TRAFFIC DEMAND MANAGEMENT IN THREE HISTORIC CITIES: RESULTS OF A MULTIVARIATE ANALYSIS OF BUSINESS ATTITUDES

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1. Introduction

The problem of traffic congestion and pollution in cities has become a major focus of UK transport policy in recent years. The government consultation paper, *Breaking the Logjam* (DETR, 1998), considered two specific traffic demand management policies: road user charges (RUC) and workplace parking levies (WPL). Legislation is now before Parliament to allow local authorities to introduce these policies.

A major issue affecting the introduction of traffic demand management policies is the possible economic impacts on the urban business sector. There has been little research on the link between transport factors and urban business performance. There is general evidence that firms located in conurbations tend to perform more poorly than firms located in other areas (see, for example, Moore *et al*., 1980; Fothergill and Gudgin, 1982; Fothergill *et al*., 1984). There is also evidence that inner city firms perform more poorly than those in outer city locations. For example, Dobson and Gerrard (1991) find that engineering firms located in the inner Leeds area tend to have a lower level of profitability than engineering firms located in the outer Leeds area. Transport problems are one possible important cause of these location effects on business performance. This is supported directly by evidence that transport factors are an important influence on commercial location decisions (Nelson *et al*., 1994).

Of all of the possible business reactions to the introduction of traffic demand management policies in urban areas, the potentially most important in economic terms is the relocation of businesses out of the urban core. Any significant degree of business evacuation of the urban core would have a profound impact on the ability of the urban economy to support the local population. In addition, any spatial restructuring of the local economy would have implications for traffic flows, shifting the locations of major traffic attractors from the urban core to the periphery. Although this may alleviate congestion in the urban core, it may serve only to create congestion elsewhere rendering traffic demand management policies somewhat counter-productive in the long run.

The objective of this paper is to report the results of a multivariate analysis of business perceptions of current transport conditions and attitudes to traffic demand management policies based on a survey of firms in three historic cities - Cambridge, Norwich and York. A key component of the survey is the information provided on whether firms are currently considering relocation and the likely impact of the introduction of RUC and WPL on the next location decision. Basic data analysis of the survey responses indicates that the overwhelming majority of firms would definitely or possibly consider relocation as a response to the introduction of traffic demand management. The multivariate analysis seeks to identify those factors that have a statistically significant effect on the probability of relocation as a response.

The structure of the paper is as follows. Section 2 briefly outlines the methodology of the multivariate analysis. Section 3 provides details of the data set used for the multivariate analysis. Section 4 presents the results of the multivariate analysis of the factors influencing the perception of acute transport problems, current relocation considerations, and relocation as a response to RUC and WPL. The final section provides a summary of the findings and a discussion of the policy implications.

2. Methodology

The multivariate analysis is conducted using data derived from completed questionnaires distributed to a stratified sample of businesses in three historic cities - Cambridge, Norwich and York. (See below for further details of the data set.) Initially the multivariate analysis is undertaken using OLS regression. A general-to-specific modelling strategy is adopted. The analysis begins with the specification of a general model using all of the available business characteristic and attitudinal variables that may potentially influence the specific response under investigation. A parsimonious model is then derived containing those explanatory variables that are statistically significant or only marginally insignificant. Only the final parsimonious models are reported.

The business attitudinal responses to be analysed are in the form of limited dependent variables (LDVs). LDVs are binary variables that take only two possible values - unity if a specific attitude is held or zero if the attitude is not held. The estimated coefficients on the explanatory variables are interpreted as increasing (decreasing) the probability of a specific attitude being held if the estimated coefficient is positive (negative). In the case of LDV models, OLS regression can only provide a first approximation since it does not allow for the bounded nature of the dependent variable. Furthermore, OLS regression is based on the assumption of normally distributed errors but the errors in LDV models are not normally distributed. Alternative, more appropriate multivariate techniques for LDV estimation are required. Two such LDV techniques are used in the analysis: Probit and Logit estimation. The results are reported for OLS, Probit and Logit estimation.

3. Data

The data used in the multivariate analysis is derived from a set of completed questionnaires distributed to a random stratified sample of businesses in Cambridge, Norwich and York. The stratified sample is based on the business sector profiles constructed by Still (1999). (See Still and Jopson, 2000, for further details of the questionnaire design and implementation.)

The initial data set contains 197 completed questionnaires. However, for the purposes of the multivariate analysis, 45 completed questionnaires are excluded from the data set due mainly to incomplete responses, particularly the lack of site turnover information. The detailed breakdown of the reasons for completed questionnaires being excluded from the final data set are as follows: zero/missing/misrecorded site turnover (36); outliers with unusually high site turnover (2); wrongly defined as business (1); missing site/company age (6). Thus the multivariate analysis is conducted on the final data set that contains 152 businesses.

The composition of the final data set is summarised in Tables 1 - 6. Table 1 provides a breakdown of the businesses by city location. Two points arise from the distribution of businesses by city location. First, the York business sector is somewhat over-represented in the sample. Although York has the smallest urban economy of the three cities as measured by total employment (Still, 1999), York businesses are the largest proportion of the final data set. This is largely due to the additional sampling that took place in York because of a below average response rate to the initial sample survey. A second point to note is that the final data set is broadly representative of the intra-urban distribution of business locations although businesses in the core areas are somewhat under-represented.

Table 1: Distribution of Businesses by City Location

	Cambridge	**Norwich**	**York**	**Total**
Urban Location				
Core	4	11	9	**24**
Inner	)	14	24	**)**
Outer	)37	12	23	**)110**
Outside Outer	2	11	5	**18**
Total	**43**	**48**	**61**	**152**

Table 2 shows the distribution of businesses by type of site unit. As can be seen, single-site independent (SSI) businesses provide just over half of the survey responses included in the final data set. The high frequency of SSIs is partly an intentional consequence of the sampling design since these types of businesses can be subjected to more detailed financial analysis using publicly available company accounts. Given the likelihood that SSIs may exhibit more location inertia compared to multi-site businesses, there may be some tendency for the final data set to be biased in favour of businesses that are less likely to relocate as a response to the introduction of traffic demand management policies. Multivariate analysis of relocation responses is necessary to control for this possible bias.

Table 2: Distribution of Businesses by Site Unit Type

Site Unit Type	Number	%
Subsidiary	21	13.8
Single Site Independent	78	51.3
HQ	45	29.6
Other/Unknown	8	5.3
Total	**152**	**100.0**

Table 3 shows the distribution of businesses in the final data set by industry sector. The main point to note is that the retail and distribution sector (defined to include hotels) is under-represented whereas the manufacturing sector is over-represented. The under-representation of the retail and distribution sector is due to the below-average response rate of these businesses as well as the greater difficulty in contacting the strategic decision-maker in retail chains. The low response rate of retail and distribution businesses is also partly responsible for the under-representation of core city locations in the sample. It may be that these types of businesses are more frequently sampled and, as a consequence, are more prone to "survey fatigue". It should also be noted that there are no significant differences between industry sectors in their geographical distribution either between or within the three cities. Hence, any sectoral differences in business responses do not appear to be a reflection of systematic locational biases.

Table 3: Distribution of Businesses by Industry Sector

Industry Sector	Number	%
Primary	7	4.6
Manufacturing	48	31.6
Retail & Distribution	26	17.1
Financial Services	23	15.1
Other Services	40	26.3
Other	8	5.3
Total	**152**	**100.0**

Table 4 provides information on the distribution of businesses by both the age of the company and the length of time that the company has been located at the specific site to be surveyed. As can be seen, the final data set includes a wide range of businesses both in terms of site age and company age. Although the average company age is just over 40 years, just over 44% of the final data set are young companies that are less than 20 years old. There are also a significant number of older, well-established companies with around a quarter of the companies over 50 years old. The final data set contains a large proportion of businesses that have only recently located at the specific site being sampled. The average length of time at the site location is just over 23 years. But 38% of the sampled businesses have been at the site location for less than 10 years.

Table 4: Distribution of Businesses by Site and Company Age

Site Age		Company Age	
<5 years	21 (13.8%)	**<10 years**	21 (13.8%)
5-9 years	37 (24.3%)	**10-19 years**	46 (30.3%)
10-19 years	43 (28.3%)	**20-29 years**	22 (14.5%)
20-29 years	23 (15.1%)	**30-49 years**	24 (15.8%)
30+ years	28 (18.4%)	**50+ years**	39 (25.7%)
Average	**23.3 years**	**Average**	**40.9 years**

Table 5 provides a breakdown of the final data set by site size, measured by both site turnover and site employment. The average annual site turnover is just under £8 million with exactly half of the sampled sites recording turnovers between £1m - £10m. The average employment at the sampled sites is 61.5 employees with just over 53% of the sampled sites having employment levels of 10 - 99 employees. The final sample contains a significant number of small sites with just over one quarter of the sample site locations having under 10 employees. In addition just over 20% of the sample are large sites with in excess of 100 employees.

Table 5: Distribution of Businesses by Site Size

Annual Site Turnover		Site Employment	
<£100k	11 (7.3%)	**<10 employees**	40 (26.3%)
£100k - £1m	31 (20.4%)	**10-24 employees**	24 (15.8%)
£1m - £10m	76 (50.0%)	**25-99 employees**	57 (37.5%)
£10m+	34 (22.4%)	**100+ employees**	31 (20.4%)
Average	**£7.96m**	**Average**	**61.5 employees**

The 152 site locations in the final data set have a combined annual turnover of £1.21bn and total employment of 9,344. The sample site locations represent just under 4% of the total estimated employment in the three cities. (See Still, 1999, for detailed profiles of the three urban economies.) As can be seen from Table 6, the average size of the sampled site locations differs markedly across the three cities. In general the final data set tends to include relatively larger sites in Norwich and relatively smaller sites in York. Whereas the average site location in the Norwich sample has an annual turnover of £12.9m, the average annual site turnover in the York sample is only £3.5m. Similarly the average site employment in the Norwich sample is 99 employees but only 35 employees in the York sample. Again this emphasises the importance of using multivariate analysis to control for differences in site size in the analysis of the determinants of business attitudes to traffic problems and proposed policy solutions.

Table 6 Average Site Size by City

	Average Site Turnover	Average Site Employment
Cambridge	£8.82m	57.2
Norwich	£12.87m	99.4
York	£3.48m	34.6
All	**£7.96m**	**61.5**

4. Results

4.1 Business perceptions of acute transport problems

In the survey, businesses were asked to score their general perceptions of different aspects of transport conditions at the specific site location being sampled. Firms were asked to evaluate transport problems using a range from 0 (no problem) to -6 (serious problem). For the purposes of the multivariate analysis, responses from -4 to -6 are defined as representing a perception of an acute transport problem. In addition some responses are merged for the purposes of analysis. The mean (i.e. average) and modal (i.e. most frequent) responses as well as the percentages of businesses perceiving acute transport problems are recorded in Table 7.

Table 7 Businesses Perceiving Acute Transport Problems

Transport Problem	Mean Response	Modal Response	Firms Perceiving Acute Problem
Traffic Noise Pollution	-2.3	-3	20.4%
Traffic-Related Air Pollution	-2.8	-2	30.9%
Congestion	-4.3	-5	69.1%
Public Transport	-3.6	-5	50.7%
Cycle/Pedestrian Provision	-2.3	0	24.3%
Staff Parking	-2.5	0	29.6%
Customer Parking	-2.6	0	30.9%

The two transport problems most frequently identified as acute are congestion and public transport. Over two-thirds of the sampled site locations perceive an acute traffic congestion problem. The modal response for congestion is -5 and the mean response is -4.3 for the 150 businesses answering this question. Just under 60% of the sampled site locations also perceive an acute public transport problem. The modal response for public transport provision is -5 and the mean response is -3.6 for the 147 businesses responding. For the other transport problems, traffic noise and air pollution, cycle/pedestrian provision, and staff and customer parking, only between one fifth to one third of the site locations perceive any acute problems.

There are, however, marked differences in the perception of acute transport problems between the three cities. The percentages of sampled businesses perceiving acute transport problems at their current site location are reported in Table 8. Cambridge businesses in general are more prone to perceive acute transport problems compared to businesses in Norwich and York, particularly with respect to traffic noise and air pollution, traffic congestion and parking, both for staff and customers. Businesses in York have the lowest tendency to perceive acute problems with public transport, cycle/pedestrian provision, and staff and customer parking. These attitudes are likely to be causally linked; better alternative provision (i.e. public transport, and cycling/pedestrian provision) can help reduce the need for staff and customer parking.

Table 8 Perceptions of Acute Transport Problems by City

Traffic Problem	% of Firms Perceiving Acute Transport Problem		
	Cambridge (n = 43)	Norwich (n = 48)	York (n = 61)
Traffic Noise Pollution	30.2	14.6	18.0
Traffic-Related Air Pollution	41.9	18.8	32.8
Congestion	86.1	60.4	63.9
Public Transport	55.8	54.2	44.3
Cycle/Pedestrian Provision	23.3	33.3	18.0
Staff Parking	41.9	31.3	19.7
Customer Parking	41.9	29.2	24.6

The results of the multivariate analysis of the factors influencing the perception of acute transport problems are presented in Tables 9(a) - 9(d). No results are reported for perceptions of acute traffic noise, public transport and cycle/pedestrian provision problems since these perceptions do not appear to be systematically linked with any of the available business characteristic variables.

The results of the multivariate analysis of the factors influencing the perception of acute traffic-related air pollution problems are presented in Table 9(a). There are four sets of significant factors: city location; site unit type; industry sector; and site age. As suggested by the basic data analysis reported in Table 8, there is a greater tendency for Cambridge businesses to perceive acute traffic-related air pollution problems compared to businesses in the other two cities. This result is confirmed by the multivariate analysis after controlling for differences in other business characteristics. The multivariate analysis also shows a significant tendency for SSIs to perceive acute traffic-related air pollution problems compared to other types of units. This may be capturing a location-inertia effect for SSIs compared to multi-site operations with the flexibility to relocate between existing sites. The third set of statistically significant factors influencing the perceptions of acute traffic-related air pollution problems is industry sector with businesses in the manufacturing, retail and distribution, and financial services sectors less prone to perceive a serious problem compared to businesses in other sectors. Finally there is a statistically significant tendency for the probability of perceiving an acute traffic-related air pollution problem to increase the longer a business has been located at its current site.

The results for the perception of acute traffic congestion problems are reported in Table 9(b). There are some similarities with the results for perceptions of acute traffic-related air pollution problems. Again businesses located in Cambridge are more likely to perceive an acute problem. SSIs are also more likely to perceive an acute congestion problem while, as in the case of acute traffic-related air pollution problems, manufacturing businesses are again less likely to perceive an acute problem. But, unlike in the case of acute traffic-related air pollution problems, there is no tendency for retail and distribution, and financial services businesses to be less likely to perceive an acute congestion problem. These sectoral differences may reflect that manufacturing businesses do not typically deal directly with the final customers and, hence, are less sensitive to traffic congestion problems. There is also some tendency for bigger sites (as measured by annual site turnover) to be less prone to

Table 9(a) Factors Influencing Perception of Acute Traffic-Related Air Pollution Problem

Dependent Variable	**Perceive Acute Traffic-Related Air Pollution Problem**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.39634 (5.159)***	-0.26918 (-1.123)	-0.45943 (-1.151)
Cambridge	0.21983 (2.700)***	0.69475 (2.673)***	1.1925 (2.703)***
SSI	0.14926 (2.063)**	0.49537 (2.122)**	0.83360 (2.101)**
Manufacturing	-0.25418 (-2.857)***	-0.79818 (-2.795)***	-1.3324 (-2.753)***
Retail & Distribution	-0.32170 (-3.064)***	-1.0246 (-2.824)***	-1.7393 (-2.700)***
Financial Services	-0.29544 (-2.641)***	-0.91027 (-2.557)**	-1.5511 (-2.516)**
Site Age (years)	-0.0019710 (-1.933)*	-0.0085679 (-1.879)*	-0.014401 (-1.704)*
R^2	0.1470		
s	0.4370		
λ		-81.7646	-81.7298
% correct	71.71%	73.68%	73.03%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

Table 9(b) Factors Influencing Perception of Acute Traffic Congestion Problem

Dependent Variable	**Perceive Acute Traffic Congestion Problem**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.62373 (9.178)***	0.19828 (1.050)	0.32810 (1.064)
Cambridge	0.27958 (3.506)***	0.93973 (3.320)***	1.6230 (3.167)***
SSI	0.14372 (1.974)*	0.51208 (2.251)**	0.84442 (2.211)**
Manufacturing	-0.16402 (-2.109)**	-0.50973 (-2.117)**	-0.87505 (-2.169)**
Site Turnover (£m)	-0.0042710 (-1.540)		
R^2	0.1342		
s	0.4373		
λ		-84.1171	-84.0707
% correct	71.05%	71.05%	71.05%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

Note: It is not computationally possible to estimate LDV models with site turnover included as an explanatory variable. However the OLS regression suggests that this variable is not statistically significant.

Table 9(c) Factors Influencing Perception of Acute Staff Parking Problem

Dependent Variable	**Perceive Acute Staff Parking Problem**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.24864 (3.833)***	-0.68028 (-3.135)***	-1.1321 (-3.014)***
Norwich	0.16471 (1.756)*	0.55625 (1.863)*	0.94022 (1.829)*
Cambridge	0.27268 (2.984)***	0.85108 (2.926)***	1.4395 (2.905)***
Core Location	0.18650 (1.864)*	0.59915 (1.961)*	0.98443 (1.909)*
HQ	-0.13754 (-1.629)	-0.39984 (-1.522)	-0.70435 (-1.558)
Manufacturing	-0.13685 (-1.708)*	-0.48230 (-1.836)*	-0.77814 (-1.759)*
Site Age (years)	-0.0028495 (-2.604)**	-0.013485 (-2.306)**	-0.022890 (-2.236)**
Site Employment	0.00063658 (1.320)	0.0021246 (1.351)	0.0036617 (1.429)
R^2	0.1186		
s	0.4403		
λ		-82.1944	-82.2299
% correct	71.05%	71.71%	71.71%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

Table 9(d) Factors Influencing Perception of Acute Customer Parking Problem

Dependent Variable	**Perceive Acute Customer Parking Problem**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.33883 (7.093)***	-0.43675 (-3.106)***	-0.71164 (-3.070)***
Cambridge	0.19046 (2.354)**	0.57105 (2.331)**	0.95121 (2.330)**
Manufacturing	-0.26442 (-3.373)***	-0.87068 (-3.276)***	-1.4892 (-3.124)***
R^2	0.0915		
s	0.4449		
λ		-86.4959	-86.4859
% correct	71.05%	71.05%	71.05%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

report an acute congestion problem. This may partly reflect a tendency for bigger sites to be located outside the core and most congested urban areas.

Table 9(c) presents the results of the multivariate analysis of the perception of acute staff parking problems. Again Cambridge businesses are more likely to perceive an acute problem as are Norwich businesses compared to those located in York. There is also a statistically significant tendency for businesses located in core urban areas to be more prone to an acute staff parking problem. Sites used as company headquarters are less likely to perceive acute staff parking problems. Similarly manufacturing businesses are also less likely to perceive an acute staff parking problem. In both cases this may reflect the benefits of more peripheral urban locations as well as possibly larger sites with more space available for staff parking. The multivariate analysis also shows, as expected, that staff parking problems tend to be more acute on sites with larger workforces. Somewhat more surprisingly, however, is the finding that businesses are less likely to perceive an acute staff parking problem the longer they have been located at their current site. By implication, there is a tendency for businesses that have more recently moved to their current location to be more likely to perceive an acute staff parking problem. This suggests that staff parking provision is not a major consideration in either the decision to relocate or the choice of a specific site location.

The results for business perceptions of acute customer parking problems are reported in Table 9(d). The multivariate analysis shows only two factors to have a statistically significant effect. Again, Cambridge businesses are more likely to perceive an acute problem compared to businesses in Norwich and York. It is also found that manufacturing businesses are less likely to perceive an acute customer parking problem. This is to be expected. Customer parking is more likely to be an acute problem in consumer-based industries such as the retail and distribution sector.

The predictive power of all of the reported estimated models in Tables 9(a) - 9(d) is high as measured by the percentage of responses correctly predicted by the estimated models. The percentage of correctly predicted responses is determined on the basis that a predicted value greater (less) than 0.5 indicates that the specific attitude under investigation is (is not) held. All of the estimated models correctly predict over 70% of the responses.

4.2 Firms currently considering relocation

Of the final sample of 152 businesses, 29 businesses responded that they are currently considering relocating. This represents 19.1% of the sampled businesses. However there is a slight tendency for the businesses currently considering relocating to be smaller in both site employment and turnover than the sample average. The average site employment of these businesses is 50.2 employees and their average annual site turnover is £6.28 million compared with the total sample averages of 61.5 employees and £7.96 million, respectively. The 29 businesses account for 15.6% of total sample employment and 15.1% of total sample turnover. Thus, it is clear that there is a significant segment of the urban business sector currently considering relocating. It follows that the attitudes of these businesses to the introduction of traffic demand management policies are of particular importance.

Table 10 Factors Influencing Current Relocation Considerations

Dependent Variable	**Currently Considering Relocating**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.35524 (4.754)***	-0.43914 (-1.706)*	-0.74858 (-1.734)*
Core Location	0.13368 (1.588)	0.47590 (1.489)	0.86206 (1.573)
SSI	-0.26290 (-3.197)***	-0.86392 (-2.890)***	-1.4440 (-2.826)***
HQ	-0.29518 (-3.278)***	-0.97651 (-2.875)***	-1.7113 (-2.822)***
Manufacturing	0.11633 (1.750)*	0.45113 (1.761)*	0.78083 (1.717)*
R^2	0.1088		
s	0.3772		
λ		-66.5025	-66.5204
% correct	82.24%	79.61%	79.61%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

Table 10 presents the results of the multivariate analysis of the factors influencing whether or not a business is currently considering relocating. Three types of factors are found to be statistically significant: urban location, site unit type (i.e. headquarters, subsidiary, SSI or other/unknown) and industry sector. Relocation is more likely to be under current consideration by businesses located in core urban areas (although this effect is marginally insignificant statistically). There is no evidence of any systematic tendency for businesses in any individual city to be more or less likely to be currently considering relocation. Business sites used by SSIs and headquarters are less likely to be currently considering relocation compared to subsidiaries. The only industry sector characterised by businesses on average being significantly more likely to be currently considering relocating is the manufacturing sector. Again this is to be expected. Consumer-based industries such as the retail and distribution sector (including hotels) are likely to display more location-inertia. Perceptions of acute transport problems are not found to have any statistically significant direct effects on the intention to relocate that can be identified separately from general location-related effects.

4.3 Relocation as a response to road user charges

The attitudes of businesses to the city and business impacts of the introduction of road user charges (RUC) are summarised in Tables 11(a) and 11(b). Businesses were asked to evaluate the direction and magnitude of the city and business impacts using a seven-point scale from -3 to +3 with zero representing no expected impact. The mean response is calculated to summarise the average evaluation of the direction and magnitude of each impact. The degree of agreement across the business sector on the direction of the impacts is shown by the balance of opinion defined as the difference between the percentage of businesses expecting a positive impact and the percentage expecting a negative impact.

In general businesses expect non-economic benefits for the city as a whole from RUC through reductions in traffic noise and air pollution, traffic congestion and parking problems. The balance of opinion in all of these cases exceeds 50% implying a large degree of agreement that the introduction of RUC will produce benefits for pollution, congestion and parking. The mean responses indicate that that on average the largest impact is expected on noise pollution (mean response = 1.040) and the smallest impact on parking (mean response = 0.832). However the overwhelming majority of businesses expect RUC to have a negative impact of the economic prosperity of the city. Of the businesses sampled, 71% expect a negative economic impact whereas only 11% expect a positive economic impact. The negative impact is also expected to be relatively large compared to other impacts of RUC on the city. The mean response is -1.432, the largest city impact in absolute terms. Opinion, in the business sector, however, is more divided on whether the introduction of RUC will make the three historic cities more or less attractive to tourists with only a small majority of businesses expecting a negative impact on tourism. The mean response for the impact on tourism is -0.443, which is relatively low given the mean responses for other city impacts.

Table 11(a) Business Attitudes to Road User Charges: City Impacts

Impact	Mean Response	Positive Impact	Negative Impact	Balance of Opinion
Noise Pollution	1.040	63.8%	3.9%	59.9%
Air Pollution	0.905	73.7%	6.6%	67.1%
Congestion	1.000	72.4%	9.2%	63.2%
Parking	0.832	63.2%	12.5%	50.7%
Economic	-1.432	11.2%	71.1%	-59.9%
Tourism	-0.443	32.9%	42.1%	-9.2%

Table 11(b) Business Attitudes to Road User Charges: Business Impacts

Impact	Mean Response	Positive Impact	Negative Impact	Balance of Opinion
Recruit Staff	-1.107	6.6%	54.6%	-48.0%
Retain Staff	-1.133	4.6%	54.6%	-50.0%
Delivery Access	-0.770	11.2%	41.4%	-30.3%
Customer Access	-1.027	9.9%	46.1%	-36.2%
Rents	-0.425	14.5%	32.2%	-17.8%
Profitability	-1.305	2.6%	63.8%	-61.2%

Note: Balance of Opinion ≡ %Positive Impact - %Negative Impact

As regards the impact of RUC on their own performance, the mean response is negative for all impacts with the largest negative impact expected for profitability. There is a relatively high degree of agreement across firms that RUC will have a detrimental effect on their business performance particularly with respect to their ability to recruit and retain staff, and their profitability. Around 55% of businesses expect RUC to make it more difficult to recruit and retain staff while 64% of the businesses expect the introduction of RUC to reduce their profitability. Less than 3% of the sampled businesses expect their profitability to increase after the introduction of RUC. The balance of business opinion is that RUC is expected to have a negative effect on the ease of both delivery and customer access although the modal response in both cases is no effect.

The basic data analysis of business responses to the introduction of RUC clearly indicates that businesses on average expect this policy to have positive non-economic effects for the city generally but negative effects on the urban economy and their own business performance. A major problem may arise for urban economies if businesses consider these negative effects to be so severe as to necessitate relocating outside the urban economy. Of the 152 businesses, 52.6% responded that the introduction of RUC would influence the business's next location decision. In addition, a further 26.3% of the businesses responded that RUC might possibly influence their next location decision. The vast majority of these businesses indicated that they would consider moving away from the urban area. Of the 29 businesses currently considering relocating, 21 of these businesses (72.4%) responded that they would be influenced by the introduction of RUC and another 5 businesses (17.2%)

Table 12 Factors Influencing Relocation as a Response to Road User Charges

Dependent Variable	**Relocation as Response to Road User Charges**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.73388 (11.667)***	0.64465 (3.569)***	1.0607 (3.469)***
Cambridge	-0.14211 (-1.687)*	-0.39961 (-1.643)	-0.66348 (-1.651)
HQ	0.16587 (1.928)*	0.50135 (1.972)*	0.82208 (1.933)*
Site Employment	-0.00099571 (-2.158)**	-0.0028213 (-2.049)**	-0.0045846 (-2.056)**
Retail & Distribution	-0.19728 (-1.937)*	-0.58098 (-1.953)*	-0.96190 (-1.969)*
Tourism Benefits	-0.29651 (-3.639)***	-0.83536 (-3.520)***	-1.3588 (-3.455)***
Customer Access Benefits	-0.24298 (-1.891)*	-0.82682 (-1.937)*	-1.3154 (-1.885)*
R^2	0.1750		
s	0.4643		
λ		-90.6531	-90.7414
% correct	66.45%	66.45%	67.11%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

responded that they might possibly be influenced. Of these 26 businesses, 24 indicated that they would consider moving away from the urban area altogether. Hence there is a significant threat of business evacuation from the urban area if road user charging is introduced. The results of the multivariate analysis of the factors influencing this threat are reported in Table 12.

There is a general tendency for businesses in Cambridge to be less likely to be influenced to relocate in response to RUC relative to businesses in Norwich and York, *ceteris paribus*. This result is statistically significant and is particularly noteworthy given the greater likelihood of businesses in Cambridge to perceive acute transport problems.

The multivariate analysis also reveals that business sites used as headquarters are more likely to be relocated in response to RUC relative to other types of site units. Sites with larger workforces as well as retail and distribution businesses are found to be less likely to relocate in response to RUC. As previously discussed, larger and more consumer-based businesses tend to display more location-inertia and, hence, are less likely to move away from their current urban locations after the introduction of RUC.

Two perceptions of expected benefits from RUC are found to significantly affect whether or not RUC influences the next location decision. The introduction of RUC is significantly less likely to influence the next location decision of those businesses that expect customer access to improve as a consequence. In addition, businesses that expect RUC to increase the attractiveness of the city for tourists are also significantly less likely to have their next location decision influenced by RUC.

4.4 Relocation as a response to workplace parking levies

The general attitude of businesses to the expected impacts of the introduction of workplace parking levies (WPL) is similar to those for the introduction of RUC. Again businesses generally expect some non-economic benefits for the city as a whole but expect negative effects on the urban economy and their own business performance. As with RUC, the majority of businesses expect WPL to lead to a reduction of both traffic pollution and traffic congestion. However, unlike RUC, businesses are more divided on the impact of WPL on the availability of parking. Some businesses may expect that WPL will increase parking problems through a "displacement effect" to the extent that businesses respond by economising on the number of parking spaces available on-site.

The mean responses for the city impacts of WPL are generally in the same direction but slightly smaller in absolute terms than for RUC. The major exception is the impact on parking of WPL for which the mean response is negative whereas the mean response of the parking impact of RUC is positive. It should also be noted that the mean response of the expected economic impact on the city is slightly greater in absolute terms than the corresponding response for RUC.

As with RUC, the overwhelming majority of businesses expect WPL to negatively affect the economic prosperity of the city. Over 72% of the businesses expect a negative economic impact whereas only 7% expect a positive economic

impact. Again business opinion is divided on the possible impact on tourism but the mean response is less negative than that for the tourist impact of RUC. Although, unlike RUC, there is no direct impact of WPL on tourists, it may be that some businesses are concerned about the displacement effect on parking availability as a possible discouragement to potential visitors. On the other hand, some businesses perceive that the non-economic benefits of reduced traffic pollution and congestion of WPL may make the city more attractive to tourists.

Table 13(a) Business Attitudes to Workplace Parking Levies: City Impacts

Impact	Mean Response	Positive Impact	Negative Impact	Balance of Opinion
Noise Pollution	0.912	56.6%	5.3%	51.3%
Air Pollution	0.851	63.8%	7.9%	55.9%
Congestion	0.993	64.5%	6.6%	57.9%
Parking	-0.129	34.2%	36.2%	-2.0%
Economic	-1.439	7.2%	72.4%	-65.1%
Tourism	-0.313	28.3%	33.6%	-5.3%

Table 13(b) Business Attitudes to Workplace Parking Levies: Business Impacts

Impact	Mean Response	Positive Impact	Negative Impact	Balance of Opinion
Recruit Staff	-0.993	8.6%	48.7%	40.1%
Retain Staff	-0.960	5.9%	45.4%	39.5%
Delivery Access	-0.507	11.2%	28.3%	-17.1%
Customer Access	-0.680	8.6%	31.6%	-23.0%
Rents	-0.399	15.1%	34.9%	-19.7%
Profitability	-1.427	1.3%	65.8%	-64.5%

Note: Balance of Opinion ≡ %Positive Impact - %Negative Impact

Just as with RUC, businesses expect WPL to have a negative impact on their own business performance. However, generally both the mean response and the balance of opinion are slightly lower with one exception. Businesses have an even greater expectation that WPL will reduce their profitability. The mean response for the expected impact on profitability is -1.427 for WPL compared to -1.305 for RUC and the respective balances of opinion are -64.5% for WPL and -61.2% for RUC.

The threat of business relocation as a response to the introduction of WPL is similar in magnitude to that for RUC. Of the 152 sampled businesses, 53.9% responded that their next location decision would be influenced and another 26.3% responded that their next location decision might possibly be influenced. Again most of these businesses indicated that they would consider moving away from the urban area altogether. Of the 29 businesses that are currently considering relocating, 21 (72.4%) would be influenced by the introduction of WPL and another 5 (17.2%)

might possibly be influenced. All of these businesses with one exception would move away from the city if it is decided to relocate.

Table 14 reports the statistically significant factors affecting the probability of businesses responding that their next location decision would be influenced by the introduction of WPL. Unlike RUC, there is no discernible location effect on the responses. In particular, businesses in Cambridge are not found to be less likely to be influenced to relocate compared to those in Norwich and York as is the case for the introduction of RUC. Businesses in the retail and distribution sector are again found to be less likely to respond by relocating. Also the longer that a business has been at its current location the less likely it is to respond to WPL by relocating. And, just as with RUC, those businesses that expect benefits for tourists from WPL are less likely to relocate.

The statistically significant effect on relocation as a response of the perceived impact on tourism for both RUC and WPL is noteworthy. This is particularly so given that the direct impact on tourists of these measures may be small especially in the case of WPL. Businesses appear to recognise that the impact on tourism is rather complex involving positive effects from the non-economic benefits of reduced pollution and congestion but negative disincentive effects from the costs of RUC and any parking displacement effects arising from WPL. As a result, unlike the city economic and business impacts, business opinion is more divided as to whether the overall impact of tourism will be positive or negative. The results of the multivariate analyses in Tables 12 and 14 seem to suggest that the attitude of a business to the expected impact on tourism of the proposed traffic demand management policies provides a good general indicator of the degree to which a business perceives potential benefits from these measures and, hence, are less likely to consider relocation as a response.

Table 14 Factors Influencing Relocation as a Response to Workplace Parking Levies

Dependent Variable	**Relocation as Response to Workplace Parking Levies**		
Estimation Method	**OLS**	**Probit**	**Logit**
Explanatory Variables			
Constant	0.68776 (12.577)***	0.49433 (3.318)***	0.80037 (3.247)***
Retail & Distribution	-0.28589 (-2.738)***	-0.77509 (-2.656)***	-1.2296 (-2.574)**
Site Age (years)	-0.0016467 (-1.496)	-0.0044339 (-1.430)	-0.0074802 (-1.395)
Tourist Benefits	-0.21570 (-2.482)**	-0.57316 (-2.428)**	-0.92147 (-2.410)**
$\mathbf{R^2}$	0.0990		
s	0.4795		
$\boldsymbol{\lambda}$		-97.0868	-97.1144
% correct	59.87%	63.82%	63.82%

t-values in parentheses. * ≡ significant at 10% level; ** ≡ significant at 5% level; *** ≡ significant at 1% level (two-tailed tests).
R^2 ≡ coefficient of determination; s ≡ standard error of regression; λ ≡ loglikelihood.
% correct ≡ % of responses correctly predicted by estimated model.

5. Summary and Conclusions

Although the vast majority of businesses indicated that increased consideration would be given to relocation if RUC or WPL are introduced, there is statistically significant evidence that the probability of relocating and moving away from the city is reduced by recognition of some of the potential benefits of such schemes. In particular, recognition of the tourist benefits for the city generally as well as expected improvements in customer access are both associated with a lower likelihood of businesses being influenced to relocate following the introduction of traffic demand management schemes.

The results of the multivariate analysis of survey responses have two principal policy implications. First, the results indicate the types of businesses that are most likely to consider relocating as a response to the introduction of traffic demand management policies. Second, the results also suggest that recognition of potential benefits from traffic demand management policies can significantly reduce the likelihood of business evacuation of the urban economy. Thus, it follows that the introduction of traffic demand management policies should be accompanied by the provision of information on the likely potential benefits of such policies with particular emphasis on the more location-mobile business operations such as multi-site firms and non-consumer-based activities.

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