

# DfT 2006-2008 M6 Toll Road Study

## Report on the M6 Toll Road Study Freight SP surveys.

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### ***Executive Summary***

This report presents the findings from the freight data collection and modelling exercise undertaken as part of the Department for Transport (DfT) funded M6 Toll Road (M6T) study. The purpose of this study was not to evaluate the success of the M6T but to understand how toll levels on an interurban trunk road influence (freight) travel demands in circumstances where there is a choice between tolled and free routes. The study contacted M6T users and non-users in that corridor, and conducted interviews with Light Goods Vehicle (LGV) and Heavy Goods Vehicle (HGV) Drivers and Managers involving a wide variety of industrial sectors.

In freight studies, the survey samples are generally small and difficult to obtain such that the obtained data is intrinsically difficult to model. The study encountered various modelling problems. One particular difficulty was that over 20% of the sample never ranked a toll road above a non-tolled alternative, regardless of the presentation of the poor quality of the latter. We show how results vary with the inclusion and exclusion of these 'Non-traders'.

Particular difficulty occurred in splitting out "per minute" effects (e.g. value of journey time savings) from "per instance of use" effects (e.g. value of using the M6T as opposed to the M6). Anticipating this problem, we had asked directly for the willingness to pay for using the M6T if travel times were identical to the untolled M6. This enabled us to force this value, by individual, into the models, if we so wished. We had further difficulty gaining separate values for the individual time related effects we were interested in (journey time, start-stop time, and journey time spread).

Broadly speaking, the results do show some possibility of freight traffic moving to use the M6 Toll road (M6T) if conditions on the M6 deteriorated sharply. However, the values of time found compared to previous SP studies are low, and often below the driver's wage rate. Whilst this is in line with the small amount of goods vehicles observable on the M6T, there appears to have been some reluctance to pay tolls *per se*, in which case using these values as general values of time would be unjustified. SP studies have difficulty in finding the full value of small journey time improvements, and relative to total journey time, the journey time savings offered were often 'small'.

The £7.50 each way toll would often form a sizable proportion of the profit margin on many freight movements. It should nevertheless be worth paying if savings in drivers' wages and vehicle operating cost were greater. However, where drivers are not on overtime, it might be difficult for respondents to see how any wages would be saved by the earlier arrival back at depot, particularly if the 'peak vehicle requirement' period had already passed.

Although we have followed standard statistical surveying procedures, the mere fact that we have combined several sources of data means that our results do not represent an unbiased random sample from the freight traffic using the M6 corridor. Since we have given separate results for HGV/LGV, and different sectors it would be possible to re-weight the findings in order to apply them in different corridors. However, that would not overcome the basic point that our surveys took place at particular times of the day on particular days of the week, and that those interviews conducted by telephone merely asked for a recent movement that used the corridor. Any application or interpretation of the study results must consider this.

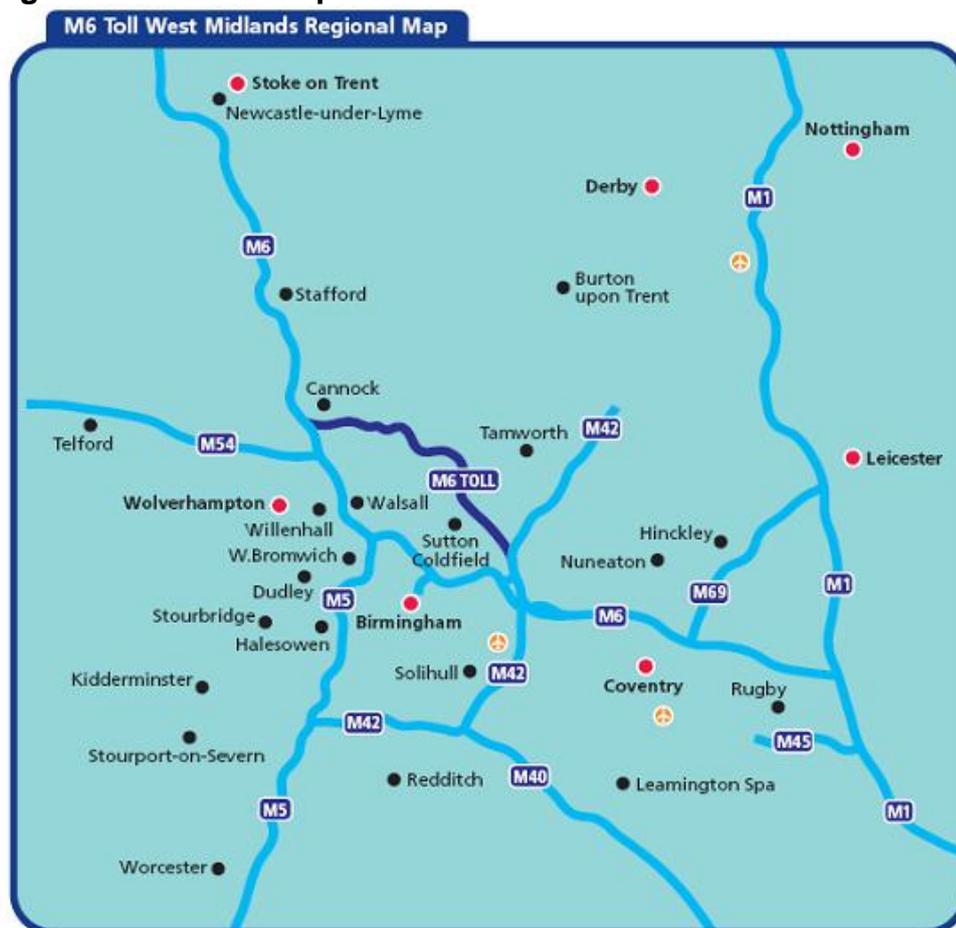
# 1. Introduction

## Background

This report presents the findings from the freight data collection and modelling exercise undertaken as part of the Department for Transport (DfT) funded M6 Toll Road (M6T) study. The purpose of this study was not to evaluate the success of the M6T but to understand how toll levels on an interurban trunk road influence (freight) travel demands in circumstances where there is a choice between tolled and free routes. The study contacted M6T users and non-users in that corridor, and conducted interviews with Light Goods Vehicle (LGV) and Heavy Goods Vehicle (HGV) Drivers and Managers involving a wide variety of industrial sectors.

The M6 Toll Road is a 27 mile stretch of three lane motorway connecting junctions 11a and 4 of the M6, designed to alleviate the congestion on a busy stretch of this motorway around Birmingham. Current tariffs for HGVs are £9 per one-way journey, although at the time of the survey they were £7.50. Tariffs are £1 cheaper overnight (between 23:00 and 06:00). Figure 1.1 shows the Toll Road and surrounding area.

Figure 1.1 M6 Toll Map



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(Source: M6 Toll Website [M6toll.co.uk](http://M6toll.co.uk))

The study looked at the value of removing start-stop driving time, which has a particularly large impact on fuel usage and emissions, and the value of the penalty of using A road alternatives, which would cause particular environmental problems in many localities from diverted traffic if tolls were imposed just on motorway use.

## **Layout of Report**

Section 2 describes the data collection and survey design. This includes the design of the Stated Preference (SP) experiments, as well as setting out useful definitions. Section 3 describes the characteristics of the collected dataset. Section 4 sets out the modelling framework and reports model results. Section 5 presents the recommended model and valuations of trip attributes and Section 6 the final study conclusions.

We gladly acknowledge helpful comments on earlier drafts by members of the project team led by Brian Vaughan, by John Bates and by Geoff Hyman and others at DfT. We are very aware that our work reported in this paper has depended entirely on the hard work put in by those, led by Dawn Fisher, at Faber Maunsell involved in the actual surveying.

## 2. Data Collection and Survey Design

### 2.1 Data Collection

Questionnaire design was completed in August 2006, with surveys beginning shortly thereafter. Due to the small number of responses possible from any method of contact, three types of interview were conducted with respondents who indicated that they were 'in scope', ie at some time had journeys where using the full length of the M6T was a reasonable alternative and were authorised to decide whether to use the M6T or not:

(i) **Face-to-Face**, utilising a laptop programmed to customise the SP experiments directly as the data on a current journey is input. These were conducted with drivers who had made a stop at a truck-stop or Motorway service area;

(ii) **Phone**, whereby the initial approach was by phone to a manager, after which the SP experiments were customised with the information gained, and then mailed out for postal return. Here we used all available databases of freight operators moving goods within the M6 corridor.

(iii) **Handouts**, whereby potential respondents were handed or posted a first stage questionnaire (for postal return), to ascertain the customisation information, after which a further postal questionnaire was sent out containing the SP experiments. Initial contact was at M6Toll booths, roadside interviews, Motorway service areas and by post to registered 'TAG' (automatic charging device) users of the M6 Toll road.

In addition, where face-to-face interviewees (or handout recipients) were not the decision makers, contact details were collected so the follow up Stated Preference exercises could take place with their managers and these were included in this group. A handout questionnaire is included as Figure B1 in Appendix B.

Despite using these three approach methods *to the maximum extent possible*, we still had only 260 observations to analyse, split as in Table 2.1. Here we also report response rates for the SP exercise, based on the initial sample garnered from the first stage questionnaire or interview. The face-to-face interviews were completed in one instance, so response rates were 100%.

**Table 2.1 Respondents by interview type**

Interview type	Number of completed surveys (n)	Response rate of 2 <sup>nd</sup> stage for 1 <sup>st</sup> stage completed
Face-to-face	62	100%
Phone	133	59%
Handouts	65	26%
<i>Total</i>	<i>260</i>	<i>61%</i>

### 2.2 The First Stage Questionnaire

The questionnaire had two parts. A first stage questionnaire recorded the following details:

- Personal and company contact details;

- M6 Toll road journey information where used. This included information on:
  1. origin and destination;
  2. commodity;
  3. whether the departure or arrival times were fixed;
  4. whether there were penalties for failing to deliver within a guaranteed time window;
  5. the normal departure time;
  6. earliest and latest (barring major incidents) arrival times;
  7. the time of passing/joining the M6 Toll road; and
  8. the amount of time spent in start-stop traffic.
  
- Information for a journey not made on the M6 Toll road. This was asked of all respondents and collected the same information as above about a journey not using the M6 Toll road, but which could have used it;
  
- Details on whether respondents would be willing to pay a toll if travel time and reliability were identical on the M6 and M6 Toll roads and, if so, how much and which features of the M6 Toll road were important.

Further questions covered the value and volume of load but did not yield sufficient responses to be useful for further analysis. Many drivers and managers did not know the value of the shipped goods, and answered the question regarding volume of load poorly. An example of the first stage questionnaire is shown in Appendix B.

## 2.3 The SP Experiments

Two SP experiments were conducted with each respondent to maximise the information obtained and to provide a safety net (in case one of the experiments failed). The first exercise, SP1, involved explicit mention of the M6T. The second, SP2, related to anonymous tolled and untolled motorways in order to avoid M6T specific effects that may be associated with the M6T in respondents' minds.

The main attributes to be included in the analysis were defined and suitable questions asked to enable the construction of these attributes at the analysis stage.

The data sought from the respondents included the following:

DT: Departure Time

SST: Expected Time in Start-Stop Traffic

EAT: Earliest Arrival Time

LAT: Latest Arrival Time, specified as the time by which 98% of arrivals would have occurred.

From these, the following additional attributes were constructed:

JT: Scheduled Journey Time, = EAT – DT

RT: Reliability, or Journey Time Spread, = LAT – EAT

JRT: 98% Journey Time, = LAT - DT

Both experiments aim to capture valuations of Journey Time (VJT), Reliability Time (VRT) and start-stop time (VSST), in terms of £ per hour per lorry load. SP1 also seeks to establish an alternative specific constant (ASC) for using the M6T, i.e. a Willingness To Pay (WTP) to use the M6T in the absence of time changes. SP1 further sought to value an ASC for the A road alternative and the incentive required to re-schedule peak journeys into the off-peak. SP2 sought the value of an ASC for anonymous tolled roads.

**Stated Preference Exercise 1.**

SP1 was based on one of the routes (M6T or not-M6T) given by the respondent in the journey information section, and examined how this route choice would be affected by changes in tolls and road conditions.

The initial design consisted of four “screens” of three columns, which related to the three broad route alternatives “M6 Toll”, “M6” and “A roads”. The first stage questionnaire provided sufficient information for customisation, regarding departure time, and earliest and latest arrival times. The experimental design therefore set out differences from these initial values. Table 2.2 shows the various levels of difference used for the three attributes JT, RT and SST. Table 2.3 shows the design of SP1 in differences.

**Table 2.2: Attributes and levels used in SP1 (minutes)**

Attribute level	JT Diff	RT Diff	SST Diff
0	0	10	10
1	15	30	20
2	30	-	-

**Table 2.3 Design of SP1**

		Attribute level differences			
		JT(mins)	RT(mins)	SST(mins)	Cost(£)
Screen1	M6-M6T	30	30	10	-5
	A road-M6T	0	10	10	-5
Screen2	M6-M6T	15	30	20	-20
	A road-M6T	15	10	10	-20
Screen3	M6-M6T	30	10	20	-10
	A road-M6T	0	30	20	-10
Screen4	M6-M6T	15	30	10	-15
	A road-M6T	15	10	20	-15

This design is orthogonal in the differences of JT, RT and SST. Because only one alternative (the M6T) has a cost, the two cost differences are identical on each screen. The four levels of cost difference selected gave a desirable set of Boundary Value Rays (Fowkes, 1991). These Rays seek to place ranges on the estimated relative attribute valuations. For example respondents with VJT=£4/hr, VRT=£3/hr, VSST=£12/hr (and zero ASC) should be willing to pay £5.50 to use the M6T relative to the M6 on screen 1, (M6-M6T) and so choose M6T as it only costs £5 more than the M6. However, in screen 3, (M6-M6T), they would be willing to pay £6.50 and so would choose the M6 rather than paying £10 to use the M6T. These calculations would change as the ASC for M6T changes. Since Cost only applies to the M6T, heavy correlation exists with the ASC for the M6T.

Simulation testing revealed that the assumed values could be recovered if the ASC was assumed to be (close to) zero (as we supposed it might be), but that simultaneous estimation of both the ASC and the other parameters was subject to considerable error. To address this questioning took place directly seeking the ASC value, for example 'how much would you be prepared to pay to use the M6T in the absence of changes in journey times?'

Respondents were offered alternative journeys with each option indicating the *departure time*, amount of *start-stop driving time* (arising from congestion, road works, traffic lights etc), *earliest arrival time*, and *latest arrival time* (defined to exclude that one in fifty occasions where there is a delay due to accidents, break-downs etc). For the M6 Toll road, one-way tolls are used.

One journey each was offered by M6Toll road, M6 and an A-road option. Where individuals were travelling past/through the M6 Toll road in the peak, (defined as being between 6am and 10am and 4pm and 7pm exclusive) a departure time shift option was included as an additional tolled route option (at half the toll rate of the peak tolled option) to enable the calculation of the sensitivity to changes in departure time. Respondents ranked the alternative routes. This experiment required four screens each presented in a similar fashion to Table 2.4. In this example, the departure time option (M6 Toll 2) is present because the journey passes the M6 Toll in the peak. The other route options use a fixed departure time, in this case 11:00, as this is what the respondent indicated.

**Table 2.4 Example SP Exercise 1 screens**

Question 1a	M6 Toll 1	M6 Toll 2	M6	A Road
Road toll (£, one way)	£5.00	£2.50	£0.00	£0.00
Departure time	11:00	14:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	50	50
Earliest arrival time	12:45	15:45	13:15	12:45
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:30	16:30	14:30	13:40
Ranking (1 = best, 2 = 2nd choice, 3 = worst)				

Question 1b	M6 Toll 1	M6 Toll 2	M6	A Road
Road toll (£, one way)	£20.00	£10.00	£0.00	£0.00
Departure time	11:00	14:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	60	50
Earliest arrival time	12:50	15:50	13:05	13:05
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:35	16:35	14:20	14:00
Ranking (1 = best, 2 = 2nd choice, 3 = worst)				

Question 1c	M6 Toll 1	M6 Toll 2	M6	A Road
Road toll (£, one way)	£10.00	£5.00	£0.00	£0.00
Departure time	11:00	14:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	60	60
Earliest arrival time	12:55	15:55	13:25	12:55
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:40	16:40	14:20	14:10
Ranking (1 = best, 2 = 2nd choice, 3 = worst)				

Question 1d	M6 Toll 1	M6 Toll 2	M6	A Road
Road toll (£, one way)	£15.00	£7.50	£0.00	£0.00
Departure time	11:00	14:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	50	60
Earliest arrival time	13:00	16:00	13:15	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:45	16:45	14:30	14:10
Ranking (1 = best, 2 = 2nd choice, 3 = worst)				

**Stated Preference Exercise 2.**

This experiment did not explicitly mention the M6 Toll road but, instead, asked respondents to consider the effect of changes in tolls and road conditions in the situation where there has been an expansion in tolled motorways. This shifts the context away from the M6T where pre-determined attitudes might make the response more ‘short-term’. It also gave more freedom in setting toll levels and journey times to improve statistical estimation.

This design consists of five screens of four columns, which relate to anonymous roads, two of which are tolled and two not. There is a potentially much greater tolled distance than on the M6 Toll. This allowed us to propose much larger hypothetical tolls than for the M6 Toll Road. Given that the design minimum acceptable time differences are the same for both experiments, the larger toll allows us to check for the higher values of time that might occur for some traffic. This makes the design presentation easier for respondents to complete.

Table 2.5 shows the attributes difference levels used in the design. In the pilot we encountered such reluctance to choose tolled options that we decided to halve all the toll values in the design to those shown in Table 2.6.

**Table 2.5: Attributes and levels used in SP2 (minutes)**

Attribute level	JT Diff	RT Diff	SST Diff
0	10	0	0
1	15	5	10
2	20	10	30
3	30*	30	40

*\*This is 60 for some journeys over 6 hours.*

**Table 2.6: Design of SP2 (minutes)**

		Attribute level differences			
		JT(mins)	RT(mins)	SST(mins)	Cost(£)
Screen1	T2-T1	15	5	10	-5
	UT1-T1	20	10	10	-15
	UT2-T1	20	5	30	-15
Screen2	T2-T1	10	5	0	-12.5
	UT1-T1	20	0	40	-20
	UT2-T1	30	5	40	-20
Screen3	T2-T1	20	30	0	-5
	UT1-T1	15	0	0	-10
	UT2-T1	10	30	30	-10
Screen4	T2-T1	30	0	30	-2.5
	UT1-T1	30	10	0	-5
	UT2-T1	15	30	40	-5
Screen5	T2-T1	30	30	10	-10
	UT1-T1	10	10	40	-20
	UT2-T1	10	0	10	-20

*Note: T stands for Tolled road, UT Untolled road.*

Table 2.7 shows that respondents were offered alternative motorway journeys in the columns, two tolled and two untolled, again varying by departure time, amount of start-stop driving time, earliest possible arrival time, and latest arrival time.

**Table 2.7 Example SP Exercise 2 Screens**

Question 2a	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£15.00	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50	70
Earliest arrival time	12:55	13:10	13:15	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:00	14:20	14:30	14:25
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2b	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£20.00	£7.50	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	80	40	80
Earliest arrival time	13:00	13:20	13:10	13:30
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:05	14:25	14:20	14:40
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2c	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£10.00	£5.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	40	70
Earliest arrival time	13:05	13:20	13:25	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:10	14:25	15:00	14:50
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2d	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£5.00	£2.50	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	70	40	80
Earliest arrival time	13:10	13:40	13:40	13:25
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:15	14:45	14:55	15:00
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2e	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£20.00	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50	80
Earliest arrival time	13:15	13:25	13:45	13:25
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:20	14:30	15:20	14:40
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

For tolled motorways a one-way toll is shown. The tolled options did not differ in terms of length and respondents considered the options in terms of the various time savings they offered.

Apart from cost, both designs were orthogonal in differences. That means that big differences in scheduled journey time should not always go with a particular size of difference in journey time spread, for example. However, the attribute levels themselves were not orthogonal. In SP1, this was because the M6T had always to be at least as quick as the M6. We were not free to offer a very slow M6T just to fit an orthogonal design, for example. In addition, tolled roads are the only ones with a cost attached, so in SP1 only the M6T alternative has a cost. Typically, therefore the M6T will have been costlier, quicker, more reliable and with less start-stop time than either of the two other alternatives. Simulations suggested this would not present any problems, but we designed exercise SP2 to have anonymous roads (two tolled motorways and two untolled motorways) which provided greater scope in designing a statistically efficient experiment. For example, options could be included with a tolled road slower than other tolled roads.

Generally, all respondents faced the same experiment, but in the latter stages of surveying, having analysed data from the field, a change was made to present larger journey time differences of 60 minutes as the third attribute level on journey time to those reporting a journey of over 6 hours. This better reflected the likely time savings for such trips and encouraged greater trading between the options for such journeys.

**Simulations for SP2**

Table 2.8, shows the results of the simulations carried out for SP2. These used single runs for 200 individuals and the following different time valuations:

- 3 levels of VJT – £0.10, £0.20 and £0.60 per min per lorry load
- 2 levels of VRT - £0.20 and £0.80 per min per lorry load
- 2 levels of VSST - £0.20 and £0.80 per min per lorry load

**Table 2.8 Results of Simulations for SP Exercise 2.**

VJT ( £ per vehicle per minute)			VRT ( £ per vehicle per minute)			VSST ( £ per vehicle per minute)			Rho-sqd
Input	Retrieved	%diff	Input	Retrieved	%diff	Input	Retrieved	%diff	
0.100	0.115	15.1	0.200	0.185	7.5	0.200	0.221	10.7	0.330
0.100	0.115	14.6	0.200	0.195	2.5	0.800	0.790	1.3	0.380
0.100	0.112	11.7	0.800	0.801	0.1	0.200	0.200	0.2	0.247
0.100	0.109	8.6	0.800	0.774	3.3	0.800	0.785	1.8	0.329
0.200	0.197	1.7	0.200	0.187	6.6	0.200	0.205	2.6	0.330
0.200	0.208	4.0	0.200	0.194	3.2	0.800	0.809	1.2	0.333
0.200	0.192	4.1	0.800	0.820	2.5	0.200	0.201	0.3	0.231
0.200	0.188	5.8	0.800	0.808	1.0	0.800	0.784	1.9	0.315
0.600	0.595	0.9	0.200	0.216	8.1	0.200	0.181	9.4	0.350
0.600	0.588	2.1	0.200	0.238	19.1	0.800	0.794	0.7	0.351
0.600	0.599	0.2	0.800	0.827	3.4	0.200	0.197	1.6	0.289
0.600	0.621	3.5	0.800	0.771	3.6	0.800	0.810	1.3	0.370

Table 2.8 shows good value recovery with the ASCs assumed to be zero.

Full versions of the second stage SP interviews can be found in Appendix B.

### 3. Data Description

#### 3.1 Our Dataset

The final dataset was comprised of 260 observations from drivers or managers, who declared they were in scope for the study, i.e. freight movements that had the option of using the M6 Toll road.

Of the 260 observations, 58 respondents had not indicated willingness over the two Stated Preference exercises to trade off the cost of a toll against any journey time/reliability benefits. We refer to these 58 individuals as 'Non-traders'. The breakdowns presented in this section refer to 'Traders' and 'Non-traders' together (as 'All') unless otherwise specified. There were 147 'Traders' in SP exercise 1 and 187 'Traders' in SP exercise 2, although when reporting results for 'Traders', unless otherwise stated, we are referring to the 202 individuals who traded in one or both exercises.

#### 3.2 HGVs vs LGVs

Table 3.1 presents the number of respondents broken down by HGV/LGVs' usage and interview type. The two vehicle categories are not mutually exclusive - respondents had the opportunity to register that they used both LGVs and HGVs if the choice of vehicle would not affect their choice of route or tolled road options. We therefore defined three categories, HGV, LGV and both.

**Table 3.1 Vehicle type breakdown by interview type and HGV/LGV**

Interview type	All Respondents		Traders	
	LGVs	HGVs	LGVs	HGVs
Phone	73	75	54	56
Face-to-face	12	62	8	51
Postal	36	43	26	34
<i>Total</i>	<i>121</i>	<i>180</i>	<i>88</i>	<i>141</i>

We found journey time and journey time spread are substantially greater for HGVs than LGVs, as we would have expected (see Table 3.2).

**Table 3.2 Journey times by vehicle type**

	Journey time (mins)	Journey time spread
LGV*	271	56
HGV*	398	98

\*Not mutually exclusive.

#### 3.3 Interview type

Table 3.3 reports average values and standard deviations for journey times, journey time spreads and start-stop time by interview type (as described in Section 2.1), both for the whole sample ('All') and for 'Traders'. The incidence of non-trading seems uniform over interview type. However, there is a clear difference in journey times and journey time spread by interview type.

**Table 3.3 Journey time elements (in minutes) by interview type**

Interview type	Journey Time (JT)		Journey Time Spread (RT)		Start Stop Time (SST)		n
	Average	SD	Average	SD	Average	SD	
Phone (Traders)	388	296	95	85	47	43	101
Phone (All)	406	390	95	81	45	41	133
Face-to-face (Traders)	378	466	101	107	39	31	51
Face-to-face (All)	378	433	107	106	38	32	62
Handouts (Traders)	259	224	43	61	20	21	50
Handouts (All)	272	270	42	57	19	20	65
Traders	353	336	84	89	41	38	202
All	366	378	85	86	39	37	260

Our view is that the journey time averages and spread reported for the handout survey are typical of M6T corridor users, being from the closest approximation we have to a random sample of all those with a reasonable option of using the M6 Toll road. The face-to-face interviews intercepted actual journeys, but only those long enough to need a truck or service station stop. This explains the higher average journey time for the face-to-face respondents. The even higher levels of journey time from the phone survey are something of a mystery. Possibly, when managers selected an in-scope journey, the longer journeys came more easily to mind. These respondents may have been in a head office far distant from the M6T. Therefore, the face-to-face and phone respondents are not a representative sample, at least with respect to journey length.

Start-stop times are just above 10% of total journey times. Variations in start-stop times are approximately in proportion to differences in the journey times, although they are lower for handout surveys.

### 3.4 Economic Sectors

The project brief defined six “economic sectors” between which freight movements were made:

- P – Primary                      Farm / mine (quarry) / fishery
- M – Manufacturing            Factory / workshop / brewery
- D – Distribution                Warehouse / storage depot
- E – Energy                        Refinery / mine / power plant
- C – Construction              Building/ prefabrication site
- F – Final                         Retail outlet / final customer

Subsequent data collection also suggested the identification of a seventh category:

- S- Services                      Service sector

We categorised all the 260 interviews relative to pairs of these, based where possible on direct information from the respondent, but otherwise deduced from origin and destination, commodities and industry knowledge.

This categorisation yielded a large potential number of sector-to-sector movements as shown in Table 3.4. Of these sector to sector movements, DD, DF, MD, MF and MM were large enough to experiment with, along with all primary flows merged together (as “P” and referred to later as Bulks), service based movements (as “S”) and all other flows (as “O”).

**Table 3.4 The distribution of responses on a sector-to-sector basis**

Origin Sector	Destination Sector	Abbreviation	Final Category	Individuals
Construction	Construction	CC	O	1
Distribution	Construction	DC	O	8
Distribution	Distribution	DD	DD/MD/MM	48
Distribution	Energy	DE	O	1
Distribution	Final	DF	DF	33
Distribution	Manufacturing	DM	O	10
Distribution	Services	DS	O	3
Manufacturing	Construction	MC	O	5
Manufacturing	Distribution	MD	DD/MD/MM	70
Manufacturing	Final	MF	MF/P	15
Manufacturing	Manufacturing	MM	DD/MD/MM	26
Manufacturing	Services	MS	O	2
Primary	Construction	PC	MF/P	3
Primary	Distribution	PD	MF/P	5
Primary	Manufacturing	PM	MF/P	11
Primary	Primary	PP	MF/P	1
Services	Final	SF	S	1
Services	Services	SS	S	17
Total				260

Table 3.5 shows the vehicle types used by each sector. As expected, LGVs have mainly been found undertaking Services, Manufacturing to Distribution and Distribution to Final; whereas HGVs have been mainly found carrying out Manufacturing to Manufacturing, Manufacturing to Distribution and Distribution to Distribution trips.

**Table 3.5 Distribution of vehicle type across the classified sectors**

Sector	LGVs*	HGVs*	N
Distribution to Distribution (DD) (Traders)	8	32	37
(All)	17	39	48
Distribution to Final (DF) (Traders)	18	11	28
(All)	22	14	33
Manufacturing to Distribution (MD) (Traders)	17	47	53
(All)	23	60	70
Manufacturing to Final (MF) (Traders)	7	5	10
(All)	10	8	15
Manufacturing to Manufacturing (MM) (Traders)	2	17	18
(All)	4	25	26
Services (S) (Traders)	14	5	14
(All)	16	6	17
Bulks (P) (Traders)	5	15	17
(All)	6	17	20
Others (O) (Traders)	17	9	25
(All)	23	11	31
Total (Traders)	88	141	202
Total (All)	121	180	260

\*Not mutually exclusive

Table 3.6 presents journey times and spread by sector-to-sector movement type, for ‘Traders’ and ‘All’ respondents. The longest journeys in terms of duration are from ‘Distribution to Final’ and ‘Others’ sectors, averaging around 9-9.5 hours. ‘Traders’ have slightly longer journey times and spreads than the average over all respondents.

**Table 3.6 Distribution of journey times (minutes) across the classified sectors**

Sector	Journey time (JT)	Journey time spread (RT)	n
Distribution to Distribution (Traders)	420	85	37
(All)	392	101	48
Distribution to Final (Traders)	545	158	28
(All)	535	154	33
Manufacturing to Distribution (Traders)	285	222	53
(All)	282	180	70
Manufacturing to Final (Traders)	291	48	10
(All)	299	43	15
Manufacturing to Manufacturing (Traders)	223	60	18
(All)	260	71	26
Services (Traders)	241	15	14
(All)	242	22	17
Bulks (Traders)	315	22	17
(All)	306	29	20
Others (Traders)	622	113	25
Others (All)	571	108	31
Total (Traders)	380	120	202
Total (All)	366	112	260

Table 3.7 splits by M6T users, (i.e. those who use the M6T sometimes), and non-users, (i.e. those who never use the M6T). It was felt that those respondents who classed themselves as existing users of the M6 Toll road may have different characteristics to existing non-users. Surprisingly, 18 M6T users refused to trade in our SP experiments, i.e. they always rejected the tolled options. However, users were more likely to trade than non-users. We can note that those least likely to be users are Manufacturing to Manufacturing, and Services.

**Table 3.7 Distribution of sector traffic by respondent type**

Sector	All respondents			Traders		
	Total	M6T Users	Non-Users	Total	M6T Users	Non-Users
Distribution to Distribution	48	23	25	37	19	18
Distribution to Final	33	17	16	28	15	13
Manufacturing to Distribution	70	31	39	53	25	28
Manufacturing to Final	15	8	7	10	6	4
Manufacturing to Manufacturing	26	8	18	18	6	12
Services	17	6	11	14	6	8
Bulks	20	12	8	17	11	6
Others	31	16	14	25	15	10
All sectors	260	121	138	202	103	99

### 3.5 Benefits from M6T Usage

Tables 3.8 reports the amounts that respondents ('All' and 'Traders') stated they would be willing to pay to use the M6T if journey time (JT) and journey time spread (RT) were the same on the M6T as on the M6 and asked to break down that value by reason.

**Table 3.8 Unpacking the ASC for M6 Toll road (pence)**

	Surface is smoother	Less stop/start driving	Impresses the customer	Provides a less stressful period for the driver	Better fuel consumption	Others	TOTAL	n
Drivers (Traders)	13	44	6	16	9	0	88	98
Drivers (All)	10	37	5	14	7	0	74	123
Managers (Traders)	6	27	7	23	27	1	90	104
Managers (All)	4	21	5	17	21	2	70	137
LGVs (Traders)	6	23	5	16	16	1	67	88
LGVs (All)	5	17	3	12	12	1	49	121
HGVs (Traders)	11	42	7	24	23	0	107	141
HGVs (All)	9	37	6	21	20	1	94	169
Drivers/HGVs (Traders)	14	45	6	17	8	0	89	83
Drivers/HGVs (All)	11	39	5	15	7	0	76	102
Drivers/LGVs (Traders)	7	24	4	12	9	0	58	32
Drivers/LGVs (All)	5	17	3	9	7	0	42	45
Managers/HGVs (Traders)	7	38	10	35	44	0	134	58
Managers/HGVs (All)	5	29	7	26	35	2	104	78
Managers/LGVs (Traders)	6	22	5	18	20	2	73	56
Managers/LGVs (All)	4	16	3	13	15	1	52	76
All Traders	9	36	6	20	18	0	89	202
All	7	29	5	16	15	1	72	260

Table 3.8 shows that respondents would pay an average of £0.72 (£0.89 for 'Traders') to obtain the non-journey time and journey time spread related benefits of using the M6 Toll road.

The largest component, 29p (36p for traders), is accounted for by a reduction in start-stop driving. The SP modelling will directly account for this trip attribute. This leaves 43p (53p for traders) comprised of 7p (9p) for smoother surface, 5p (6p) for impressing the customer, 16p (20p) for reducing driver stress and 15p (18p) for better fuel consumption.

It is interesting to note that whilst Drivers and Managers have similar overall valuations, Drivers weight more highly the benefits from less start-stop driving, whilst Managers weight better fuel consumption more important. HGV users value all attributes of the toll road significantly higher than LGVs.

## 4. Modelling Framework and Results

### 4.1 Model forms

The initial model form used for the SP1 and SP2 analysis is the basic MNL model:

$$U_{ijk} = \sum_{r \neq 1} \alpha_r DR_{ijk r} + \beta.C_{ijk} + \gamma.DT_{ijk} + \lambda.JT_{ijk} + \mu.RT_{ijk} + \theta.SST_{ijk} + \varepsilon_{ijk}$$

Where:

$i$  is the individual respondent ( $i=1, n$  where  $n$  is the number of respondents being modelled);  
 $k$  is the SP option set (i.e. 'screen',  $k=1, 4$ );  
 $j$  is the alternative within option set  $k$  ( $j=1, 3$  for off-peak;  $j=1, 4$  for peak);  
 $r$  are the road type options ( $r=1, 3$  with  $r=1$  representing the untolled M6);  
 $DR_{ijk r}$  are dummy (0,1) variables, with the value 1 if alternative  $j$  within option set  $k$  for individual  $i$  is road type  $r$ ;  
 $DT_{ijk}$  is a dummy (0,1) variable with the value 1 if alternative  $j$  within option set  $k$  for individual  $i$  involves a shift in Departure time (i.e. if the original journey was 'peak');  
 $C$  is the cost variable, zero for untolled roads and initially equal to the Toll for the M6T, but later sometimes equal to Toll minus individual  $i$ 's directly reported ASC;  
and JT, RT and SST as previously defined.

For SP1, according to this specification, "ASCs" should be estimated for both the M6Toll ( $r=2$ ) and the A-road ( $r=3$ ). An addition to the ASC occurs where the alternative involves a shift (by 3 hours) out of the peak. Where the Cost variable includes the individual's reported ASC as summarised in Table 3.8, the dummy representing the M6T ASC ( $r=2$ ) will be always zero, as the individual's value replaces the M6T ASC.

For SP2, the specification is identical, except that the Departure time shift dummy (DT) is dropped, we have five screens ( $k$ ) each with four alternatives ( $j$ ) and there is only one ASC,  $r=2$  relating to a tolled motorway, while  $r=1$  denotes an untolled motorway.

Segmentations on the Cost variable took place as follows. The segmented cost model is:

$$U_{ijk} = \sum_{r \neq 1} \alpha_r DR_{ijk r} + [\beta + \omega_s DC_{is}].C_{ijk} + \gamma.DT_{ijk} + \lambda.JT_{ijk} + \mu.RT_{ijk} + \theta.SST_{ijk} + \varepsilon_{ijk}$$

where  $DC_i$  are dummy (0,1) variables, taking the value zero unless that individual respondent  $i$  satisfies the criterion for segmentation  $s$  for a particular variable (e.g. is a Driver as opposed to a Manager). For other segmentation variables, further coefficients are added to the Cost.

Segmentations on JT, RT and SST took place in a similar way.

The SP analysis extended to the use of Mixed Logit that began by adding a Normally distributed random term  $v$  to the ASC coefficient, in addition to the standard Logit  $\varepsilon_{ijk}$  for the model as a whole, to obtain:

$$U_{ijk} = \sum_{r \neq 1} [\alpha_r + v_{ir}] DR_{ijk_r} + \beta.C_{ijk} + \gamma.DT_{ijk} + \lambda.JT_{ijk} + \mu.RT_{ijk} + \theta.SST_{ijk} + \varepsilon_{ijk}$$

This allows the ASCs  $\alpha_r$  to vary randomly with the individual  $i$ . The previous specification can be interpreted as if  $\alpha_r$  varies randomly with  $j$  and  $k$ . The revised specification effectively partitions the random effect between individuals and, within individuals by  $j$  and  $k$ . The software estimates a **mean** and a **standard deviation** for each ASC. The dummy variable  $DR_{ijk_r}$  ensures the correct alignment of the ASC's with the SP options.

Further Mixed Logit work added error terms to C, JT, RT and SST in a similar way, but with Log-normal distributions.

## 4.2 SP1 Models

The investigation of the SP1 data began by looking at explanatory variables of interest in sets of binary explosions (BE). BE is the treatment of binary choices between column 1 and each of the other columns as individual observations. Where three columns exist in SP1 this gave three BE observations (col 2 v col 1, col 3 v col 1 and col 3 v col 2) per respondent. Where the journey was classified as 'peak' and an additional fourth column with a departure time shift was presented, three more BE observations (col 4 v col 1, col 4 v col 2, and col 4 v col 3) were added. For Traders, we obtained some interesting Binary logit models with segmentations on the cost parameter applied one attribute at a time.

This method does not give "all else held constant", but "everything as it is" values. By this we mean that if we say that the values for Drivers are different to those for Managers it might well be a third variable that is causing this rather than whether the respondent was a Driver or a Manager. Nevertheless, we believe there is some interest in seeing these "everything as it is" models (which we refer to as 'splits'), and so we report the models in summary form in Appendix A.

The models presented in this section are "all else held constant" segmentation models where the data segmentations simultaneously enter the models as a series of interaction dummies with Cost. Before getting to the segmentations, we present two unsegmented MNL models, the first just for Traders and the second for all respondents. These are Models M6.1 and M6.2 in Table 4.1. The statistical fit as measured by the adjusted rho-squared statistic is worse for Model M6.2. The log-likelihood increase is 60.7 for Model M6.1 and 63.4 for M6.2, suggesting that the Traders provide the vast majority of the predictive power. However, for the reasons discussed in Section 3 it is impossible to accurately estimate an M6T ASC simultaneously with journey time coefficients. In Model M6.1, there are insignificant journey time elements and an unbelievably large ASC, implying residents were willing to pay £5 to use the M6T even in the absence of journey time benefits. Model M6.2 by contrast has a non-significant M6T ASC.

Models M6.3 and M6.4 repeat Models M6.1 and M6.2 but with our preferred segmentation variables. Models M6.1 and M6.3 have higher VJT than Models M6.2 and M6.4. For VRT, there are no significant coefficients and Models M6.2 and M6.4 actually

have negative estimates. For VSST, Models M6.1 and M6.3 have *lower* values than models M6.2 and M6.4. The position is therefore unclear and unsatisfactory. The next step was to remove the M6T ASC, giving models M6.5 for Traders, and M6.6 for All respondents as shown in Table 4.2.

The estimated monetary values of time for Models M6.5 are closer in size to those expected. Including Non-traders, Model M6.6, halves VJT and VRT disappears. Again, examination of the log-likelihood values suggests that the Traders are providing all the model explanation. The 'Base Values' shown are those applicable when the segmenting variables are all set at their default (base) levels. For other levels, e.g. for 'Managers' instead of 'Drivers', the Base values should be multiplied by the 'Base Value Adjustment Factors' (BVAF) shown in the tables. For example, for Model M6.3 in Table 4.1, VJT is  $4.35 \times 0.656 = \text{£}2.85/\text{hr}$  for Managers.

We then sought to mitigate the exclusion of the M6T ASC by netting off from the toll values the directly reported values of ASC by individual. This yields Models M6.7 and M6.8 in Table 4.2. The fit for Model M6.7 is superior to that for either Model M6.5 or Model M6.3. The valuations of the time elements are plausible and the value of the M6T ASC has been directly allowed for by including respondents' individual own estimates. Model M6.8, all respondents, however, shows less improvement over Model M6.6, presumably, because the vast majority of direct ASC estimates for Non-traders were zero. Furthermore, the true ASC values for Non-traders were probably negative. Model M6.8 still reports a negative VRT estimate.

Finally, we report two models that experimented with data in different forms. In Table 4.3 Model M6.9 doubles the number of observations by adding in the consideration of the options ranked 2<sup>nd</sup> in each screen relative to those ranked 3<sup>rd</sup> or 4<sup>th</sup>. This did not overcome the difficulties in the all respondents models. Model M6.10 looked at exploded binary pairs where each pair contained one tolled and one untolled option. The reason for this was to check that correlation between the estimated values was not causing a problem. We had worked with an orthogonal design in differences but identified a possible route for leakage. The procedure used in Model M6.10 closed off that possibility. The results from Model M6.10 are however clearly no better than the other results presented for all respondents.

In summary, the individual models using SP1 are disappointing

**Table 4.1 SP1 Results**

	M6.1:Traders			M6.2: All respondents				M6.3:Traders				M6.4: All respondents			
Individuals	202			260				202				260			
Observations	586			1034				586				1034			
Rho-sq w.r.t. constants	0.0862			0.0542				0.1126				0.0786			
Adjusted rho-sq	0.0767			0.0487				0.0924				0.0669			
Log Likelihood (full)	-643.7			-1092.9				-625.1				-1064.8			
Log Likelihood (const)	-704.4			-1155.6				-704.4				-1155.6			
	Coeff,	t-stat	Value	Coeff.	t-stat	Value	Coeff.	t-stat	Base Value	Coeff	t-stat	Base Value			
Cost	-0.212	-9.1		-0.193	-9.2		-0.186	-7.3		-0.164	-7.0				
Journey time (JT)	-0.013	-1.5	3.79 £/h	-0.007	-1.2	2.19 £/h	-0.013	-1.5	4.35 £/h	-0.007	-1.2	2.55 £/h			
Journey time spread (RT)	-0.002	-0.2	0.43 £/h	0.006	1.1	-1.80 £/h	-0.001	-0.2	0.44 £/h	0.006	1.1	-2.19 £/h			
Start-Stop time (SST)	-0.027	-2.3	7.53 £/h	-0.031	-3.6	9.77 £/h	-0.029	-2.4	9.34 £/h	-0.033	-3.7	12.20 £/h			
M6T ASC	1.048	2.2	4.95 £	0.239	0.7	1.24 £	1.247	2.6	6.72 £	0.460	1.3	2.80 £			
A road ASC	-0.518	-2.5	-2.45 £	-0.674	-4.0	-3.48 £	-0.518	-2.4	-2.79 £	-0.466	-3.2	-2.84 £			
Departure time shift ASC	-0.765	-4.0	-3.61 £	-0.468	-3.2	-2.42 £	-0.799	-4.1	-4.31 £	-0.704	-4.1	-4.29 £			
<i>Base Cost*Drivers</i>									Base Value Adjust Factor			Base Value Adjust Factor			
Cost*Manager							-0.097	-4.1	0.656	-0.111	-5.1	0.597			
<i>Base: Cost*(HGV/ mixed)</i>															
Cost*LGV only							-0.055	-1.8	0.771	-0.067	-2.5	0.711			
<i>Base=(DD,MD,MM)</i>															
Cost*(DF)							0.041	1.3	1.288	0.080	2.9	1.942			
Cost*(MF,P)							-0.087	-2.2	0.681	-0.073	-2.0	0.691			
Cost*Service							0.083	2.4	1.806	0.101	3.1	2.594			
Cost*Other							0.022	0.5	1.137	0.003	0.1	1.022			
<i>Base: Cost*Not from a port</i>															
Cost*From a Port							-0.062	-1.7	0.750	-0.048	-1.4	0.773			

**Table 4.2 SP1 Results (ctd)**

	M6.5: Traders no M6T ASC			M6.6: All no M6T ASC			M6.7: Traders Net Toll			M6.8: All Net Toll		
Individuals	147			260			147			260		
Observations	586			1034			586			586		
Rho-sq w.r.t. constants	0.1077			0.0778			0.1142			0.0874		
Adjusted rho-sq	0.0890			0.0670			0.0956			0.0683		
Log Likelihood (full)	-628.5			-1065.6			-624.0			-1054.6		
Log Likelihood (const)	-704.4			-1155.6			-704.4			-704.4		
	Coeff.	t-stat	Base Value	Coeff.	t-stat	Base Value	Coeff.	t-stat	Base Value	Coeff.	t-stat	Base Value
Cost	-0.160	-7.0		-0.150	-7.4		-0.157	-6.9		-0.157	-7.6	
Journey time (JT)	-0.031	-4.8	11.51 £/h	-0.012	-2.8	4.90 £/h	-0.028	-4.6	10.89 £/h	-0.012	-2.7	4.55 £/h
Journey time spread (RT)	-0.017	-2.9	6.34 £/h	0.001	0.4	-0.58 £/h	-0.015	-2.6	5.63 £/h	0.002	0.5	-0.69 £/h
Start-Stop time (SST)	-0.038	-3.4	14.39 £/h	-0.037	-4.3	14.67 £/h	-0.037	-3.2	14.02 £/h	-0.037	-4.4	14.21 £/h
M6T ASC			£			£			0.00 £			0.00 £
A road ASC	-0.938	-6.7	-5.86 £	-0.595	-5.7	-3.97 £	-0.881	-6.4	-5.62 £	-0.586	-5.7	-3.73 £
Departure time shift ASC	-0.652	-3.5	-4.07 £	-0.622	-3.9	-4.14 £	-0.103	-4.1	-0.66 £	-0.609	-3.9	-3.88 £
<i>Base Cost*Drivers</i>			Base Value Adjust Factor			Base Value Adjust Factor			Base Value Adjust Factor			Base Value Adjust Factor
Cost*Manager	-0.092	-4.0	0.636	-0.108	-5.0	0.582	-0.103	-4.1	0.603	-0.121	-5.2	0.566
<i>Base: Cost*(HGV/ mixed)</i>												
Cost*LGV only	-0.052	-1.8	0.754	-0.065	-2.5	0.697	-0.057	-1.8	0.732	-0.069	-2.5	0.694
<i>Base=(DD,MD,MM)</i>												
Cost*(DF)	0.039	1.3	1.324	0.077	2.8	2.069	0.048	1.5	1.442	0.088	3.1	2.285
Cost*(MF,P)	-0.081	-2.1	0.663	-0.071	-2.0	0.678	-0.132	-2.7	0.543	-0.115	-2.6	0.577
Cost*Service	0.078	2.3	1.960	0.098	3.1	2.899	0.083	2.3	2.133	0.104	3.1	2.951
Cost*Other	0.021	0.5	1.155	0.003	0.1	1.024	0.036	0.9	1.297	0.018	0.5	1.130
<i>Base: Cost*Not from a port</i>												
Cost*From a Port	-0.059	-1.7	0.731	-0.047	-1.4	0.761	-0.054	-1.5	0.744	-0.044	-1.3	0.780

**Table 4.3 SP1 Results (ctd)**

	M6.9: Exploded			M6.10: Exploded binary pairs			
Individuals	260			260			
Observations	2068			3062			
Rho-sq w.r.t. constants	0.0964			0.0985			
Adjusted rho-sq	0.0907			0.0947			
Log Likelihood (full)	-1746.2			-1501.4			
Log Likelihood (const)	-1932.5			-1665.3			
	<i>Coeff.</i>	<i>t-stat</i>	<i>Base Value</i>	<i>Coeff.</i>	<i>t-stat</i>	<i>Base Value</i>	
Cost	-0.119	-7.9		-0.104	-8.8		
Journey time (JT)	-0.007	-1.6	3.61 £/h	0.000	0.0	0.05 £/h	
Journey time spread (RT)	0.004	1.0	-2.08 £/h	0.012	2.7	-6.73 £/h	
Start-Stop time (SST)	-0.024	-3.1	11.99 £/h	-0.006	-0.6	3.30 £/h	
M6T ASC	-0.236	-0.9	-1.98 £	0.353	1.4	3.39 £	
A road ASC	-0.506	-4.3	-4.23 £	-0.306	-1.9	-2.94 £	
Departure time shift ASC	-0.578	-4.7	-4.84 £	-0.317	-2.3	-3.05 £	
<i>Base Cost*Drivers</i>			<i>Base Value</i>			<i>Base Value</i>	
Cost*Manager	-0.057	-4.4	<i>Adjust Factor</i> 0.679	-0.071	-7.1	0.594	
<i>Base: Cost*(HGV/ mixed)</i>							
Cost*LGV only	-0.061	-3.6	0.660	-0.055	-4.2	0.656	
<i>Base=(DD,MD,MM)</i>							
Cost*(DF)	0.035	1.9	1.420	0.041	2.9	1.645	
Cost*(MF,P)	-0.064	-2.8	0.651	-0.058	-3.4	0.643	
Cost*Service	0.036	1.4	1.431	0.037	2	1.548	
Cost*Other	0.012	0.6	1.107	0.016	1	1.179	
<i>Base: Cost*Not from a port</i>							
Cost*From a Port	-0.005	-0.3	0.959	0.005	0.4	1.049	

### 4.3 SP2 Models

Based on early modelling, the prior set of considered SP1 segmentations are applied throughout. Before getting to the segmentations, we present two unsegmented MNL models: M7.1 for Traders and M7.2 for All respondents in Table 4.4. Low estimates for VJT are still apparent but all three journey time components are successfully estimated. The Toll Road Bonus is high for Traders but small, negative and non-significant for all respondents. Statistical fit does not look particularly good. The log-likelihood increase for Traders is 106.6, while for ALL it is only 104.6, suggesting that the Non-traders are adding nothing to the model not already in the 'constants'. Essentially, all the addition of the Non-traders is doing is altering the proportion choosing each alternative, which the 'constants' pick up in any case. Nevertheless, having a model that includes the non-Traders is valuable since it avoids the question of what to do about the non-Traders. If a model is estimated with Traders only then its value of time cannot be taken to be representative of the whole population, and there are obvious problems for forecasting.

Models M7.3 and M7.4 repeat Models M7.1 and M7.2, but adding in the set of segmentation variables. In both cases, fit improves. By taking out the Managers, who have a larger (negative) Cost coefficient, the reported 'Base' Values tend to increase. Values for segmentations of interest arise by using the BVAF factors. For instance, all monetary values for Managers are 70% of those shown for the Base.

In an attempt to get better estimates, Models M7.5 and M7.6 reported in Table 4.5, the individuals' directly supplied estimate of Tolloed Road ASC is used, subtracting that figure from the toll charges. Statistical fit improves, particularly for Model M7.6. Model M7.6 has time element estimates in the expected order, though still rather smaller than might have been expected. However, given that 28% of the SP2 sample always ranked the tolled options 3<sup>rd</sup> and 4<sup>th</sup>, and that relatively few freight vehicles actually use the M6T, Model M7.6 presents an acceptable representation of reality. Nevertheless, given reservations relating to the use of individuals' own reported ASCs, the team has agreed that Model M7.4 is our preferred SP2 model.

Model M7.7 doubles the sample size by adding in the choice of the second ranked alternative over the 3<sup>rd</sup> and 4<sup>th</sup> ranked alternatives, for ALL. The direct comparison is with Model M7.4, in relation to which goodness of fit has improved but valuations have collapsed. The conclusion reached is that the extra 'second layer' data is less reliable and hence excluded it from further analysis.

Model M7.8 takes a Nested Logit structure, with the choice of Toll v Non-toll coming first, followed by the choice of particular road. Again, the relevant comparison is with M7.4. The Lambda parameter clearly indicates that the Nesting is beneficial, and the goodness of fit statistics reflects this. However, the valuations do not seem to have changed very much. The negative M6T ASC for all respondents taken together may be correct from the point of view of the data, but is untenable as a real effect. It is only believable as a protest against toll roads, and not an effect to take account in our judgement of the transport realities.

**Table 4.4 SP2 Results**

	M7.1 Traders			M7.2 All			M7.3 Traders			M7.4 All		
Individuals	202			260			202			260		
Observations	935			1299			935			1299		
Rho-sq w.r.t. constants	0.1001			0.076			0.1265			0.097		
Adjusted rho-sq	0.0962			0.0731			0.1161			0.0893		
Log Likelihood (full)	-985.2			-1270.9			-930.1			-1242.1		
Log Likelihood (const)	-1064.8			-1375.5			-1064.8			-1375.5		
	Coeff	t-stat	Value	Coeff	t-stat	Value	Coeff	t-stat	Base Value	Coeff	t-stat	Base Value
Cost	-0.236	-12.1		-0.221	-12.0		-0.226	-9.8		-0.214	-9.8	
Journey time (JT)	-0.009	-2.3	2.32 £/h	-0.013	-3.8	3.44 £/h	-0.010	-2.5	2.55 £/h	-0.013	-3.8	3.63 £/h
Journey time spread (RT)	-0.016	-2.8	4.03 £/h	-0.010	-2.1	2.76 £/h	-0.017	-2.9	4.43 £/h	-0.011	-2.2	2.98 £/h
Start-Stop time (SST)	-0.043	-15.8	11.07 £/h	-0.040	-17.8	10.75 £/h	-0.044	-15.9	11.65 £/h	-0.040	-17.9	11.18 £/h
Toll Road ASC	0.439	2.2	1.86 £	-0.089	-0.5	-0.40 £	0.621	3.0	2.74 £	-0.082	-0.4	-0.38 £
<i>Base Cost*Drivers</i>									<b>BVAF</b>			<b>BVAF</b>
Cost*Manager							-0.093	-4.4	0.708	-0.092	-4.7	0.699
<i>Base: Cost*(HGV/ mixed)</i>												
Cost*LGV only							-0.073	-2.8	0.756	-0.060	-2.5	0.780
<i>Base=(DD,MD,MM)</i>												
Cost*(DF)							0.113	4.2	1.998	0.118	4.8	2.234
Cost*(MF,P)							-0.041	-1.2	0.848	-0.031	-1.0	0.874
Cost*Service							0.142	4.3	2.692	0.121	4.0	2.304
Cost*Other							0.064	2.0	1.394	0.049	1.6	1.298
<i>Base: Cost*Not from a port</i>												
Cost*From a Port							-0.052	-1.6	0.814	-0.029	-1.0	0.879

**Table 4.5 SP2 Results (ctd)**

	M7.5 : Traders Net Toll			M7.6 All Net Toll			M7.7 All Exploded			M7.8 Nested Logit		
Individuals	202			260			260			260		
Observations	935			1299			2597			1299		
Rho-sq w.r.t. constants	0.134			0.1065			0.1377			0.1031		
Adjusted rho-sq	0.1227			0.0982			0.1340			0.0947		
Log Likelihood (full)	-922.1			-1224.0			-2284.5			-1233.7		
Log Likelihood (const)	-1064.8			-1375.5			-2649.5			-1375.5		
	Coeff.	t-stat	Base Value	Coeff	t-stat	Base Value	Coeff	t-stat	Base Value	Coeff	t-stat	Base Value
Cost	-0.190	-10.6		-0.217	-12.3		-0.217	-14.8		-0.296	-8.0	
Journey time (JT)	-0.010	-2.5	3.14 £/h	-0.013	-4.0	3.73 £/h	-0.012	-4.6	3.28 £/h	-0.019	-4.7	3.93 £/h
Journey time spread (RT)	-0.025	-5.1	7.80 £/h	-0.011	-2.7	3.04 £/h	-0.005	-1.6	1.51 £/h	-0.014	-2.6	2.93 £/h
Start-Stop time (SST)	-0.044	-15.7	13.82 £/h	-0.040	-17.9	11.07 £/h	-0.033	-19.6	9.09 £/h	-0.043	-17.4	8.74 £/h
Toll Road ASC			£			£	0.060	0.4	0.28 £	-0.279	-0.9	-0.94 £
<i>Base Cost*Drivers</i>			<b>BVAF</b>			<b>BVAF</b>			<b>BVAF</b>			<b>BVAF</b>
Cost*Manager	-0.113	-5.1	0.628	-0.118	-5.6	0.648	-0.047	-4	0.823	-0.150	-4.1	0.664
<i>Base: Cost*(HGV/ mixed)</i>												
Cost*LGV only	-0.060	-2.3	0.761	-0.054	-2.2	0.802	-0.035	-2.4	0.861	-0.120	-2.8	0.712
<i>Base=(DD,MD,MM)</i>												
Cost*(DF)	0.110	4.1	2.384	0.128	5.0	2.434	0.073	4.5	1.510	0.206	4.4	3.300
Cost*(MF,P)	-0.074	-1.9	0.719	-0.066	-1.7	0.766	-0.009	-0.5	0.962	-0.050	-0.9	0.856
Cost*Service	0.144	4.4	4.104	0.131	4.2	2.516	0.087	4.3	1.672	0.211	4	3.499
Cost*Other	0.074	2.3	1.632	0.064	2.1	1.417	0.003	0.1	1.013	0.072	1.4	1.321
<i>Base: Cost*Not from a port</i>												
Cost*From a Port	-0.042	-1.3	0.820	-0.022	-0.7	0.907	0.031	1.8	1.164	-0.042	-0.9	0.876

#### **4.4 Pooling of SP1 and SP2 Data**

Due to the difficulties encountered with the separate modelling of SP1 and SP2 there was interest in whether a model pooling the SP1 and SP2 data would yield an improved outcome. Adding extra sample size should, all else equal, improve the explanatory power of the model.

Preliminary modelling established that there was no significant scale difference between SP1 and SP2 responses so we proceeded to estimate multinomial logit models. Table 4.6 shows three pooled models. Model M8.1 takes all respondents and estimates ASCs for the M6T and for experiment SP2's anonymous toll roads. The estimates of these two ASCs are small, not much different to each other, and not significantly different to zero. The fit is quite good. However, the value of journey time spread (VRT) appears to be too small. VRT should be at least half the value of VJT as reducing the spread by 2 minutes implies a 1 minute saving in the average time taken. VJRT is also statistically insignificantly different from zero.

Models M8.2 and M8.3 deduct the individual's estimate of their willingness to pay to use the M6T in the absence of time savings from the toll values presented in the experiment. This assists the model estimation of the time elements and replaces the need to include a tolled road ASC. Model M8.3, for All respondents, has similar difficulties to Model M8.1, with VRT being small and insignificant. By contrast, Model M8.2, for Traders, has an acceptable goodness of fit, plausible (though low) values of time, and significant coefficient estimates for all attributes modelled. The monetary estimates show great similarities with those from Model M7.4 (for All respondents), which is the most plausible model from the SP2 model analyses. Since, for most purposes, a model is required that includes the Non-traders, Model M7.4 remains the preferred model.

**Table 4.6 Pooled Model Results**

	M8.1 All			M8.2 Traders			M8.3 All		
Individuals	260			202			260		
Observations	2333			1521			2333		
Rho-sq w.r.t. constants	0.0991			0.143			0.1104		
Adjusted rho-sq	0.0937			0.1362			0.1058		
Log Likelihood (full)	-2311.9			-1553.6			-2282.9		
Log Likelihood (const)	-2566.3			-1812.7			-2566.3		
	<i>Coeff</i>	<i>t-stat</i>	<i>Base Value</i>	<i>Coeff</i>	<i>t-stat</i>	<i>Base Value</i>	<i>Coeff</i>	<i>t-stat</i>	<i>Base Value</i>
Cost	-0.193	-12.3		-0.279	-14.9		-0.311	-17.2	
Journey time (JT)	-0.014	-5.1	4.26 £/h	-0.018	-6.4	3.90 £/h	-0.014	-5.7	2.79 £/h
Journey time spread (RT)	-0.003	-1.0	0.99 £/h	-0.016	-5.4	3.43 £/h	-0.004	-1.6	0.79 £/h
Start-Stop time (SST)	-0.039	-18.4	12.17 £/h	-0.044	-16.4	9.36 £/h	-0.039	-18.7	7.59 £/h
M6T ASC	0.128	0.7	0.66 £						
Toll Road ASC	0.154	1.0	0.80 £						
A road ASC	-0.653	-7.3	-3.39 £	-0.806	-7.6	-2.89 £	-0.671	-8.4	-2.16 £
3 Hr Dep. time shift ASC	-0.770	-4.9	-3.99 £	-0.590	-3.5	-2.11 £	-0.732	-5.2	-2.35 £
<i>Base Cost*Drivers</i>			<b>BVAF</b>			<b>BVAF</b>			<b>BVAF</b>
Cost*Manager	-0.101	-6.9	0.657	0.107	6.6	1.625	0.119	7.6	1.619
<i>Base: Cost*(HGV/ mixed)</i>									
Cost*LGV only	-0.063	-3.6	0.754	-0.057	-2.9	0.830	-0.060	-3.3	0.838
<i>Base=(DD,MD,MM)</i>									
Cost*(DF)	0.100	5.4	2.076	0.081	4.0	1.410	0.109	5.7	1.538
Cost*(MF,P)	-0.050	-2.1	0.793	-0.098	-3.2	0.741	-0.089	-3.0	0.778
Cost*Service	0.111	5.0	2.347	0.114	4.8	1.688	0.117	5.2	1.603
Cost*Other	0.028	1.2	1.173	0.055	2.3	1.246	0.043	1.8	1.159
<i>Base: Cost*Not from a port</i>									
Cost*From a Port	-0.038	-1.7	0.836	-0.045	-1.9	0.862	-0.032	-1.4	0.907

## 4.5 Mixed Logit Modelling

During the SP design process it was realised that the statistical power available was unlikely to permit accurate recovery of both the journey time coefficients and the ASC in favour of the tolled road, even with the size of samples then envisaged. This relates to the fact that realism required the tolled roads usually to be quicker and more reliable than non-tolled roads. As there was separately a desire to 'unpack' the ASC, direct questioning took place seeking to establish the ASC and its split by components.

Due to errors in calculating the ASC from the respondent data, it initially appeared that it was close to the (large) value estimated in the models (for Traders). Having identified the calculation errors it was clear that the models for Traders were grossly overestimating ASC, presumably at the expense of underestimating the values of time. To overcome this we imposed the directly obtained ASC figure, for each individual, into our models, to eliminate distortion in the estimation of values of time. Somewhat higher values of time resulted, see Model M7.6 in Table 4.5.

Since our direct ASC question did not permit negative responses, e.g. on the grounds of protest against tolled roads, using that question to obtain correct valuations for ASC and values of time is of limited benefit. Negative ASCs might apply to both Traders and Non-traders. Traders will mostly have a positive ASC, and this is borne out by the evidence, but the average from the direct questioning was only 53p per Trader. When subtracting the respondents' ASC from the toll in our previous models we have only subtracted the non-negative values we had. Those without a positive ASC value have this reset to zero, rather than their unknown true negative value. It would therefore appear that we were distorting the model, holding many ASCs (and the average ASC) higher than they should have been.

Consequently, use of a Mixed Logit Normal Distribution for the ASC took place. This returns an insignificant mean ASC (negative in the results presented here) in Table 4.7. This has much too wide a distribution ( $\pm$  £15), but serves to check that the ecological fallacy (identification problem) is not a problem in this analysis. This term takes up some of the random noise rather than the residual error, but this does not seem to pose a problem.

MMNL also has the advantage of dealing with the repeated observations problem when calculating standard errors from SP data. Our MMNL models used 1000 draws per person from modified Latin hypercube shifted and shuffled samples. The way we dealt with the fact that the same respondent decides across different choice sets, the repeated measurement effect, was to employ the same parameter draws for all the choice sets faced by the same individual. We have used code developed by Richard Connors and Nicolás Ibáñez at ITS, building on code provided by Kenneth Train (see Train, 2006).

Table 4.7 presents the MMNL models for SP2 with the default now Managers rather than Drivers. Model M9.1 only includes a Normal distribution on the ASC. Model M9.2 adds Log-normal distributions for the time variables. Model M9.3 adds a Log-normal distribution for Cost and estimates correlations between the Cost and Time

parameters. As the estimated parameter on the time coefficients are distributed Log-normally, they do not represent the mean value but a transformation of the mean and (Normally distributed) variance.

For Normally distributed parameters, like the ASC, we provide four values in the corresponding row of the table. The First and third columns refer to the mean and standard deviation of the distribution, and the second and fourth refer to the t-ratio associated with those two parameters. For a Log-normally distributed parameter, we also provide four values, but to build the real distribution of the parameter, we need an extra step, which is to take the following exponential:

$$-1 * \exp(\text{param}(1^{\text{st}} \text{ column}) + \text{param}(3^{\text{rd}} \text{ column}) * N(0,1))$$

As stated in Section 4.3, we favour Model M7.4 over M7.3, i.e. we favour including all respondents. This worsens the fit, but does not materially affect the base values of time, and avoids the question of what to do about Non-traders if forecasting with the Traders model. Furthermore, the ASC becomes insignificant, at 38p. Excluding these individuals in Model M7.3 increases the value of the ASC to be significant at about £2.74, which we believe, is implausibly high as an overall mean value. M9.1 adds the Normal Distribution for ASC, but this has little effect on the base values of time. This suggests that the 'Negative ASC' problem was not of great magnitude in itself. It looks as though our respondents are genuinely displaying low values of time; presumably, because they cannot see the reduced costs associated with faster and more reliable journey times, nor what additional revenue arises.

Model M9.2 proceeds further to place Log-normal distributions on the time parameters. The effect is to increase the mean values of time.

Model M9.3 further adds a Log-normal distribution to the Cost parameter. This raises complications for parameter valuations since these are now the ratio of two distributions. The model therefore estimates correlations between the Cost, JT, RT and SST parameter estimates so that the correct points in each distribution match up. For example, the negative correlation between Cost and the JT parameter estimate indicates that a high Time parameter estimate would go with a low Cost parameter estimate, so that the ratio of Time to Cost parameter estimates will have a wider distribution of values of time than would be the case for independent parameter estimates. Due to the positive skew, this will make the mean value of time estimates higher than for the independent case.

No BVAF values exist since these adjustments are much more difficult in the case of Mixed logit models.

**Table 4.7: Results of Mixed Logit Models on SP2**

	M9.1: SP2 All respondents				M9.2 All respondents			
Individuals	260				260			
Observations	1299				1299			
Rho-sq w.r.t. constants	0.1837				0.2330			
Adjusted Rho-sq	0.1761				0.2240			
Log Likelihood (model)	-1122.8				-1054.9			
Log Likelihood (constants)	-1375.4				-1375.4			
	Parameter	t-stat	Base Value	Distribution	Parameter	t-stat	Base Value	Distribution
				Param t-stat				Param t-stat
Cost	-0.467	-9.4			-0.592	-6.5		
Journey time (JT) *	-0.021	-5.4	3.99 £/h		-3.884	-13.8	3.33 £/h	0.97 3.8
Journey time spread (RT) *	-0.014	-2.7	2.66 £/h		-4.120	-4.8	2.70 £/h	-0.99 -2.6
Start-Stop time (SST) *	-0.044	-18.5	8.35 £/h		-2.956	-21.7	11.5 £/h	1.25 9.9
Tolled Road ASC <sup>†</sup>	-0.351	-1.1	-1.11 £	2.871 9.8	-0.349	-0.9	-0.59 £	3.54 9.0
<i>Base Cost*Managers</i>								
Cost*Drivers	0.152	-3.5			-0.175	-3.2		
<i>Base: Cost*(HGV only and mixed)</i>								
Cost*LGV only	-0.162	-3.1			-0.178	-2.6		
<i>Base=(DD,MD,MM)</i>								
Cost*(DF)	0.227	4.4			0.259	3.9		
Cost*(MF,P)	-0.088	-1.2			-0.124	-1.3		
Cost*Service	0.230	3.6			0.248	2.9		
Cost*Other	0.075	1.2			0.125	1.5		
<i>Base: Cost*Not from a port</i>								
Cost*From a Port	-0.006	-0.1			0.026	0.4		

Where distributions are applied, \* represents Log-normally distributed;<sup>†</sup> Normally distributed.

Note: Base group in mixed logit estimations were Managers, whereas in Sections 4.2 to 4.4 we used Drivers as base.

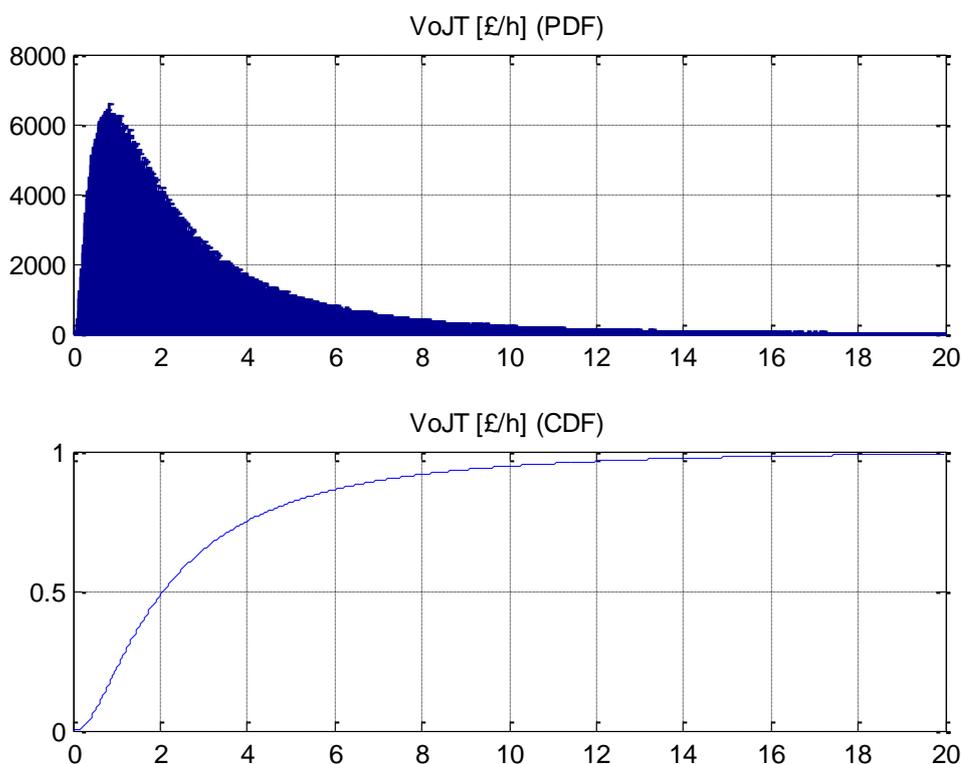


Figures 4.1 to 4.4 for Model M9.2 are very informative. There are two distributions for each parameter, the first the density and the second the cumulative. The distributional form chosen for JT, RT and SST were all Log-normal with a lower bound fixed at zero, whilst that for the ASC was Normal. Leakage for the pure random noise effects into the estimated distributions will serve to make them much too wide, giving too many low and high estimates. The centre of the distributions should be in the right place, though.

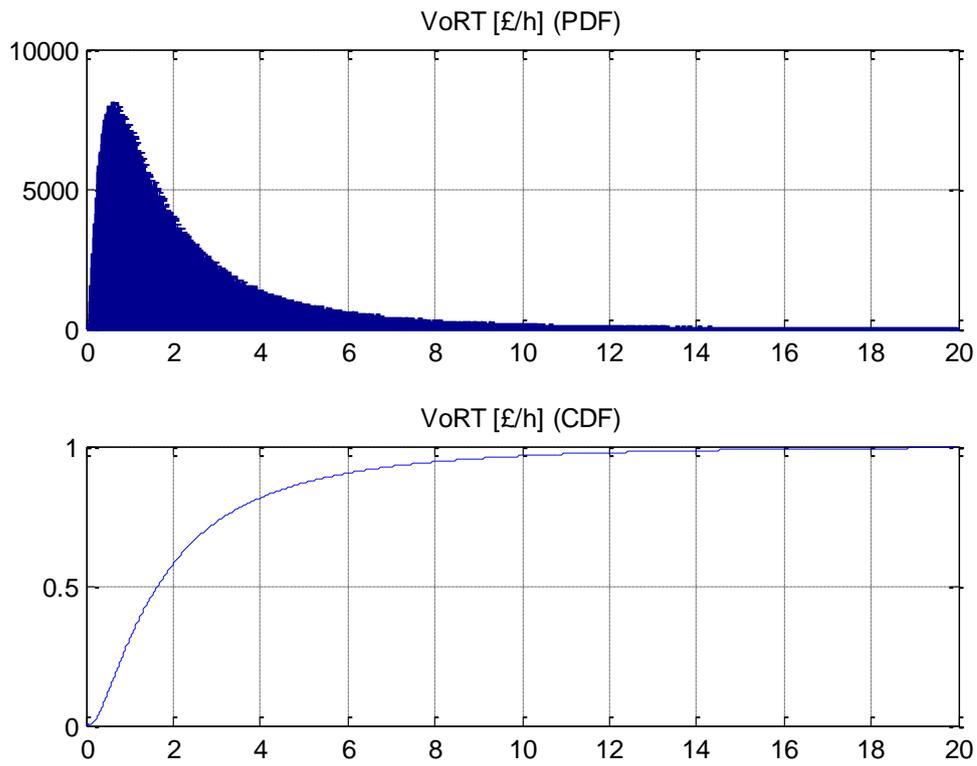
We first note that half of the modelled individual values of journey time (VJT) were below £2/hr since the cumulative function had reached 0.5 at about that value. The modal VJT is less than £1/hr. There is a long tail to the right, but very few values will be above the driver's wage rate (around £10/hr).

We would expect the VRT to be in the range 0.5 VJT to VJT and that is the case here, with the median about £1.60/hr. The value of the start-stop time has a much longer tail, with a median slightly above £5/hr, but a mode of less than £2/hr. The estimated distribution of the value of the ASC is much wider than is plausible. This almost certainly arises from leakage of random noise from the residuals. The average value is slightly above zero.

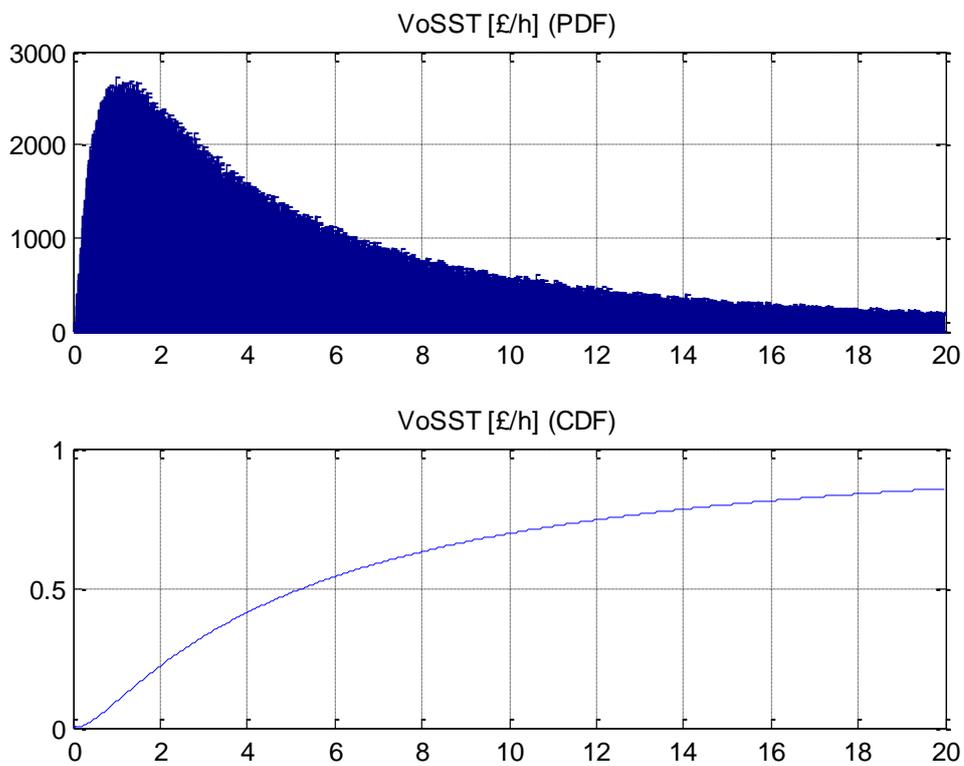
**Figure 4.1 Distribution of VJT from Mixed Logit Model M9.2**



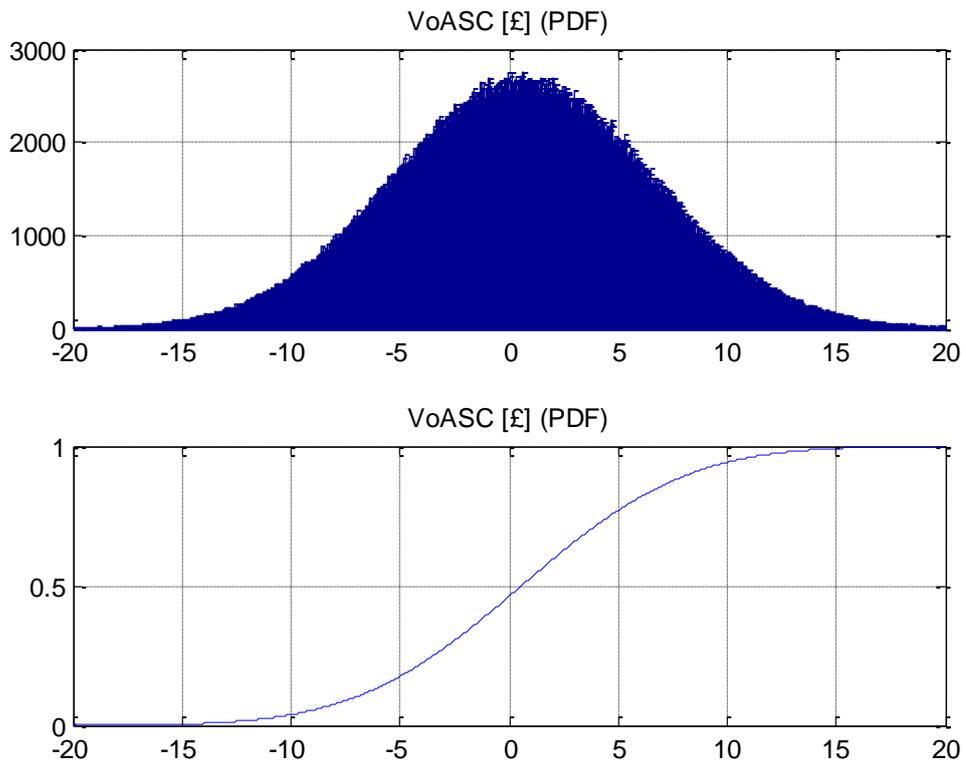
**Figure 4.2 Distribution of VRT from Mixed Logit Model M9.2**



**Figure 4.3 Distribution of VSST from Mixed Logit Model M9.2**



**Figure 4.4 Distribution of ASC from Mixed Logit Model M9.2**



## 5. Recommended Model and Monetary Values

### 5.1 Introduction

Section 5 provides our final recommendations regarding preferred models, and discusses implications for monetary valuations of journey time savings. These monetary valuations are derived as the ratio of the appropriate time and cost coefficients, having taken account of dummy variable effects. It is instructive to look at some of these monetary valuations before finalising our decision regarding preferred models, and we begin that in Section 5.2.

### 5.2 Monetary Valuations

When calibrating segmented models, such as those in Table 4.5 above, it becomes difficult to see the implications for monetary values. While it might seem sufficient to take a coefficient, say for start-stop time, and divide it by the cost coefficient, the resulting monetary valuation will only apply when all the other segmentation effects are set at their implicit default values. Here the defaults are:

- (i) Drivers (as opposed to Managers);
- (ii) The firm runs either just HGVs or both HGVs and LGVs (as opposed to just LGVs);
- (iii) The movement is from a Distribution site to a Distribution site (DD), from Manufacturing to Distribution (MD) or from Manufacturing to Manufacturing (MM); and
- (iv) The traffic is not moving from a port.

On that default basis, Table 5.1 presents the monetary valuations of JT, RT and SST from our SP2 models in Section 4.3. Interpretation of coefficients from the Mixed Logit in terms of monetary valuations of those is more difficult and presented later.

**Table 5.1 Monetary Values: HGV Drivers to Distribution or Manufacturing, not from a port for selected SP2 Models (All respondents).**

	M7.4 All Value (t-stat)	M7.6 Net toll Value (t-stat)	M7.7 Exploded Value (t-stat)	M7.8 Nested Value (t-stat)	M8.1 All Value (t-stat)	M9.1 All Value (t-stat)
Journey time (JT) £/hr	3.63 (3.8)	3.73 (4.0)	3.28 (4.8)	3.93 (5.0)	4.26 (4.8)	3.99 -
Journey time spread (RT) £/hr	2.98 (2.1)	3.04 (2.8)	1.51 (1.5)	2.93 (2.5)	0.99 (1.0)	2.66 -
Start Stop time (SST) £/hr	11.18 (9.2)	11.07 (11.1)	9.09 (13.6)	8.74 (8.3)	12.17 (11.0)	8.35 -

The above table also shows the t-ratios for the monetary valuations. In general, this requires a very complex calculation, but for the defaults it is simple enough. These monetary values arise from models based on all respondents.

From Table 5.1, we can see that the Nested logit model (i.e. Model M7.8 in Table 4.5) yields the highest values of journey time, some £3.93 per hour. The remaining

values of time are £2.93 for journey time spread and £8.74 for start-stop time. Values for the multinomial models, M7.4 (containing the tolled road ASC) and M7.6 are somewhat lower, and the exploded specification (Model M7.7) yields lower values. All time parameters are significant with the exception of RT in the exploded model M7.7. In all three cases that estimate the Toll Road bonus it is small and insignificant, and even negative in the Nested logit, suggesting a protest vote by some respondents. We have kept the ASC in these models to show clearly that its effect is not significant.

Construction of monetary valuations can take place for any combination of effects desired. Table 5.2 reports detailed segmentations of the value of journey time, journey time spread and start-stop time measures for the multinomial model M7.6. These arise from the Base Value Adjustment Factors reported in the Tables 4.4 and 4.5 and explained in Section 4. Note that the ratios between differences in the time valuations in Table 5.2 will be constant across the different groups as they are segmented by Cost. Driver/Manager, HGV/LGV and Sector segmentations show how valuations vary across models. Across the models and time measures, Drivers have higher valuations than Managers do, HGVs have higher valuations than LGVs, and the Services sector have higher values than elsewhere. The Driver/HGV/Service sector combination has the highest monetary values, with £9.39, £7.65 and £27.86 per hour respectively for JT, RT and SST. The lowest values are found in Managers/LGV/MF and P sector, of £1.78, £1.45 and £5.28 per hour respectively for JT, RT and SST.

**Table 5.2 VJT, VRT, and VSST by sector, respondent type and vehicle type (not from port), in £/hr from Model M7.6.**

			DD,MD,MM	DF	MF,P	Services	Other
VJT	Driver	HGV/Mixed	3.73	9.08	2.86	9.39	5.29
	Driver	LGV	2.99	5.67	2.40	5.79	3.92
	Manager	HGV/Mixed	2.42	3.91	2.02	3.97	2.99
	Manager	LGV	2.08	3.11	1.78	3.14	2.50
VRT	Driver	HGV/Mixed	3.04	7.40	2.33	7.65	4.31
	Driver	LGV	2.44	4.62	1.96	4.72	3.19
	Manager	HGV/Mixed	1.97	3.19	1.64	3.23	2.43
	Manager	LGV	1.70	2.53	1.45	2.56	2.03
VSST	Driver	HGV/Mixed	11.07	26.96	8.48	27.86	15.69
	Driver	LGV	8.88	16.84	7.13	17.19	11.63
	Manager	HGV/Mixed	7.18	11.61	5.99	11.77	8.87
	Manager	LGV	6.19	9.22	5.28	9.33	7.40

Understanding the monetary valuations from the Mixed logit analysis is more complex. In Model M9.2 where the time attributes are Log-normal distributions, the means and median values of time arise without simulation. The distributed Log-normal parameter on the time coefficients means that they do not represent the mean value, in the same way as fixed or Normally distributed values would. Instead,

for example, the journey time coefficient is a transformation of the mean and (normally distributed) variance. From this, we can calculate the distribution of, for example, the values of journey time, with the relevant segmentations, for example the extra cost for Drivers (as opposed to a base of Managers) added to the cost coefficient in the denominator. From this expression, we can also derive the mean and medians of the values of journey time.

$$\beta_{JT} = e^{\mu_{JT} + \sigma_{JT}V}, V \sim N(0,1)$$

$$VoJT \sim \frac{e^{\mu_{JT} + \sigma_{JT}V}}{\beta_c + \beta_{cdriver} + \dots} = e^{\mu_{JT} - \ln(\beta_c + \beta_{cdriver} + \dots) + \sigma_{JT}V}$$

$$\text{Mean } VoJT = e^{\mu_{JT} - \ln(\beta_c + \beta_{cdriver} + \dots) + \frac{\sigma_{JT}^2}{2}}$$

$$\text{Median } VoJT = e^{\mu_{JT} - \ln(\beta_c + \beta_{cdriver} + \dots)}$$

Exactly the same process is required to derive distributions for the value of reliability and start-stop time.

For the ASC, which is normally distributed, the following process applies:

$$ASC = \mu_{ASC} + \sigma_{ASC}V, V \sim N(0,1)$$

$$VoASC \sim \frac{\mu_{ASC} + \sigma_{ASC}V}{\beta_c + \beta_{cdriver} + \dots} = \frac{\mu_{ASC}}{\beta_c + \beta_{cdriver} + \dots} + \frac{\sigma_{ASC}}{\beta_c + \beta_{cdriver} + \dots}V$$

$$\text{Mean } VoJT = \text{Median } VoJT = \frac{\mu_{ASC}}{\beta_c + \beta_{cdriver} + \dots}$$

Tables 5.3, and 5.4, show the mean, and median, of the VJT, VRT and VSST distributions. Due to the positive skew of the Log-normal distribution, the means are larger than the medians. Compared with the mean values from the multinomial Model M7.6, the medians are lower and the means are somewhat higher. Again, across the models and time measures, Drivers have higher mean and median valuations than Managers, HGVs higher than LGVs but this time the higher values occur in the DF sector. The Driver/HGV/DF sector combination has the highest monetary values, with medians of £7.84, £6.19 and £19.84 per hour respectively for JT, RT and SST. The lowest median values are found in Managers/LGV/MF and P sector, of £1.38, £1.09 and £3.49 per hour respectively for JT, RT and SST.

### 5.3 Recommendations

We were not satisfied with the model results from SP1. The results from SP2 were much better. Pooling of SP1 and SP2 was possible having checked the relative scaling, but the resulting models offered no advantages over those based on SP2. The monetary values we recommend from the fixed coefficient modelling of SP2 are those from Model M7.4 based on All individuals (rather than Traders) and using ASCs directly estimated from the model rather than individuals' own reported values.

The best non-fixed coefficient model was Model M9.2 which offers higher values of time than Model M7.4, and overall we prefer this model. It is richer in that it uses distributions of values for the journey time, spread, start-stop time and the ASCs. Due to the complexity of the modelling, Model M9.2 does not provide us with t-statistics on the mean value of time, although we have presented information on the distribution of the values of time in Figures 4.1-4.4. We suggest that the t-statistics from Model M7.4 may be taken as indicative of the significance of the values of time estimated by Model M9.2. For a Driver of an HGV, moving within Manufacturing and Distribution not from a port, the VJT is estimated at £3.73 per hour with an addition (VSST) of £11.07 per hour in start-stop traffic, plus £3.04 per hour of VRT (spread of arrival times).

**Table 5.3 Mean values of VJT, VRT, and VSST by sector, respondent type and vehicle type (not from port), in £/hr from Model M9.2.**

			DD,MD,MM	DF	MF,P	Services	Other
VJT	Driver	HGV/Mixed	4.73	12.54	3.65	11.72	6.77
	Driver	LGV	3.32	5.88	2.74	5.69	4.20
	Manager	HGV/Mixed	3.33	5.93	2.75	5.75	4.23
	Manager	LGV	2.56	3.86	2.21	3.78	3.06
VRT	Driver	HGV/Mixed	3.83	10.14	2.95	9.47	5.47
	Driver	LGV	2.68	4.75	2.22	4.60	3.40
	Manager	HGV/Mixed	2.70	4.80	2.23	4.64	3.42
	Manager	LGV	2.07	3.12	1.78	3.06	2.47
VSST	Driver	HGV/Mixed	16.33	43.26	12.58	40.44	23.35
	Driver	LGV	11.44	20.28	9.46	19.64	14.49
	Manager	HGV/Mixed	11.50	20.47	9.50	19.82	14.59
	Manager	LGV	8.84	13.33	7.61	13.05	10.56

**Table 5.4 Median values of VJT, VRT, and VSST by sector, respondent type and vehicle type (not from port), in £/hr from Model M9.2.**

			DD,MD,MM	DF	MF,P	Services	Other
VJT	Driver	HGV/Mixed	2.96	7.84	2.28	7.33	4.23
	Driver	LGV	2.07	3.68	1.72	3.56	2.63
	Manager	HGV/Mixed	2.08	3.71	1.72	3.59	2.64
	Manager	LGV	1.60	2.42	1.38	2.36	1.91
VRT	Driver	HGV/Mixed	2.34	6.19	1.80	5.79	3.34
	Driver	LGV	1.64	2.90	1.35	2.81	2.07
	Manager	HGV/Mixed	1.65	2.93	1.36	2.84	2.09
	Manager	LGV	1.26	1.91	1.09	1.87	1.51
VSST	Driver	HGV/Mixed	7.49	19.84	5.77	18.54	10.71
	Driver	LGV	5.25	9.30	4.34	9.01	6.65
	Manager	HGV/Mixed	5.28	9.39	4.36	9.09	6.69
	Manager	LGV	4.05	6.11	3.49	5.98	4.84

## **6. Conclusion**

This report has documented on the freight SP work of the 2006-8 UK Department for Transport M6 Toll road project. Freight SP surveys quite normally have to manage with small sample sizes, and the limitations this presents for the depth of modelling that can be supported must be accepted. Effects that are marginal in statistical terms may therefore be real effects that a larger sample size would have found significant and are included in the results. Nevertheless, we have tried to exclude variables from our models wherever reasonable to provide results that are easy to understand.

Some complicated interactions are at work and careful interpretation of our results is necessary. Generally, the magnitude of the values of time found is smaller than previous SP values and the current DfT recommended values. They are, however, consistent with how little goods traffic appears to be willing to pay the current toll. There may be some aversion to paying tolls, per se, that is both holding our estimated values down and depressing actual M6T freight traffic. Furthermore, the £7.50 each way toll would often form a sizable proportion of the profit margin on many freight movements. It should nevertheless be worth paying if savings in driver's wages and vehicle operating cost were greater. However, where drivers are not on overtime, it might be difficult for respondents to see how any wages would be saved by the earlier arrival back at depot, particularly if the 'peak vehicle requirement' period had already passed.

Section 5 provides the recommended values and includes journey time spread (Reliability) and start-stop time valuations in addition to journey time itself. We have relied most on the second SP experiment, although results from the first experiment were not much different. Results show consistency across the model types, the Multinomial Logit (MNL) results being quite adequate. A Nesting structure offered some improvement, and we used Mixed Multinomial Logit (MMNL) to allow for distributional variation in the Tolloed Road Bonus variable, which we suspected was for some respondents negative as a protest against toll roads. However, this did not appear to be important, as judged from the MMNL results.

In summary, we have thoroughly analysed a small but rich dataset using state of the art techniques. Broadly speaking, the results do show some possibility of freight traffic moving to use the M6 Toll road if conditions on the M6 deteriorated sharply. The 'A Road' alternative is sufficiently worse than the M6T already that it would not attract much traffic in that case.

## ***Appendices***

### ***Appendix A. Initial Exploratory Analysis of SP1, for Traders***

#### **A1.1 Introduction**

##### **Model Types**

Two types of modelling referred to as: 'Splits' and 'Segmentations' took place. As a first approximation, the Splits are an initial means of investigative work, while the Segmentations represent our main modelling effort to derive our recommended values. The position is, however, complex and it is important to understand the differences between the two model types to interpret the model outputs.

For example, if you wanted to know whether, in the M6T corridor, Managers had higher values of time than Drivers. You might be tempted to look at the preferred model, which segments the Cost variable using a dummy that is zero for Drivers and one for Managers. That dummy is easy to apply, it is one for managers so you apply the Base Value Adjustment Factor (BVAF) shown to the base values of time (for Drivers) to get values of time for Managers. It should be emphasised that that value only applies to Managers with all the other segmenting dummies set at their base values, e.g. HGVs not coming from a port etc. Managers, in our sample, do not just have HGVs, for instance. To use this model you would need to know what proportions of HGV and LGV they had, and the same applies to all the other segmenting variables. Our segmenting variables are not orthogonal, and we must be aware of potentially large correlations between them.

What you need are the results from models that only have Managers in, or models that have a single segmentation that splits out Managers. We refer here to both of these as Splits. In Splits models, Managers values of time may differ from Drivers because Managers may be reporting a higher proportion of LGV trips than are Drivers. The full Segmenting model will apportion those two effects so the effect due to Managers may look much smaller than from a Splits model. The Splits model will give results for Managers that incorporate all effects (LGV/HGV, etc) and may have little to do with the respondent being a Manager as opposed to a Driver.

We have chosen to include our Splits models results in this report, albeit in an Appendix, since we had many requests to look at a range of effects of interest to one group or another. For example, there was interest in the effect of having a Delivery Window. That variable dropped straight out of our Segmentation model as not being statistically significant. In order to provide those interested in that effect with at least something, we have decided to include those early runs. However, as other models replace them, their description is not as complete as might be wished, and there are some minor inconsistencies with the later modelling. We have placed these results in an Appendix so as not to confuse the issue as regards our main (Segmentation) results.

Experimentation involving the time parameters (together) yielded nonsensical estimates due to multicollinearity and the segmentations took place on the cost

parameter. Statistically different segments arose for Drivers/Managers, LGV only vs HGV/Mixed vehicles, and whether journey was driving from a port. Initial results suggested similarities across several of the different sectors, so we simplified the segmentation by of industrial sectors merging the sectors in the following way:

- i) Base group: This consists of traffic going to a distribution centre or to a manufacturing point (sectors DD, MD and MM).
- ii) Distribution to Final (DF)
- iii) Manufacturing to Final and Bulks flows (MF,P)
- iv) Service sector flows (S)
- v) Others (O)

This section briefly reports initial exploratory analysis of SP1 using the 'Splits' method, as described above. We use a dummy variable on 'Cost' for the dimension of interest. This procedure forces all valuations to change in the same proportion, i.e. if group 1 has a 10% higher value of JT than group 2, it will also have a 10% higher valuation of RT and all other attributes. Furthermore, it was impossible to derive useful estimates when an M6T dummy was included, so none was included in the models reported in this section. All the estimates presented here assume a toll road 'Bonus' of zero.

Data from SP1 yielded 3120 exploded binary pairs (three binary combinations per choice scenario\*four choice scenarios \*260). The three binary combinations were Col 1 v Col 2, Col 1 v Col 3 and Col 2 v Col 3. Degrees of freedom are only two-thirds of the number of observations, so a 22% overstatement occurs for all t-statistics. Column 4, if present (i.e. if it was a 'peak' journey), was ignored. However, of these 61 were immediately rejected, being based on equal rankings, leaving 3059 valid pairs. Furthermore, only SP1 Traders are considered (147 of the 260), reducing the sample size yet further. Consequently treat the results in this section with caution. Note that while we have previously noted that we have 202 of what we define to be 'Traders', of these only 147 traded in the SP1 experiment. We call these SP1 Traders, and similarly for SP2.

## **A1.2 The effect of commodity type: Bulks vs Non-bulks**

We begin by looking for differences between Bulks and Non-bulks. Bulks are flows originating from Primary industries, with non-bulks being anything else.

Table A1.1, shows there is not much difference between the monetary valuations for Bulks and Non-bulks. The t-statistic for the difference of the cost coefficients is 1.5, which is non-significant. However, the direction of difference is as expected and the t value is high, so it would be sensible to take these differentiated figures forwards as our best estimates.

**Table A1.1 SP1 results split by Bulk/Non-bulk**

	Parameter	t-stat	Monetary Values	
			Bulk	Non-bulk
Cost: Bulk	-0.2029	-7.8	1	
Cost: Non-bulk	-0.1596	-13.1		1
Scheduled Journey time	-0.02138	-4.9	£6.32/hr	£8.04/hr
Journey time spread	-0.01034	-2.8	£3.07/hr	£3.90/hr
Start-stop time	-0.02458	-2.8	£7.27/hr	£9.24/hr
A-road penalty	-0.9723	-9.2	£5.08	£6.09
Rho sq w.r.t. constants	0.0977			

For Non-bulks, the figures indicate that, for example, avoiding 40 minutes of start-stop driving and saving 15 minutes scheduled/expected journey time should be sufficient to cover payment of the (then) £7.50 M6 Toll road toll. For Bulks traffic to pay the toll, conditions on the M6 would have to be even worse.

### **A1.3 Different valuations of Drivers and Managers**

Where we intercepted Drivers we asked them if they could answer questions regarding making the decision to use tolled roads or not. All but four claimed they were in a position to do that, and so we proceeded to ask them to complete the SP experiments based on the details regarding the load they were moving when intercepted. The only other group of respondents were Managers, who were necessarily divorced from a particular load moving in the M6T corridor and so had to imagine such a load. This immediately gives a reason for expecting a difference in valuations, but we also thought that Managers might have different valuations anyway. In the event, we also had to take into account the evidence that Managers reported much longer distance journeys than did Drivers, which could also give rise to differences in valuations.

Table A1.2 shows a clear difference between the willingness to pay of drivers and managers. It is the largest of the factors we have found affecting value differences. The t-statistic for the difference is 2.57, clearly significant at the usual 5% level.

**Table A1.2 SP1 results split by Drivers/Managers**

	Parameter	t-stat	Monetary Values	
			Drivers	Managers
Cost: Drivers	-0.1445	-11.6	1	
Cost: Managers	-0.1944	-13.0		1
Scheduled Journey time	-0.0217	-5.0	£9.01/hr	£6.70/ hr
Journey time spread	-0.0106	-2.8	£4.39/hr	£3.26/hr
Start-Stop time	-0.0258	-3.0	£10.70/hr	£7.95/hr
A-road penalty	-0.4918	-9.3	£3.40	£2.53
Rho sq w.r.t. constants	0.1048			

As we have found elsewhere, Managers were much more reluctant to spend money on toll payments than were drivers. This may largely be due to interviewing managers about a hypothetical journey, whereas the drivers had in mind the actual journey they were making and would be subject to a range of abnormal circumstances that the manager would have had no reason to consider. As profit margins in road haulage have traditionally been low, those movements on behalf of others to an agreed price might become unprofitable if haulage managers did not take such an attitude. Drivers, on the other hand, have a much closer relationship with the customer, and may face difficulties if arriving late, such as having to go to the back of the queue as a punishment. Naturally, if drivers repeatedly choose to use toll roads in situations where their manager can see no benefit, the manager will refuse to reimburse the driver, and so impose his/her will. Managers were also considering longer journeys than were Drivers, and the M6T benefits would have seemed smaller proportionately.

#### **A1.4 Differential valuation depending on whether there was a fixed arrival time or not, or whether there was an arrival time window or not.**

Next, we conflate the very similar non-cost parameter estimates from two runs, one breaking down the cost term by whether or not a fixed arrival time existed (FIX) or not (NFIX); and the second breaking down the cost term by whether there was a delivery time window (WIN) or not (NWIN). Table A1.3 gives the results, Rho-squared values being similar to those in Table A1.1.

**Table A1.3 SP1 results split by arrival time requirements**

	Parameter	t-stat	FIX	Monetary Values		
				NFIX	WIN	NWIN
Cost: FIX	-0.1504	-11.1	1			
Cost: NFIX	-0.1700	-13.0		1		
Cost: WIN	-0.1572	-8.7			1	
Cost: NWIN	-0.1626	-13.2				1
Scheduled JT	-0.0213	-4.9	£8.50/hr	£7.52/hr	£8.13/ hr	£7.86/hr
JT spread	-0.0103	-2.8	£4.11/hr	£3.64/hr	£3.93/hr	£3.80/hr
Start-Stop time	-0.0246	-2.8	£9.81/hr	£8.68/hr	£9.39/hr	£9.08/hr
A-road penalty	-0.97	-9.2	£6.45	£5.71	£6.17	£5.97

The above results show no statistically interesting difference in monetary valuations between columns. As might be expected, valuations are highest where there is a fixed arrival time specified, the next highest being where there is a specified delivery time window. However, these effects seem very weak.

**A1.5 Differential valuation depending on whether the respondent was an existing M6Toll user.**

Table A1.4 breaks down the Cost term by how the respondent answered the question ‘Do any of your freight movements use the M6 Toll road (Y/N)?’. If they replied “yes” then they are a USER if not, NUSER.

**Table A1.4 SP1 results split by M6 Toll road usage**

	Parameter	t-stat	Monetary Values	
			USER	NUSER
Cost: USER	-0.1515	-12.0	1	
Cost: NUSER	-0.1784	-12.5		1
Scheduled JT	-0.0214	-4.9	£8.48/hr	£7.20/hr
JT Spread	-0.0104	-2.8	£4.12/hr	£3.50/hr
Start-Stop time	-0.0248	-2.9	£9.82/hr	£8.34/hr
A-road penalty	-0.9732	-9.2	£6.42	£5.46
Rho sq w.r.t. constants		0.0987		

There is little difference in values between the two groups, but the difference is almost significant at the 5% level. As expected, current USERS have higher values of time. Not all eligible traffic of USERS is using the M6T for the journey in question. Perhaps they use it for just a small amount of premium traffic. Consequently, do not interpret the above results as applying to traffic using or not using the M6T – the question related to whether the respondent EVER used the M6T not whether they ALWAYS used it.

## ***A2. Analysis of experiment SP2 using two-way splits for Traders***

### **Initial investigation of SP2 data for Traders by splitting the data and estimating separate models**

As with SP2, we began our investigation of SP2 by looking at some “everything as it is” splits. Appendix A7 presents the detailed results and the following provides a brief summary. Table A7.1 contains, in its rightmost column, a simple model for the whole of the data. We have again taken an explosion to binary choices, giving us 5501 from 187 individuals. Significant coefficient estimates arose for Cost, Journey Time (JT), Journey Time Spread (RT), and Toll Road ASC. Values of time are low, with none occurring for start–stop time, whilst the valuation of the Toll road ASC looks too high.

Two divisions of the sample took place: Drivers v Managers; and Bulks v Non-bulks. Table A2.1 shows a better goodness of fit for Managers than for Drivers. Between these two groups, there was no difference in estimated Toll Road Bonus, but quite large though not significant differences between their values of time. There were only 15 individuals in the Bulks group (leaving 172 in Non-bulks), and no significant differences, though the estimate of Toll Road bonus was considerably lower for Bulks. The problems of excessive Toll road bonus and inadequate values of time remain, and little reliance be placed on these early results.

### **Results from exploratory analysis of SP2 data for Traders by segmenting a single journey time variable.**

Partly due to our early failure to adequately estimate the coefficient of start-stop time, we experimented with forming just one time variable, this was set equal to JT plus RT, i.e. the time by which 98% of the journeys were completed, which we call JRT. Tables A2.2 to A2.6 show the results, and are summarised here.

Firstly, Table A2.2 shows the results from segmenting JRT by the sectors defined in sub-section 4.4. We must bear in mind that there are small numbers of individuals in each sector. VJRT varied between £1.60/hr, for Distribution-to-Distribution movements, up to £7.66/hr for Services movements. These values are all clearly too low, and the associated Toll Road Bonus of £3.20 is clearly too high. This last point affects all the results from this segmentation experiment. Higher values of JRT occurred where there was a fixed arrival time, but not quite significantly so. No effect by journey distance was found, nor between LGVs and HGVs, or Bulks and Non-bulks. This experimental approach did not add therefore succeed or add value to the base analyses.

### **Results from segmentation on Cost for SP2 Traders data**

Following on from these disappointing results, Table A2.7 reports the results from a model segmenting the Cost variable by whether the respondent said they used the

M6T or not. The only other variables were the ASC for a tolled road and JRT. Here there was a significant difference, with those who sometimes used the M6T having a smaller Cost coefficient, and therefore higher monetary values of everything else. Nevertheless, the value of time is too low and the Toll road Bonus too high.

## **A2.1 Introduction**

Section A2 looks at experiment SP2, first splitting the data in the dimension of interest, and later using a 98% journey time dummy on the dimension of interest. Data from SP2 yielded 7200 exploded binary pairs (six binary combinations per choice scenario \* five choice scenarios \*260). This time, the six binary comparisons are Col 1 v Col 2, Col 1 v Col 3, Col 1 v Col 4, Col 2 v Col 3, Col 2 v Col 4, and Col 3 v Col 4. The t-statistics overstate by some 40%, due to us having more observations than degrees of freedom. Of the 7200 exploded binary pairs, 137 use equal rankings, leaving 7073 pairs. Once again, these results are for the 187 Traders, not the full 260, reducing the number of pairs further.

## **A2.2 Summary of results**

Table A2.1 summarises the results for some two-way splits as well as for the total sample. We looked at Drivers vs Managers (in first two columns), Bulks vs Non-bulks (in columns 3-4) and results for the whole sample (TOTAL) in column 5. Looking at the results for TOTAL first, we see that the value of scheduled journey time is just under £2 per hour, whilst the value of journey time spread is just over £7 per hour. These are much lower than the values found in Section A6. This is explained by the presence here of the Toll Road Bonus of £2.18 which is absent from Section 6. This forces the values of time here to be lower than those presented in Section A1. The benefit for using the M6 Toll for fixed journey times is £2.18, which is considerably more than the 53p found from the direct question. The number of individuals in TOTAL is 187, which are just the SP2 Traders, and these yielded 5501 binary choices.

**Table A2.1 Results of analysis of SP2 using two-way splits**

	Drivers	Managers	Bulks	Non-bulks	TOTAL
Binary observations	2687	2814	440	5061	5501
Individuals	90	94	15	172	187
Rho-sq wrt constants	0.1080	0.2083	0.1714	0.1505	0.1521
Cost Parameter	-0.1430	-0.2116	-0.1689	-0.1713	-0.1712
<i>t-stat</i>	-14.2	-17	-6.3	-21.2	-22.1
ASC parameter	0.3267	0.4711	0.2146	0.3851	0.3726
<i>t-stat</i>	2.7	3.6	0.7	4.2	4.3
Scheduled journey time parameter	-0.0070	-0.0047	-0.0096	-0.0051	-0.0055
<i>t-stat</i>	-2.3	-1.5	-1.3	-2.3	-2.6
Journey time spread parameter	-0.0180	-0.0221	-0.0184	-0.0203	-0.0201
<i>t-stat</i>	-5.2	-5.9	-2.1	-7.6	-7.8
Toll Road Bonus	£2.29	£2.23	£1.27	£2.28	£2.18
Value of scheduled journey time	£2.90/hr	£1.31/hr	£3.40/hr	£1.79/hr	£1.94/hr
Value of journey time spread	£7.77/hr	£6.30/hr	£6.54/hr	£7.11/hr	£7.04/hr

### A2.3 Drivers versus Managers

Moving on to look at Drivers versus Managers, the bonus respondents are willing to pay to use a toll road with no change in travel time is some £2.20. Both valuations of time are some £1.60 per hour higher for Drivers than for Managers, and the cost coefficients are significantly different. On the face of it, this suggests that Drivers are more willing to use toll roads than their Managers would like but that conclusion must be very tentative because:

- i) Drivers were interviewed with an actual load, whereas Managers were interviewed at their desk, probably missing some real world pressures to expedite the job;
- ii) Drivers do not necessarily match to these managers, so the loads being moved by the drivers might have been more urgent or valuable than those being considered by the managers (or perhaps not). As table 4.9 showed, Managers were much more likely to be answering as an LGV user, and we shall see later that HGV users have higher values of time than LGV users.

It is nevertheless interesting that while drivers and managers agree on the value of using toll roads when journey times are not affected, managers are more reluctant to pay tolls to save time than are drivers. Possibly, Drivers find the journey on the M6Toll more pleasant per minute compared to the M6, a factor that the Managers do not take into account.

## **A2.4 Bulks v Non-bulks**

Bulks are those flows originating from primary industries with non-bulks being anything else. As can be seen from Table A2.1, the bulks sample is quite small. There are no statistically significant differences at the 5% level. There are some interesting aspects to the results but they must be viewed with great caution. As might be expected, the non-time related bonus for using a tolled road is higher for the probably higher value and more urgent Non-bulks than it is for Bulks. The same applies to journey time uncertainty, but the values for scheduled journey time go the other way, with Bulks having the highest value. Relatively, Non-bulks seem more concerned about unplanned delays (compared to slowings in the schedule) than do the Bulk respondents.

## **A2.5 Results by sector to sector flows**

Here we again analyse SP2 but consider just the sum of scheduled journey time and journey time spread, i.e. the 98% journey time. We are not meaning to assume that respondents have paid no attention to other elements of journey time, but we thought it prudent at this stage, in view of the difficulties we were encountering, to restrict ourselves to just one journey time segment. Table A2.2 shows that the rho-squared with respect to constants was 0.1530 and model fit was generally satisfactory for a freight discrete choice model, where sample sizes are limited and can become very small when segmenting.

**Table A2.2 SP2 results by sector**

	Individuals	Parameter (t)	Monetary value
Cost		-0.1856 (-25.6)	1
ASC (Toll Road Bonus)		0.5931 (7.9)	£3.20
98% Journey time			
By DD	34	-0.004936 (-1.7)	£1.60/hr
By DF	26	-0.02063 (-6.5)	£6.67/hr
By MD	52	-0.0101 (-4.0)	£3.27/hr
By MF	10	-0.00871 (-1.8)	£2.82/hr
By MM	16	-0.001204 (-3.0)	£3.89/hr
By S	13	-0.0237 (-5.6)	£7.66/hr
By P	13	-0.009468 (-2.3)	£3.06/hr
By O	23	-0.006844 (-1.9)	£2.21/hr
Total	187		
Rho-sq w.r.t constants	0.153		

Arranging the segmented 98% journey time valuations in ascending order, does not make the adjacent valuations significantly different, but the difference between the first and last would be. Very roughly, a difference of £3/hr between any pair is statistically significant at the 5% level.

Least bothered about journey time savings appear to be movements within the distribution system. This might not seem obviously plausible, but it should be noted that ports have been coded D and some schedule slack time has to be allowed for international movements, particularly movements between ports, i.e. 'land-bridging'. At the other end of the scale, 'services' and movements for distribution to the final customer both have relatively high value of time, as might be expected. Movements originating in manufacturing or primary extraction sites have a value of time at the low end, though movements between manufacturing sites have slightly higher values, presumably reflecting JIT considerations.

## **A2.6 Segmentation on whether there was a fixed arrival time**

Table A7.3 considers the effect of whether the arrival time was fixed or not. The exact question here was: "Was the arrival time fixed?". The segmentation uses the 98<sup>th</sup> percentile journey time. We conclude that the presence of a fixed arrival time

seemed to raise the value of time by about 20%, though this was not quite statistically significant.

**Table A2.3 SP2 results by fixed arrival time**

	Parameter (t)	Monetary Value
Cost	-0.1847 (-25.5)	1
ASC (Toll Road Bonus)	0.5883 (7.9)	£3.19
98% journey time		
For fixed arrival time	-0.01192 (-6.3)	£3.87/hr
For no fixed arrival time	-0.01008 (-4.3)	£3.27/hr
Rho-sq w.r.t constants	0.1492	

## A2.7 Segmentation on distance

Here we are measuring distance by travel time, using three bands: (1) up to 3 hours; (2) 3-8 hours; (3) above 8 hours. The Rho-squared w.r.t. constant was 0.1494 and an interesting model occurs when segmenting on 98<sup>th</sup> percentile journey time, as shown in Table A2.4.

**Table A2.4 SP2 results by distance**

	Parameter (t)	Monetary Value
Cost	-0.1848 (-25.5)	1
ASC (Toll Road Bonus)	0.5885 (7.9)	£3.18
98% Journey time		
(1) For Short Journeys	-0.0131 (-5.4)	£4.25/hr
(2) For Medium Journeys	-0.009585 (-4.7)	£3.11/hr
(3) For Long Journeys	-0.01302 (-4.6)	£4.23/hr
Rho-sq w.r.t constants	0.1494	

The pattern was not expected. No coefficient is significantly different to another but the differences are large.

## A2.8 Segmentation by HGVs and LGVs

We have been concerned to obtain reasonable numbers of LGVs and HGVs in our sample. LGVs are of particular interest to as they are becoming more numerous in the goods vehicle fleet and little research exists in past VoT studies. Table A2.5 again shows good fit. Segmented 98% journey time is used. LGVs appear to have a slightly lower value of time than HGVs.

**Table A2.5 SP2 results by vehicle type**

	Parameter (t)	Monetary Value
Cost	-0.1847 (-25.6)	1
ASC (Toll Road Bonus)	0.5944 (7.9)	£3.16
98% Journey time		
For HGVs	-0.01026 (-5.9)	£3.33/hr
For LGVs	-0.008805 (-4.5)	£2.86/hr
Rho-sq w.r.t constants	0.150	

## A2.9 Segmentation by Bulks and Non-bulks

This duplicates the work of A2.3 above, but with the Rho-squared w.r.t. constants at 0.1492 for this run compared 0.1714 and 0.1505 for the two individual runs in Table A2.1, it seems that the latter should be preferred over Table A2.6. However, we should note that in that table VJT was higher for Bulks than Non-bulks, whereas Table A2.6 has the valuations much more plausibly round the other way.

**Table A2.6 SP2 results by Bulks/Non-bulks**

	Parameter (t)	Monetary Value
Cost	-0.1847 (-25.5)	1
ASC (Toll Road Bonus)	0.5882 (7.9)	£3.18
98% Journey time		
For Bulks	-0.008506 (-2.2)	£2.76/hr
For Non-bulks	-0.01159 (-6.8)	£3.77/hr
Rho-sq w.r.t constants	0.1492	

The difference between Bulks and Non-bulks is not significant for 98% journey time, but there is a strong suggestion that Non-bulks have a higher value of time than Bulks, which is as expected.

### A2.10 Segmentation by M6 Toll road users and non-users

Here we change tack once again, by changing to segmenting on the Cost variable. . Table A2.7 segments on the cost coefficient.

**Table A2.7 SP2 results split by M6 Toll road usage**

	Parameter (t)	Monetary Values	
		USER	NUSER
Cost: USER	-0.1685 (-21.8)	1	
Cost: NUSER	-0.2079 (-23.2)		1
98% Journey time	-0.0114 (-6.6)	£4.06/hr	£3.29/hr
Toll Road Bonus	0.5984 (8.0)	£3.55	£2.88
Rho sq w.r.t. constants	0.1525		

These results are broadly similar to those presented for exercise SP1 in A6.5 above and the same caveats apply. However, this time the cost coefficients are quite clearly significantly different. We can clearly say that those respondents that sometimes use the M6T have higher values of time than those who never use the M6T. Both values for 98% journey time are, though, very low.



## Appendix B. Questionnaires.

### LGV/HGV User Survey

Department for  
**Transport**

We are currently conducting research on behalf of the Department for Transport into usage of the M6 Toll Road and alternatives to it. The purpose of the survey is to investigate attitudes towards different types of roads, traffic conditions and tolls. There is a prize draw of £1000 available.

We wish to know about journeys you undertake on the M6 Toll Road and alternative routes such as the M6 or A roads. Please fill in one or both of the columns on the right hand side as appropriate. Please circle one of the lettered options where these are provided.

	A journey where you use the M6 Toll Road.	A journey you make (on the M6 corridor) where you do not use the M6 Toll Road but could have.
Q1	Where did your journey start?	
Q2	Where is your destination?	
Q3	Do you use the M6 anywhere between junctions 4 and 11 as part of this journey?	a) Yes b) No
Q4	Is the main purpose of this journey to: a) transport goods (or run empty backloads); b) provide a service (eg plumber) c) neither of above? (Please specify)	a) Yes b) No
Q5	What is the type, if any, of commodity transported?	a) Yes b) No c)
Q6	What is your normal departure time for this journey?	
Q7	What is the earliest arrival time for this journey?	
Q8	What is the latest arrival time (barring weather/accidents or breakdowns) for this journey?	
Q9	At what time did you join or pass the M6 Toll Road?	
Q10	Approximately how much time on this journey was spent in start/stop traffic, ie congestion, in minutes?	
Q11	Is the departure time on this journey fixed?	a) Yes b) No
Q12	Is the arrival time on this journey fixed?	a) Yes b) No

Q13	What type of vehicle do you drive?	a) HGV (Lorry) b) LGV (Van)
Q14	Would you be willing to help us by answering some more questions about your use of the M6 corridor?	a) Yes b) No

If you answered Yes to Q14 above, please tell us about yourself and your company

Name	
Contact address	
Post code	
Phone number	
Email	
Fax number	

The follow up exercise involves choices between routes with different toll levels. If you are not the person who decides whether tolls can be paid then please indicate below the name of the person in your company who could decide this. If you can make this decision then please leave blank

Contact name	
--------------	--

Please return using the freepost envelope provided or alternatively send to the following address: Faber Maunsell, FREEPOST ALM1534, Altrincham, WA14 2BR.

We will send you a second part of the survey which involves choices between routes with different characteristics so we can see how such choices are affected by changes in tolls and road conditions.

Those completed forms we receive back within a month will be entered into a Prize Draw for £1000. If you have any queries please call Tony Fowkes on 0113 3435340. Thank you for your assistance.

Fig B1: First Stage Questionnaire for Handout Surveys

**M6 Toll Questionnaire**

Thankyou for your help regarding the M6 Toll Road in the last month. Enclosed is a short questionnaire which should take no more than 15 minutes to complete. Honestly!

**Instructions**

We now wish to examine how your chosen route described would be affected by changes in tolls and road conditions. Questions 1 to 3 examine the features considered important in toll road use beyond journey times.

In Exercise 1 you will be offered alternative journeys in the columns. The entries we have made in each column indicate the departure time, amount of stop/start driving time (arising from congestion, roadworks, traffic lights etc), earliest arrival time, and latest arrival time (defined to exclude that one in fifty occasions where there is a delay due to bad weather, accidents, break-downs etc). For tolled motorways a one-way toll is also shown.

We would like you to rank the columns with '1' being the rank of the most preferred column. If there are two columns that you feel are equally good you can use the '=' sign to denote that, eg. if you cannot distinguish between second and third place you should rank both as '2='. The harder it is for you to make the ranking decisions, the more information your rankings will provide, so please persevere!

In Exercise 2 we want you to consider a situation where there has been an expansion in tolled motorways, and there is a choice between two different tolled roads and two untolled roads. Here we wish to examine how you would rank these four options for your chosen route described in the previous questionnaire.

If there are any questions you cannot answer please leave those areas of the form blank

Please use these shaded boxes  for your rankings

Please return the questionnaire either in the freepost envelope provided or by fax to 0161 927 8399 FAO Dawn Fisher.

All participants returning this questionnaire within 2 weeks will receive a £5 High Street Voucher

Q1

If <i>travel times</i> and <i>reliability</i> were identical on the M6 and M6 Toll Roads, would you be prepared to pay a toll, however small, to use the M6 Toll Road.	
Y/N	N
If 'N'	Continue onto next page

Q2

If 'Y'	
Assuming <i>travel times</i> and <i>reliability</i> were identical on the M6 and M6 Toll Roads, how much would you be prepared to pay for each loaded (one-way) journey? (£)	

Q3

We would like to know how important features other than journey time and reliability are in your decision to use the M6T or not. Consider the amount in Q2 to be 100%. Could you please indicate what % you would allocate to the following reasons for using the M6T in the absence of time and reliability benefits. Please make sure the total sums to 100%		
1) Surface is smoother		%
2) Less stop/start driving		%
3) Impresses the customer		%
4) Provides a less stressful period for the driver		%
5) Better fuel consumption		%
6) Others - please specify		%
7) Others - please specify		%

**Fig B2: Page 1 of Second Stage Questionnaire for Handout Surveys**

## M6/M6Toll Corridor Freight Research Survey

Work undertaken for



by  
 Institute for Transport Studies, University of Leeds  
 Faber Maunsell  
 Hugh Gunn Associates  
 4cast

October 2006

Start Interview

Q1	Do any of your freight movements use the M6 Toll Road (Y/N)?	
	If 'N', Continue onto next page	
	If 'Y', please tell us below about a journey that you use the M6 Toll Road for	
Q2	From	
Q3	To	
Q4	Via	
Q5	Name of commodity transported	
Q6	£ per load or ton of commodity (please specify)	
Q7	Tonnes of commodity/ size of van	
Q8	Sector transported from (specify or select from drop down menu)	
Q9	Sector transported to (specify or select from drop down menu)	
Q10	Normal departure time (eg 18:15 day 1)	day 1
Q11	Earliest arrival time (eg 20:45 day 2)	day
Q12	Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive (eg 21:45 day 2)	day
Q13	At what time did you join the M6Toll Road? Eg 21:00 day 1	day
Q14	Approximately how much time on this journey was spent in stop/start traffic, ie not free flowing (mins)	
Q15	Is the departure time fixed? (Y/N)	
Q16	Is the arrival time fixed? (Y/N)	
Q17	Specify the start time of any promised or guaranteed delivery window	day
Q18	If you answered Q17 give details of any penalties for failing to deliver within this window (egs £10 per hour or 2 hours per load)	per

OK

Q19	Do any of your movements use roads other than the M6T?	
	If 'N' continue to next page, if 'Y' tell us below about a journey you use this road for	
Q20	From	
Q21	To	
Q22	Via	
Q23	Do you use M6 or A roads for this journey (M6/A)	
Q24	Name of commodity transported	
Q25	£ per load or ton of commodity (please specify)	
Q26	Tonnes of commodity/ size of van	
Q27	Sector transported from (specify or select from drop down menu)	
Q28	Sector transported to (specify or select from drop down menu)	
Q30	Normal departure time (eg 18:15 day 1)	
Q31	Earliest arrival time (eg 20:45 day 2)	day 1 <input type="text"/>
Q32	Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive (eg 21:45 day 2)	day <input type="text"/>
Q33	At what time approximately did you first pass near the M6 Toll Road on this journey (eg 21:00 day 1)	day <input type="text"/>
Q34	Approximately how much time on this journey was spent in stop/start traffic, ie not free flowing (mins)	<input type="text"/>
Q35	Is the departure time fixed? (Y/N)	<input type="text"/>
Q36	Is the arrival time fixed? (Y/N)	<input type="text"/>
Q37	Specify the start time of any promised/ guaranteed delivery window	day <input type="text"/>
Q38	If you answered Q37 please give details of any penalties for failing to deliver within this window (egs £10 per hour or 2 hours per load)	per <input type="text"/>

OK

The following exercise involves choices between routes with different toll levels. If you are not the person who decides whether a given amount of toll can be paid then please indicate below the name of the person in your company who could decide this. If you can make this decision then please proceed (press OK).

OK

### Exercise 1 Instructions

We now wish to explain how your chosen route from liverpool to coventry could be affected by changes in tolls and road conditions

You will be offered alternative journeys in the columns. The entries we have made in each column indicate the *departure time*, amount of *stop/start driving time* (arising from congestion, roadworks, traffic lights etc), *earliest arrival time*, and *latest arrival time* (defined to exclude that one in fifty occasions where there is a delay due to bad weather, accidents, break-downs etc). For tolled motorways a one-way toll is also shown.

We would like you to rank the columns with '1' being the rank of the most preferred column. If there are two columns that you feel are equally good you can use the '=' sign to denote that, eg, if you cannot distinguish between second and third place you should rank both as '2='. The harder it is for you to make the ranking decisions, the more information your rankings will provide, so please persevere!

Please use these shaded boxes

for your rankings

Start Exercise 1

Q1 If *travel times* and *reliability* were identical on the M6 and M6 Toll Roads, would you be prepared to pay a toll, however small, to use the M6 Toll Road. Y/N

If 'N'  Continue onto next page

Q2 If 'Y'  
Assuming *travel times* and *reliability* were identical on the M6 and M6 Toll Roads, how much would you be prepared to pay for each loaded (one-way) journey? (£)

Q3 We would like to know how important features other than journey time and reliability are in your decision to use the M6T or not. Consider the amount in Q2 to be 100%. Could you please indicate what % you would allocate to the following reasons for using the M6T in the absence of time and reliability benefits. **Please make sure the total sums to 100%**

1) Surface is smoother	<input type="text"/>	<input type="text"/>
2) Less stop/start driving	<input type="text"/>	
3) Impresses the customer	<input type="text"/>	
4) Provides a less stressful period for the driver	<input type="text"/>	
5) Better fuel consumption	<input type="text"/>	
6) Others - please specify	<input type="text"/>	
7) Others - please specify	<input type="text"/>	

OK

Question 1a	ME Toll	ME	A Road
Road toll (£, one way)	£5.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50
Earliest arrival time	12:45	13:15	12:45
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:30	14:30	13:40
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 1b	ME Toll	ME	A Road
Road toll (£, one way)	£20.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50
Earliest arrival time	12:50	13:05	13:05
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:35	14:20	14:00
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 1c	ME Toll	ME	A Road
Road toll (£, one way)	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50
Earliest arrival time	12:55	13:25	12:55
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:40	14:20	14:10
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 1d	ME Toll	ME	A Road
Road toll (£, one way)	£15.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50
Earliest arrival time	13:20	13:15	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:45	14:30	14:10
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 2a	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£15.00	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50	70
Earliest arrival time	12:55	13:10	13:15	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:00	14:20	14:30	14:25
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2b	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£20.00	£7.50	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	40	50
Earliest arrival time	13:00	13:20	13:10	13:30
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:05	14:25	14:20	14:40
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2c	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£10.00	£5.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	40	70
Earliest arrival time	13:05	13:20	13:25	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:10	14:25	15:00	14:50
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2d	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£5.00	£2.50	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	70	40	50
Earliest arrival time	13:10	13:40	13:40	13:25
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:15	14:45	14:55	15:00
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2e	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£20.00	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50	50
Earliest arrival time	13:15	13:25	13:45	13:25
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:20	14:30	15:20	14:40
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Figure B3: Face to Face Interview Screens

## **M6 Toll Questionnaire**

Thankyou for your help regarding the M6 Toll Road in the last month. Enclosed is a short questionnaire which should take **no more than 15 minutes to complete**. Honestly! Please ensure that this questionnaire is **completed by someone who makes decisions for your company regarding whether you use the toll road or not**.

We now wish to examine how your chosen route described in the previous questionnaire would be affected by changes in tolls and road conditions.

In Question 1 you will be offered alternative journeys in the columns. The entries we have made in each column indicate the departure time, amount of stop/start driving time (arising from congestion, roadworks, traffic lights etc), earliest arrival time, and latest arrival time (defined to exclude that one in fifty occasions where there is a delay due to bad weather, accidents, break-downs etc). For tolled motorways a one-way toll is also shown.

We would like you to rank the columns with '1' being the rank of the most preferred column. If there are two columns that you feel are equally good you can use the '=' sign to denote that, eg, if you cannot distinguish between second and third place you should rank both as '2='. The harder it is for you to make the ranking decisions, the more information your rankings will provide, so please persevere!

In Question 2 we want you to consider a situation where there has been an expansion in tolled motorways, and there is a choice between two different tolled roads and two untolled roads. Here we wish to examine how you would rank these four options for your chosen route described in the previous questionnaire

Question 3 onwards concern the nature of your business' current use of the M6 Toll road. If there are any questions you cannot answer please leave those areas of the form blank

Please use these shaded boxes



Please return the questionnaire either in the freepost envelope provided or by fax to **0161 927 8399** FAO Susan Green.

Question 1a	M6 Toll	M6	A Road
Road toll (£, one way)	£5.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50
Earliest arrival time	12:45	13:15	12:45
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:30	14:30	13:40
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 1b	M6 Toll	M6	A Road
Road toll (£, one way)	£20.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	60	50
Earliest arrival time	12:50	13:05	13:05
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:35	14:20	14:00
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 1c	M6 Toll	M6	A Road
Road toll (£, one way)	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	60	60
Earliest arrival time	12:55	13:25	12:55
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:40	14:20	14:10
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 1d	M6 Toll	M6	A Road
Road toll (£, one way)	£15.00	£0.00	£0.00
Departure time	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	60
Earliest arrival time	13:00	13:15	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	13:45	14:30	14:10
Ranking (1 = best, 2 = 2nd choice, 3 = worst)			

Question 2a	Tolled Motorway 1	Tolled Motorway 2	Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£15.00	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50	70
Earliest arrival time	12:55	13:10	13:15	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:00	14:20	14:30	14:25
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2b	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£20.00	£7.50	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	80	40	80
Earliest arrival time	13:00	13:20	13:10	13:30
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:05	14:25	14:20	14:40
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2c	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£10.00	£5.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	40	40	70
Earliest arrival time	13:05	13:20	13:25	13:15
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:10	14:25	15:00	14:50
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2d	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£5.00	£2.50	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	70	40	80
Earliest arrival time	13:10	13:40	13:40	13:25
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:15	14:45	14:55	15:00
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

Question 2e	Tolled Motorway 1	Tolled Motorway 2	Untolled Motorway 3	Untolled Motorway 4
Road toll (£, one way)	£20.00	£10.00	£0.00	£0.00
Departure time	11:00	11:00	11:00	11:00
Expected time in stop/start traffic (minutes)	40	50	50	80
Earliest arrival time	13:15	13:25	13:45	13:25
Latest arrival time (barring weather/accidents or breakdowns), ie time by which 98% of consignments would arrive	14:20	14:30	15:20	14:40
Ranking (1 = best, 2 = 2nd choice, 3 = 3rd choice, 4 = worst)				

**Fig B4: Second Stage Phone Interviews**

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