Changes in the frequency of shopping trips in response to a congestion charge

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Abstract

This paper presents an analysis of shopping trips into London's central shopping district (Oxford Street area) before and after the introduction of the congestion charging scheme in February 2003. In collaboration with a major department store, three surveys have been conducted in order to understand changes in shopping frequency and the reasons for so doing. The analysis is based on tabulations of the raw data, binary logit models to analyse which customer groups have reduced their shopping frequency and ordered logit models to analyse which groups have reduced their shopping more than others. The outcome shows that within the sample surveyed the congestion charging scheme has caused a significant number to shop less often in central London and only a few to shop more often in the Oxford Street area. Negative experiences with the congestion charging scheme or a generally bad perception of the scheme are the main reasons for this. Other events, such as the Central Line closure or terrorist threats occurring at the same time also have a temporary influence on the shopping frequency in central London . Evidence from other travel demand measures

on city centre shopping activities suggest that the long-term effects of the congestion charge could be more positive.

Introduction

On 17 February 2003, after almost 40 years since the first proposal for a road pricing scheme (Ministry of Transport, 1964), London introduced a pioneering congestion charging (CC) scheme. Vehicles inside a 22-square kilometre zone enclosing the core shopping, government, entertainment and business districts between 7:00 and 18:30 on weekdays are charged a £5 daily fee (£8 since July 2005), unless they are eligible for a resident discount or are exempted. Exemptions are granted to environmentally friendly vehicles (battery powered or hybrid cars), motorcycles, disabled motorists (Blue Badge holders), taxis, buses and certain other categories deemed to be "essential". From a political point of view the scheme can be considered a success: Ken Livingstone, the London Mayor who introduced CC, was re-elected in 2004 with a program including an extension of the charged area to the West.

The impact on traffic was sudden and dramatic. According to *Transport for London*'s own data (TfL, 2004), traffic in the zone has been reduced by 12% (34% for cars; motorcycle, taxi, bus and cycle traffic increased). *Transport for London* estimates that the number of car trips into the zone has fallen by 65,000 to 70,000 per day, of which 20% to 30% are displaced through trips, 50% to 60% have shifted to public transport, and 15% to 25% made different adaptations (travelled at other times or chose alternative destinations).

From an economic perspective, the assessment of the CC is controversial. An early survey by the *London Chamber of Commerce and Industry* of its members found that 79% of traders reported reduced takings in the last year (LCCI, 2004). The majority (42.3%) blamed CC more than other events that occurred since the introduction of the scheme. Among these other events, which the Mayor of London and *Transport for London* (TfL, 2004) believe to be the main reasons for any sales decline, are a 3-month closure of a major underground line serving central London following an accident (in the following simply referred to as "Central Line closure"), increased fear

of terrorism because of the Iraq war, a perceived economic downturn in the UK, and increasing competition from other sources (Windsor-Cundell, 2003). *London First* gave a more positive assessment, although in a recent press release it observed that "there may be sectors, especially retail and leisure, where the impact of the charge may not have been wholly positive" (London First, 2004). Taking data up to February 2004, Carmel (2003, 2004) studied retail sales in central London. He found that the onset of the decline in sales predated the introduction of CC and suggested that the most significant reasons are a general economic downturn, a fall in the number of overseas visitors and the Central Line closure. More recently, Prud'homme and Bocarejo (2005) argue that congestion costs were not so onerous for central London (0.1% of the GDP of the CC zone) and estimate that the economic benefits of the system cover just 60% of its cost leading to a loss of around £50 million per year, even if a very high time value is assumed for the benefits of congestion relief.

According to Transport for London (2005), in 2004/05 the scheme generated £189 million revenues, with a net gain of £97 million, while it had a neutral impact on business performance. Quddus *et al* (2005a,b) reported an econometric analysis of two data sets; sales data for six John Lewis stores (one within the CC zone and five outside) for a period spanning the introduction of the charge, and the London Retail Sales Monitor (LRSM) index for central London (an area greater than but encompassing the CC zone). Even after allowing for other factors, most notably the temporary closure of the Central Line, the John Lewis sales data suggests that CC had a significant effect on John Lewis within the CC area. However, the LRSM data suggested no overall impact of the charge on retail as a whole within central London. Various explanations for these two results are possible, ranging from product and customer mix offered by different stores to the diversion of customers to stores outside the charged zone but inside central London. This study throws more light on the impact on John Lewis customers.

The objective of this study is firstly to understand changes in the number of shopping trips to central London since the introduction of the scheme and secondly to conclude to what extent changes in shopping behaviour can be attributed to the CC.

Road pricing and evidence on its impact on retail

Congestion charging is receiving much attention in the literature. To name a few, TRB (2005), Litman (2004), several publications relating to EU research projects on urban transport pricing (European Commission, 2004) and Evans *et al* (2003) provide useful summaries and discussions about recent applications. The book edited by Button and Verhoef (1998) and a recent special issue edited by Wong *et al* (2005) gather interesting contributions on theoretical and practical developments in road pricing. However, a relatively sparse literature regarding the impact of city centre congestion charging on city centre activities, in particular retail, shows that this is still a relatively little understood field. This is not surprising as most of the earlier established charging schemes cover either highways or wider areas than the central London scheme. For example the charging schemes in Norway (Oslo, Bergen) cover whole cities, leaving residents with fewer options to redirect their shopping as is the case in London. The Singapore scheme, Electronic Road Pricing (ERP), is also not fully comparable to London. Besides the CBD-cordon it covers major highways in the city. Furthermore, the shopping facilities in the CBD do not face the same amount of competition as in London (LTA, 2005).

Reports from London increased concerns of retailers in other UK cities, specifically Edinburgh. The city considered introducing a charging scheme and only decided against it very recently in a public referendum (Saunders, 2005). Turok and Bailey (2004) looked at activity patterns in Scotland and found that many customers are coming from rural areas to shop in Edinburgh. These customers rely on access by car, so a charge might incline them to shop elsewhere, for example in not too distant (for some) Glasgow.

Ison (2000) showed that 83% of the local authorities are concerned about the impacts of road user charging and Bonsall (2000) points out that several cities have "commissioned studies to look at the possible impact of road pricing on their local economy". Bonsall (2000) also states ideas to compensate shoppers for the fee, as in most cases it is mainly car commuters at whom the charge is aimed. However, reimbursement schemes, such as reduced parking fees on public parking spaces for those who purchased goods, require a significant additional administrative and

enforcement burden. Bonsall concludes that in many cases the simpler alternative to congestion charging is a parking levy aimed at commuters.

Stopher (2004) provides a summary of issues related to congestion charging. Among the negative impacts mentioned are travel time instability, increased emissions, and the time (users) and costs (scheme operator) need for registration of the car. Stopher further mentions activity dispersal: Congestion charging might cause some residents to move out of the city centre. He does not, however, link these changes to a negative impact on the city centre retail sector.[1]

Whitehead (2002), on the other hand, predicts that congestion charging will have a positive impact on the retail sector of a city centre surrounded by a charging cordon, but in the long-term only, and primarily if money is reinvested in public transport and the improvement of the city centre environment. He mentions that it might take up to 20 years for the benefits to become visible. Whitehead emphasises the need for greater awareness of the concerns of the business community. His research is based on a national survey in the UK of those within business, industry, government and academia who are thought to be familiar with the process of economic change.

Still and Simmonds (2000) note that the impact of any traffic demand management (TDM) measure on urban vitality is still in a research stage. A reason for this is that these policies mostly do not come as an isolated measure but as a package with other policies, which complicates the impact assessment. This is also true for the CC. Nevertheless, looking at other TDM measures aimed at discouraging car travel in the city centre (see for example VTPI, 2005) leads to some important findings and in general supports Whitehead's hypothesis.

Hass-Klau (1993) looks at the impact of pedestrianisation and traffic calming on the retail sector in German and British cities. When the impacts of the schemes were not yet well known, retailers in all cities were opposed to their introduction. The fear was always to lose the "high spending car-dependent customers". In the first year or two after the introduction of the schemes, the turnover did indeed suffer slightly in some

[1] The London scheme tries to avoid dispersal of residents by charging residents only 10% of the fee.

cases, however in almost all cases in the longer run pedestrianisation and traffic calming proved to be beneficial for turnover. After some time the initial scepticism of many retailers has turned into support for such schemes. It is however also important to note that the increased turnover often does not directly translate into higher profits, because of increased costs for the retailer in terms of rent (prime location) and delivering costs.

In general the impacts of traffic calming were less than those of pedestrianisation, as one would also expect. Hass-Klau further regroups data from Wiggins (1993) who conducted a case study in Leicester. The data suggests a direct relationship between vacant shops and traffic flow: In streets with less traffic flow there are also less vacant shops.

Park and Ride is another TDM measure that is often aimed at revitalizing the city centre. However, the conclusions here are not as clear. Cairns (1997) shows with Scottish case studies that Park and Ride facilities can lead to a small change in land use patterns that encourages the development of out-of-town shopping centres. On the other hand, Park and Ride can attract more car-bourn customers from the surroundings to the city centre retailers as the successful example of Oxford shows (Cairns, 1997).

Still and Simmonds (2000) review the impact of parking restraint policies on office activities as well as retail activities. The authors emphasise that there are only a few definitive conclusions on the impact of such policies on urban vitality. In particular, they conclude that although this policy is always strongly opposed by retailers, there is no statistical evidence that parking is linked to the performance of retailing or of other economic sector. They suggest that studying the effects of transport policies has to consider carefully the period of analysis, the evolution of the situation in the absence of any intervention, and not only the net changes but also the distributional consequences. In particular the authors highlight that large retailers can more easily react and adapt themselves to a policy limiting parking than smaller, local shops.

Survey design

Three surveys were conducted in cooperation with a major retailer (the John Lewis Partnership), which has a large branch located within the charged zone and five other branches in the London area but outside the zone. The John Lewis Partnership is long established and is among the best-known stores in Britain with branches in all major cities of the country. The John Lewis stores in London are known to be frequented mainly by residents in the urban area and its surroundings rather than tourists. The store is probably best known for its selection of general household goods. However, it also offers a wide range of other products such as electronic items and furniture. The majority of John Lewis customers are female, but the store is frequented by many social-demographic groups.

Two exit surveys were conducted in the first week of December 2003 at the Oxford Street branch (located within the CC zone) and a second branch, located at Bluewater (just outside the M25, London's ring motorway), which has become a major out-of-town shopping alternative for car users in recent years. These exit surveys looked at the behavioural changes of customers. In particular, it was envisaged that the Oxford Street survey would help to understand better the behaviour of customers continuing to shop inside the CC zone, whereas the Bluewater survey might capture some customers who have changed shopping location in order to avoid the charge.

Finally, a postal survey was conducted among holders of store cards from the Oxford Street branch, in order to capture some who may have ceased to shop at the Oxford Street store since the introduction of the charge and to record impressions on the operation of the scheme and suggestions about improvements.

The postal survey had 36 questions in total; both exit surveys were shortened to 20 questions. The main reason for excluding certain questions from the exit surveys was that it is not possible to keep respondents attention for long enough. A focus group of Oxford Street sales staff was conducted to assist the design of the questionnaire, as they had a good understanding of customer behaviour through daily contact.

The first section of the Oxford Street exit survey dealt with questions relating to shopping frequency at this store. The Bluewater survey asked about shopping at the Bluewater as well as the Oxford Street branch and the postal survey asked about shopping frequency before and after congestion charging in all six branches in Greater London. This allowed an analysis of whether shoppers have diverted to other branches. In an attempt to minimise the impact of other events happening in the first half of 2003 (mentioned in the introduction, but especially the closure from January up to May 2003 of a major metro line – the Central Line – serving Oxford Street) the respondents were not asked if their shopping frequency had changed before and after the 17 February 2003 but rather 'before 2003' and 'since congestion charging'.

The postal survey further asked about shopping frequency in the 'Oxford Street Area' and if it had changed, comparing 'before 2003' with 'since congestion charging'. The objective is to understand whether any reduction in shopping frequency is specific to the John Lewis store or whether it affects all Oxford Street Area stores. Of course results might be biased because it is John Lewis visitors who were interviewed. Respondents who indicated that CC had impacted on their shopping frequency in the Oxford Street Area (in the postal survey) or their shopping frequency at JL Oxford Street (in the exit surveys) were asked about the reasons for this. The list of possible reasons included CC as well as nine other possible explanations such as 'Less attractive Oxford Street' and 'Less money for shopping'.

All three questionnaires asked customers whether they had experienced any improvements since the introduction of the scheme and if yes, which. The respondents were asked to rate to what degree they had experienced reduced congestion, cheaper parking, better public transport and an improved environment in Oxford Street. Similarly, all respondents were asked which aspects of CC they dislike. Among these are 'The fare itself', 'Providing personal details' and 'The payment procedure'. Finally, the questionnaires concluded with a section on personal details. This included questions on gender, age and working status. If the respondents said that they are

working they were asked about their job sector (public, "blue collar", "City worker[2]") and whether they drive regularly into the congestion charging zone for work.

Sampling technique and response rates

For the exit survey the intention was to interview 500 customers at each branch. Customers were approached randomly when they left the store. 508 surveys were completed at Oxford Street and 596 at Bluewater. Bluewater surveys often were completed quicker, as there were more customers without experience of the congestion charging scheme, which meant that some questions were not filled in by these customers.

The postal survey was sent to 5,500 account holders of the Oxford Street branch out of a total of 49,000. The account holder database was divided into three groups depending on their observed shopping behaviour before and after the introduction of the congestion charging scheme and people were selected so as to focus the survey on customers who have changed their shopping behaviour,

- Group 1: Oxford Street account holders (OSAH) who have not shopped at Oxford Street since February 2003 but who shopped there between September 2002 and February 2003 and have shopped at other London John Lewis branches since February 2003;
- Group 2: OSAH who have shopped at Oxford Street since February 2003;
- Group 3: OSAH who have not shopped anywhere on account since February 2003 but who shopped at Oxford Street between September 2002 and February 2003.

As Group 1 is of special interest for this study, the survey was sent out to all 3,000 customers from this group, 1,500 randomly selected customers from Group 2 and 1,000 randomly selected customers from Group 3. All surveys were sent out in

[2] The "City" is one of the main business districts of London with a focus on banking activities. According to participants in the focus group, many City workers used to go to JL Oxford Street during their lunch time before 2003 and have not returned since the reopening of the Central Line. This was investigated in the survey but the results are not conclusive.

November 2003 and participants were asked to reply within 14 days. Exactly 1000 responses were collected and Table 1 shows the response rates.

A response rate of 18.2% was higher than the usually expected[3] rate of 15% for active account holders (Group 1 and Group 2) and 10% for inactive account holders (Group 3) respectively. This might suggest a strong interest among customers in CC. No additional incentives, like prize draws or vouchers, were given for the completion of the questionnaire.

In all three surveys, the majority of responses came from women (70 to 75%), which is not surprising as the majority of John Lewis customers are female. In all surveys the vast majority of respondents are aged over 25. However, the age distribution between the three surveys differs: The percentage of customers aged 55 or older is much larger in the postal survey than the exit surveys.

In terms of employment data, the postal and Bluewater survey data correspond well, but the Oxford Street data differs. 62.4% of the Oxford Street respondents, but only around 40% of the Bluewater and postal respondents, state that they work full-time. Because of this, and considering the differences in the age distribution, it is not surprising that more Bluewater and postal respondents are unemployed or retired. In all surveys, around 30% of the respondents state that they work in the public sector whereas only a minority of respondents have a 'blue collar' job (less than 4% in all surveys).

Descriptive analysis

In order to get a realistic picture of the changes in shopping frequency the three surveys have to be differentiated. On the one hand, the postal survey was focused on customers who have changed their shopping behaviour and so the changes in frequency are likely to be **overestimated**. Weighting the postal survey responses so that they correspond to the composition of Oxford Street Account Holders might not give a true picture, as it is likely that those who were impacted by CC are also more

[3] Based on the experience from other surveys done by John Lewis with account holders.

motivated to return the survey. Similarly, the Bluewater results might overestimate the changes in frequency, because the sample will be a mix of customers who have always shopped at Bluewater and those who have diverted to Bluewater because of CC. We can separate these two groups, but those customers who are now shopping more often at Oxford Street and less often at Bluewater are more likely to be missed out. On the other hand, the Oxford Street exit survey interviewed customers who are currently shopping inside the CC zone so that one could argue that these results underestimate the change in shopping frequency. These biases have to be taken into account in the following analysis. The differences in the direction of the bias might allow one to estimate an average that is closer to the truth.

23.8% of the postal survey respondents stated that they changed the frequency with which they go shopping at the Oxford Street branch since the introduction of CC. Of these only 4.5% (10 respondents) state they are now shopping more often at this branch and 95.5% say they shop less often at this branch.

Figure 1 shows that there are substantially fewer customers shopping every week and that there is a significant increase in customers shopping very infrequently (less than twice a year) and customers who do not intend to shop at JL Oxford Street anymore. Table 2 shows in detail which customers have changed their shopping frequency. The matrix shows that a number of customers “dropped by one category”, for example 34 customers who said they were shopping every week at JL Oxford Street are now only shopping “at least once a month”.

The exit surveys only asked whether customers are shopping less, the same or more often. Because customers were interviewed after a shopping trip, as expected fewer customers have changed their shopping frequency compared to answers in the postal survey. Similarly, as also expected, there is a higher percentage of customers in the Oxford Street exit survey sample who say they are now shopping more often at JL Oxford Street (Figure 2).

Figure 3 confirms that the reduction in shopping trips to the Oxford Street area is similar to the reduction in shopping trips to JL Oxford Street. Note the percentage of customers going to the Oxford Street area should always be higher than those going to JL Oxford Street (the former contains the latter), which is confirmed by the data.

Applying a chi-square test also gives the same results. With 95% certainty it can be concluded that the shopping frequency reduction at John Lewis is the same as the reduction in central London according to the survey results.

Which customers reduced their shopping frequency?

In order to single out the importance of specific attributes and experiences with the charging scheme, a binary logit model, expressed as

$$P_n(i) = \frac{e^{V_{in}}}{e^{V_{in}} + e^{V_{jn}}} \quad (1)$$

where i is the choice made by the individual n and V_{in} is the utility of option i for person n (there are just two options, i and j. Note that the choice set and utility function might vary across individuals. The utility function V_{in} is linear in the attributes

$$V_{in} = x_{in}\beta_{in} + \varepsilon_{in} \quad (2)$$

where x_{in} are the explanatory variables and β_{in} are the coefficients to be estimated. It is assumed that the error terms are independently and identically distributed, which means that the utility of each option is independent of the utility of other options. In our model x_{in} are the respondent's personal attributes as well as his/her mode choice and the respondent's experiences with CC (see Table 4). In order to handle these categorical variables, each category but one (to avoid multicollinearity) is entered as a dummy variable. The β for each category is therefore relative to the reference category.

The results of the binary logit models are significant, meaning that the attributes do, at least to some degree, explain the dependent variable (in this case whether the shopping frequency changed or not). Table 4 shows the results for two different models, where Model B includes the attribute 'Group' (see Table 1). The results show that 'Group' is indeed significant as one would expect; for example customers in Group 3 have reduced their shopping more than customers in Group 1. In addition to the common explanatory variables in Model A and B, Model A includes 'Driving to

central London for Work', and the employment sector of the respondent. Model B instead includes the employment status of the respondents.

Among the personal attributes, it can be seen that men have changed their shopping frequency more than women (Table 4 shows a positive coefficient for gender in both models). Employment status is another significant category as shown in Model B; especially customers with part-time jobs are more likely to shop less often than those working full-time after the introduction of CC. The models do not show that age or the intended expenditure of customers is significant (t-statistics are not significant for all groups). Asking customers about their intended expenditure is a difficult question as customers will often only decide their expenditure in-store and the answers should therefore be looked at with some scepticism. Nevertheless, this analysis suggests that customers are nowadays not spending more per trip.

As expected, the models show a correlation between the means of transport and the change in shopping frequency. Those who use their cars more often are also more likely to shop now with reduced frequency, while public transport users reduce their shopping frequency less (see positive coefficients for car use prior to 2003 and negative coefficients for public transport users; t-statistics indicate significance at or near 95% significance level).

Further, in the analysis the ratings of the different aspects 'Experienced improvements since CC' and the 'Disliked aspects of CC' were averaged. The extent to which respondents have experienced improvements is not significant but the extent to which customers dislike some aspects of the congestion charging scheme is significant. "Significant" here means that these customers have reduced their shopping frequency more often.

The survey also included a simple question on how customers in general feel about CC. Three possible answers were given: 'It's a good thing'; 'It's a bad thing' and 'Don't know/don't care'. Including these answers in the regression model leads to similar results. Customers who think CC 'is a bad thing' have changed their shopping frequency more often. However, the regression models do not show a significant relationship between a person being in favour of the scheme and his/her shopping

frequency, meaning that those who replied ‘it’s a good thing’ have not changed their behaviour significantly less than those with no experience or no opinion about the scheme.

Regression models have also been fitted to the data from the Oxford Street exit surveys. Because of the significantly smaller sample size of customers who have changed their shopping frequency, these models are more difficult to fit. However, the results point to similar conclusions. Especially the importance of the disliked aspects and the general feeling about CC are important factors that determine whether customers have reduced their shopping frequency.

Why did customers reduce their shopping frequency?

As mentioned earlier, those who stated that they had changed their shopping frequency were asked for the reasons. Figure 4 shows the responses from the postal survey. CC was mentioned most often, followed by car parking or traffic jams, with ‘Oxford Street being less attractive’ in third position. The results from the Oxford Street exit survey are very similar which confirms the observations from the postal survey. The only significant difference is that ‘better shops elsewhere’ was almost never mentioned in the Oxford Street exit survey, which is perhaps not surprising.

Ordered regression models have been developed to understand which customers have changed their shopping frequency more than others. Because the questionnaire did not ask for a specific number of times the respondent visit JL Oxford Street, the grouping as shown in Table 3 was applied. The logic behind this grouping is that a decrease from ‘at least once a month’ to ‘every 2-3 months’ might just mean the customers make only a few shopping trips less, however, a reduction from ‘at least once a week’ to ‘every 2-3 months’ is a far more significant decrease. It should be noted that this grouping is not necessarily correlated with sales value. In terms of sales value a drop from ‘2-3 times a year’ to ‘never’ might be far more significant than a reduction in shopping frequency from ‘at least once a month’ to ‘every 2-3 months’.

Because only customers who actually have changed their behaviour were asked for their reasons, the latent variable has four categories (slight decrease, decrease, significant decrease and very significant decrease of the shopping frequency). The models looked at the indicated reasons for the change as well as personal characteristics and customer group. In order to understand the relative effect of the attributes on trip generation, an ordered logit model has been developed. Alternatively an ordered probit model would also be suitable. Probit models show the change in the cumulative normal distribution of the dependent variable through the change of the independent variables whereas logit models refer to the change in the log odds of the dependent variable. Long (1997) writes that the choice between logit and probit is mainly a matter of convenience, as both models come to very similar results. In the following, a logit model is used. The reduction of shopping trips a person makes can be calculated with an ordered logit model of the following general specification:

$$y_{in}^{*} = x_{in}\beta_{in} + \varepsilon_{in} \tag{3}$$

where y_{in}* is a latent variable measuring the severity of the change in shopping frequency for person n. The levels of frequency reduction are defined in Table 3 so that

$$y_{in} = \begin{cases} 1 \text{ if } -\infty \le y_{in}^{*} \le \mu_1 \text{ (slight decrease in shopping frequency)} \\ 2 \text{ if } \mu_1 \le y_{in}^{*} \le \mu_2 \text{ (decease in shopping frequency)} \\ 3 \text{ if } \mu_2 \le y_{in}^{*} \le \mu_3 \text{ (Signficiant decrease in shopping frequency)} \\ 4 \text{ if } \mu_3 \le y_{in}^{*} \le \infty \text{ (very significant decrease in shopping frequency)} \end{cases} \tag{4}$$

where the threshold values μ_1, μ_2 and μ_3 are unknown parameters to be estimated. The parameters of the model are estimated by the method of maximum likelihood (Long, 1997). In (3), the partial change in $\boldsymbol{y}^*$ with respect to $\boldsymbol{X_n}$ is $\boldsymbol{\beta_n}$. This implies that for a unit change in $\boldsymbol{X_n}$, $\boldsymbol{y}^*$ is expected to change by $\boldsymbol{\beta_n}$ units, holding all other variables constant. It should be noted that the predicted probability of the amount of shopping decrease, m, for given $\boldsymbol{X_n}$ is

$$\hat{\Pr}(y = m \mid \boldsymbol{X_n}) = F(\hat{\mu}_m - \boldsymbol{X_n}\hat{\boldsymbol{\beta}}_{\boldsymbol{n}}) - F(\hat{\mu}_{m-1} - \boldsymbol{X_n}\hat{\boldsymbol{\beta}}_{\boldsymbol{n}}) \tag{5}$$

where F is the Gumbel distribution. For this analysis, the focus is on the estimation of $\hat{\beta}_n$.

Results of two ordered logit models are shown in Table 5. The models only differ in that Model B includes customer group as an explanatory variable. The models show that CC is one of the most important factors for a larger reduction in shopping trips as indicated by the negative sign of the coefficient for those who did not answer "very much". The interpretation is therefore as follows: Among those who have reduced their shopping, those who are "little" or "fairly" influenced by the charge, have reduced their shopping less than those who are influenced "much" or "very much".

"Terrorist threats" is significant with the same sign, meaning that those (few) who mentioned terrorist threats as a reason for shopping less, have reduced their shopping frequency more drastically.

The 'Central Line closure' is also significant, but with a positive sign. Therefore, the customers for which the Central Line closure was important have changed their frequency less drastically. This might be explained by the fact that the 'Central Line closure' was only active for a few months, meaning that customers have only changed their shopping destinations temporarily.

Conclusions

The analysis of the surveys provides strong evidence of a negative impact on John Lewis Oxford Street attributable to CC. Biases in the responses to the postal and exit surveys have to be taken into account. However, the combination of postal and exit survey allows a more reliable estimate of the effect. Whereas respondents to the postal survey might be motivated by their dislike of the charging scheme, the Oxford Street exit survey interviewed those who continue to shop at John Lewis Oxford Street. Therefore, taking some average value between the results of these surveys get close to the true impact. Taking this into account, the following conclusions can be drawn:
A significant number of customers have reduced their frequency of shopping primarily to avoid the £5 charge or issues related to the charge, like the fear of fines or

the payment procedure. There are far fewer customers who are now shopping more often in Oxford Street. It was found that part-time working men have reduced their shopping frequency at JL Oxford Street most significantly. There are undoubtedly benefits through the congestion charging scheme in terms of travel time savings, but these benefits do not (yet) seem to attract more customers. However, the disliked aspects of CC seem to be a significant factor behind the reduction in shopping frequency. A general disliking of the scheme, rather than the £5 charge itself, appears to deter some customers from shopping in central London.

Those customers who mentioned CC as a reason for their reduced shopping frequency have changed their number of shopping trips to central London more drastically than others. In particular the data suggest that customers affected by the Central Line closure have only changed their shopping destinations temporarily. The study looked at reductions in the frequency of shopping trips and not at sales reductions. However, the analysis does not support the assumption that customers are now spending more per trip, which suggests that losses in shopping frequency also mean losses in sales.

This study has focused on the impact of CC on one store. The impact will not be uniformly distributed across the retail sector. However, it is believed that the size of the JL Oxford Street store and the variety of goods it offers gives some indication about what might be happening in other stores. Moreover, the survey asked specifically about shopping trips to the Oxford Street area and not just the John Lewis store. There is a general perception that the Oxford Street Area is in decline, not just because of CC but also because of less attractive shops on Oxford Street and more attractive alternatives elsewhere. This is to some degree confirmed by the surveys but the results suggest that CC has a larger impact than otherwise anticipated. It can be concluded that the effect on the retail sector is significant and needs to be taken into account in the evaluation of congestion charging schemes.

Further work should look at whether the impact might be reduced over time, once customers get fully used to the scheme. The experience from other TDM measures, in particular pedestrianisation, would support this thesis. However, a clear difference between congestion charging and pedestrianisation is that the latter makes the shopping experience more pleasant, whereas CC reduces the traffic flow but in the

London case probably not enough to make a difference to the perception of the shoppers. Maybe one should rather compare the impacts of CC to the experiences with Park and Ride, which suggest that in the long run some new customers are attracted to the city centre because of easier access, whereas others are diverted to out-of-town shopping centres. City centre congestion charging might have a similar impact.

Finally, the conclusions from this analysis might encourage some skepticism as to whether compensating shoppers (as opposed to commuters) for the charge would be a successful move as has been done to compensate for the effect of parking restraint policies (Simmonds and Still, 2000). On one hand, some customers clearly are avoiding central London because of the charge, on the other hand the analysis showed that it is not just the charge that concerns customers.

Acknowledgements

We would like to thank the John Lewis Partnership for their funding of this study and their support throughout the analysis. In particular we would like to thank Nigel Brotherton and Jane Rose. We further thank various anonymous reviewers for their helpful comments.

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Table 1 Response rate of the different customer groups

	Group 1 (have been shopping at a JL branch since CC, but not in JL Oxford Street)	**Group 2** (have been shopping at JL Oxford Street since CC)	**Group 3** (have not been shopping at any JL branch since CC)	**Total**
Total Oxford Street Account Holders (OSAH)	3,000	40,000	6,000	**49,000**
Sent questionnaires (% of OSAH)	3,000 (100%)	1,500 (3.75%)	1,000 (16.7%)	**5,500 (11.2%)**
Expected Response Rate	450 (15%)	225 (15%)	100 (10%)	**775 (14.1%)**
Collected Responses	557 (18.6%)	299 (19.9%)	144 (14.4%)	**1,000 (18.2%)**

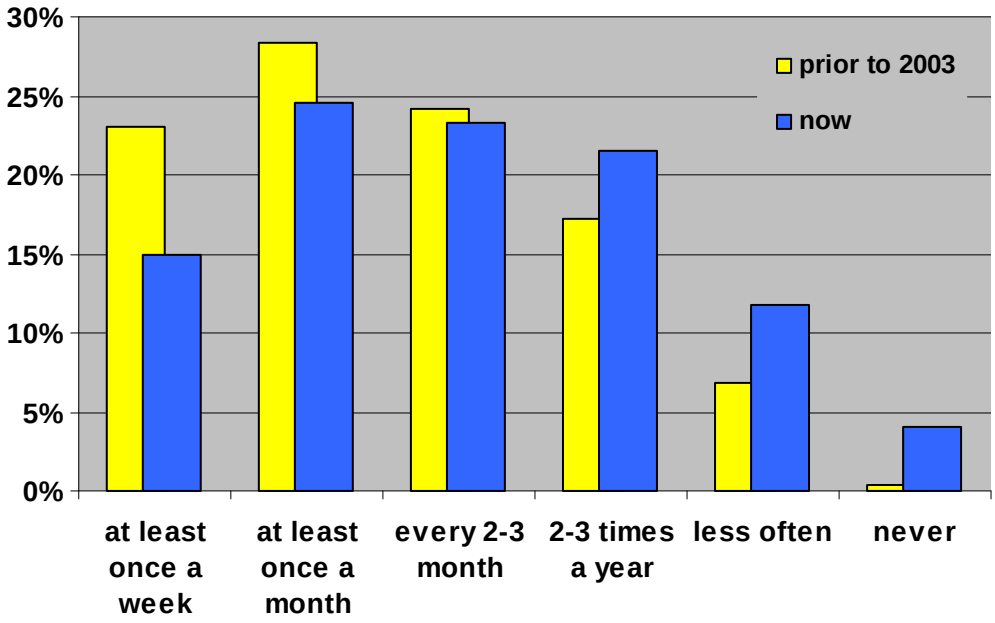

Figure 1 Changes in shopping frequency at John Lewis Oxford Street. Results from postal survey, 937 (93.7%) valid responses.

Table 2 Shifts in shopping frequency at JL Oxford Street (results from postal survey)

Before 2003 \ Since CC	at least once a week	at least once a month	every 2-3 months	2-3 times a year	less often	never
at least once a week	108	34	8	8	3	4
at least once a month	2	209	29	13	14	9
every 2-3 months	0	5	155	24	27	11
2-3 times a year	1	0	0	169	10	10
less often	0	1	0	1	75	5
never	0	0	0	0	0	2

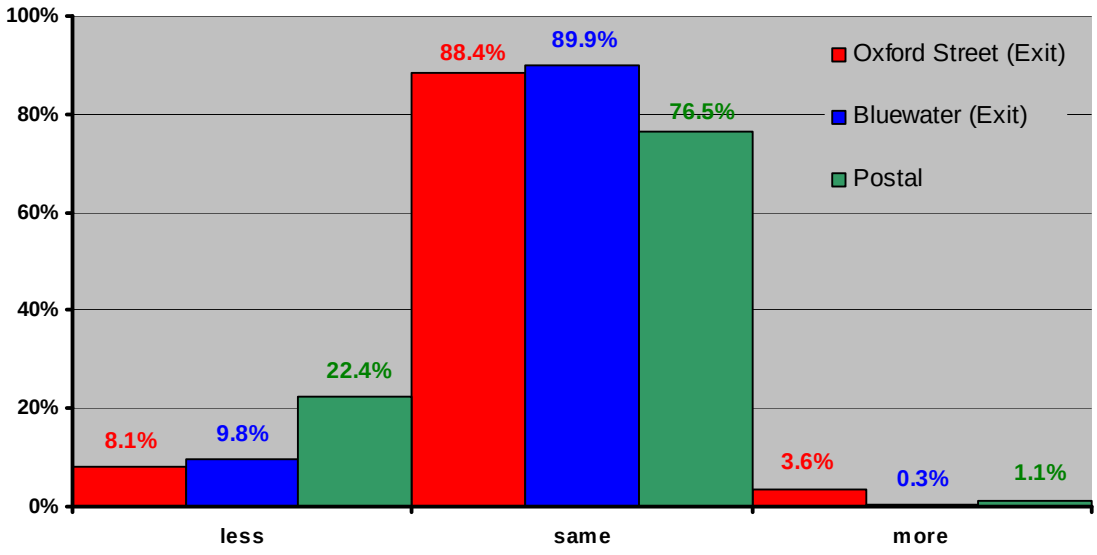

Figure 2 Changes in shopping frequency since CC at JL Oxford Street. Results from Bluewater exit survey (583 valid responses), Oxford Street exit survey (507) and postal survey (938).

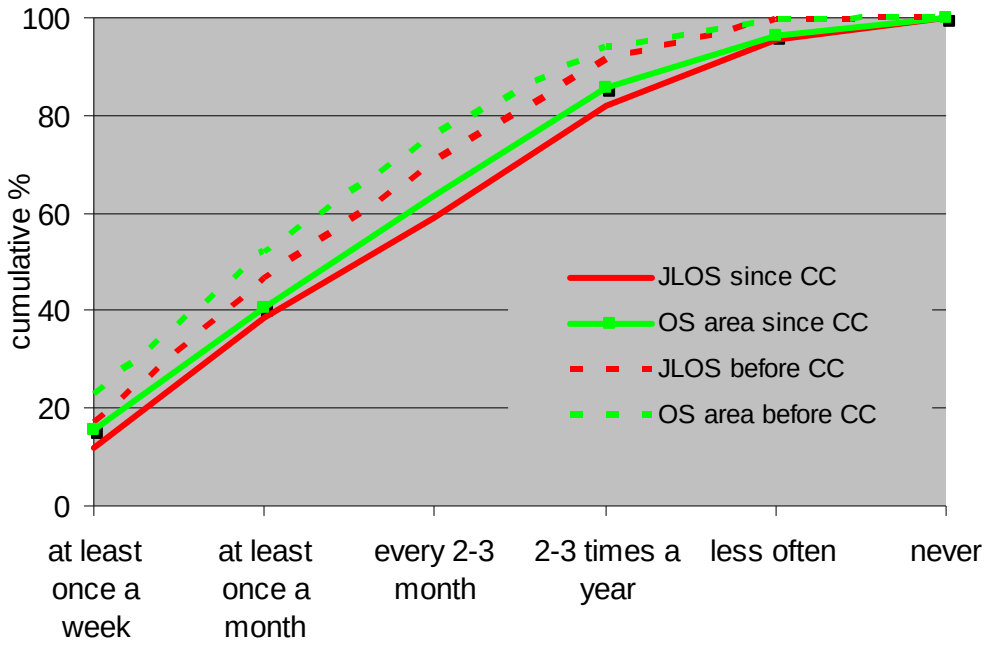

Figure 3 Comparison of changes in shopping frequency at Oxford Street area (OS area) and John Lewis Oxford Street (JLOS)**.** Results from postal survey, 925 valid responses.

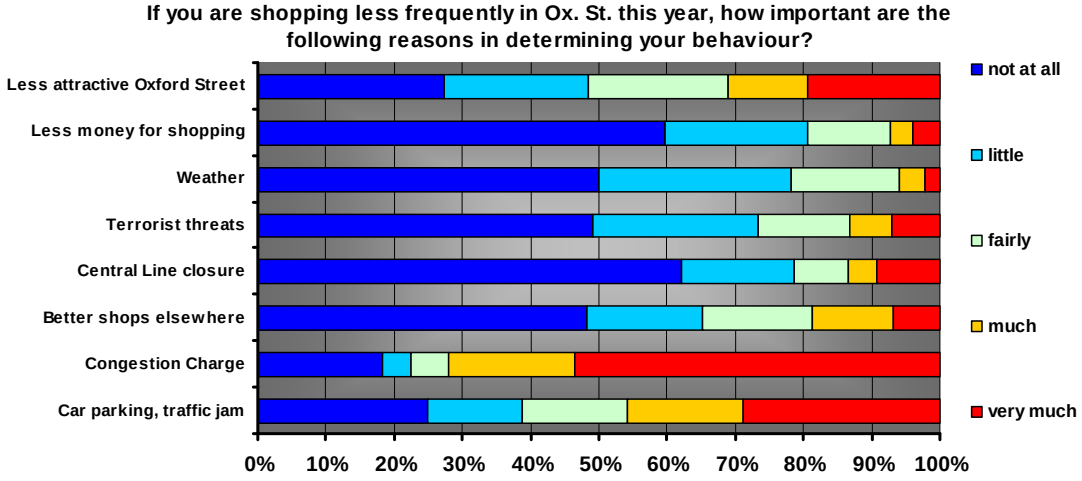

Figure 4 Reasons for reduced shopping in the Oxford Street area. Results from postal survey, for all options min. 218, max. 289 valid responses.

Table 3 Grouping the shifts in shopping frequency at JL Oxford Street

Before 2003 \ Since CC	at least once a week	at least once a month	every 2-3 months	2-3 times a year	less often	never
at least once a week	0 - not less	3 - high decrerase	4 - very high decrerase	4 - very high decrerase	4 - very high decrerase	4 - very high decrerase
at least once a month		0 - not less	2 - decrerase	2 - decrerase	2 - decrerase	2 - decrerase
every 2-3 months			0 - not less	1 - slight decrerase	1 - slight decrerase	1 - slight decrerase
2-3 times a year				0 - not less	1 - slight decrerase	1 - slight decrerase
less often					0 - not less	1 - slight decrerase
never						0 - not less

Table 4 Binary Logit Model – Customers who changed their shopping frequency
(bold coefficients indicate significance at the 95% level)

Attributes explaining whether or not a respondent has changed his/her shopping frequency		Model A			Model B		
		Percentage of observations	Coefficient	t-statistics	Percentage of observations	Coefficient	t-statistics
Average experience of improvements	never	15.6%	-1.853	-1.26	16.1%	-0.101	-0.09
	seldom	40.0%	-0.272	-0.22	40.4%	0.563	0.53
	sometimes	34.1%	-0.187	-0.17	34.8%	0.621	0.60
	often or always	10.2%	Reference		8.6%	Reference	
Average dislike of negative aspects	not at all	17.1%	**-3.423**	**-2.49**	15.4%	-1.851	-1.66
	little	24.4%	**-2.844**	**-2.41**	24.3%	**-2.871**	**-3.10**
	fairly	23.9%	-0.896	-0.88	23.6%	-1.390	-1.74
	much	19.0%	-2.262	-2.29	18.4%	-1.197	-1.57
	very much	15.6%	Reference		18.4%	Reference	
Trust	not at all	14.6%	-2.448	-1.75	17.2%	-1.576	-1.35
	little	24.4%	-2.203	-1.76	24.0%	**-2.625**	**-2.43**
	fairly	42.9%	**-2.836**	**-2.21**	40.4%	**-2.747**	**-2.67**
	much	14.1%	-1.203	-0.93	14.6%	-1.891	-1.71
	absolutely	3.9%	Reference		3.7%	Reference	
General feeling about congestion charging	it'a good thing	56.1%	-0.715	-0.85	55.4%	0.694	0.91
	it'a bad thing	32.2%	**2.376**	**2.76**	33.0%	**1.648**	**2.19**
	don't know/ don't care	11.7%	Reference		11.6%	Reference	
Car use prior to 2003	always	11.7%	2.886	1.70	10.5%	**3.630**	**2.45**
	mostly	24.9%	2.571	1.74	26.6%	**3.579**	**2.91**
	sometimes	20.5%	1.821	1.58	19.1%	**2.426**	**2.34**
	seldom	12.7%	0.999	0.90	13.1%	1.749	1.79
	never	30.2%	Reference		30.7%	Reference	
PT use prior to 2003	always	22.0%	-2.302	-1.29	24.0%	-2.710	-1.53
	mostly	29.8%	-1.777	-1.11	28.8%	-2.846	-1.80
	sometimes	31.7%	-2.413	-1.79	31.8%	-2.747	-1.87
	seldom	9.8%	**-3.192**	**-2.17**	9.4%	-2.291	-1.49
	never	6.8%	Reference		6.0%	Reference	
Walking/ cycling prior to 2003	always	2.0%	-0.749	-0.39	1.9%	-1.344	-0.53
	mostly	4.4%	-2.618	-1.50	4.5%	-1.010	-0.91
	sometimes	18.0%	-0.350	-0.41	15.7%	1.128	1.50
	seldom	8.8%	0.040	0.04	8.6%	0.071	0.08
	never	66.8%	Reference		69.3%	Reference	
Taxi use prior to 2003	always	1.5%	-2.323	-0.84	1.1%	-2.434	-0.48
	mostly	1.5%	-18.391	0.00	1.9%	0.816	0.47
	sometimes	18.0%	0.569	0.80	18.0%	0.628	1.00
	seldom	21.0%	-0.233	-0.34	19.9%	-0.198	-0.34
	never	58.0%	Reference		59.2%	Reference	
Intended expenditure	less than £100	22.0%	-0.186	-0.22	21.0%	-1.205	-1.63
	£100-£500	57.6%	0.257	0.35	56.6%	0.200	0.35
	more than £500	2.9%	-0.934	-0.57	3.4%	-0.495	-0.25
	don't know	17.6%	Reference		19.1%	Reference	
Gender	male	30.7%	1.010	1.49	29.2%	**1.236**	**2.02**
	female	69.3%	Reference		70.8%	Reference	

Attributes explaining whether or not a respondent has changed his/her shopping frequency		Model A			Model B		
		Percentage of observations	Coefficient	t-statistics	Percentage of observations	Coefficient	t-statistics
Age group	up to 34 years	9.8%	0.814	0.52	8.2%	-0.991	-0.82
	35-44 years	24.4%	0.375	0.29	23.2%	-0.187	-0.19
	45-54 years	34.6%	-0.355	-0.28	31.1%	-1.195	-1.28
	55-64 years	26.3%	-0.056	-0.04	27.0%	-0.954	-1.07
	over 65 years	4.9%	Reference		10.5%	Reference	
Frequency of shopping at JL Oxford Street prior to 2003	>once a week	22.0%	-0.922	-0.55	19.9%	2.279	1.68
	>once a month	27.8%	-0.935	-0.60	29.6%	1.513	1.23
	All 2-3 months	26.3%	0.225	0.15	25.8%	1.030	0.91
	2-3 times a year	18.5%	-1.562	-0.97	18.0%	-0.441	-0.37
	less often & never	5.4%	Reference		6.7%	Reference	
Driving in central London for work	usually driving	13.7%	-0.471	-0.58			
	not usu. driving	86.3%	Reference				
Employment sector	public	31.2%	-1.006	-0.98			
	oth.white collar	33.2%	-0.830	-0.86			
	blue collar /oth.	27.3%	-0.883	-0.88			
	city	8.3%	Reference				
Employment status	studying				0.7%	2.312	0.90
	part-time				24.0%	**1.988**	**2.81**
	unemployed				8.2%	1.225	1.54
	retired				12.7%	0.816	0.94
	full-time				54.3%	Reference	
Customer group	group 1				54.7%	**3.284**	**4.40**
	group 3				15.4%	**2.774**	**3.25**
	group 2				30.0%	Reference	
Constant			4.958	1.51		-1.845	-0.64
Change in Frequency	no change (0)	135			171		
	decrease (1)	70			96		
Number of Observations		**205**			**267**		
Degrees of Freedom		**45**			**47**		
Log Liklihood (final)		**128.561**			**163.799**		
R2		**0.17**			**0.261**		

Table 5 Ordered Logit Model – Extent of changes in the shopping frequency
(bold coefficients indicate significance at the 95% level)

Attributes explaining the degree of changes in the shopping frequency			Model A		Model B	
		Number of observations	Coefficient	t-statistics	Coefficient	t-statistics
Worsened traffic conditions (Parking problems, traffic jams	not at all	24.1%	-0.249	-0.34	-0.942	-1.19
	little	17.3%	-0.423	-0.65	-0.067	-0.10
	fairly	15.8%	-1.276	-1.76	-1.149	-1.52
	much	16.5%	-1.237	-1.77	-1.390	-1.85
	very much	26.3%	Reference		Reference	
Congestion Charge	not at all	15.8%	-1.154	-1.44	-1.105	-1.26
	little	3.8%	**-3.851**	**-2.83**	**-4.103**	**-2.75**
	fairly	6.0%	**-2.827**	**-2.30**	**-5.012**	**-3.31**
	much	18.0%	**-1.286**	**-2.31**	**-1.708**	**-2.75**
	very much	56.4%	Reference		Reference	
Better shops elsewhere	not at all	51.1%	**1.409**	**2.053**	0.888	1.20
	little	19.5%	1.374	1.682	1.564	1.74
	fairly	16.5%	**1.844**	**2.222**	**2.156**	**2.33**
	much & very much	12.8%	Reference		Reference	
Central Line closure	not at all	69.9%	0.238	0.271	0.673	0.73
	little	17.3%	1.449	1.479	**2.504**	**2.37**
	fairly	2.3%	1.693	1.097	**4.423**	**2.51**
	much	4.5%	0.309	0.260	-0.057	-0.05
	very much	6.0%	Reference		Reference	
Terrorist threats	not at all	54.9%	-1.402	-1.393	**-2.180**	**-2.03**
	little	27.1%	-1.393	-1.345	**-2.684**	**-2.36**
	fairly	8.3%	-1.281	-1.192	-1.904	-1.68
	much	3.8%	-2.038	-1.489	-2.659	-1.80
	very much	6.0%	Reference		Reference	
Weather (e.g. 2003 summer heat wave)	not at all	54.9%	0.465	0.429	0.160	0.140
	little	25.6%	0.860	0.765	-0.117	-0.098
	fairly	15.0%	-0.525	-0.447	-1.505	-1.202
	much & very much	4.5%	0.000	.	0.000	.
Less money for shopping	not at all	63.2%	-0.583	-0.580	0.320	0.279
	little	22.6%	0.299	0.293	1.213	1.032
	fairly	9.0%	0.070	0.056	0.459	0.315
	much & very much	5.3%	Reference		Reference	
Oxford Street has become less attractive	not at all	35.3%	-0.585	-0.771	-0.948	-1.168
	little	25.6%	-0.723	-0.962	-1.210	-1.467
	fairly	15.8%	-1.203	-1.411	-1.244	-1.371
	much	11.3%	0.416	0.499	1.272	1.423
	very much	12.0%	Reference		Reference	
Intended expenditure	less than £100	12.8%	-0.848	-1.076	-0.933	-1.083
	between £100-£500	64.7%	0.389	0.803	0.213	0.409
	more than £500	3.8%	-0.610	-0.535	-0.580	-0.478
	really don't know	18.8%	Reference		Reference	
Gender	male	26.3%	-1.038	-1.844	-1.579	-2.564
	female	73.7%	Reference		Reference	

Attributes explaining the degree of changes in the shopping frequency			Model A		Model B	
		Number of observations	Coefficient	t-statistics	Coefficient	t-statistics
Age group	up to 34 years	10.5%	-0.844	-0.768	-0.863	-0.728
	35-44 years	30.1%	-0.033	-0.037	0.033	0.034
	45-54 years	27.1%	-0.087	-0.099	0.038	0.041
	55-64 years	21.8%	-1.433	-1.566	-1.227	-1.248
	over 65 years	10.5%	Reference		Reference	
Employment status	studying	2.3%	-0.560	-0.402	-1.684	-1.134
	working part-time	18.8%	-0.784	-1.370	-1.084	-1.698
	unemployed & not working	14.3%	-1.084	-1.705	-1.753	-2.521
	retired	12.0%	-0.634	-0.761	-0.339	-0.390
	working full-time	52.6%	Reference		Reference	
Customer group	group 1	66.9%			**-3.377**	**-5.382**
	group 3	13.5%			**-1.502**	**-2.036**
	group 2	19.5%			Reference	
			Threshold	**t-statistics**	**Threshold**	**t-statistics**
Change in Shopping Frequency	slight decrease	31.58	**-3.297**	**-1.757**	**-7.018**	**-3.345**
	decrease	39.10	**-0.975**	**-0.526**	**-3.985**	**-1.979**
	high decrease	16.54	**0.400**	**0.215**	**-2.379**	**-1.190**
	very high decrease	12.78				
Number of observations		**133**				
Degrees of Freedom				**43**		**41**
Log Liklihood (intercept only)				**-171.8**		**-170.4**
Log Liklihood (final)				**-121.95**		**-138.3**
Pseudo r^2				**0.290**		**0.188**
AIC				**2.480**		**2.696**