Monograph:
Toner, J.P. (1991) The Demand for Taxis in Leeds and the Value of Time. Working Paper. Institute of Transport Studies, University of Leeds , Leeds, UK.

Working Paper 334

Published paper
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August 1991

THE DEMAND FOR TAXIS IN LEEDS AND THE VALUE OF TIME

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This work was sponsored by the West Yorkshire Passenger Transport Authority and the District Councils of Bradford, Calderdale, Kirklees, Leeds and Wakefield.

ABSTRACT

This paper presents the detailed results of stated preference experiments undertaken to estimate the value of time and various demand parameters. It continues a series of reports in this series (Pells [1990], Toner [1991]). Full details of the experimental design are contained in Toner [1990].

It is found that taxi passengers have a value of waiting time of about 7.4 p/min when a trip is made from a rank, and 9.7 p/min if the trip is booked by telephone. Existing users are relatively insensitive to price, but this depends greatly on the existence of an alternative mode of travel. Waiting time effects are minimal. Large reductions in price would cause significant numbers of bus users to switch to taxi.

CONTENTS

THE DEMAND FOR TAXIS AND THE VALUE OF TIME.

1 INTRODUCTION

In this paper, we report the detailed results of the stated preference (SP) experiments conducted to ascertain the value of time of taxi passengers and to derive some elasticities. The chosen method of administration was on-street interview for reasons of cost and expediency. This may introduce some biases (outlined below) but it is believed that the data generated are adequate for our purposes if not perfect. There are three principal sections to the report; survey details, outlining the trip characteristics recorded; the values of time derived from the SP data; and estimation of demand elasticities.

2 SURVEY DETAILS.

The survey work was carried out in the city centre of Leeds over an eight-day period in July 1990. The questions asked of the respondents varied according to their most recent experience of taxis or hire cars. Those who had undertaken a taxi or hire car trip in the last month gave details of that trip and were then asked to complete the SP experiment, people having travelled from a rank and people having booked a cab by phone receiving different sets of cards. Those who had not made a trip in the last month and who were planning to leave the city centre by bus were asked for details of the bus trip and then undertook a different SP experiment. This method of administration may have introduced certain biases through the sample not being totally random:

(a) respondents found in the city centre may not be wholly typical of the population of Leeds. In particular, we might expect there to be a greater proportion of non-Leeds residents who generally have no cause to use taxis in Leeds. We might also expect to have underrepresented people whomuse taxis for trips who;;y outside the city centre, for example to and froma district shopping centre. Similarly, any estimate of bus patronage derived from the interviews will probably be too low.

(b) Other taxi users may be underrepresented, notably short-term visitors to Leeds for business purposes who, on arriving at Leeds railway station, take a cab to their ultimate destination and, on completion of their business, thence back to the railway station, thus having no chance of being interviewed. It is quite possible that this important sector of the market, for whom quality of service, as measured by waiting time, may be as important as price, will have different priorities to other taxi users.

(c) People who do not currently use taxis, but might do so if they were cheaper or more readily available, may have been excluded. To some extent, the survey of bus users will pick up some of these so that the possibility of abstraction from other modes can be considered; but people who, say, walk because of the long queue of prospective taxi passengers are omitted.

The problems outlined above may not be too serious, however. Trips from a taxi rank are almost exclusively fron central Leeds, and thus at least that part of the sample should be unaffected by (a). Also, the phone-booked trips will include some made outwith the city centre. Although these cannot be uniquely identified, trips made from private house will have a greater chance of being suburban than those from a transport terminal. If the results are broadly similar across origins and destinations, then the problem is less significant. Concerning (b), it is again a question of identifying within the sample those who may fall into this category and examining the results for differences. With regard to (c), bus users and abstraction from bus is catered for; car users are loath to switch from car under most circumstances and can safely be disregarded; the walkers are simply unmeasurable within the framework adopted and will have to be assumed to be unaffected by relatively marginal changes in the taxi industry.

In all, 958 people were contacted during the survey; 255 were screened out as being non-taxi users generally and non-bus users on this occasion. This left 267 respondents who had made a taxi trip booked by telephone, 224 who had nmade a trip from a rank or by flagdown and 212 bus users. Table 1 reports the average characteristics of the trips reported by the respondents.

Table 1: mean trip characteristics reported by respondents

	FARE (£)	WALK TIME (mins)	BOOKING TIME (mins)	WAIT TIME (mins)	AVERAGE LATENESS (mins)
RANK TRIPS	3.78 (2.31)	3.7 (4.1)	-	6.5 (10.0)	-
F/DOWN TRIPS	3.78 (2.31)	-	-	8.1 (10.6)	-
PHONE TRIPS -hackney	3.81 (2.15)	-	1.7 (1.4)	7.4 (5.4)	5.6 (10.8)
PHONE TRIPS -priv hire	3.21 (3.25)	-	1.6 (1.8)	9.0 (7.6)	3.1 (3.8)
BUS TRIPS	0.45 (0.72)	12.0 (6.9)	-	10.3 (7.0)	-

(standard deviations in parentheses)

Overall, these figures appear to make sense. The walk time for taxis is relatively low because some people reported zero walking times, for example if they caught a cab at the railway station having arrived there by train. The walk time for bus includes time spent at both ends of the journey. The waiting times are broadly as expected, althought the waiting time at rank is higher than has been observed by objective observation of the taxi ranks in Leeds.

It is also instructive to examine the different taxi trip characteristics at different times of day (Table 2). The pattern which emerges is of higher fares at night for both rank and flagdown trips. The waiting time for phone hirings is broadly similar across the day; but at ranks, waiting time is very low duruing the day and much higher at night. The implication of this latter is that waiting time elasticities must be very low during the day; indeed, for over one third of respondents, waiting time was zero, and so any improvement in service levels at these times will simply increase the queues of cabs waiting for passengers and have an adverse impact on the profitability of the rank trade.

Table 2: taxi trip characteristics by time of day.

	-PHONE TRIPS--			--RANK TRIPS--		
	FARE	BOOK	WAIT	FARE	WALK	WAIT
BEFORE 8 am	3.78	1.8	9.5	3.16	3.6	0.2
8am - 6pm	3.1	1.6	8.7	3.54	3.2	3.0
6pm - 9pm	2.90	1.6	7.5	4.00	1.1	1.7
9pm - MIDNIGHT	2.95	1.8	10.4	3.07	3.9	8.5
AFTER MIDNIGHT	4.33	1.7	8.0	4.34	5.2	10.0

It is also worth noting that phone trips, over 80% of which are undertaken by private hire according to this survey, usually have lower prices than rank trips except late at night when the fares are similar. This suggests that private hires, which set their own fares, are pricing up more at times of peak demand than is permitted for hackney carriages, assuming no change in the relative distributions of trip lengths.

Table 3 shows the mode of hiring of reported taxi trips. Given the number of hackneys (262) and hire cars (1400), it seems likely that the estimated share of private hire cars is lower than is really the case. For hackney carriages, the split of

Table 3: mode of hiring of taxi and hire car trips

Rank	34.0%
Flagdown	11.6%
Phone -hackney	10.8%
Phone - priv hire	43.6%

work is broadly consistent with previous evidence which suggests between a quarter and a third of the work is telephone booked in Leeds and the bulk of the remainder is rank work.

The tables in the appendix give further details of the trips undertaken and the reasons for using or not using taxis. Here we simply highlight the salient features.

RANK-BASED TRIPS

The dominant origins were from a place of leisure or a transport terminal, accounting for 47.8% and 26.3% of trips respectively. 80.8% of trips were to a private house, suggesting taxis' major role is transporting people from the city centre to home. 62.9% of trips were made after 9pm (including 39.3% after midnight) and 21.9% during the daytime. Most respondents had relativelylittle luggage, 12.9% being encumbered with suitcases or more than two items. 21.9% used a taxi for this particular trip because it was quick, and 33% because there was no other means available. If we divide trips into non-discretionary trips (NDTs), comprising those where the taxi was used because the respondent had liggage, did not know Leeds, wished to avoid drink-driving or had no other means available, and discretionary trips (the rest), then NDTs account for 50.9% of all trips and DTs for 49.1%. The main modes people would have used in the absence of a taxi were bus (37.5%) and walk (41.1%), this latter being the only alternative for those who used a taxi because no other means was available. The frequency of use of taxis gives an average of 0.45 trips per person per week for those who currently use taxis. Reasons for not using taxis were largely unrelated to availability, deterrents being the price (49.6%), the availability of a car (15.6%) and the adequacy of buses (13.8%).

PHONE BOOKED TRIPS

The overwhelming majority of phone booked trips originated at a private house (67%), although a sizeable minority were from a place of entertainment or leisure (19.1%). The same combination appears for destinations, where 41.6% were to a private house and 28.5% for leisure purposes, with 12% to work. Phone trips were much more evenly spread through the day, with 31.1% between 8am and 6pm, 28.1% between 6pm and 9pm and 33.3% after 9pm (of which 12% were after midnight). 10% od passengers had non-negligible amounts of luggage. Looking at the reason a taxi was used, 28.5% did so because it was quick, 11.2% to avoid drink driving and 20.2% because no other means was available. Using the same breakdown as before, NDTs accounted for 37.1% of trips and DTs for 62.9%. Taxi usage is estimated to be 1.02 trips per person per week. 37.5% did not use taxis more because of the cost, 20.6% because they had a car available and 15.7% because buses were adequate. The discretionary nature of the trips reported is reflected by the 13.5% who would not have gone anywhere had a taxi not been available; 39.0% would have caught a bus, 20.6% walked and 21.3% gone by car.

BUS USERS

Bus trips were, unsurprisingly given the method used to obtain the sample, predominantly from work or shopping to a private house, and undertaken before 6.30pm with little luggage. From this sample, bus patronage is estimated at 7.5trips per person per week for those who use buses. Taxi use is estimated at 0.13

trips per week for the 47% who sometinmes use taxis, 0.06 per week for all. Bus users were relatively more inclined not to use taxis because of the cost (58.3%) or because buses were adequate (19.1%).

Overall, the survey gave a reasonable spread of journey purposes, trip characteristics and different socio-economic backgrounds. We can thus attempt to measure the influence of such things on the parameters of interest.

3 VALUES OF TIME

3.1 Introduction.

Having presented the basic trip details, we now turn to some results. In all cases, the calibration was of a binomial logit model. The tables in the Appendix present the full details for various breakdowns, and we highlight the most important findings here. A word is necessary concerning the statistics which indicate how good a model is. The overall goodness of fit indicator for disaggregate models is rho-sq, which is similar (but not identical) in concept to the R measure used in least squares estimation. As a rule of thumb, rho-sq of about 0.2 is reckoned to be acceptable, although, as will be seen, some of the models fall short of this standard. The significance levels reported for individual variables require careful interpretation; they are, for time and cost variables, the significance of the parameter estimates under the null hypothesis that $\beta > 0$. These are not the same as the significance of the value of time, although in practice the discrepancy is slight. Where a significance level is not indicated, the parameter estimate is significant at 1% level (one-tailed test). For the two taxi experiments, vehicle type was modelled as deviation from a large saloon car, a positive value indicating that the vehicle was preferred to the latter, a negative value that the large saloon car was preferred. For medium and small saloon cars, a one-tailed test was conducted under the null hypothesis that $\beta_i < 0$ that is, a large saloon car is preferred. The parameter estimat had to be significant at 10% level before the vehicle value was reported. FX4s were likewise tested under a one-tailed test, but under different null hypotheses. For rank trips, we tested $H_0: \beta_i > 0$ (FX4s preferred to large saloon cars) and for telephone trips $H_0: \beta_i < 0$. Again, a 10% criterion for reporting was applied.

Similar tests were conducted for people who undertook the taxi v bus experiment. The null hypothesis on the intercept term was $H_0: \beta_i < 0$ that is, taxi is, other things being equal, preferred to bus; as it turned out, the intercept was largely insignificant and where it was significant, it was the wrong sign, suggesting an element of justification bias or, alternatively, non-compensatory decision making, with bus users generally preferring the bus option even when taxi was not much dearer than bus_but considerably quicjer.

3.2 Taxirank and flagdown hirings.

Table 5 presents the basic aggregate and disaggregate models for rank and flagdown users; in each case there are two models calibrated one including vehicle type and the other excluding it (which means we assume respondents ignored vehicle type in ranking the alternatives). Obviously in choosing between alternative taxi journeys, an alternative specific constant of the type found in binary choice models for predicting between modes would be meaningless and the intercept terms were therefore suppressed in estimation.

Table 5: basic models for rank and flagdown users

	AGGREGATE				DISAGGREGATE			
	INCL. VEH		EXCL. VEH		INCL. VEH		EXCL. VEH	
	value	t	value	t	value	t	value	t
FX4	.213	1.5	-		.226	1.78	-	
Medium	.082	0.5	-		.080	0.53	-	
Small	-.033	0.16	-		-.049	0.34	-	
Walk	.165	5.9	.154	6.6	.165	6.4	.151	7.09
Wait	.155	9.7	.149	10.7	.156	10.2	.149	11.04
Cost	.021	6.9	.019	10.3	.021	7.46	.019	10.68
VO FX4	10.1	1.6	-		10.7	1.87	-	
VO Med	3.9	0.5	-		3.8	0.88	-	
VO Sma	-1.6	0.2	-		-2.3	0.60	-	
VO walk	7.8	7.97	7.96	7.57	7.8	8.80	7.9	8.81
VO wait	7.4	9.42	7.7	10.98	7.4	10.50	7.8	12.18
Observ^{n}s	30		30		3360		3360	
G. of fit	0.83		0.83		0.13		0.13	

Notes: Values of time are in pence per minute, values of vehicle type are related to a base of large saloon car. t-ratios applied to values of time etc are, in this instance, those applied to the value of time and not the coefficient. The goodness of fit measure for the aggregate models measures the explained deviation around 0 and are adjusted to allow for the number of independent variables. For the disaggregate models, rho-sq is defined as 1 - (model log-likelihood/null log-likelihood); the reported figures are rhobar-sq.

As can be seen, all four models give similar results, with the value of walking time ranging between 7.8 and 7.96p/min and the value of wait time varying between 7.4 and 7.8p/min, all highly significant. Vehicle type is relatively insignificant, only a London-style black cab, denoted FX4, being significantly different from zero.. Even then, the amount by which it is preferred to a large saloon is only about 10p. Of course, these figures are averages, and it may be that different circumstances will cause different valuations of time. To investigate this, we ran models which looked at the effects of journey purpose (defined by origin and destination), trip circumstances (the time the trip was made, the number of people travelling, luggage carried), the specific details of the trip (rank or flagdown, the fare paid, the walk time, the waiting time), general issues relating to the use of taxis (reason for doing so this trip, alternative mode if taxi not available for this trip, frequency of use of taxis, reasons for not using taxis more) and socio-economic factors (sex, age, employment status, income).

Looking first of all at journey purpose, the striking feature is the lack of variation in the destinations of the respondents. Apart from trips to a private house, the models calibrated have too small sample sizes to be of much use. The few work-related trips give a model with hifgher values of both walk and wait time than the overall models; this might be expected for rank-based trips, since they will not be people in Leeds suburbs travelling to work but more likely people arriving in Leeds by some means and then obtaining a cab in the city centre to complete their journey, or else people travelling on employers' business from Leeds centre. The trip origins give little variation in values of time, walk ranging from 5.9 (shopping) to 10.8(transport) and wait lying between 5.7 (private house) and 8.3 (shopping). The higher value of walk for people catching a taxi at a transport terminal suggests these people expect to find a taxirank at the railway and coach stations and would be less happy than other people to have to walk to reach a taxi rank.

Most of the models run disaggregating by trip circumstances had reasonable sample sizes and can therefore be accepted as valid results. The interesting features of the effect of the time of travel ara the much higher values of time for passengers travelling between 6pm and 9pm (walk=12.2p/min wait=13.0p/min) compared with daytime trips and trips made between 9pm and midnight (roughly half the values). One explanation is that trips between 6pm and 9pm will include people such as businessmen returning to Leeds after a day away on business; we would expect these people to have higher values of time. The data support this hypothesis; out of 27 reported trips between 6pm and 9pm, 19 were from a transport terminal and 17 of these 19 were to a private house suggesting that these were not people arriving in Leeds in the early evening to participate in leisure activities. We also find values of time for late night passengers (after midnight) slightly higher than daytime (walk and wait just under 9p/min). The bulk of these are leisure trips to home and thus without a binding arrival time constraint; presumably, people just want to get home to bed as soon as possible after a night out.

Party size had relatively little effect on values of time, save that values were a little higher for four people travelling together (walk=10.5p/min, wait=9.3p/min). Assuming that the cost of the taxi trip is split in some way between the travellers, this is not a surprising result. Indeed, given the larger party size for trips after midnight (2.62 people per hiring against 1.77 for all other trips) this would also explain the slightly higher values obtained for late night trips.

The luggage disaggregation was dominated by people with no or little luggage, and these people had values of time very much in line with the overall average. The only distinction to be drawn was for people with suitcases, who had higher values of walking time (8.8p/min) and lower values of waiting time (4.9p/min). It is to be expected that people with luggage would tend to be in favour of more ranks and, with a consequently greater dispersion of cabs, higher waiting times than the average.

Turning now to the specific details of the reported trips, we find little difference between those who hired their taxi at a rank and flagdown users. Likewise, the fare paid has little effect, except people facing fares between £4 and £5 indicated slightly higher values of time than other groups. Examining details such as when these trips were made and the journey purpose, there appears to be no obvious reason why the values of time should be higher for this fare band. For flagdown users, the rule of thumb appears to be that the longer it took the respondent to get a cab, the lower the value of waiting time; small sample sizes render this result insignificant, though. A broadly similar pattern occurs for rank users; those who did not wait had values of time for walk and wait of 13.8p/min and 12p/min respectively compared with 4.9p/min and 4.7p/min for those who waited between 5 and 10 minutes. Clearly for those who experience little waiting time, one of the attractions of taxi as a mode is that low waiting time, and such people are loath to see waiting time increase. Interestingly, when models were calibrated across all the data which allowed non-linearities in the values of time such as may be evident here, none of the various non-linear terms tried was significant.

The reasons people had used a taxi for their particular trip did not by and large influence the values of time. Those who had luggage (walk=7.1p/min, wait=6.5p/min) and those who had no other means available (walk=6.4p/min, wait=7.0p/min) had values a little below average, and those who chose to use a taxi because it was quick had a higher value of waiting time (10.8p/min); but the only figures which stand out are those who used a taxi to avoid drink driving, with walk valued at 15p/min and wait at 11.5p/min . While the small sample size means the result must be treated with caution, it is backed up by peoples' reasons for not using taxis more; those who found buses adequate or taxis too expensive had values of time at the average level and just below respectively, but those who had a car available had values of time of 13.2p/min and 12.8p/min respectively for walk and wait. Clearly car users are relatively more influenced by service quality than taxi users at large.

Over 80% of respondents would have travelled by bus or walked had a taxi not been available when they made their trip; no differences were found between the two groups concerning the value of walking and waiting time.

Turning finally to socio-economic factors, there is no significant difference between males and females, although males had slightly higher values of time. Nor did age have much effect, although there was an unusual result for 35-44 year olds who had a high value of walk time (11.6p/min) and a low value of wait time (4.3p/min); the very low rho-sq and relatively insignificant coefficients mean we cannot be too dogmatic in insisting that this group behaves differently from others. People of pensionable age had much lower valuesm of time (walk=2.3p/min, wait=3.1p/min) but calculated from a very small sample. People in full-time employment had higher values (9.9 and 9.7 for walk and wait) than the other categories, retired people having the lowest values (4.1 and 2.6). Income was the only socio-economic factor which appeared to have any impact on the values of time; even then, its influence was unclear with surprisingly high values for those with incomes between £5,000 and £7,500. If we consider this to have been an aberration (although it may be that these are younger people with low financial commitments and therefore a relatively high disposable income) and divide simply into two categories - under £15,000 and over £15,000 - we obtain values of walk and wait time of 7.5 and 6.9 for the low income group and 13.4 and 14.0 for the high income group. Although these differences are significant, the latter group constitutes only 12% of our sample of taxi users, and so for the bulk of the market, we can sassume homogeneous values of time.

Two other attempts were made to see if the market for taxis could be broken down into different groupings according to the circumstances of the trip. The first was discretionary versus non-discretionary trips as outlined earlier; and the second focussed on whether people were "captive" to taxi or not, captives being those who had no other means available or who made their trip after midnight. In the event, the results from both were very similar, showing no significant differences between groups (Table 6).

Table 6: values of time according to nature of trip

VO walk	VO wait	rho-sq	sample	
8.3	7.8	0.13	110	Discretionary trips
7.2	7.1	0.14	114	Non-discretionary trips
7.7	7.7	0.15	112	Captives
7.9	7.0	0.11	112	non-captives

Overall, it seems that for most types of people for most types of trip, the assumption that there is a homogeneous value of time for taxi users of 7.8p/min and a homogeneous value of waiting time for taxi users of 7.4p/min is valid; the exceptions to the rule seem to be people (presumably businessmen) travelling from a transport terminal to a private house between 6pm and 9pm and, more generally, those with incomes over £15,000. While our survey has probably underrepresented businessmen generally, it is believed that the group with incomes over £15,000 constitute only a small part of the market.

3.3 Telephone booked taxis and hire cars.

Table 7 presents the basic aggregate and disaggregate models for those who booked a cab by telephone; once again, we calibrate models both with and without vehicle type.

Table 7 basic models for telephone users

	AGGREGATE				DISAGGREGATE			
	INCL. VEH		EXCL. VEH		INCL. VEH		EXCL VEH	
	value	t	value	t	value	t	value	t
FX4	-.312	2.07	-		-.359	2.98	-	
Medium	.029	0.18	-		.010	0.08	-	
Small	-.364	2.27	-		-.364	2.88	-	
Book	.056	1.67	.059	1.50	.056	2.08	.060	2.24
Wait	.155	7.67	.158	8.48	.154	9.44	.161	12.04
Cost	.016	5.68	.017	7.93	.016	6.92	.017	11.29
VO FX4	-19.0	1.73	-		-22.5	2.44	-	
VO Med	1.7	0.18	-		0.6	0.08	-	
VO Sma	-22.2	2.66	-		-22.8	3.40	-	
VO book	3.43	1.62	3.47	1.48	3.52	2.03	3.53	2,23
VO wait	9.41	9.55	9.23	9.93	9.66	11.59	9.49	14.88
Observ^{n}s	30		30		4005		4005	
G. of fit	0.80		0.73		0.12		0.11	

Notes: Values of time are in pence per minute, values of vehicle type are related to a base of large saloon car. t-ratios applied to values of time etc are, in this instance, those applied to the value of time and not the coefficient. The goodness of fit measure for the aggregate models measures the explained deviation around 0 and are adjusted to allow for the number of independent variables. For the disaggregate models, rho-sq is defined as 1 - (model log-likelihood/null log-likelihood); the reported figures are rhobar-sq.

All four models give broadly similar results. The value of booking time is fairly small, ranging between 3.43p/min and 3.53p/min; for the aggregate model, it is not significant at 5% level (1TT), but it is significant at 5% level in the disaggregate models. Waiting time is always significant, varying between 9.23p/min and 9.66p/min. Considering vehicle type, a medium saloon is valued the same as a large saloon car, and both are preferre to London-style taxis and small saloon cars by 22.5p and 22.8p respectively in the disaggregate model; these values are significant at 2½% and 1% respectively. As with the rank and flagdown trips, further analysis was undertaken to investigate the effects of journey purpose, trip crcumstances, trip details, general issues relating to the use of taxis and socio-economic variables on these valuations.

Looking first at journey purpose, it is clear that the nature of phone booked trips is different from that of rank trips. There are two dominating origins; a private house and a place of entertainment. Both of these give results in line with the overall figures cited above; other origins have sample sizes too small to yield meaningful models. There is a better spread of destinations, all giving reasonable results. It seems that people travelling to work or a transport terminal have higher values of waiting time (15.1p/min and 11.5p/min respectively) and those going to the shops a lower value (5.9). These results are not surprising; the first two cases presumably involve a more binding arrival time constraint than the last case. The valuation of booking time is relatively invariant across origins and destinations.

Disaggregating by trip circumstances generally produced models with reasonable sample sizes and hence acceptable results especially for waiting time. The salient features of the models looking at the time the trip was made are the high value of waiting time for trips made before 8am (13.2p/min) and the low value for trips after midnight (7.0). Unlike the rank case, there is a sizeable number of trips reported between 6pm and 9pm; the dominant journey purpose in this case is leisure, two thirds of destinations being a place of entertainment, and the slightly higher value of waiting time reflects a desire to make the most of the leisure opportunity. Generally speaking, the value of waiting time decreased as party size increased or as the amount of luggage carried increased, although the wide spread of responses in some cases gave relatively insignificant parameter estimates. All the disaggregations had trouble producing highly significant coefficients on booking time; it appears that booking time is perceived to be relatively fixed and that a booking cannot be accomplished in substantially less time than is currently the case.

Roughly two thirds of the respondents in the phone user category booked their cab to arrive as soon as possible for immediate use; the remainder had telephoned before they needed a cab and arranged for it to come at a specific time. Both groups valued waiting time at 9.7p/min (in the case of advance booked cabs, the value of waiting time is interpreted as the value of the punctuality of the cab's arrival). Considering the fare paid, we see a higher value of waiting time for fares between £3 and £5; there is no obviouv reason why this should be so and it is worth pointing out that the cost coefficients o these models are much less significant than on the models for other fares. For people who were able to tell us which company they had phoned, it was possible to work out whether they had used a hackney carriage or a private hire car. No significant difference was found in waiting time valuation for the two groups, although those who did not know which company they had phoned had a value of waiting time of only 6p/min. Looking at waiting time, it seems that those experiencing prompt arrival placed a higher value on waiting time than those experiencing a worse quality of service. For cabs booked immediately, wait time was valued at 15.1p/min for those receiving a cab within 5 minutes and at 7.7p/min for those for whom it took between 5 and 10 minutes for a cab to arrive. The pattern is less clear for prebooked cabs, since 60% arrived on time, giving a relatively small sample size for late cabs. In spite of the seeming non-linearity in the value of waiting time, none was found when models were run incorporating a non-linear term.

The reason why people phoned for a taxi for the particular trip made did have some effect on the value of waiting time; those who wanted a cab because it was quick had a value of waiting time of 13.0p/min whereas those who wanted to avoid walking had a value of 6.4p/min. Peoples' alternative course of action in the absence of a cab had little influence, as did frequency of use save that in the latter case, daily users had a value of wait of only 5.9p/min. The reason why people did not use taxis more had its anticipated effect; those who found taxis too expensive had the lowest value of waiting time (6.9p/min) and those with a car available the highest (19.0p/min) with bus users in between (10.1p/min).

Turning finally to socio-economic factors, we found very consistent results across sex and age, with the exception of a lower value of waiting time of 7.6p/min for over 60s. For those groups with large enough sample size, we found economically inactive (in education, retired, unemployed) to have lower values of time (6.9, 6.5 and 8.4p/min respectively) and those in full and part time employment to have higher values (11.0 and 11.3p/min respectively). As with the rank trade, the effect of income puts people into one of two groups. Those with incomes between £5,000 and £15,000 had values of waiting time of 10.1 or 10.2p/min, and those eith incomes between £15,000 and £20,000 gave a value of 16.7p/min. Once again, those with incomes over £15,000 accounted for about 12% of trips.

The previous breakdown of trips into discretionary and non-discretionary, and of respondents into captive and non-captive again showed little difference, certainly no significant differences.

Table 8: values of time according to nature of trip

VO book	VO wait	rho-sq	sample	
4.2	10.5	0.11	168	Discretionary trips
2.7	8.7	0.14	99	Non-discretionary trips
1.8	7.6	0.16	59	Captives
4.2	10.5	0.11	208	non-captives

So for telephone booked trips as with rank trips, the conclusion is that for most types of people for most types of trip we can accept a homogeneous value of booking time of 3.5p/min and a homogeneous value of waiting time of 9.7p/min. The principal exceptions appear to be people with incomes over £15,000 and trips with a fixed arrival time constraint (to work or to a transport terminal).

3.4 Vehicle type.

We have seen that for rank trips, a London-style taxi is preferred to a large saloon car by about 10p, but other sized saloon cars have no effect. For phone-booked trips, no difference was found between medium and large saloon cars, and these were preferred to London-style taxis and small saloon cars by about 20p. Very few of the attempts to assess the relative value of vehicle type according to journey details or respondent characteristics yielded sensible results. It appears that, by and large, existing taxi users are indifferent as to vehicle type and on the whole this would appear to be an irrelevant consideration. Therefore, results reported hereafter will ignore the vehicle-type variables.

3.5 Bus users

The purpose of this part of the survey was not prticularly to find out the values of time of bus passengers; sufficient work has already been undertaken in this area. It was included more to provide a check on the results from the taxi experiments - if the bus users values of time are broadly consistent with those from previous studies, then we can accept that the taxi results are correct. Bus users were included as a large group of people who could be attracted to use taxis if circumstances were different. This is dealt with in section 7.5 and need not concern us here. So here, we present only a broad brush summary of bus users values of time.

Table 9: basic models for bus users

	AGGREGATE		DISAGGREGATE	
	value	t	value	t
Intercept	-.59	0.69	-.63	1.49
Walk	.029	0.59	.034	1.62
Wait	.038	0.67	.044	1.79
In veh time	.035	0.51	.043	1.49
Cost	.019	4.70	.020	10.74
ASC	-31.8	0.65	-31.1	1.46
VO walk	1.59	0.59	1.77	1.67
VO wait	2.06	0.66	2.19	1.80
VO IVT	1.87	0.51	2.19	1.52
Observ^{n}s	9		1792	
G of fit	0.70		0.35	

Notes: Values of time are in pence per minute, the ASC less than zero means it is in favour of bus. t-ratios applied to values of time etc are, in this instance, those applied to the value of time and not the coefficient. The goodness of fit measure for the aggregate model measures the explained deviation around 0. For the disaggregate model, rho-sq is defined as 1 - (model-log-likelihood/null log-likelihood).

Clearly the aggregate model suffers from too few observations to be able to give significant results. So we focus on the disaggregate model. The ASC is not significant at 10% level for a two-tailed test; this is probably as well, since it is in favour of bus, suggesting an element of justification bias. The values of time, of the order of 2p/min are plausible; possibly IVT is valued a little highly and walk and wait are a little low, but overall the figures suggest that the method has worked and we can be confident that this also holds true for the taxi experiments.

Looking very briefly at some disaggregations, we can find little evidence of significant differences in values of time if we split by journey circumstances or respondent type. Those people who sometimes use taxis exhibit slightly higher values of time, but clearly not high enough for them to use a taxi for the reported trip. (For example, value of wait = 4.1p/min for those who use taxis monthly, but 1.9p/min for those who never use taxis.) There is limited evidence of higher values of time for higher income groups; but we had so few bus users earning over £15,000 that these models would not converge. Cursory examination of the data suggests that these bus users would be most unlikely to use taxis for their trip out of Leeds, certainly not if changes to the taxi market were marginal. However, we shall examine this in more detail in section 7.5 .

3.6 Conclusion to section 3

All in all, there is little evidence that taxi users' exhibit heterogeneous values of time (except higher income earners) and certainy not in any way which could be reflected by price discrimination against certain groups by, for example, the provision of a two-tier charging structure (low fare, high waiting time for people with low values of time and high fare, low waiting time for people with high values of time) such as could be achieved by a shared taxi scheme. The only feasible price discrimination would be according to time of day, party size and luggage. It seems safe to conclude that we can treat taxi rank users as having a value of waiting time of 7.4p/min and phone users of having a value of waiting time of 9.7p/min.

4 ELASTICITY ESTIMATION.

4.1 Methodology

It can be shown that the binomial logit model (expressed in terms of attribute differences) yields a point elasticity for mode k with respect to attribute j of

$$\epsilon_{jk} = \beta_j(1 - P_k)A_j$$

and this is the basic analytical device used in this section.

Clearly, any elasticities calculated are sensitive to P_k, and the question of defining the appropriate population will therefore be of relevance. If we assume that there is a demand for "taxi-type" trips which can be met by either rank based trips or phone booked trips, and that trips not undertaken by one mode are undertaken by the other (that is, changes in attributes will simply alter the balance between the two and will not generate new trips or abstract from other modes), then the point price elasticity of demand for rank trips at the average fare level is

$$\epsilon = 0.021 * 0.55 * 378 = 4.37$$

given that rank trips account for 45% of all taxi trips according to our sample. This high figure arises out of the assumption that fares for telephone trips remain unchanged; since they are a close substitute for rank trips, a high elasticity is maybe to be expected. However, the problem with restricting the population to existing taxi-type trips is that a £1 increase in (say) fares in both sectors would leave the positions unchanged compared with the present. In practice, we would expect such a change to reduce the overall size of the market which in this formulation cannot happen.

Alternatively, we could define the population as being all bus and taxi trips; this would allow for switching from bus to taxi or vice versa. The implicit assumption behind such a definition is that switching to or from taxi from modes other than bus is zero. In this case, taxi's share of the market is about 6% (130,000 trips per week in Leeds, and of the order of 2 million bus trips) and so taxi's own price point elasticity of demand is -7.5 . Such an approach though takes no account of the individual circumstances facing (say) the taxi user. Half our sample who took a taxi from a rank or flagged one down on street made their trip late at night (after the buses had stopped running) or said they would have walked in the absence of a taxi. For these people, taxi's share of the combined taxi and bus market for such trips is 100%. This would give zero elasticity at all levels of all variables. This too is unsatisfactory. The solution is to assign probabilities to each individual's choice of taxi; this will also avoid aggregation bias which is present in the previous techniques.

Aggregation bias arises when disaggregate data are used to obtain aggregate results which are based on average attribute values, and arises out of the non-linearity of the logit model. So to overcome this, for each individual i, we use our model to predict a probability of choposing mode k, P_{ki}, and then define an elasticity with respect to attribute j of

$$\epsilon_{jki} = (1 - P_{ki})\beta_j A_{jki} \ .$$

These elasticities will have a distribution over the sample in the same way that the choice probabilities and attribute levels do, and the appropriate aggregate elasticity weights the individual elasticities according to each individual's probability of chhosing mode k. Thus

$$\epsilon_{jk} = \frac{\sum_i P_{ki}(1 - P_{ki})\beta_j A_{jki}}{\sum_i P_{ki}} .$$

This has the effect of giving more weight to those who are "captive" to taxis at the expense of those who are not. The problem remains of how to assign choice probabilities to each individual. For rank based trips in particular, our respondents had two major alternatives to travelling by taxi; to travel by bus (37.5%) or to walk (41.1%). It was therefore decided to allocate people to an alternative mode on the basis of their captiveness to taxi. Those who made a trip late at night or who said that in the absenve of a taxi they would walk were allocated an alternative walking journey in which the distance of the walk was calculated from the taxi fare and the time taken from an assumed walking speed of three miles per hour. The value of walking time was assumed to be the same for the taxi trip or the walk, and it was further assumed that there was no alternative specific constant in favour of taxi. In practice, because taxi in-vehicle time was omitted, there should be a positive ASC, which would increase the probability of choosing taxi; not including it means elasticities calculated are possibly slightly high. However, if walking speed is a little over three mph, then we are overpredicting taxi, nd the reverse applies. Trials on the data suggested that the results are not particularly sensitive to fairly small changes in walking speed or the addition of an ASC; fare is the dominant factor.

Those who were not captive to taxi were allocated an alternative bus journey. The bus fare was calculated from the taxi fare and multiplied by the party size, no account being taken of the use of passes or permits. Waiting times were derived from the bus user survey. Those in the latter survey were waiting on average for 10.3 minutes, almost all journeys being made before the end of the evening peak. Since bus frequencies in Leeds in the evening are typically half those in the daytime, waiting times of 10 minutes were assumed for daytime trips and 20 minutes for evening trips. The bus user wsurvey gave an average walk time of 12.0 minutes; since taxi ranks are more evenly spread throughout the city than bus stops, we assumed an average walk to a bus stop for our taxi users of a little more than this - 10 minutes plus the walk time to the taxi rank. Again, in-vehicle time was excluded - partly because we have no value for it. (It was excluded from the SP design because (a) it is not something which the licensing authority can directly affect although it does influence choice and (b) to include it would have made the SP exercise very difficult for the respondents, since it would have then included five variables.) The same approach was followed for telephone users. These figures must be treated with caution, though, since the range of options open to phone users was rather greater (one third would have gone by car or not gone anywhere) and so to allocate non-captives to bus is less secure than for rank trips.

For the sample who had made (or were about to make) a bus trip, there were major problems inderiving details of the potential alternative taxi trip, especially in arriving at the correct taxi fare. Therefore it was decided for this group only to use average attribute values to obtain elasticity estimates, notwithstanding the problem of aggregation bias.

4.2 Rank and flagdown users.

The effects of changes in fare, wait time and walk time were investigated. We look first at fares.

Table 10: price elasticities for rank users

Fare index	40	80	100	120	160	200
Demand level	318	255	218	183	111	35
Point elasticity	0.13	0.58	0.81	1.10	2.80	8.70
Arc elasticity	0.40	0.70	-	0.96	1.44	2.64

The interesting point here is that demand appears to be inelastic at current fare levels, and consistent with Roy Allen's estimate of just below unity. Clearly, reducing fares would not provide sufficient extra business to pay for the lower fare per hiring; but industry revenues could be increased by raising fares by 20%. Doubling fares would choke off five sixths of current demand.

It may be thought that the nature of many taxi trips (made late at night with no other mode available) would lead to inelastic demand. However, the sensitivity to price which has been discovered during unmet demand studies would imply a higher elasticity. Table 11 breaks down the market into captives and non-captives.

Table 11: price elasticities for rank users

Fare index	40	80	100	120	200	
Demand level	122	117	111	102	19	CAPTIVES
Point elasticity	0.03	0.15	0.31	0.70	10.70	
Arc elasticity	0.10	0.24	-	0.46	2.50	
Fare index	40	80	100	120	200	
Demand level	243	153	107	72	16	NON CAPTIVES
Point elasticity	0.24	1.30	1.90	2.35	3.80	
Arc elasticity	0.90	1.60	-	2.20	2.70	

Not surprisingly, captives are much less sensitive to price at current fare levels than non-captives, the elasticities being 0.3 and 1.9 respectively. This suggests that if price discrimination is feasible, prices should rise in the captive market and fall in the non-captive. We can see that doubling fares has broadly the same effect in each market, but reducing the fares would bring in much more non-captive business.

We also checked to see if other factors influenced the price elasticity at current fares. Income and sex of the respondent had no effect; and looking at the reason why people did not use taxis more, those who had a car available ($\epsilon = 1$) were more price sensitive. Age had relatively little effect, save that 16-24 year olds were less price sensitive ($\epsilon = 0.6$) and pensioners more sensitive ($\epsilon = 2.0$). More frequent users had lower elasticities; for those using taxis at least weekly, $\epsilon = 0.6$; $\epsilon = 0.85$ for quarterly users; and $\epsilon = 1$ for those using taxis less often.

Looking at service effects, we find very low elasticities at current levels of walk and wait time.

Table 12: wait time elasticities for rank users

Wait index	40	80	100	120	200
Demand level	233	223	218	214	196
Point elasticity	0.04	0.09	0.11	0.12	0.22
Arc elasticity	0.07	0.10	-	0.11	0.15

Demand is very insensitive to waiting time at current levels and remains so even if it doubles. Non-captives have slightly higher elasticities (0.19 against 0.09 at current waiting times) but even the complete eradication of waiting time at rank would have only a minor influence on demand (a 12% increase). By and large, waiting time elasticity is higher for those who waited longer; Table 13 shows this for current levels of waiting time.

Table 13: effect of waiting time on waiting time elasticity

Current wait (mins)	0	1-2	2-5	5-10	10-20	over20
τ	0	.03	.13	.27	.16	.83

The reason for the unexpected fall in elasticity for those waiting 10-20 minutes is that these people were largely travelling at night, so the (1 - P) term in the elasticity dominates the attribute level.

Demand was even less sensitive to walking time. At current levels, $\tau = 0.07$. Reducing walking by 60% gives a new demand of 227 (current 218), a point elasticity of 0.02 and arc elastiity 0.04 . Doubling walk time gives 203, 0.18 and 0.1 respectively. The walk time experienced had little effect on the elasticity. Overall, given the details we have on elasticities, levels of fare and time, we can derive values of time by using the formula

$$\frac{\epsilon_p}{P} = \frac{\epsilon_t}{vT}$$

which gives results for v, the value of time, consistent with those reported in section 3.

4.3 Telephone booked trips.

Demand for telephone trips was found to be slightly more inelastic than demand for rank trips, although the distinction is probably slight enough to be disregarded.

Table 14: price elasticities for phone users

Fare index	40	80	100	120	200
Demand level	368	300	261	219	65
Point elasticity	0.13	0.51	0.78	1.10	3.90
Arc elasticity	0.37	0.62	-	0.96	2.00

Again, as with the rank trade, fares could be increased by about 20% before revenues started to fall. The differences between captives and non-captives was less marked; and in this sector, captives accounted for only about 20% of trips.

Table 15 price elasticities for phone users

Fare index	40	80	100	120	200	
Demand level	59	57	55	52	15	CAPTIVES
Point elasticity	0.03	0.10	0.20	0.40	8.30	
Arc elasticity	0.08	0.16	-	0.31	1.87	
Fare index	40	80	100	120	200	
Demand level	319	247	206	1655	52	NON CAPTIVES
Point elasticity	0.16	0.66	1.03	1.50	3.10	
Arc elasticity	0.48	0.81	-	1.22	1.99	

It would seem that the revenue-maximising policy would be to price up at night, but leave the daytime fares alone. Extreme policies (doubling fares or reducing them sharply) seem to have the same sort of effect in each market. Few other factors consistently affected the price elasticity, except trips to work shopping or hospital had $\epsilon > 1$, and trips to a place of leisure were inelastic ($\epsilon = 0.67$). (Trips from a pplace of leisure were even less elastic, $\epsilon = 0.4$).

Quality of service effects were largely conspicuous by their absence. The booking time elasticity was 0.02, and further consideration of it need not concern us here. Waiting time elasticity was 0.17 at current levels (this was an amalgamation of waiting time for immediate hirings and punctuality of advance bookings).

Table 16: wait time elasticities for phone users

Wait index	40	80	100	120	200
Demand level	287	269	261	253	219
Point elasticity	0.06	0.14	0.17	0.20	0.37
Arc elasticity	0.10	0.14	-	0.17	0.25

Elasticities for non-captives were slightly higher (0.2 at current waiting times, against 0.09 for captives). The only effects which could be obtained were those influenced by quality of service received.

Table 17: effect of waiting time on waiting time elasticity

Current wait (mins) or punctuality	< 5 mins or on time	5-10 <5min late	10-20 >5min late	over20
τ	0.06	0.25	0.49	4.6

The significant finding is the very high elasticity from those who had to wait over 20 minutes for a cab to arrive. These were only 7 out of 267 in the sample and can probably be regarded as within tolerable limits.

4.4 Bus users.

For this sample, it was necessary to deal in averages because of the difficulty of identifying unique journey characteristics for all respondents. The bus fare average of 45p indicated a 3½ mile trip, and the in-vehicle time of 21.6 minutes was consistent with this, giving a speed of just under 10 mph. A taxi in-vehicle time of 10 minutes was imputed from this.

Table 18: effect of improving taxi service on demand from bus users

Fare index	100	90	80	70	60	50	40	30	20	10
Dem (out of 212)	0.4	1	2	4	7	15	30	55	91	130
ϵ	7.5	6.8	6	5.2	4.4	3.5	2.6	1.7	0.9	0.3
Wait index	100	90	80	70	60	50	40	30	20	10
Demand	.4	.4	.4	.4	.4	.4	.4	.5	.5	.5
τ	.3	.3	.2	.2	.2	.1	.1	.1	.1	0

As can be seen, reductions in the waiting time for taxis would not cause our bus passengers to switch; it is price to which they are sensitive. However, large changes are needed to cause significant numbers to change mode - even halving taxi fares would cause bus to lose only 7% of its passengers. This figure is rendered more significant when we consider the overall size of the bus market; a 7% shift is equal to 140,000 trips per week, which is roughly the size of the existing taxi market.

4.5 Conclusion to section 4

Existing taxi users are relatively insensitive to price; aggregate price elasticity at current fares is about 0.8 for both rank and phone booked trips. "Captives", mostly those using taxis late at night are much less sensitive than those who have bus as a feasible alternative. Waiting time effects are minimal, with elasticity of 0.1 for rank hirings and 0.17 for phone bookings. Non-marginal reductions in price would cause significant numbers of bus users to switch to taxi.

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TRIP PURPOSE

	Value of					Coefficient on				
	FX4	M	S	Walk	Wait	Walk	Wait	Cost	rho-sq	N
ORIGIN=										
Priv house	-	-	-	8.0	5.7	0.171	0.122	0.021	0.11	23
Work/coll	44*	-	-	8.8	6.5	0.328	0.240	0.037	0.25	8
Shopping	-	-	-	5.9	8.3	0.093+	0.131	0.016	0.10	27
Transport	25*	-	-	10.8	7.3	0.224	0.151	0.021	0.15	59
Leisure	14&	-	-	6.6	7.7	0.147	0.171	0.022	0.15	107
Medical	-	-	-	-	-	-	-	-	-	-
DESTIN=										
Priv house	14*	-	-	7.8	7.2	0.164	0.152	0.021	0.13	181
Work/coll	-	-	-	16.2	9.0	0.275*	0.152*	0.017+	0.20	10
Shopping	-	-	-	4.2	12.0	0.068#	0.193@	0.016#	0.15	7
Transport	-101*	-64&	-73@	7.3	2.7	0.215+	0.081#	0.029&	0.42	6
Leisure	-	-	-	6.1	10.4	0.128+	0.220	0.021#	0.18	15
Medical	-	-	-	18.7	12.1	0.426&	0.275@	0.023#	0.33	5

TRIP CIRCUMSTANCES

	Value of					Coefficient on				
	FX4	M	S	Walk	Wait	Walk	Wait	Cost	rho-sq	N
TRIPTIME=										
before 8am	-	-	-	23.2	10.7	0.453*	0.209@	0.020#	0.34	5
8am to 6pm	-	-	-	6.7	5.8	0.154	0.132	0.023	0.10	49
6pm to 9pm	-	-	-	12.2	13.0	0.129@	0.138	0.011+	0.11	27
9pm-midn't	13&	-	-	6.3	5.6	0.199	0.176	0.031	0.18	53
After midn	-	-	-	8.9	8.8	0.169	0.168	0.019	0.16	88
PARTYSIZE=										
1	-	-	-	8.2	7.2	0.204	0.180	0.025	0.16	75
2	-	-	-	6.8	6.6	0.135	0.132	0.020	0.10	81
3	-	-	-	6.9	8.2	0.133	0.158	0.019	0.16	37
4	-	-	-	10.5	9.3	0.197	0.173	0.019	0.17	31
LUGGAGE=										
None	18*	-	-	7.6	7.4	0.165	0.160	0.022	0.13	146
1 or 2 bags	-	-	-	7.5	8.9	0.152	0.180	0.020	0.15	44
>2 bags	-	-	-	7.7	3.8	0.189+	0.094+	0.024&	0.17	6
Suitcases	39@	58*	34&	8.8	4.9	0.172@	0.096@	0.020*	0.20	23

TRIP DETAILS

	Value of					Coefficient on				
	FX4	M	S	Walk	Wait	Walk	Wait	Cost	rho-sq	N
MEANS OF HIRING =										
Rank	12&	-	-	8.4	7.5	0.164	0.145	0.019	0.12	167
Flagdown	-	-	-	6.4	7.3	0.168	0.191	0.026	0.19	57

* significant at 2.5%
@ significant at 5%
& significant at 10%
+ significant at 15%
# not significant at 15%

TRIP DETAILS

	Value of FX4	M	S	Walk	Wait	Coefficient on Walk	Wait	Cost	rho-sq	N
TIME TO FLAGDOWN										
< 2 mins	-	-	-	6.1	7.8	0.168@	0.217	0.028	0.19	20
2-5 mins	-	-	-	9.5	9.8	0.273	0.281	0.029*	0.26	18
5-15 mins	-	-	-	5.4	3.7	0.143&	0.098&	0.027*	0.15	13
over 15 min	-	-	-	0.7	5.7	0.015#	0.122+	0.022+	0.20	6
FARE										
< £2	-	-	-	9.5	5.8	0.201	0.122	0.021	0.12	38
£2-£3	-	-	-	7.5	7.0	0.165	0.156	0.022	0.13	74
£3-£4	25@	31@	-	6.6	6.7	0.151	0.153	0.023*	0.19	45
£4-£5	25&	-	-	10.7	10.0	0.197	0.185	0.018*	0.15	34
> £5	-	-	-	6.4	8.6	0.134*	0.179	0.021	0.15	33
WALK TIME										
0 min	-	-	-	11.5	8.8	0.180	0.137	0.016*	0.13	34
0-5 min	-	-	-	8.0	7.0	0.175	0.153	0.022	0.13	105
5-10 min	-	-	-	6.5	10.5	0.128&	0.208	0.020*	0.18	21
WAIT TIME										
0 min	-	-	-	13.8	12.0	0.180	0.156	0.013	0.15	58
1-2 min	46@	-	-	15.7	8.9	0.212	0.120	0.014&	0.12	34
2-5 min	-	-	-	7.4	7.4	0.157*	0.158	0.021	0.13	25
5-10 min	-	-	-	4.9	4.7	0.179*	0.172	0.037	0.24	24
10-20 min	54&	81@	-	1.7	10.1	0.035#	0.204*	0.020+	0.26	12
> 20 min	-	-	-	7.9	5.0	0.150&	0.095&	0.019@	0.07	14

USE/NON-USE OF TAXIS

	Value of FX4	M	S	Walk	Wait	Coefficient on Walk	Wait	Cost	rho-sq	N
REASON FOR USING TAXI										
Avoid walk	25&	-	-	7.4	9.4	0.160	0.203	0.022	0.17	28
Quick	27@	-	23&	10.8	7.8	0.212	0.154	0.020	0.16	49
Drink driv	81@	-	82&	15.0	11.5	0.233&	0.178*	0.015#	0.23	10
Luggage	-	-	-	7.1	6.5	0.104&	0.096*	0.015@	0.11	25
d/k Leeds	30&	-35&	-	10.7	6.6	0.720@	0.440*	0.067@	0.45	5
No other	-	-	-	6.4	7.0	0.154	0.169	0.024	0.16	74
ALTERNATIVE MODE										
Bus	14&	-	-	7.1	7.0	0.150	0.149	0.021	0.11	84
Train	-	-	-	8.8	15.2	0.190#	0.326*	0.021#	0.33	5
Walk	-	-	-	7.5	6.8	0.159	0.143	0.021	0.13	92
Car driv	-	-	-	7.9	19.8	0.153#	0.384&	0.019#	0.42	3
Car pass	-	-	-	10.7	7.6	0.285	0.204	0.027	0.23	23
Not go	-	-	-	9.3	9.4	0.293@	0.295	0.031@	0.30	10

* significant at 2.5%
@ significant at 5%
& significant at 10%
+ significant at 15%
# not significant at 15%

USE/NON-USE OF TAXIS

	-------Value of------					--Coefficient on--				
	FX4	M	S	Walk	Wait	Walk	Wait	Cost	rho-sq	N
FREQUENCY OF USE										
Weekly	-	-	-	9.3	7.5	0.152	0.121	0.016	0.10	66
Quarterly	13@	-	-	7.1	6.7	0.190	0.179	0.027	0.17	117
Less	-36&	-	-41&	8.1	10.4	0.128@	0.164*	0.016@	0.14	26
REASON FOR NOT USING										
Too expens	14@	-	-	6.5	6.2	0.155	0.147	0.024	0.14	111
Car avail	44@	-	-	13.2	12.1	0.201	0.184	0.015@	0.16	35
Buses adeq	-	-	-	7.2	8.2	0.207	0.236	0.029	0.28	31

SOCIO-ECONOMIC FACTORS

	-------Value of------					--Coefficient on--				
	FX4	M	S	Walk	Wait	Walk	Wait	Cost	rho-sq	N
SEX										
Male	21*	-	-	8.7	7.6	0.153	0.134	0.018	0.11	115
Female	-	-	-	7.5	7.3	0.178	0.172	0.024	0.16	100
AGE										
16-24	-	-	-	8.7	7.4	0.197	0.166	0.023	0.15	120
25-34	-	-	-	6.6	8.8	0.166	0.225	0.025	0.19	56
35-44	-	-	-	11.6	4.3	0.221	0.082@	0.019@	0.09	21
45-59	93&	-	-	6.5	8.5	0.070#	0.092+	0.011#	0.12	8
over 60	-	-	-	2.3	3.1	0.069#	0.092@	0.030@	0.14	13
STATUS										
F/time emp	-	-	-	9.9	9.7	0.194	0.190	0.020	0.17	116
P/time emp	-	-	-	-0.2	3.7	-0.003#	0.046	0.012	0.05	15
F/t educ	-	-	-	7.1	6.5	0.219	0.198	0.031	0.21	49
Retired	-	-	-	4.1	2.6	0.134#	0.086+	0.033@	0.12	13
Housewife	34&	-	-	6.0	7.1	0.214+	0.252*	0.036@	0.25	7
Unemployed	33&	-	-	7.3	3.2	0.157*	0.069&	0.022	0.12	23
INCOME										
< £5k	14&	-	-	6.8	5.3	0.184	0.142	0.027	0.15	74
£5k-£7.5k	-	-	-	12.9	10.4	0.167	0.135	0.013*	0.12	44
£7.5k-£10k	-	-	-	4.9	7.0	0.107&	0.151	0.022*	0.13	24
£10k-£15k	-	-	-	7.0	8.5	0.168*	0.203	0.024	0.15	29
£15k-£20k	-	-	-67&	10.0	15.6	0.154+	0.241	0.015+	0.30	10
over £20k	-	-	-49&	15.2	13.4	0.249+	0.259*	0.019&	0.31	14
under £15k	11&	-	-	7.5	6.9	0.164	0.150	0.022	0.12	171
over £15k	-	-	-54@	13.4	14.0	0.232	0.243	0.017@	0.30	24

* significant at 2.5%
@ significant at 5%
& significant at 10%
+ significant at 15%
# not significant at 15%

TRIP PURPOSE

	Value of					Coefficient on				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
ORIGIN=										
Priv house	-	-	-16&	3.1	9.3	0.046&	0.141	0.015	0.10	179
Work/coll	-58*	-	-33&	1.3	11.2	0.027#	0.237	0.021*	0.25	17
Shopping	-	-	-	12.9	10.5	0.248&	0.201@	0.019&	0.23	9
Transport	-	-	-	23.4	9.4	0.876+	0.351+	0.037#	0.73	3
Leisure	-60	-	-47	3.0	10.0	0.048#	0.162	0.016	0.17	51
Medical	-	-	-	2.5	18.7	0.038#	0.280*	0.015#	0.24	8
DESTIN=										
Priv house	-32	-	-16&	2.4	8.6	0.038#	0.137	0.016	0.14	111
Work/coll	-	-	-	1.0	15.1	0.010#	0.141	0.009&	0.08	32
Shopping	-	-	-	4.5	5.9	0.101#	0.134@	0.023*	0.17	15
Transport	-	-	-38&	4.0	11.5	0.079#	0.225	0.020*	0.16	23
Leisure	-20&	-	-30*	4.9	10.6	0.079&	0.171	0.016#	0.12	76
Medical	-	-	-	3.7	9.4	0.056#	0.143@	0.015+	0.07	10

TRIP CIRCUMSTANCES

	Value of					Coefficient on				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
TRIPTIME=										
before 8am	-	-	-32&	1.5	13.2	0.039#	0.346	0.026	0.28	20
8am to 6pm	-18&	-	-22&	5.3	8.5	0.081&	0.133	0.016	0.09	83
6pm to 9pm	-	-	-	6.0	11.3	0.076&	0.143	0.013	0.10	75
9pm-midn't	-52&	-22&	-39*	1.1	9.8	0.019#	0.167	0.017	0.16	57
After midn	-	-	-	1.7	7.0	0.032#	0.133	0.019	0.15	32
PARTYSIZE=										
1	-28	-	-19@	2.0	9.4	0.037#	0.177	0.019	0.15	96
2	-	-	-	4.4	11.3	0.078&	0.198	0.017	0.14	83
3	-	-	-	3.5	8.3	0.050#	0.118	0.014	0.10	45
4	-71	-	-64*	6.7	5.9	0.099&	0.087@	0.015*	0.13	36
LUGGAGE=										
None	-27	-	-25	2.7	9.6	0.042&	0.149	0.016	0.12	206
1 or 2 bags	-	-	-	6.0	13.4	0.089+	0.198	0.015*	0.13	30
>2 bags	-	-	-	8.2	7.2	0.201+	0.176&	0.024&	0.23	8
Suitcases	-52*	-	-57*	5.6	7.0	0.177+	0.222@	0.031*	0.28	14

TRIP DETAILS

	Value of					Coefficient on				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
MODE OFF USE =										
Immediate	-19*	-	-25	3.8	9.7	0.067@	0.169	0.017	0.12	175
Advance	-33*	-	-	2.7	9.7	0.036#	0.130	0.013	0.12	92

* significant at 2.5%
@ significant at 5%
& significant at 10%
+ significant at 15%
# not significant at 15%

TRIP DETAILS

	-------Value of------					--Coefficient on--				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
PUNCTUALITY										
On time	-48*	-	-	1.6	11.4	0.017#	0.124	0.011	0.11	54
< 5m late	-	-	-	9.4	9.2	0.124+	0.120@	0.013&	0.14	19
>5 min late	-	-	-	0.7	7.0	0.017#	0.166*	0.024*	0.22	16
FARE										
< £2	-16@	-17@	-25	3.7	8.3	0.097@	0.217	0.026	0.17	85
£2-£3	-	39@	-	3.6	10.9	0.040#	0.119	0.011	0.10	86
£3-£4	-	-	-	-1.3	15.7	-0.012#	0.151	0.010@	0.10	42
£4-£5	-137	-	-92*	11.7	14.9	0.122&	0.156	0.010&	0.20	26
> £5	-	-	-	2.2	7.2	0.041#	0.135	0.019	0.11	28
BOOK TIME										
0 min	-36@	-	-31&	2.3	11.7	0.037#	0.188	0.016	0.16	44
< 1 min	-27*	-	-20&	3.8	9.4	0.056&	0.134	0.014	0.10	118
1-2 min	-	-	-17&	5.0	9.5	0.099@	0.187	0.020	0.13	73
>2 min	-36@	-	-	2.0	6.9	0.039#	0.140	0.020*	0.13	32
WAIT TIME										
<5 min	-29&	-	-	0.1	15.1	0.001#	0.180	0.012	0.14	94
5-10 min	-	-14&	-27*	5.7	7.7	0.154	0.210	0.027	0.17	55
10-20 min	-	-	-	4.3	2.8	0.096#	0.064#	0.022	0.14	19
>20 min	-	-	-	11.1	5.5	0.115#	0.057#	0.010#	0.10	7
COMPANY										
Hackney	-	-	-	-0.1	11.8	-0.002#	0.158	0.013	0.10	53
Hire car	-20*	-	-19@	3.1	10.3	0.048&	0.159	0.015	0.12	169

USE/NON-USE OF TAXIS

	-------Value of------					--Coefficient on--				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
REASON FOR USING TAXI										
Avoid walk	-	-	-	4.9	6.4	0.130+	0.170	0.026	0.20	18
Quick	-	-	-	3.3	13.0	0.044#	0.170	0.013	0.11	76
Drink driv	-33&	-	-	4.5	10.9	0.070#	0.172	0.016*	0.13	30
Luggage	-	-	-	9.1	7.1	0.151+	0.116&	0.017&	0.15	14
No other	-	-	-	0.9	8.1	0.020#	0.170	0.021	0.17	54
ALTERNATIVE MODE										
Bus	-23&	-	-20&	6.1	11.3	-0.083@	0.156	0.014	0.11	104
Walk	-32*	-	-29*	1.2	7.9	0.026#	0.170	0.022	0.18	55
Car driv	-33&	-	-39&	8.3	10.3	0.169&	0.211&	0.020@	0.19	20
Car pass	-35*	-29@	-45	5.3	7.5	0.116&	0.164	0.022	0.15	37
Not go	36&	56*	-	-0.7	6.6	-0.010#	0.092*	0.014*	0.10	36

* significant at 2.5%
@ significant at 5%
& significant at 10%
+ significant at 15%
# not significant at 15%

USE/NON-USE OF TAXIS

	-------Value of------					--Coefficient on--				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
FREQUENCY OF USE										
Daily	-	-	-	0.8	5.9	0.018#	0.133*	0.023	0.14	21
Weekly	-35	-	-22@	4.5	11.8	0.068&	0.179	0.015	0.15	104
Quarterly	-	29&	-	1.9	10.8	0.024#	0.134	0.012	0.09	105
Less	-30@	-39*	-33*	4.2	8.7	0.114+	0.234	0.027	0.20	24
REASON FOR NOT USING										
Too expens	-24	-	-24*	4.2	6.9	0.086@	0.142	0.021	0.14	100
Car avail	-40&	-	-48@	3.2	19.0	0.036#	0.212	0.011*	0.18	55
Buses adeq	-	-	-	3.8	10.1	0.056#	0.148	0.015	0.10	42

SOCIO-ECONOMIC FACTORS

	-------Value of------					--Coefficient on--				
	FX4	M	S	Book	Wait	Book	Wait	Cost	rho-sq	N
SEX										
Male	-36	-	-27*	4.6	9.7	0.069@	0.148	0.015	0.11	133
Female	-	-	-20@	2.7	9.2	0.049+	0.164	0.018	0.12	128
AGE										
16-24	-28	-	-24*	2.3	8.7	0.051#	0.195	0.022	0.19	90
25-34	-	-	-	4.8	9.9	0.086&	0.177	0.018	0.14	75
35-44	-	-	-40&	7.9	11.0	0.090+	0.126	0.011@	0.07	37
45-59	-	-	-	-2.9	11.1	-0.024#	0.094*	0.008&	0.05	31
over 60	-	-	-62*	2.4	7.6	0.051#	0.158	0.021*	0.12	20
STATUS										
F/time emp	-30	-	-19@	3.8	11.0	0.062&	0.179	0.016	0.15	139
P/time emp	60@	-	-	-6.6	11.3	-0.087#	0.149	0.013&	0.07	27
F/t educ	-59	-	-41*	3.6	6.9	0.078#	0.152	0.022	0.22	38
Retired	-	-	-56@	6.8	6.5	0.096+	0.091@	0.014@	0.06	23
Housewife	-	-	-	0.5	15.9	0.004#	0.144*	0.009#	0.10	15
Unemployed	-	-	-	9.1	8.4	0.157&	0.146&	0.017*	0.13	22
INCOME										
< £5k	-31	-	-27*	5.6	8.1	0.094*	0.136	0.017	0.12	100
£5k-£7.5k	-	-	-44*	5.5	10.1	0.103&	0.190	0.019	0.13	35
£7.5k-£10k	-	-	-	2.4	10.2	0.061#	0.258	0.025	0.22	34
£10k-£15k	-36&	-	-	3.4	10.1	0.043#	0.129	0.013*	0.12	36
£15k-£20k	-	-	-	-1.0	16.7	-0.014#	0.242	0.015&	0.20	17

* significant at 2.5%
@ significant at 5%
& significant at 10%
+ significant at 15%
# not significant at 15%