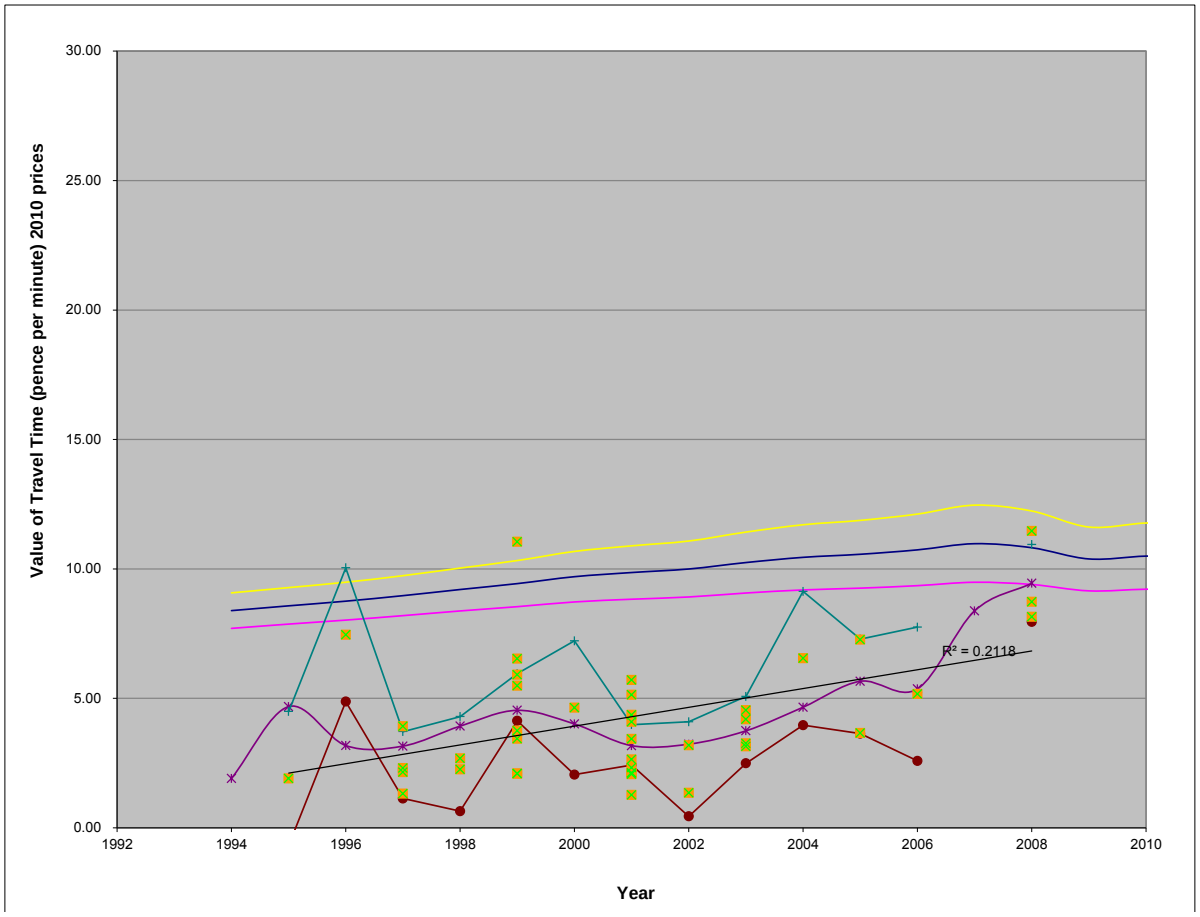


Table 3: Rail Values Compared with Appraisal Values for Other

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mean	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	10.1	9.8375	2.97663	2.264368	4	6.112615	13.56239	8.390026	0.349946	7.704146	9.075907	0.63174	0.32677
1995	8.332857	11.15	0	4.52873601	1	3.700229	18.59977	8.574962	0.359722	7.86992	9.280004	0.56681	0.33974
1996	6.938571	3.915	1.11016	3.20229994	2	-1.35278	9.182783	8.755554	0.373184	8.024126	9.486982	-1.5014	0.12924
1997	7.465455	7.3975	3.51134	2.264368	4	3.672615	11.12239	8.967967	0.393729	8.196272	9.739662	-0.6833	0.31588
1998	7.752	8.94	5.58779	2.02531231	5	5.608361	12.27164	9.205486	0.422242	8.377907	10.03307	-0.1283	0.39567
1999	11.16158	3.23	0	4.52873601	1	-4.21977	10.67977	9.433382	0.454498	8.542582	10.32418	-1.3629	0.15759
2000	10.98125	12.6262	6.41433	1.25604538	13	10.55996	14.69235	9.701035	0.497699	8.725562	10.67651	2.16506	0.03829
2001	11.21875	4.165	0.09192	3.20229994	2	-1.10278	9.432783	9.861186	0.525954	8.830336	10.89204	-1.7553	0.08549
2002	4.448	7.03	0	4.52873601	1	-0.41977	14.47977	9.99801	0.551364	8.917357	11.07866	-0.6506	0.32285
2003	9.085	3.44	0.41012	3.20229994	2	-1.82778	8.707783	10.24679	0.600263	9.070297	11.42328	-2.0892	0.04499
2004	9.496	13.5333	8.46234	2.61466695	3	9.232206	17.83446	10.44796	0.642084	9.189496	11.70642	1.14598	0.20689
2005	12.09												
2006	12.196	10.6467	5.44851	2.61466695	3	6.34554	14.94779	10.73689	0.705285	9.354557	12.11922	-0.0333	0.39872
2007	10.87286	12.86	3.24838	1.71170132	7	10.04425	15.67575	10.97502	0.759846	9.485751	12.46429	1.00652	0.24039
2008	10.93455	7.565	3.52354	2.264368	4	3.840115	11.28989	10.81934	0.723937	9.400448	12.23823	-1.3689	0.15631

Figure 3: Rail Values Compared with Appraisal Values for Other

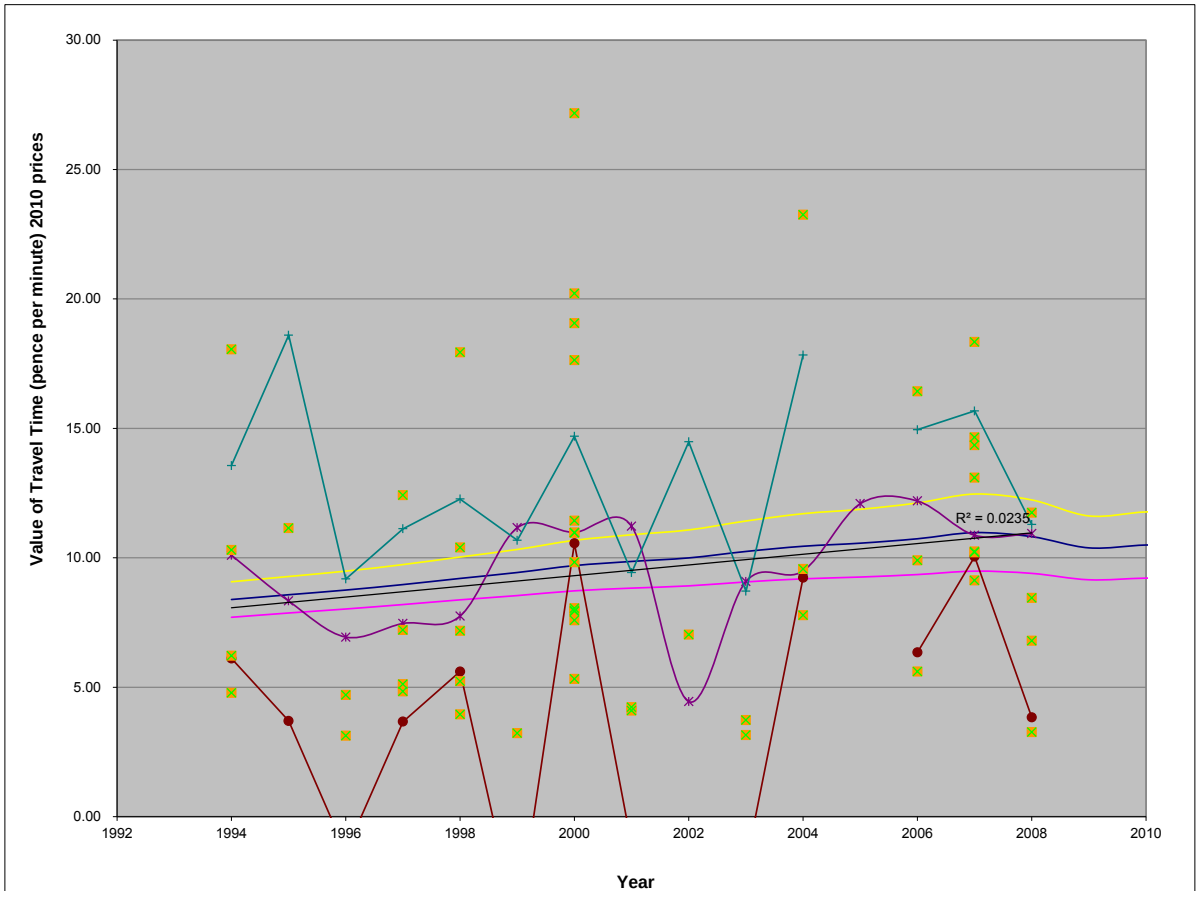


Table 4: All Modes Commuting Compared with Appraisal Values for Commuting

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mean	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	7.331875	7.34727	1.09957	1.26063122	11	5.273534	9.421011	9.389266	0.53066	8.349191	10.42934	-1.4929	0.13089
1995	6.838276	7.298	1.30019	1.86981827	5	4.222149	10.37385	9.596227	0.544063	8.529884	10.66257	-1.1802	0.19882
1996	6.762917	6.23077	0.70421	1.15961206	13	4.323207	8.138331	9.798328	0.560413	8.699938	10.89672	-2.77	0.00861
1997	7.290741	7.47	1.37036	1.70690274	6	4.662145	10.27786	10.03604	0.583655	8.892095	11.17998	-1.4225	0.14505
1998	7.206897	8.87875	2.01264	1.47822114	8	6.447076	11.31042	10.30185	0.614536	9.097379	11.50631	-0.889	0.26873
1999	7.904286	6.21	0.7922	1.07954008	15	4.434157	7.985843	10.55688	0.648699	9.285459	11.82831	-3.4514	0.00103
2000	7.187209	9.3725	1.34518	1.2069625	12	7.387047	11.35795	10.85641	0.694015	9.496169	12.21666	-1.0658	0.22607
2001	7.425667	6.46438	1.28009	1.04526019	16	4.744922	8.183828	11.03564	0.723593	9.617423	12.45385	-3.5958	0.00062
2002	5.5432	3.435	0.245	2.95644227	2	-1.42835	8.298348	11.18876	0.750213	9.718367	12.65915	-2.5421	0.01576
2003	6.363077	4.04	0.59665	1.58028487	7	1.440431	6.639569	11.46717	0.801574	9.896113	13.03823	-4.1915	0.00006
2004	6.926667	11.8925	3.85576	2.09052038	4	8.453594	15.33141	11.69229	0.845679	10.03479	13.34979	0.08878	0.39737
2005	8.783333	7.27	0	4.18104076	1	0.392188	14.14781	11.82493	0.872662	10.11454	13.53532	-1.0664	0.22592
2006	12.56727	6.0525	0.54264	2.09052038	4	2.613594	9.491406	12.01564	0.912672	10.22683	13.80444	-2.6142	0.01309
2007	12.06391	17.7933	3.16621	1.70690274	6	14.98548	20.60119	12.28213	0.970826	10.37935	14.18492	2.80658	0.00777
2008	13.32947	11.2692	1.52155	1.15961206	13	9.361669	13.17679	12.10791	0.93252	10.2802	13.93561	-0.5636	0.34036

Figure 4: All Modes Commuting Compared with Appraisal Values for Commuting

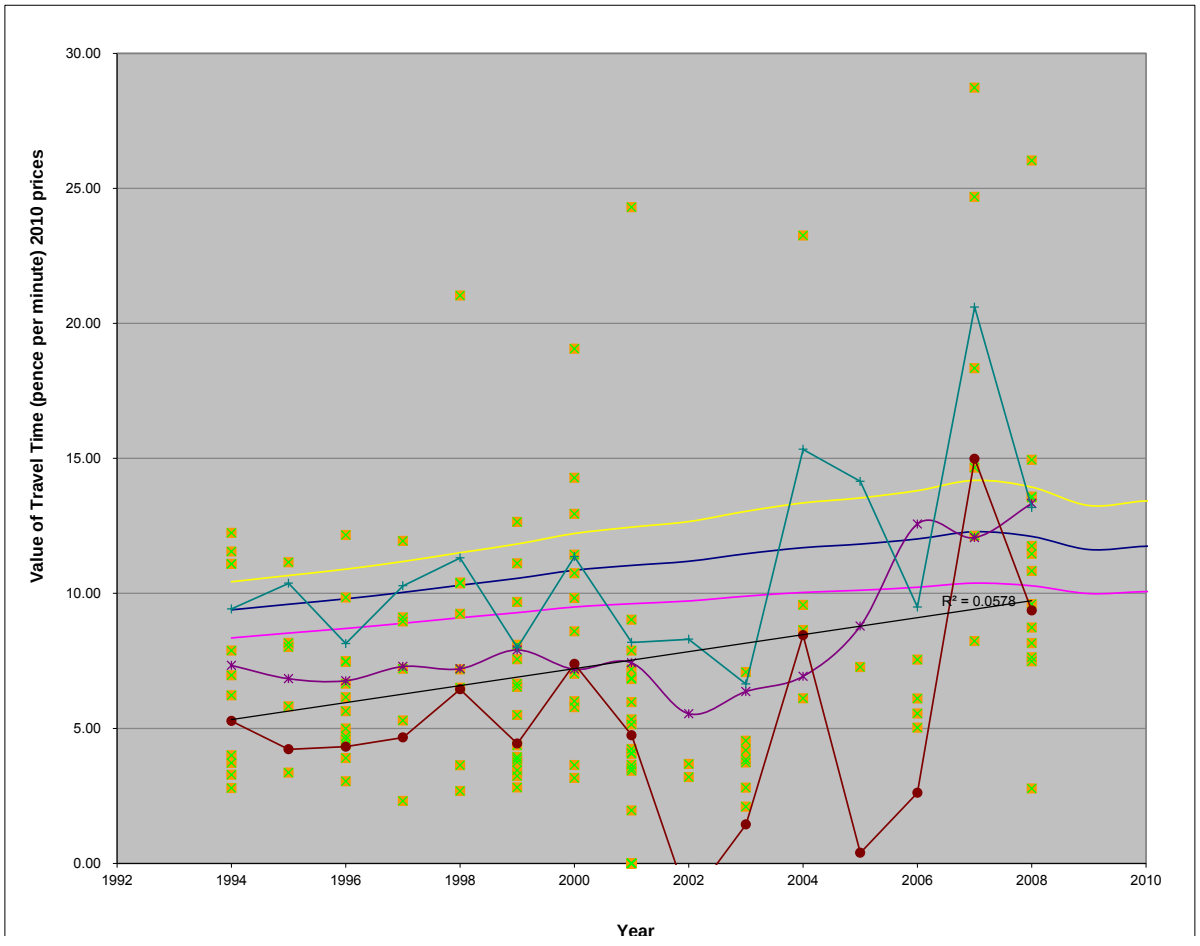


Table 5: All Modes Other Compared with Appraisal Values for Other

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mea	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	7.476207	7.28235	0.97309	1.016925	17	5.609511	8.955195	8.390026	0.349946	7.704146	9.075907	-1.03	0.23472
1995	7.019149	7.75083	3.46016	1.210383	12	5.759753	9.741914	8.574962	0.359722	7.86992	9.280004	-0.6527	0.32241
1996	6.558421	6.28278	3.37261	0.988274	18	4.657067	7.908488	8.755554	0.373184	8.024126	9.486982	-2.3408	0.02577
1997	6.125588	5.39	3.74892	1.482411	8	2.951434	7.828566	8.967967	0.393729	8.196272	9.739662	-2.3327	0.02626
1998	6.744643	6.5075	5.01607	1.482411	8	4.068934	8.946066	9.205486	0.422242	8.377907	10.03307	-1.7504	0.08622
1999	7.814634	7.80583	5.95266	1.210383	12	5.814753	9.796914	9.433382	0.454498	8.542582	10.32418	-1.2588	0.18064
2000	7.745532	8.31762	4.74773	0.914964	21	6.812504	9.822735	9.701035	0.497699	8.725562	10.67651	-1.3282	0.16513
2001	7.412895	6.83571	4.77593	1.120597	14	4.992332	8.679097	9.861186	0.525954	8.830336	10.89204	-2.4441	0.02013
2002	5.641304	3.77333	2.93026	2.420767	3	-0.20883	7.755495	9.99801	0.551364	8.917357	11.07866	-2.5072	0.01722
2003	5.288235	3.78833	1.65291	1.711741	6	0.97252	6.604147	10.24679	0.600263	9.070297	11.42328	-3.5605	0.00070
2004	6.884118	6.98125	2.43521	1.482411	8	4.542684	9.419816	10.44796	0.642084	9.189496	11.70642	-2.1459	0.03990
2005	7.596667	12.8167	13.5888	2.420767	3	8.834505	16.79883	10.56648	0.667585	9.258035	11.87492	0.89609	0.26702
2006	9.594167	4.9125	1.39467	2.096445	4	1.463847	8.361153	10.73689	0.705285	9.354557	12.11922	-2.6332	0.01245
2007	9.165	11.406	2.20833	1.875118	5	8.321431	14.49057	10.97502	0.759846	9.485751	12.46429	0.21302	0.38999
2008	12	14.97	0	4.192891	1	8.072694	21.86731	10.81934	0.723937	9.400448	12.23823	0.97549	0.24790

Figure 5: All Modes Other Compared with Appraisal Values for Other

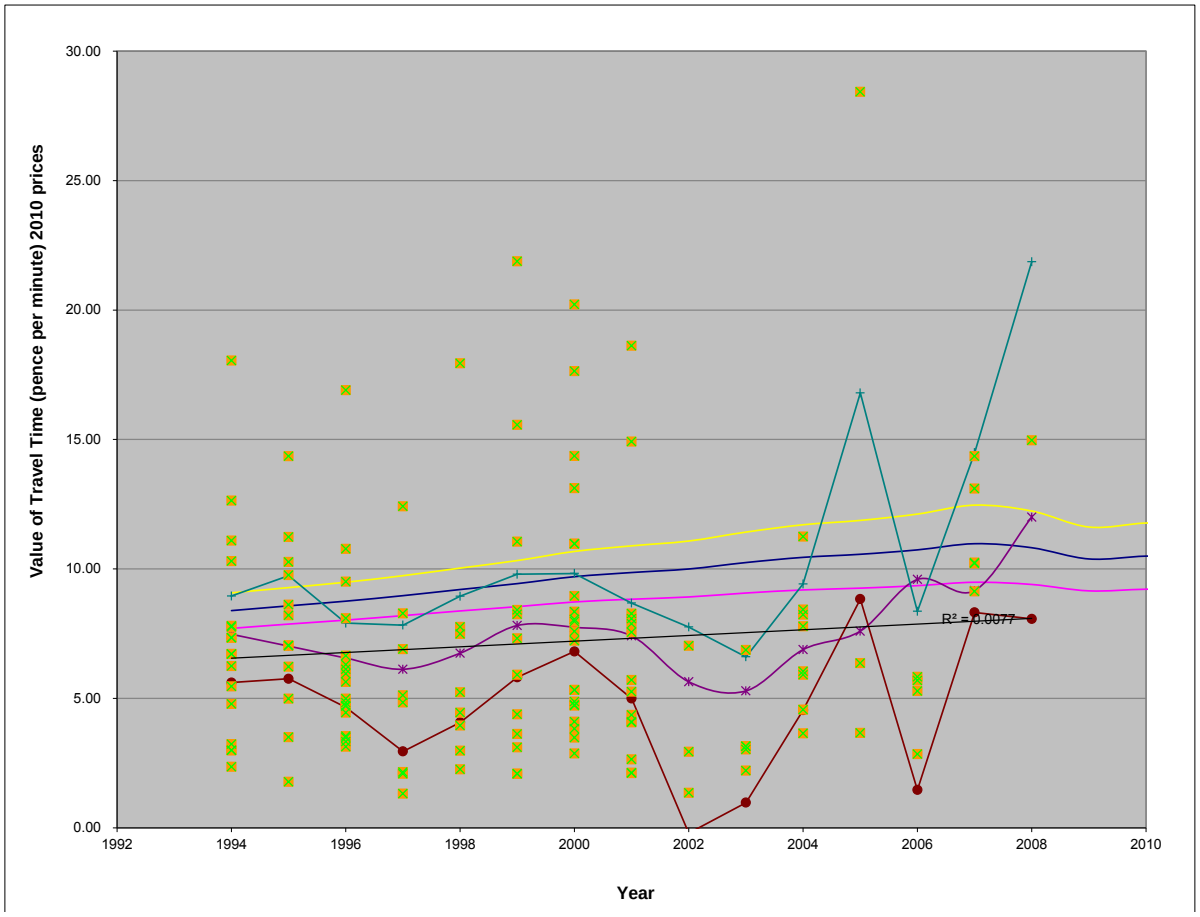


Table 6: Car Values (Average per Study) Compared with Appraisal Values for Other

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mea	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	8.268333	7.37667	1.3858	1.103066	6	5.562123	9.19121	8.390026	0.349946	7.704146	9.075907	-0.8757	0.27190
1995	7.999286	9.16	4.44365	1.103066	6	7.345457	10.97454	8.574962	0.359722	7.86992	9.280004	0.50424	0.35132
1996	8.3775	6.385	1.56271	1.910566	2	3.242119	9.527881	8.755554	0.373184	8.024126	9.486982	-1.2177	0.19006
1997	7.037143	8.2	2.69533	1.350974	4	5.977647	10.42235	8.967967	0.393729	8.196272	9.739662	-0.5457	0.34374
1998	7.901429	3.69	0	2.701948	1	-0.75471	8.134705	9.205486	0.422242	8.377907	10.03307	-2.0168	0.05220
1999	8.492	9.41	7.48119	1.910566	2	6.267119	12.55288	9.433382	0.454498	8.542582	10.32418	-0.0119	0.39891
2000	9.088	9.975	2.55266	1.910566	2	6.832119	13.11788	9.701035	0.497699	8.725562	10.67651	0.13876	0.39512
2001	8.588	6.67	0	2.701948	1	2.225295	11.11471	9.861186	0.525954	8.830336	10.89204	-1.1593	0.20373
2002	7.1725	8.16	3.3234	1.910566	2	5.017119	11.30288	9.99801	0.551364	8.917357	11.07866	-0.9243	0.26025
2003	7.684	5.7	0	2.701948	1	1.255295	10.14471	10.24679	0.600263	9.070297	11.42328	-1.6427	0.10350
2004	12.6325	8.2	0.48083	1.910566	2	5.057119	11.34288	10.44796	0.642084	9.189496	11.70642	-1.1153	0.21419
2005	10.67667	28.43	0	2.701948	1	23.98529	32.87471	10.56648	0.667585	9.258035	11.87492	6.41834	0.00000
2006	12.132	6.41	0.41243	1.559971	3	3.843848	8.976152	10.73689	0.705285	9.354557	12.11922	-2.5274	0.01636
2007	9.211429	13	0	2.701948	1	8.555295	17.44471	10.97502	0.759846	9.485751	12.46429	0.72147	0.30753
2008	11.3125	10.75	2.77842	1.559971	3	8.183848	13.31615	10.81934	0.723937	9.400448	12.23823	-0.0403	0.39862

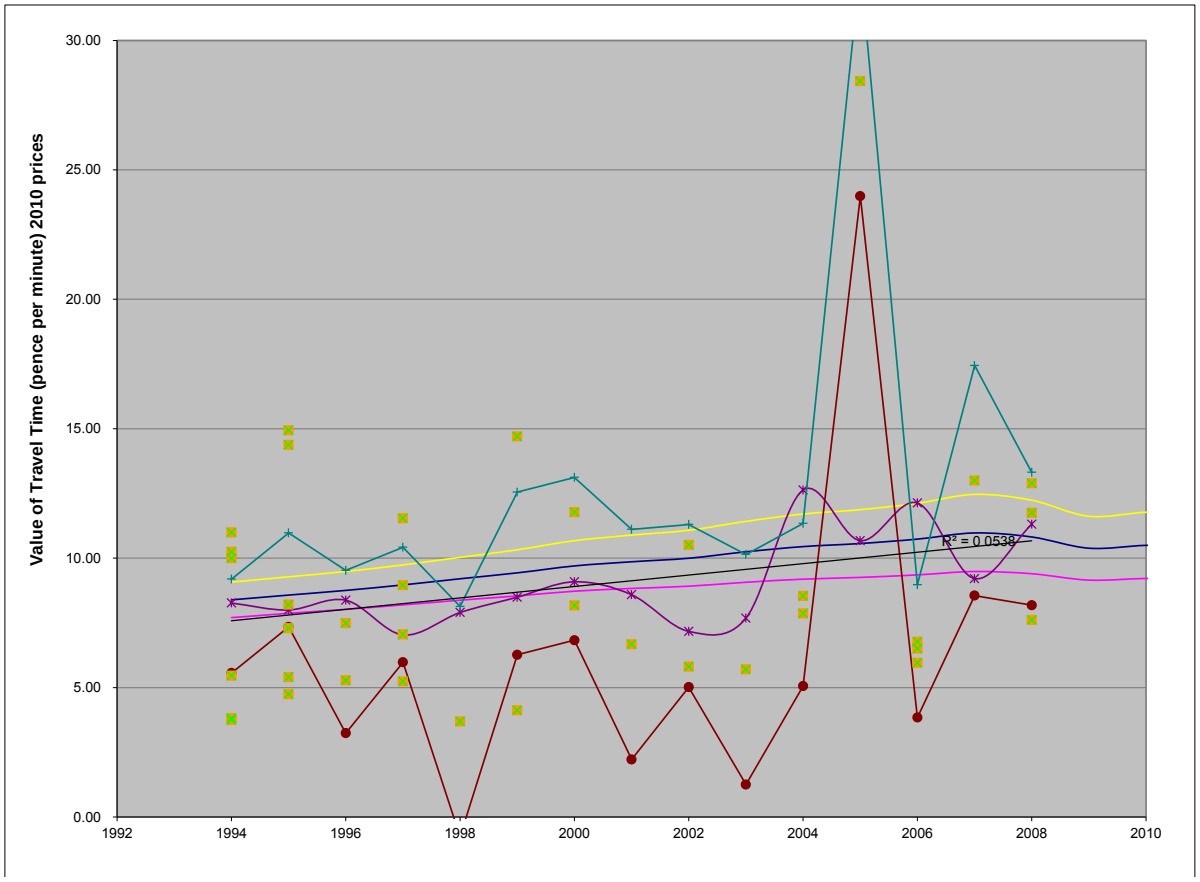


Table 7: All Modes Commuting (Average per Study)

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mean	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	6.813333	7.17333	1.52851	1.62772378	6	4.495728	9.850939	9.389266	0.53066	8.349191	10.42934	-1.2943	0.17264
1995	6.078235	6.09333	1.66592	2.30194904	3	2.306627	9.88004	9.596227	0.544063	8.529884	10.66257	-1.4809	0.13326
1996	5.911875	5.25125	0.54587	1.40965014	8	2.932376	7.570124	9.798328	0.560413	8.699938	10.89672	-2.9975	0.00447
1997	6.685789	6.86	1.43473	1.78308206	5	3.92683	9.79317	10.03604	0.583655	8.892095	11.17998	-1.6928	0.09520
1998	7.14	8.45333	1.79595	1.62772378	6	5.775728	11.13094	10.30185	0.614536	9.097379	11.50631	-1.0624	0.22688
1999	8.253125	5.844	0.63697	1.78308206	5	2.91083	8.77717	10.55688	0.648699	9.285459	11.82831	-2.4838	0.01825
2000	8.520769	10.422	2.29181	1.78308206	5	7.48883	13.35517	10.85641	0.694015	9.496169	12.21666	-0.227	0.38879
2001	9.737	9.81333	3.25196	2.30194904	3	6.026627	13.60004	11.03564	0.723593	9.617423	12.45385	-0.5066	0.35091
2002	7.66	7.91	4.47	2.81930028	2	3.272251	12.54775	11.18876	0.750213	9.718367	12.65915	-1.1239	0.21215
2003	8.96875	4.18	0.97	2.81930028	2	-0.45775	8.817749	11.46717	0.801574	9.896113	13.03823	-2.4862	0.01814
2004	9.028571	11.8925	3.85576	1.99354635	4	8.613116	15.17188	11.69229	0.845679	10.03479	13.34979	0.09245	0.39724
2005	9.564286	7.27	0	3.9870927	1	0.711233	13.82877	11.82493	0.872662	10.11454	13.53532	-1.116	0.21402
2006	11.582	6.055	0.495	2.81930028	2	1.417251	10.69275	12.01564	0.912672	10.22683	13.80444	-2.0115	0.05276
2007	12.64667	19.265	2.765	2.81930028	2	14.62725	23.90275	12.28213	0.970826	10.37935	14.18492	2.34185	0.02570
2008	14.53	12.636	3.76773	1.78308206	5	9.70283	15.56917	12.10791	0.93252	10.2802	13.93561	0.26245	0.38544

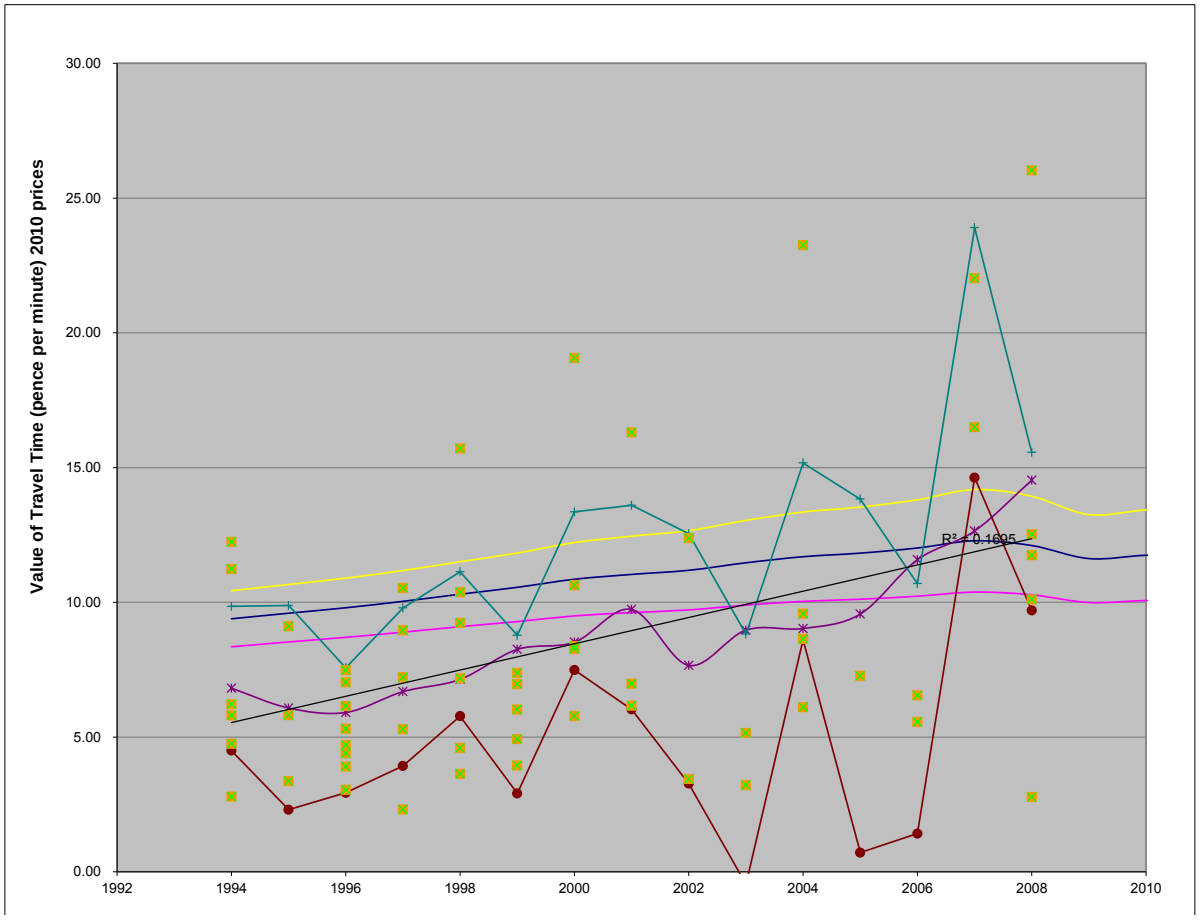
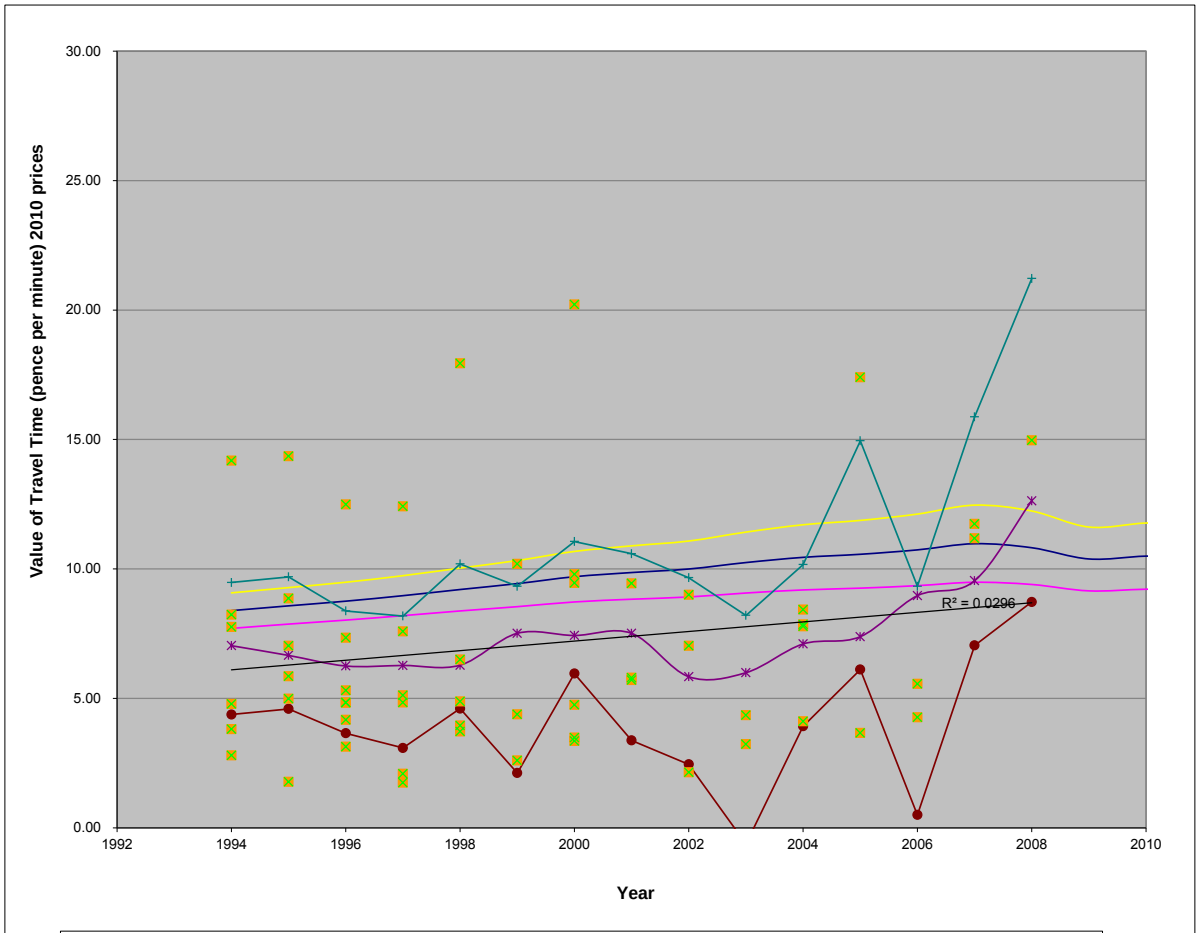


Table 8: All Modes Other (Average per Study)

Year	Meta Data							Appraisal VTTS					
	3YR MA	mean	stdev	StErr mea	nobs	LCI	UCI	Central	StErr	LCI	UCI	t-stat	p-val
1994	7.035	6.92667	1.69662	1.549904	6	4.377074	9.47626	8.390026	0.349946	7.704146	9.075907	-0.921	0.26105
1995	6.659474	7.14333	4.24195	1.549904	6	4.59374	9.692926	8.574962	0.359722	7.86992	9.280004	-0.8998	0.26614
1996	6.251053	6.01571	3.12758	1.434933	7	3.65525	8.376179	8.755554	0.373184	8.024126	9.486982	-1.8479	0.07234
1997	6.272222	5.63333	3.96216	1.549904	6	3.08374	8.182926	8.967967	0.393729	8.196272	9.739662	-2.0853	0.04536
1998	6.282857	7.398	5.99368	1.697835	5	4.605061	10.19094	9.205486	0.422242	8.377907	10.03307	-1.0331	0.23396
1999	7.514286	5.72333	3.96931	2.191896	3	2.117665	9.329002	9.433382	0.454498	8.542582	10.32418	-1.6574	0.10103
2000	7.43	8.50667	6.41085	1.549904	6	5.957074	11.05626	9.701035	0.497699	8.725562	10.67651	-0.7337	0.30480
2001	7.513333	6.98333	2.12801	2.191896	3	3.377665	10.589	9.861186	0.525954	8.830336	10.89204	-1.2767	0.17659
2002	5.8375	6.05667	3.53206	2.191896	3	2.450998	9.662335	9.99801	0.551364	8.917357	11.07866	-1.7438	0.08721
2003	5.992222	3.79	0.79196	2.684513	2	-0.62602	8.206024	10.24679	0.600263	9.070297	11.42328	-2.3472	0.02538
2004	7.1025	7.045	1.97795	1.898238	4	3.922399	10.1676	10.44796	0.642084	9.189496	11.70642	-1.6982	0.09434
2005	7.38375	10.53	9.71565	2.684513	2	6.113976	14.94602	10.56648	0.667585	9.258035	11.87492	-0.0132	0.39891
2006	8.968333	4.915	0.91217	2.684513	2	0.498976	9.331024	10.73689	0.705285	9.354557	12.11922	-2.0975	0.04421
2007	9.544	11.46	0.39598	2.684513	2	7.043976	15.87602	10.97502	0.759846	9.485751	12.46429	0.17383	0.39296
2008	12.63	14.97	0	3.796475	1	8.724798	21.2152	10.81934	0.723937	9.400448	12.23823	1.07394	0.22411

Figure 8: All Modes Other (Average per Study)



The final piece of analysis is that we compare the official appraisal values for each year with the values that are implied by the meta-model in Abrantes and Wardman (2011). These are reported in Table 9 for commuting and Table 10 for other trips.

We report four sets of implied values from the meta model, all of which relate to car. Two sets of values are RP based, distinguishing London and South East (LSE) and elsewhere. The other two sets are based on SP data for the same two regional segments. The motivation behind this is it highlights the potential impact of RP data and higher incomes in the South East, as detected in the meta-model, and brings its wider set of meta-data to bear on comparisons.

The results are little different between commuting and other. What they indicate is that there is a very close degree of correspondence, both in absolute values and trend, between the official values and the average of the RP values. Indeed, the Non LSE values where incomes are lower are closely associated with the lower bound of the official values whereas the LSE values where incomes are higher closely follow the upper bound of the official values. All in all, the degree of correspondence between the official values and meta-analysis RP based values is striking.

The same cannot be said with regard to the meta-analysis values implied by SP data which are somewhat lower than official values. This is in line with the results presented above which are dominated by SP evidence.

Table 9: Official Values for Commuting and Commuting Values Implied by Meta Model (Car)

Year	Appraisal Values: Commuting				RP Non LSE	RP LSE	SP Non LSE	SP LSE
	Central	Std Err	LCI	UCI				
1994	9.39	0.53	8.35	10.43	8.02	10.21	5.67	7.22
1995	9.60	0.54	8.53	10.66	8.22	10.47	5.81	7.40
1996	9.80	0.56	8.70	10.90	8.41	10.71	5.95	7.58
1997	10.04	0.58	8.89	11.18	8.64	11.01	6.11	7.78
1998	10.30	0.61	9.10	11.51	8.90	11.34	6.29	8.02
1999	10.56	0.65	9.29	11.83	9.15	11.65	6.47	8.24
2000	10.86	0.69	9.50	12.22	9.44	12.02	6.68	8.50
2001	11.04	0.72	9.62	12.45	9.62	12.25	6.8	8.66
2002	11.19	0.75	9.72	12.66	9.77	12.44	6.91	8.80
2003	11.47	0.80	9.90	13.04	10.04	12.79	7.10	9.04
2004	11.69	0.85	10.03	13.35	10.26	13.07	7.26	9.24
2005	11.82	0.87	10.11	13.54	10.39	13.24	7.35	9.36
2006	12.02	0.91	10.23	13.80	10.58	13.48	7.48	9.53
2007	12.28	0.97	10.38	14.18	10.85	13.82	7.67	9.77
2008	12.11	0.93	10.28	13.94	10.67	13.60	7.55	9.61

Note: The SP values assume that the SP had 9 comparisons, as is typical, and were not obtained from phone or internet methods. In all cases, the numeraire is neither toll charge nor fuel cost.

Table 10: Official Values for Other and Other Values Implied by Meta Model (Car)

Year	Appraisal Values: Other				RP Non LSE	RP LSE	SP Non LSE	SP LSE
	Central	StdErr	LCI	UCI				
1994	8.39	0.35	7.70	9.08	7.19	9.16	5.08	6.48
1995	8.57	0.36	7.87	9.28	7.37	9.39	5.21	6.64
1996	8.76	0.37	8.02	9.49	7.54	9.61	5.33	6.80
1997	8.97	0.39	8.20	9.74	7.75	9.87	5.48	6.98
1998	9.21	0.42	8.38	10.03	7.98	10.17	5.64	7.19
1999	9.43	0.45	8.54	10.32	8.20	10.45	5.80	7.39
2000	9.70	0.50	8.73	10.68	8.47	10.78	5.99	7.63
2001	9.86	0.53	8.83	10.89	8.62	10.98	6.10	7.77
2002	10.00	0.55	8.92	11.08	8.76	11.16	6.19	7.89
2003	10.25	0.60	9.07	11.42	9.00	11.47	6.37	8.11
2004	10.45	0.64	9.19	11.71	9.20	11.72	6.51	8.29
2005	10.57	0.67	9.26	11.87	9.32	11.87	6.59	8.40
2006	10.74	0.71	9.35	12.12	9.49	12.09	6.71	8.55
2007	10.98	0.76	9.49	12.46	9.73	12.39	6.88	8.76
2008	10.82	0.72	9.40	12.24	9.57	12.19	6.77	8.62

Note: The SP values assume that the SP had 9 comparisons, as is typical, and were not obtained from phone or internet methods. In all cases, the numeraire is neither toll charge nor fuel cost.

7. Summary

The findings indicate that the appraisal values of time in 1994 were larger than what is SP dominated UK evidence, although we can see that even in the observations for 1994 only there is a large spread in individual valuations and we concede that there might be other uncontrolled for extraneous influences. But if these factors, especially within the car values of time, introduce unwanted noise which blurs the analysis but which is essentially having a random effect, the evidence if anything points to values larger than the other UK evidence.

The figures for car in Table 6 are most relevant, since this is the market upon which the appraisal values are based. The degree of correspondence between the appraisal values and the meta-values for 1994, the year from which the appraisal values stem, is closer for car than for the other comparisons made, although the appraisal values are still larger and the correspondence would be slightly worse if the commuting appraisal values were used.

As for variations over time, there is a greater degree of consistency between growth in the appraisal values, which are assumed to grow with a GDP elasticity of 0.8, and the trend growth in the samples of meta-values. Car travel, and indeed travel by other modes, will have become more comfortable over time with more opportunities to spend travel time usefully, and this would be expected to exert a downward influence on values of time over time, but the evidence does not support this. Presumably there are also countervailing influences which act to increase the value of time over time, such as more difficult and crowded travelling conditions. This suggests that either these factors are cancelling each other out or the GDP elasticity represents the net impact of a number of correlated factors, such as income growth, comfort and travel conditions.

There is no support, either from the meta-analysis or from the analysis of samples of meta-values presented here, for the GDP elasticity varying over time. However, we note that the meta-analysis recovered a GDP elasticity of 1.06 for commuting and 0.9 for other, and that the results here are consistent with this finding, particularly the commuting values, to have a stronger trend than the official central values over the time period analysed.

We also point out that the above GDP elasticity values are for all the variables in our data set. When restricted to in-vehicle time, the GDP elasticity increases to 1.04 from the 0.9 for all variables. This difference is consistent with the 0.823 for in-vehicle time and 0.723 for all variables estimated for the GDP elasticity in the 2003 work that influenced current recommendations (Mackie et al., 2003).

We have recognised that extraneous influences, such as the effects from RP data, London and the South East and SP presentation format apparent in the meta-analysis, could be having a bearing in the tabulations presented, but further segmentations would result in very small samples sizes from which it would be extremely difficult to draw conclusive results. One way to overcome this is to use the Abrantes and Wardman (2011) meta-model estimated to all this data to predict what the value of time would be.

When we do this, we find that the official values, which are based on SP data, coincide very closely with what the meta-model would imply for RP data. If we are prepared to accept that values implied from RP evidence represent the 'truth', then we can only conclude that the Department's official values closely represent the best available evidence. The only issue then is the GDP elasticity going forward. Should we wish to argue that only SP methods can provide robust estimates, then the official values appear to be substantially larger than other SP based valuations.

8. References

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Appendix 1: New Studies Identified

1. Hess, S. (2012) Rail user perceptions towards coach environment. ITS Research Study.
2. Hess, S. (2012) Valuation of rail delays. ITS Research Study.
3. Accent (2011) Valuation of Airport Facilities and Airline Service Quality. Report for CAA.
4. Accent (2012) Valuation of London Airport Facilities (Confidential Accent Report).
5. Accent (2010) Non train user travel behaviour research for franchising study. Report for LEK.
6. Accent (2012) Non train user travel behaviour research for franchising study. Report for LEK.
7. Accent (2011) Calculating impact on demand of fare increases. Report for Network Rail.
8. Burge P., Rohr, C and Kim, C. W. (2010) Modelling choices for long-distance travellers in the UK: An SP analysis of mode choice. Paper presented at ETC Glasgow.
9. Local connections to long distance rail travel: An evaluation of through services and interchange factors. Unpublished ITS Masters dissertation, 2011.
10. ITS (2011) The effects of park and ride parking supply on public transport demand. Report for Transport Scotland.
11. MVA (2012) Multi-Modal Willingness to Pay Attribute Evaluation Research Study. Report for Transport for London.
12. ITS (2011) Understanding the role of surface access and flight characteristics in Airport choice, Working paper in progress.
13. MVA (2002) Central Scotland transport corridor studies. Prepared for Scottish Executive. Faber Maunsell (2004), Glasgow Airport Rail Link. Prepared for Strathclyde Passenger Transport.
14. MVA (2009) Scottish Lifeline Ferries Review: Stated Preference Research. Prepared for Scottish Government.
15. MVA (2008) High Occupancy Vehicle Lane: Stated Preference Research. Prepared for Transport Scotland.
16. Mohammed, S. (2012) Combining stated and revealed preference data in rail route choices. ITS Masters dissertation.
17. Aref Alipour (2012) Analysis of competition between Great Western and Chiltern trains between Oxford and London. Unpublished ITS Masters dissertation, 2012.