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Car Ownership and Mode of Transport to Work in Ireland[1]

Nicola Commins and Anne Nolan

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Abstract: Rapid economic and demographic change in Ireland over the last decade, with associated increases in car dependence and congestion, has focused policy on encouraging more sustainable forms of travel. In this context, knowledge of current travel patterns and their determinants is crucial. In this paper, we extend earlier Irish research to examine the joint decision of car ownership and mode of transport to work. We employ cross-section micro-data from the 2006 Census of Population to estimate discrete choice models of car ownership and commuting mode choice for four sub-samples of the Irish population, based on residential location. Empirical results suggest that travel and supply-side characteristics such as travel time, costs, work location and public transport availability, as well as demographic and socio-economic characteristics such as age and household composition have significant effects on these decisions.

Corresponding Author: anne.nolan@esri.ie

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1 Introduction

As a result of rapid economic and demographic change over the last decade, and the resulting increase in car ownership, Ireland has experienced many of the problems associated with increasing car dependence. Over the period 1996-2006[2], the population of Ireland grew by 16.9 per cent while the numbers in employment increased by 47.6 per cent, largely due to increases in the rate of female participation in the labour force and inward migration. In terms of the implications for transport, the most striking is the increase in new vehicle registrations, which increased by over 60 per cent over the period (Central Statistics Office, 2007). Data for journeys to work, school and college confirm this shift towards the private car; the proportions driving to work increased from 46.3 per cent in 1996 to 57.1 per cent in 2006 (see Figure 1), while the proportion of primary school students travelling as car passengers increased from 35.8 per cent in 1996 to 55.0 per cent in 2006, overtaking the proportions walking (24.3 per cent), which has traditionally been the primary means of transport to school for this age-group. The resulting levels of congestion impact on all those using the road and public transport network; in the Dublin area, average journey speeds in the morning peak for car and bus[3] decreased by 12.4 per cent and 6.2 per cent respectively between 2003 and 2004 (Dublin Transportation Office, 2005). There are also wider economic impacts, with carbon dioxide emissions from transport increasing by 88.7 per cent between 1996 and 2006 (Lyons et al., 2008).

[insert Figure 1 here]

Environmental considerations imply a need to reverse or at the very least to halt this shift in favour of the private car. Current policy focuses on a variety of measures that seek to limit or redirect travel demand in the short- to medium-term and encourage alternative more sustainable

[2] Economic activity has contracted sharply since late 2007. Unemployment reached 11.4 per cent in February 2009 (Central Statistics Office, 2009a), a return to net emigration is forecast for 2009 and 2010 (Barrett *et al*., 2009) and new car registrations fell by 63.6 per cent between March 2008 and March 2009 (Central Statistics Office, 2009b).

[3] Bus speeds on Quality Bus corridor routes (that is, routes with dedicated road space for buses) only.

land-use strategies in the longer term (see Department of Transport, 2008a, 2008b, Dublin Transportation Office, 2001, 2006a, 2006b, European Commission, 2007, FitzGerald et al., 2008, Morgenroth and FitzGerald, 2006). Investment in public transport and measures which seek to use existing infrastructure more efficiently such as improved cycle and bus lanes, parking restrictions, road pricing, carpooling *etc*. are all considered necessary if a shift away from the private car towards more sustainable methods of transport such as walking, cycling and public transport is to be achieved. Current initiatives include the provision of tax relief for the purchase of public transport tickets and bicycles for commuting trips with more severe measures such as urban road pricing or the introduction of a carbon tax proposed but yet to be implemented.

In this context, knowledge of the factors influencing the demand for passenger transport is crucial. In this paper we concentrate on transport demand for a specific journey purpose, namely the journey to work, and examine the influence of demographic, socio-economic and supply-side factors on choice of mode of transport for the journey to work in Ireland in 2006 using discrete choice econometric methodologies. We extend previous Irish research to incorporate the endogeneity of the car ownership decision by estimating a joint model of car ownership and mode of transport to work. The 2006 Census of Population also contains detailed information on home and work location for the full population of working individuals, allowing us to consider the influence of proximity to rail connections for the first time. Section 2 discusses previous literature in the area, both international and Irish. Section 3 describes the data and provides some descriptive statistics, while Section 4 describes the econometric methodology employed. Section 5 presents empirical results and Section 6 concludes.

2 Previous Research

Internationally, there is an extensive research literature on the determinants of various aspects of travel behaviour, and in particular commuting behaviour. Due to the nature of such decisions, and the data available, discrete or qualitative choice methods such as multinomial or conditional

logit[4] are typically employed. The models are grounded in consumer utility theory whereby the individual chooses among alternatives with the aim of maximising personal utility. Ben-Akiva and Lerman, 1975 apply the multinomial logit methodology to the choice between a number of different alternatives for the journey to work in Washington, and find particularly significant effects for lifecycle and public transport availability. Aside from modal choice, the multinomial logit methodology has been extensively applied to other transport decisions such as the number of cars to own (Alperovich et al., 1999, Bhat and Pulugurtha, 1998 and Cragg and Uhler, 1970), choice of car type (Lave and Train, 1979 and McCarthy, 1996), tourist destination (Eymann and Ronning, 1997) and choice of departure time (McCafferty and Hall, 1982). A number of studies have analysed mode choice for other journey purposes, using a variety of methods (see Cohen and Harris, 1998 for trips to visit friends and relatives, Domencich and McFadden, 1975 for shopping trips, Ewing et al., 2004 for mode choice for the journey to school and McGillivray, 1972 for other journey purposes including personal business, visiting friends and relations, shopping and other recreation).

Asensio, 2002, De Palma and Rochat, 2000, Dissanayake and Morikawa, 2005, Thobani, 1984 and Train, 1980 all use the nested multinomial logit methodology to estimate modal choice for the journeys to work in Barcelona, Geneva, Bangkok, Karachi and San Francisco respectively. The nested multinomial logit model overcomes the restrictive requirement of the multinomial logit methodology to have distinct and independent alternatives. More recent versions of the nested multinomial logit model (such as the generalised or cross-nested logit) have been developed to incorporate situations in which correlations exist between alternatives across nests as well as alternatives within nests, thus allowing for the incorporation of related decisions such as car ownership or residential/employment location. Vega and Reynolds-Feighan, 2008 estimate a joint model of residential location and mode of transport to work for those working in four areas of Dublin, while Salon, 2009 estimates a joint residential location-car ownership-mode of

[4] The multinomial logit and conditional logit models differ in the type of explanatory variables that can be included; the conditional model can support individual-specific as well as alternative-specific variables while the multinomial logit can support only the former.

transport to work model for residents of New York City (although model selection tests favour the conditional logit).[5]

Much of the early research on Irish travel patterns was carried out in the context of research on the sustainability of residential and commercial development (see for example, MacLaran and Killen, 2002, McCarthy, 2004 and Williams and Shiels, 2000). The interactions between commuting and the housing and labour markets have been analysed by Morgenroth, 2002 who used gravity models to analyse the determinants of inter-county commuting flows and Keane, 2001 who similarly related commuting to issues of job search and the development of local labour market areas. Horner, 1999 and Walsh *et al*., 2005 described patterns of travel to work using earlier versions of the Census of Population (COP) data employed in this paper. Both papers highlighted a substantial phenomenon of long-distance commuting.

Research on the travel behaviour of individuals using disaggregated data has been increasing in recent years in Ireland, in part due to the increased availability of detailed micro-data on commuting behaviour from the Census of Population. Nolan, 2003 examined the income and socio-economic determinants of household car ownership, car use and public transport use in the Dublin area, using micro-data from the 1987, 1994 and 1999 Irish Household Budget Surveys. McDonnell et al., 2006 focused on the determinants of bus use in a particular QBC (quality bus corridor) catchment area in Dublin. They found that the key to attracting commuters to bus was shorter journey times at peak times, even in high income areas. Vega and Reynolds-Feighan, 2006 estimated a simultaneous model of residential location and mode of transport to work in the Dublin area using data from the 2002 Census of Population, and found significant effects for alternative-specific characteristics such as travel time, as well as individual socio-economic characteristics. In a later paper, using the same data, Vega and Reynolds-Feighan, 2008 concentrated on four employment sub-centres in the Dublin area, and found that the spatial distribution of employment exerted a large and significant influence on modal choice for the

5 De Donnea, 1971, Lave, 1970 and Madan and Groenhout, 1987 all use the binary logit methodology but the ability of the conditional, multinomial and nested logit methods to incorporate more than two categories of the dependent variable means that they are favoured in applied work relating to modal choice. Bhat and Pulugurtha, 1998 and Hausman and Wise, 1978 estimate multinomial probit models, but the computational complexity of this model means that it is rarely applied.

journey to work. Commins and Nolan, 2008, using the same data employed in this paper (i.e., the 2006 Census of Population), examined choice of mode of transport for the journey to work in the Greater Dublin Area, but assumed that residential location and household car ownership status were exogenous.

3 Data

The data employed in this paper are micro-data from the Place of Work Census of Anonymised Records (POWCAR) from the 2006 Census of Population (COP). The COP is carried out every five years by the Central Statistics Office and includes all individuals present in the country on the last Sunday in April. For the first time, the micro-data for 2006 constitute the entire population of working individuals aged 15+ years surveyed at home in private households. In total 1,834,472 individuals are included in the micro-data file. After excluding individuals working from home, those with a mobile place of employment and where "other means"[6] and lorry/van were recorded, the final sample for estimation is 1,564,330 individuals. Due to the substantial difference in population density and public transport provision across different areas of Ireland, we further divide the sample into four sub-samples; Dublin city and county (494,370 individuals), Dublin commuter belt (i.e., the surrounding counties of Kildare, Meath and Wicklow; 187,779 individuals), other urban areas (377,649 individuals) and rural areas (504,532 individuals).[7] Table 1 defines the four sub-samples, and provides some details on public transport availability and transport characteristics in each area.

[insert Table 1 here]

Each individual observation contains information on demographic and socio-economic characteristics such as age, gender, household type, housing tenure, marital status, education level, socio-economic group and industrial group, as well as variables relating to county and

[6] These observations are excluded as the modelling approach requires that alternatives be distinct and independent.
[7] To ease the computational burden, we take a 10 per cent random sample in each case.

electoral division (ED[8]) of residence, county, ED and geo-code of place of work, distance travelled, time of departure and mode of transport for the journey to work. Mode of transport refers to the usual mode of transport for the outward journey to work. Where more than one mode of transport is used, the mode of transport used for the greater part of the journey (by distance) is recorded. Household car ownership refers to the number of cars or vans available for use by the household. All variables are self-reported. The COP does not contain information on income or prices.

Our joint model of household car ownership and mode choice for the journey to work consists of six alternatives; two car ownership levels (no car or at least one car) and three modes of transport to work (walk/cycle, bus/train and motorcycle/car driver/car passenger). See Section 4 for further details on methodology. Table 2 presents car ownership and modal shares for 2006, and indicates that the majority of workers travelled by car in each of the four areas, followed by walking/cycling and public transport. However, it is clear that the range of options available to those in the Greater Dublin Area (i.e., Dublin city and county and commuter belt) is wider, with public transport really only attracting a significant number of commuters here. The proportion of households with at least one car is considerably higher in rural areas than in Dublin city and county. Consequently, the distribution of individuals across all six alternatives is more dispersed for Dublin city and county than for the other areas, in particular, rural areas.

[insert Table 2 here]

Independent variables are individual- as well as alternative-specific. While (self-reported) travel times for the individual's chosen mode are available in POWCAR, travel times for alternative modes are not. To estimate travel times for the non-chosen modes, we regress time on distance for each mode, and use the fitted values to predict average travel times for each of the alternatives for each individual (see De Palma and Rochat, 2000 and Hole and FitzRoy, 2004 for similar applications). Cost information is not available in POWCAR. We construct a simple alternative-specific (monetary) cost per kilometre variable using information on public transport

[8] The electoral division (ED) is the smallest administrative area for which population statistics are published. There are 3,440 EDs in the state.

fares and car operating costs (including fuel). We assume zero costs for the walking and cycling modes (in common with others in the literature (see also Hole and FitzRoy, 2004)).[9]

Individual-specific independent variables include the age of the individual (classified using a nine-category variable representing five-yearly age groups) and gender (with males regarded as the reference category). We also include a seven-category household composition variable to identify households with children, single parent households, other households *etc*. This is important as POWCAR does not include household identifiers, meaning that we cannot link household members. Individuals that are married[10] are indicated by a binary variable for marital status, as are individuals with third level education as their highest level of education completed. The socio-economic group of the individual is represented by a four-category variable that identifies individuals in the three highest socio-economic groups (employers and managers, higher professional, lower professional), with those in all other socio-economic groups regarded as the reference category. We include a four-category indicator for industrial group, in an attempt to proxy job characteristics such as flexibility in working hours, provision of company vehicles *etc*. Individuals working in the commercial sector, in public administration and defence, and in education, health and social services are included, with those in all other industrial groups regarded as the reference category.

We also include dummy variables for those living and working in densely populated EDs (i.e., with 150 persons or more per square km). This provides a crude proxy for public transport availability and parking provision with the expectation that those living and working in densely populated areas will have better public transport options and/or poorer parking availability than those living and working in less densely populated areas. We also construct a rail availability index based on ED-level data. This is a binary variable, which identifies individuals who live and work in EDs with 75 per cent of addresses within two kilometres of a rail station (for the Dublin city and county and commuter samples, the cut-off is 100 per cent due to the smaller size of the

[9] Further details on the construction of the time and cost variables are available from the authors.
[10] Co-habitation is not recorded in the Census.

EDs). Potentially important omitted variables include cycle lane facilities[11], bus service availability and more general indicators of public transport quality and frequency, although even if available, matching such variables to EDs would be difficult. Variable definitions and summary statistics are presented in Table 3.

[insert Table 3 here]

4 Methodology

In this application, an individual chooses among six discrete alternatives (representing two car ownership alternatives and three mode of transport alternatives). We specify a conditional logit model, a particular type of discrete choice econometric method. The conditional logit model extends the multinomial logit model to include variables that describe the attributes of the choices (such as travel time), as well as variables that describe the attributes of the individuals (such as age or gender). Assume each individual *i* faces a choice between a set of *J* alternatives ($j = 1, 2, ..., J$), with the attributes of the choices described by z_{ij} and the characteristics of the individual described by x_i. The model is based on McFadden's random utility framework (see McFadden, 1974), in which each individual *i* aims to maximize their utility. The (unobserved) utility of each alternative is assumed to be a linear function of various independent variables and an error term as follows:

$$U_{ij}^{*} = x_i' \alpha_j \; + \; z_{ij}\beta + \varepsilon_{ij} \qquad (1)$$

where U_{ij}^{*} is the unobserved utility individual *i* derives from alternative *j*, x_i is the vector of individual-specific independent variables, α_j is the vector of estimated parameters for the individual-specific variables, z_{ij} is the vector of alternative-specific variables, β is the vector of

[11] See Ewing *et al*., 2004 for a discussion of the effect of footpaths and cycle lanes on choice of mode of transport to school in Florida.

alternative-specific parameters and ε_{ij} is the error term. An individual *i* chooses alternative *j* if it gives the highest utility among all possible alternatives. The distributional assumptions concerning the random error component ε_{ij} determine the form of the model. The most common assumption is that the error terms are independently and identically distributed with a Type 1 Extreme Value (or Weibull) distribution, which results in the following probability of individual i choosing alternative *j*:

$$\Pr(y_i = j) = \frac{\exp(x_i\alpha_j + z_{ij}\beta)}{\sum_{k=1}^{K}\exp(x_i\alpha_k + z_{ik}\beta)} \qquad (2)$$

Conditional logit regression methods (using the 'asclogit' command in STATA 10) are used to obtain estimates of the parameters α_j and β. The conditional logit model reduces to the multinomial logit model when all independent variables are individual-specific. As with the multinomial logit, a restrictive feature of the conditional logit model is the assumption of 'Independence from Irrelevant Alternatives' (IIA). The property implies that the relative probabilities between a pair of alternatives are specified without reference to the nature of the other alternatives in the choice set. Hausman and Small-Hsiao tests of the IIA property have been developed for the multinomial logit and conditional logit models, but are prone to errors (see for example, Scott Long and Freese, 2006). To test the appropriateness of the conditional logit methodology, we follow Salon, 2009 and also estimate a nested logit model. The assumption of independent alternatives cannot be rejected for the Dublin city and county sample, and while rejected for the other three samples, the inclusive values are either outside the normal range for some nests (indicating inconsistency with utility maximization) and/or the empirical results are very similar in sign and significance to those from the conditional logit model.[12] We therefore concentrate on the estimation of conditional logit models of car ownership and mode choice.

[12] Results are available on request from the authors.

In order to estimate the models, the data must be constructed in such a way that there are J observations for each individual i. As there are 35,528, 13,896, 26,899 and 35,292 individuals in our sample with complete information on all variables of interest respectively, this results in respective sample sizes of 213,168, 83,376, 161,394 and 211,752. Estimation results are presented in terms of odds ratios, with values greater than unity indicating an increased probability of observing the alternative in question, and values smaller than unity a reduced probability of observing the alternative in question (in comparison with the base alternative).

It is possible that each individual does not have access to the full range of alternatives, particularly in rural areas where public transport options may just not be available. We therefore estimate a second specification of the model with a restricted choice set. We consider walking and cycling to be unavailable for those travelling over ten kilometres to work and public transport to be unavailable for those living in EDs with fewer than 100 per cent of addresses within two kilometres of a rail station (see also Ewing et al., 2004 and Hole and FitzRoy, 2004).[13] As very few individuals who travel by motorised means to work (motorcycle or car) live in households without a car, we also consider the case when this alternative is dropped from the model.[14] Reference to these results is made in Section 5.

5 Empirical Results

Tables 4, 5, 6 and 7 present estimation results for the conditional logit models of car ownership and mode choice for each of the four sub-samples, while Tables 8 and 9 present the time and cost elasticity estimates respectively. Our travel cost variable is necessarily a crude approximation of the monetary costs associated with the various transport modes, but nonetheless, our results indicate that travel cost exerts a negative and significant effect for residents of Dublin city and county, other urban areas and rural areas (as expected). The effect of travel cost is insignificant for residents of the commuter counties. Travel time is a much more significant influence overall

[13] In the absence of more detailed information on public transport availability, access to rail services at the ED level is used here to proxy, albeit imperfectly, public transport availability.
[14] Results from these various robustness checks are available from the authors.

however; with the effects for the no car-walk or cycle and car-walk or cycle alternatives being particularly pronounced. The cross elasticities of travel time are highest for the car-motorised means alternatives, suggesting that an increase in travel time for this alternative is associated with proportionately large increases in the probability of other alternatives being chosen (e.g., in the commuter belt around Dublin, an increase of one per cent in travel time for those owning cars and choosing motorised means to work leads to a decline of 1.3 per cent in the probability of choosing that alternative, and a 5.2 per cent increase in the probability of the other alternatives).

[insert Tables 8 and 9 here]

The results for the individual-specific variables for Dublin city and county (Table 4), suggest that age has a significant influence on individuals' car ownership and mode choice decisions, with older age groups being significantly less likely to choose all car ownership-mode alternatives in comparison with the base alternative of owning a car and travelling by motorised means (motorcycle, car passenger or car driver) to work. Compared with the base alternative, females are significantly less likely to choose the no car-walk or cycle, no car-public transport and car-walk or cycle options. However, females in Dublin city and county are significantly more likely to choose the car-public transport option than males, perhaps reflecting competing demands on the household car which favour males and the significantly lower probability of females cycling to work which has been observed in other studies (see Commins and Nolan, 2008 and Pooley and Turnbull, 2000). Household composition also proves to be a significant determinant of car ownership and transport mode choice for the journey to work. Households with children are less likely to choose any of the no-car-owning alternatives, compared with single adult households. However, contrary to prior expectations, all other households are more likely to own a car but to walk, cycle or take public transport, than own a car and take motorised means to work, compared with single person households. This may suggest that car ownership is of more importance for non-work trips, particularly when there are children in the household. It may also reflect the fact that our measure of car ownership refers to the number of cars or vans available for use by the *entire* household, rather than the individual commuter; as such, individuals in larger households face competition for the household car for the journey to work. Married individuals are significantly less likely to choose the public transport alternatives than the base alternative.

While higher education levels are negatively associated with the no-car-owning alternatives, those with a third level education in Dublin also have an increased probability of walking or cycling to work, or opting for public transport, despite owning a car. These divergent effects may suggest that the income effects associated with higher education, which are observed through the greater probability of car ownership, are counteracted by a greater awareness of the detrimental environmental effects of car driving among the higher educated, whose choose more environmentally friendly modes of transport for commuting purposes. Socio-economic group, used as a proxy for household resources, is similarly significant. Those in the top three socio-economic groups are less likely to choose any alternative over owning a car and driving or travelling as a passenger in a car to work, with the effects for the top two socio-economic groups particularly large and significant, as expected. The results for industrial group suggest that those working in commerce or public administration and defence in the Dublin sample are significantly more likely to choose the two car-owning alternatives. Despite a recent survey which highlighted the high degree of free car parking available to public servants (i.e., those working in public administration) in the Dublin area[15], other characteristics of these occupations such as the availability of subsidised public transport fares and/or their more regular working hours may make them more amenable to non-motorised modes. Those in the education and health industries do not behave significantly differently from those in all other industries (the base category), except that they are significantly less likely to choose the public transport options, perhaps because of irregular/non-peak working hours.

Public transport availability is evidently an important consideration, as shown by the highly significant rail proximity variable. Those living and working in parts of Dublin city and county which are well serviced by rail are significantly more likely to choose all car ownership-mode combinations other than owning a car and travelling by motorised means, with the results for those choosing the no car-walking, cycling and public transport alternatives particularly significant. For instance, in comparison with living in a car-owning household and choosing a

[15] The survey by the Dublin City Business Association suggested that up to 60 per cent of car parking spaces in Dublin city centre were used by public servants, the majority of whom have free parking (Irish Times, June 16th, 2008).

motorised means of transport to work, those living and working in areas with all addresses within 2km of a railway station are nearly three times as likely to choose the no car-public transport option, and over 3.5 times more likely to choose the no car-walking or cycle option. Public transport alternatives, along with walking and cycling, even for those in car-owning households, also become more attractive for those working in densely populated areas.

[insert Table 4 here]

Results for the sample of those living in the commuter belt counties of Kildare, Meath and Wicklow (see Table 5) are broadly in line with those observed for Dublin city and county, with age, household composition, living and working in densely populated areas, and access to rail having the highest significance. These variables all have the same signs as previously outlined, with younger people, those working in densely populated areas and those living and working near a railway station significantly more likely to choose all car ownership-mode combinations over owning a car and travelling by motorised means to work. Individuals in higher socio-economic groups are also still less likely to choose any alternative over owning a car and taking a motorised mode to work, with the effects for choosing the no car-walking or cycling alternative particularly small and significant. Due to the smaller number of observations in this sample, the significance levels of some variables such as gender, marital status and industrial group fall.

[insert Table 5 here]

The results for other urban and rural areas (Tables 6 and 7 respectively) differ in some respects to the samples outlined above, partly due to smaller sample sizes and reduced significance levels. However, the main drivers of car ownership levels and transport mode choice are still clearly evident, in the significance of age, gender, household composition and socio-economic group. The results for the rail availability and work population density variables indicate some differences in comparison with the results for Dublin city and county and the commuter counties. For example, rail availability is less significant for the other urban and rural samples, reflecting the relatively poor availability of rail connections suitable for commuting outside the Greater Dublin Area, although it has, in general, the expected effects. While those working in densely

populated areas are significantly more likely to choose the car-public transport option in both urban and rural areas, those working in densely populated areas are significantly less likely to choose the walking or cycling alternatives in the rural sub-sample. Why this is the case is not entirely clear, although it is possible that conditions for walking and cycling in rural areas are so poor (no cycle lanes, poor lighting, lack of a continuous footpath *etc*.) as to make these alternatives unpopular even for those working in densely populated areas.

[insert Tables 6 and 7 here]

Comparing the results across the four sub-samples indicates differences in the effects of some variables, most notably for education, industrial group and work location population density. While in all cases the probability of choosing a no car alternative is lower among those with a third level education, the possible preference for more environmentally friendly modes of transport among higher educated car owners in Dublin city and county and the commuter counties is not reflected in other parts of the country (where the car-walking or cycling and car-public transport alternatives are significantly *less* likely to be chosen). Explaining these divergent effects is difficult although it is possible that education in the Dublin city and county or commuter samples may be correlated with other factors such as work or home location, which may not have been picked up by the aggregated nature of the dummy variables. The effect of workplace population density also differs across the four areas. In general, those resident in rural areas behave differently to those resident in the other three areas of the country; for example, while those working in areas with high population density are significantly more likely to choose the car-walk or cycle option in Dublin city and county, the commuter counties and other urban areas, rural residents who work in densely populated areas are significantly *less* likely to choose this option. The relative quality of walking and cycling facilities in rural areas may explain this counterintuitive result.

Some of our models are fitting better than others, in part due to amount of variation across alternatives and the quality of independent variables available to us. For example, the Dublin city and county sample has the highest significance levels for all variables, followed by the commuter counties. These areas are better serviced by public transport, and have lower car ownership

levels, meaning that individuals are more likely to choose from a wider variety of alternatives than the other urban and rural areas. It also proved more difficult to construct reliable cost variables for areas outside of Dublin, due to insufficient data, which may account for the insignificance of the cost variable for the commuter sample. Finally, the small proportion of individuals choosing the no car-motorised means option leads to less significant results, although consistent with expectations (e.g., non-single households are significantly less likely to choose the no car-motorised option, perhaps reflecting competing household demands such as the presence of school-age children which would make car-sharing more attractive).

Nonetheless, the results from all four samples give a clear indication that the dominant socio-economic influences on car ownership and modal choice are age, gender, household composition and socio-economic group, regardless of household location. Regional characteristics, such as work and home location are also significant. The strong effects of travel time, along with the positive results for rail availability, suggest some scope for policy intervention. The impact of rail proximity on the probability of travel by public transport suggests that there would be positive effects from the provision of better quality public transport. It would be interesting to test the relative popularity of bus and rail services, given international evidence on potential for rail services (which are not subject to congestion in the same way as bus services) to divert significant amounts of commuters away from motorised means (see for example, Webster and Bly, 1980). A change in the relative time or monetary costs of public transport relative to driving a car are also likely to make these more sustainable modes more attractive to commuters, with our results suggesting that changes to travel time would have stronger effects. Faster or cheaper public transport journeys, or relatively more expensive car trips, perhaps through the introduction of road pricing or carbon taxes have the potential to induce modal shifts. However, influencing behaviour that is associated with individual or household characteristics is more challenging.

We also estimated alternative models for each of the four sub-samples, based on a restricted choice set. In rural areas in particular, it is questionable whether all alternatives are available to all commuters. To restrict the choice set, we exclude walking and cycling as an alternative where the individual travels more than ten kilometres to work, and exclude public transport as an

alternative where the individual lives in an area with poor rail availability. The results[16] are largely consistent with those from the unrestricted models, although significance levels fall.

Finally, we also estimated a simple joint residential location-car ownership-mode choice model for the Dublin city and county sample[17]. Our analysis thus far has assumed that residential location is exogenous, but of course, an individuals' mode of transport to work (or preferred mode of transport to work) may also influence their residential location.[18] We estimated a model with twelve alternatives, comprising two residential location (Dublin city centre and not), two car ownership levels (no car and one or more cars) and three modes of transport (walk/cycle, public transport and motorised means). Most of the variables have similar effects on the joint residential location-car ownership-mode decision, with age, gender, household composition, socio-economic group, rail availability and working densely populated areas having particularly consistent effects. The divergent effects of education found for the joint car ownership-mode choice model, where those with a third level education are significantly more likely to choose the car-walk or cycle and car-public transport options, is replicated here, where those with a third level education are significantly *more* likely to choose the outside city centre-car-public transport option (with no significant difference in the effect of education on the car-public transport option however).

6 Summary and Conclusions

Despite the limitations associated with using Census of Population data to examine modal choice decisions (see Section 3), the results highlight the importance of individual demographic and socio-economic characteristics, travel times and costs, as well as regional and travel variables such as rail availability and home and work location in explaining the joint car ownership-mode of transport decision in Ireland.

[16] Results are available on request from the authors.
[17] Results are available on request from the authors.
[18] Of course, it is also possible that work location is not exogenous either, although as individuals have less choice over their work location, we leave the estimation of such a four-way model as future research.

In the Greater Dublin Area, those working in densely populated areas are significantly more likely to choose the car-walk or cycle and car-public transport options, indicating the effect of public transport availability and city centre parking difficulties and restrictions. The significant positive results observed for public transport use by those working in densely populated areas also add weight to the argument for the development of more concentrated employment districts, to reverse the trends of employment suburbanisation and urban sprawl, which increase car dependence. In addition, in comparison with those with poor rail availability, those living and working in EDs with good rail facilities are in general significantly more likely to choose all options in favour of owning a car and travelling by motorised means to work. This reflects the importance of public transport provision in influencing modal choice. In other urban and rural areas, rail availability and home and work location exert less significant effects, although the results are similar in effect and indicate the importance of public transport provision and parking restrictions on modal choice decisions.

The importance of household or family interactions in determining travel behaviour is confirmed by the significance of age, gender, household type and marital status. Non-single households are significantly less likely to choose the no car options, while females are also significantly less likely to choose these options (but are significantly more likely to choose the car-public transport option). Individual modal choice decisions are often made with reference to other members of the household, in particular with regard to the needs and schedules of school-age children and/or the availability of the household car. In recent years, the proportion of schoolchildren being driven to school has increased substantially, and while the results here are static, the results for household type and marital status to some extent reflect this situation with individuals in households with young children in particular being significantly less likely to choose the no car options.

Of course, the research is subject to a number of caveats. We assume that residential location (and indeed work location) is exogenous but it is possible that individuals make their housing and work location decisions on the basis of (preferred) travel arrangements. We have however made an attempt to estimate a joint residential location-car ownership-mode choice model for the Dublin city and county sample and obtained results which are consistent with expectations (e.g.,

those living and working near railway stations are significantly more likely to choose all residential location-car ownership-mode options over living outside the city centre, owning a car and travelling by motorised means to work). A further limitation of this analysis concerns the nature of the data available; in particular, information on alternative characteristics such as in-vehicle time, waiting time, and public transport frequency is simply not available, let alone easily matched to EDs. Our data is also lacking any information on other household members' travel patterns, such as the necessity of dropping children to school, which may influence the car ownership and mode choice decision of an individual. Other potentially important omitted variables include information on the provision of bus services at a detailed regional level and the provision of other services such as cycle lanes, park and ride facilities and dedicated road space for buses.

While necessarily crude, our travel time and cost measures indicate the importance of alternative-specific factors in influencing travel behaviour. A change in the relative time or monetary costs of public transport relative to driving a car are likely to make these more sustainable modes more attractive to commuters. For example, in the Dublin area, increasing the cost of a commuting journey for those who have a car and drive to work by one per cent reduces the probability of that alternative being chosen by approximately 0.05 per cent (and increases the probability of alternatives being chosen by 0.08 per cent), while the respective changes for a similar increase in travel time are approximately 1.2 per cent and 1.7 per cent (see Tables 8 and 9). Faster or cheaper public transport journeys, or relatively more expensive car trips, perhaps through the introduction of road pricing or carbon taxes have the potential to induce modal shifts. The results, while subject to concerns over the reliability of our time and cost measures, suggest that travel time exerts a stronger influence on individual travel behaviour. In this context, measures which seek to make more sustainable modes of transport more comparable with the private car in terms of journey times (e.g., dedicated cycle and bus lanes, more frequent public transport services etc.) may be just as important as monetary incentives in inducing individuals to travel by more sustainable forms of transport.

References

Alperovich, G., Deutsch, J. and Machnes, Y. (1999): 'The Demand for Car Ownership: Evidence from Israeli Data'. *International Journal of Transport Economics*, 26 (3), 351-375.

Asensio, J. (2002): 'Transport Mode Choice by Commuters to Barcelona's CBD'. *Urban Studies*, 39 (10), 1881-1895.

Barrett, A., Goggin, J. and Kearney, I. (2009). *Quarterly Economic Commentary (Spring 2009).* Dublin, Economic and Social Research Institute.

Ben-Akiva, M and Lerman, S. (1975): 'Disaggregate Behavioural Model of Automobile Ownership'. *Transportation Research Record, 569, 34-51.*

Bhat, C. and Pulugurtha, V. (1998): 'A Comparison of Two Alternative Behavioural Choice Mechanisms for Household Auto Ownership Decisions'. *Transportation Research Part B: Methodological, 32(1), 61-75.*

Central Statistics Office (2007): *Transport 2006*. Dublin: Stationery Office.

Central Statistics Office (2008): *Database Direct (Census of Population Interactive Tables).* Available from: www.cso.ie/px/

Central Statistics Office (2009a). *Live Register (April 2009)*. Dublin: Stationery Office.

Central Statistics Office (2009b). *Vehicles Licensed for the First Time (March 2009*). Dublin: Stationery Office.

Cohen, A. and Harris, N. (1998): 'Mode Choice for VFR Journeys'. *Journal of Transport Geography*, 6 (1), 43-51.

Commins, N. and Nolan, A. (2008). *The Determinants of Mode of Transport to Work in the Greater Dublin Area*. ESRI Working Paper No. 268. Dublin: Economic and Social Research Institute.

Cragg, J. and Uhler, R. (1970): 'The Demand for Automobiles'. *Canadian Journal of Economics*, 3 (3), 386-406.

De Donnea, F. (1971): The Determinants of Transport Mode Choice in Dutch Cities: Some Disaggregate Stochastic Choice Models. Rotterdam, Rotterdam University Press.

De Palma, A. and Rochat, D. (2000): 'Mode Choice for Trips to Work in Geneva: An Empirical Analysis'. *Journal of Transport Geography*, 8, 43-51.

Department of Transport (2008a): *Statement of Strategy 2008-2010*. Dublin: Department of Transport.

Department of Transport (2008b): *2020 Vision – Sustainable Transport and Travel*. Public Consultation Document. Dublin: Department of Transport.

Dissanayake, D. and Morikawa, T. (2005): 'Household Travel Behavior in Developing Countries: Nested Logit Model of Vehicle Ownership, Mode Choice and Trip Chaining'. *Transportation Research Record*, 1805, 45-52.

Domencich, T. and McFadden, D. (1975): *Urban Travel Demand: A Behavioural Analysis*. Amsterdam, North Holland.

Dublin Transportation Office (2001): A Platform for Change: An Integrated Transport Strategy for Greater Dublin Area 2000 to 2016. Final Report. Dublin: Dublin Transportation Office.

Dublin Transportation Office (2005): *Road User Monitoring Report 2004*. Dublin: Dublin Transportation Office.

Dublin Transportation Office (2006a): *DTO Cycling Policy*. Dublin: Dublin Transportation Office.

Dublin Transportation Office (2006b): *Greater Dublin Area Travel Demand Management Study*. Final Report. Prepared by Booz Allen Hamilton Consultants. Dublin: Dublin Transportation Office.

European Commission (2007): *Green Paper: Towards a New Culture for Urban Mobility*. Brussels: Commission of the European Communities.

European Environment Agency (2006): *Urban Sprawl in Europe: the ignored challenge*. EEA Report No 10/2006. Luxembourg: Office for Official Publications of the European Communities.

Ewing, R., Schroeer, W. and Greene, W. (2004): 'School Location and Student Travel: Analysis of Factors Affecting Mode Choice'. *Transportation Research Record*, 1885, 55-53.

Eymann, A. and Ronning, G. (1997): 'Microeconometric Models of Tourists' Destination Choice'. *Regional Science and Urban Economics*, 27, 735-761.

FitzGerald, J., Bergin, A., Conefrey, T., Diffney, S., Duffy, D., Kearney, I., Lyons, S., Malaguzzi Valeri, L., Mayor, K. and Tol, R. (2008): *Medium-Term Review 2008-2015*. Dublin: Economic and Social Research Institute.

Hausman, J. and Wise, D. (1978): 'A Conditional Probit Model for Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous Preferences'. *Econometrica, 46 (2), 403-246.*

Hole, A. and FitzRoy, F. (2004): *Commuting in Small Towns in Rural Areas: The Case of St. Andrews.* Department of Economics, University of St. Andrews.

Horner, A. (1999): 'The Tiger stirring: aspects of commuting in the Republic of Ireland 1981–1996'. *Irish Geography, 32, 99–111*.

Keane, M. (2001): 'A Model of Commuting Distances: Some Preliminary Insights from a Spatial Model of Job Search'. *European Research in Regional Science*, 11, 169-177.

Lave, C. (1970): 'The Demand for Urban Mass Transportation'. *The Review of Economics and Statistics*, 52 (3), 320-323.

Lave, C. and Train, K. (1979): 'A Disaggregate Model of Auto-Type Choice'. *Transportation Research Part A: Policy and Practice*, 13, 1-9.

Lyons, S., Mayor, K. and Tol, R.S.J. (2008): 'Environmental Accounts of the Republic of Ireland: 1990-2005'. *Journal of the Statistical and Social Inquiry Society of Ireland*, 37, 190-216.

MacLaran, A. and Killen, J., 2002. The Suburbanisation of Office Development in Dublin and its Implications for Transport. *Journal of Irish Urban Studies*, 1 (1), 21-35.

McCafferty, D. and Hall, F. (1982): 'The Use of Multinomial Logit Analysis to Model the Choice of Time to Travel'. *Economic Geography, 36 (3), 236-246.*

McCarthy, C. (2004). Crawling through the Sprawl. *Irish Banking Review*, Summer, 15-26.

McCarthy, P. (1996): 'Market Price and Income Elasticities of New Vehicle Demands'. *The Review of Economics and Statistics*, 78 (3), 543-547.

McDonnell, S., Ferreira, S. and Convery, F. (2006): 'Impact of Bus Priority Attributes on Catchment Area Residents in Dublin, Ireland'. *Journal of Public Transportation,* 9 (3), 137-162.

McFadden, D. (1974): 'Conditional Logit Analysis of Qualitative Choice Behaviour'. In Zarembka, P. (ed.) *Frontiers in Econometrics*. New York: Academic Press.

McGillivray, R. (1972): 'Binary Choice of Urban Transport Mode in the San Francisco Bay Region'. *Econometrica*, 40 (5), 827-848.

Madan, D. and Groenhout, R. (1987): 'Modelling Travel Mode Choices for the Sydney Work Trip'. *Journal of Transport Economics and Policy*, 21 (2), 135-149.

Morgenroth, E. and FitzGerald, J. (2006): *Ex-Ante Evaluation of the Investment Priorities for the 2007-2013 National Development Plan*. Policy Research Series No. 59. Dublin: Economic and Social Research Institute.

Morgenroth, E. (2002): *Commuting in Ireland: An Analysis of Inter-County Commuting Flows.* ESRI Working Paper No.144. Dublin: Economic and Social Research Institute.

Nolan, A. (2003): 'The Determinants of Urban Households' Transport Decisions: A Microeconometric Study using Irish Data'. *International Journal of Transport Economics*, 30 (1), 103-132.

Pooley, C. and Turnbull, J. (2000): 'Modal Choice and Modal Change: The Journey to Work in Britain since 1890'. *Journal of Transport Geography, 8, 11-24.*

Salon, D. (2009). Neighborhoods, cars, and commuting in New York City: A discrete choice approach. *Transportation Research Part A*, 43, 180-196.

Scott Long, J. and Freese, J. (2006): *Regression Models for Categorical Dependent Variables using Stata*. College Station, Texas: Stata Press.

Thobani, M. (1984): 'A Nested Logit Model of Travel Mode to Work and Auto Ownership'. *Journal of Urban Economics, 15(3), 287-301.*

Train, Kenneth (1980): 'A Structured Logit Model of Auto Ownership and Mode Choice'. *The Review of Economic Studies, 47(2), 357-370.*

Vega, A. and Reynolds-Feighan, A. (2006): *Choice of Residential Location and Travel Mode to Work in the Greater Dublin Area*. Paper Presented to UTSG, Dublin, January 2006.

Vega, A. and Reynolds-Feighan, A. (2008): 'Employment Sub-Centres and Travel to Work Mode Choice in the Dublin Region'. *Urban Studies*, 45 (9), 1747-1768.

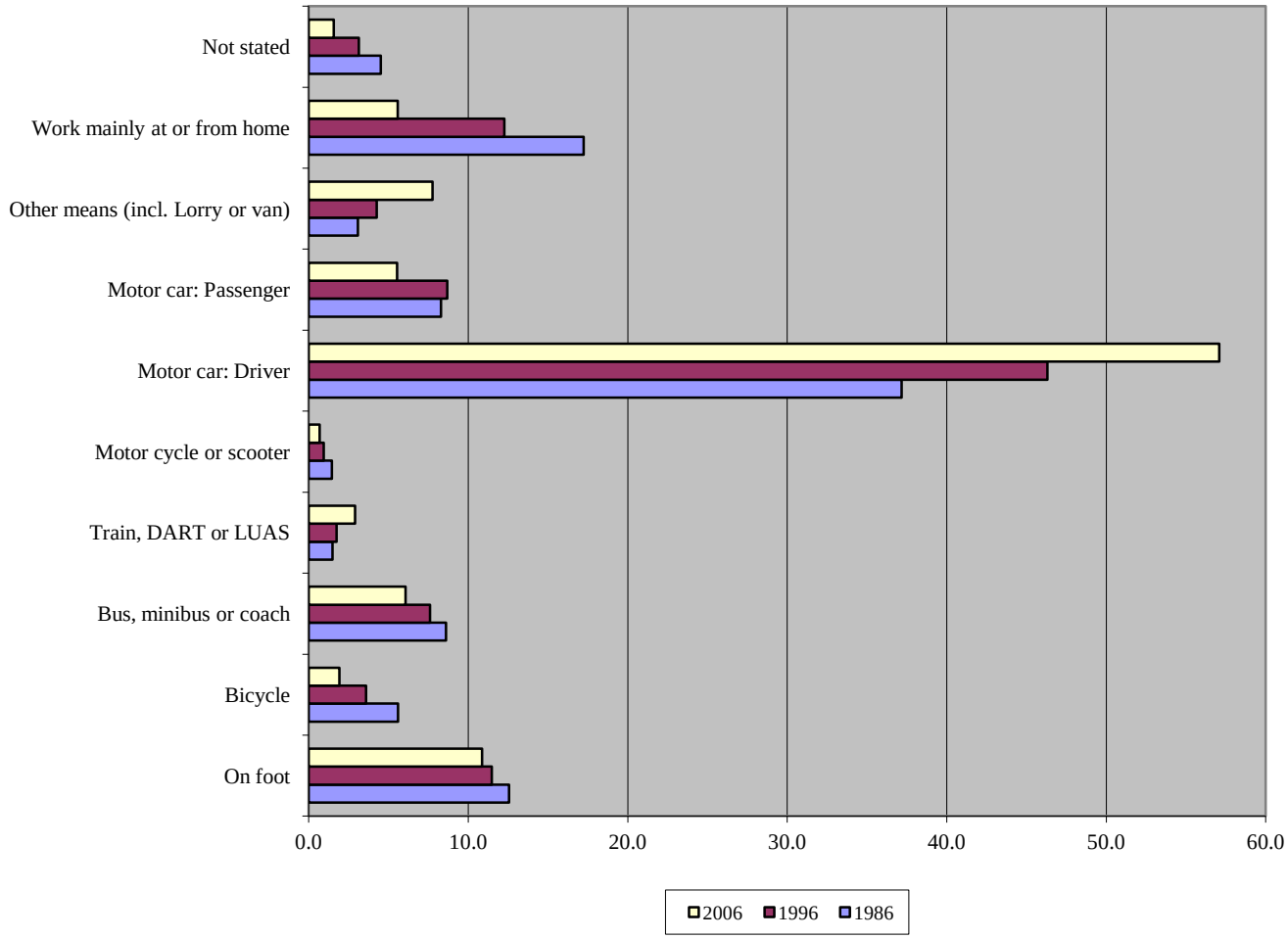
Walsh, J., Foley, R., Kavanagh, A. and McElwain, A. (2005): *Origins, Destinations and Catchments: Mapping Travel to Work in Ireland in 2002*. Paper presented to the Statistical and Social Inquiry Society of Ireland, October 2005.

Webster, F. and Bly, P. (1980). The Demand for Public Transport: Report of the International Collaborative Study of the Factors Affecting Public Transport Patronage. Crowthorne, Transport and Road Research Laboratory.

Williams, B. and Shiels, P., 2000. Acceleration into Sprawl: Causes and Potential Policy Responses. Article in Quarterly Economic Commentary (Spring 2000). Dublin: Economic and Social Research Institute.

FIGURES AND TABLES

Figure 1: Mode of Transport to Work, 1986, 1996 and 2006 (Percentage of all Commuters)



Source: CSO Census Interactive Tables (www.cso.ie)

Table 1: Sub-Sample Definitions and Selected Characteristics

	Dublin city & county	Commuter	Other urban	Rural
Definition	Dublin County Borough, Fingal, South Dublin, Dun Laoghaire-Rathdown	Kildare, Meath and Wicklow	Cork, Galway, Limerick and Waterford cities and EDs with residential density of 150 persons per km^2 or greater	EDs with residential density of fewer than 150 persons per km^2
Resident working population	494,370	187,779	377,649	504,532
Population density	4097[19]	598	1610	46
Average kms to work	10	21	11	18
Median kms to work	7	16	5	12
Public transport options	Extensive bus service; suburban coastal light rail line (DART); four radial suburban heavy rail lines (Commuter); two radial tram lines (LUAS)	Inter-urban bus and rail services; four radial suburban heavy rail lines (Commuter)	City bus services in cities with inter-urban bus and rail services; one suburban rail line in Cork	Inter-urban bus and rail services

The samples exclude those who stated that they work at home, travelled by "other" means (including lorry or van), or did not answer the question (see also Section 4).
Source: 2006 POWCAR

[19] Despite having the highest population density in the country, Dublin is a low density city by European standards (see European Environment Agency, 2006).

Table 2: Household car ownership and mode of transport to work, 2006 (full population of working individuals 15+ years; %)

	Dublin city & county	Dublin commuter belt	Other Urban	Rural
No household car	*14.5*	*4.7*	*12.0*	*2.8*
On foot or bicycle	6.9	2.7	8.1	1.7
Bus, train or LUAS	6.8	1.2	2.0	0.3
Motorcycle, scooter, car driver or passenger	0.8	0.8	1.9	0.8
At least one household car	*85.5*	*95.3*	*88.0*	*97.2*
On foot or bicycle	11.8	7.2	14.0	4.9
Bus, train or LUAS	17.0	9.2	3.2	1.3
Motorcycle, scooter, car driver or passenger	56.7	78.9	70.8	91.0
Total	100.0	100.0	100.0	100.0

The samples exclude those who stated that they work at home, travelled by "other" means (including lorry or van), or did not answer the question (see also Section 4).
Source: 2006 POWCAR

Table 3: Variable definitions and summary statistics, 2006 (independent variables)

	Definition	Dublin city & county	Commuter	Other urban	Rural
Age 25-29	=1 if aged 25-29	18.8	15.4	18.4	13.0
Age 30-34	=1 if aged 30-34	16.2	16.8	15.5	15.0
Age 35-39	=1 if aged 35-39	12.2	14.5	12.7	14.8
Age 40-44	=1 if aged 40-44	11.3	12.6	11.4	13.6
Age 45-49	=1 if aged 45-49	10.0	10.8	10.4	12.3
Age 50-54	=1 if aged 50-54	8.5	8.9	8.1	10.1
Age 55-59	=1 if aged 55-59	6.2	5.8	5.7	6.6
Age 60+	=1 if aged 60+ years	4.3	3.7	3.8	4.0
	(Reference category = aged 15-24 years)	12.5	11.5	14.0	10.6
Female	=1 if female	48.5	48.7	49.1	54.2
	(Reference category = male)	51.5	51.3	50.9	45.8
Lone parent with at least one resident child under 19	=1 if lone parent with children under 19 years	3.9	3.9	4.8	4.2
Lone parent with resident children but none under 19	=1 if lone parent with children over 19 years	3.6	3.2	3.4	4.1
Couple with at least one resident children under 19	=1 if couple with children under 19 years	33.3	44.1	35.6	49.2
Couple with resident children but none under 19	=1 if couple with children over 19 years	12.0	11.5	10.3	13.2
Couple with no resident children	=1 if couple with no resident children	17.8	19.8	17.8	17.0
Other households	=1 if other household types	20.2	11.0	18.9	6.5
	(Reference category = single households)	9.2	6.5	9.2	5.8
Ever married	=1 if married, separated/divorced, widowed	51.1	62.5	53.9	66.4
	(Reference category = single)	48.9	37.5	46.1	33.6

The samples exclude those who stated that they work at home, travelled by "other" means (including lorry or van), or did not answer the question (see also Section 4).

Table 3: continued

		Dublin city & county	Commuter	Other urban	Rural
Third level	=1 if highest level of education completed is third level	54.5	47.0	46.0	42.0
	(Reference category = less than third level)	45.5	53.0	54.0	58.0
Employers or managers	=1 if employer or manager	20.7	20.2	14.7	14.3
Higher professional	=1 if higher professional	12.3	7.6	8.7	6.3
Lower professional	=1 if lower professional	17.1	16.6	16.2	17.9
	(Reference category = all other socio-economic groups)				
Commerce	=1 if works in commerce	41.1	33.0	30.1	26.8
Public administration	=1 if works in public administration or defence	7.9	7.8	6.2	6.7
Health, education, social	=1 if works in health, education or social work	19.2	19.5	21.5	25.7
	(Reference category = all other industrial groups)	49.9	55.6	60.4	61.5
Population density (home)	=1 if population density of home ED is >=150 per km^2	98.4	63.0	*	*
Population density (work)	=1 if population density of work ED is >=150 per km^2	97.5	80.5	83.6	53.9
Rail available	=1 if lives and works in an ED where 100 per cent of addresses are within 2 kilometres of a rail station	34.8	4.1		
	(Reference category = does not live and work in such an ED)	65.2	95.9		
Rail available	=1 if lives and works in an ED where 75 per cent of addresses are within 2 kilometres of a rail station			19.6	2.1
	(Reference category = does not live and work in such an ED)			80.4	97.9

The samples exclude those who stated that they work at home, travelled by "other" means (including lorry or van), or did not answer the question (see also Section 4).

* As the urban and rural samples are defined on the basis of population density above and below 150 persons per km^2 (see Section 3), the population density (home) variable drops out of the analysis in these two sub-samples.

Table 4: Dublin City and County (Odds Ratios – Reference Choice is Car Owner and Motorcycle, Car Driver or Car Passenger)

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Individual-specific variables					
Age 15-24	ref	ref	ref	ref	ref
Age 25-29	0.77***	0.68***	0.62**	0.69***	0.60***
Age 30-34	0.48***	0.42***	0.70*	0.68***	0.48***
Age 35-39	0.41***	0.40***	0.62*	0.57***	0.39***
Age 40-44	0.33***	0.31***	0.46***	0.58***	0.39***
Age 45-49	0.34***	0.36***	0.35***	0.61***	0.36***
Age 50-54	0.25***	0.29***	0.31***	0.52***	0.34***
Age 55-59	0.19***	0.28***	0.56*	0.49***	0.31***
Age 60+	0.16***	0.22***	0.30***	0.35***	0.35***
Male	ref	ref	ref	ref	ref
Female	0.66***	0.88**	0.56***	0.79***	1.33***
Single Person	ref	ref	ref	ref	ref
Lone parent with at least one resident child under 19	0.37***	0.37***	0.46**	0.87	1.15
Lone parent with resident children but none under 19	0.31***	0.51***	0.65*	1.11	1.94***
Couple with at least one resident children under 19	0.09***	0.11***	0.13***	1.19**	1.47***
Couple with resident children but none under 19	0.11***	0.11***	0.16***	1.38***	2.17***
Couple with no resident children	0.50***	0.44***	0.23***	1.47***	1.81***
Other households	0.88	0.99	0.58***	2.40***	2.17***
Single	ref	ref	ref	ref	ref
Ever married	0.83**	0.79***	0.66**	0.78	0.76***
Less than third level	ref	ref	ref	ref	ref
Third level	0.91	0.72***	0.51***	1.16***	1.19***

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level

Table 4: continued

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Employers and managers	0.26***	0.37***	0.26***	0.57***	0.66***
Higher professional	0.47***	0.37***	0.32***	1.06	0.78***
Lower professional	0.49***	0.54***	0.45***	0.89*	0.89**
All other socio-economic groups	ref	ref	ref	ref	ref
Commerce	1.09	1.12**	0.98	1.49***	1.83***
Public administration and defence	1.24*	1.11	0.49**	1.92***	2.19***
Education, health and social work	0.90	0.75***	0.80	1.04	0.73***
All other industrial groups	ref	ref	ref	ref	ref
Population density (home)	2.26*	3.78***	1.24	1.28	1.68***
Population density (work)	1.22	1.51**	0.78	1.66***	3.23***
Living and working in an ED with less than 100 per cent of addresses within 2kms of a rail station	ref	ref	ref	ref	ref
Living and working in an ED with 100 per cent of addresses within 2kms of a rail station	3.62***	2.72***	2.01***	2.32***	1.88***
Alternative-specific variables					
Travel time			0.77***		
Travel cost			0.98***		
Number of Observations			213,168		
Number of Individuals			35,528		
Log-Likelihood			-34,877.82		

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level

Table 5: Commuter Counties - Kildare, Meath, Wicklow (Odds Ratios – Reference Choice is Car Owner and Motorcycle, Car Driver or Car Passenger)

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Individual-specific variables					
Age 15-24	ref	ref	ref	ref	ref
Age 25-29	0.90	0.81	1.08	0.66***	0.58***
Age 30-34	0.75	0.67	0.92	0.41***	0.48***
Age 35-39	0.61	0.33***	0.68	0.53***	0.43***
Age 40-44	1.01	0.42**	0.93	0.65**	0.43***
Age 45-49	0.71	0.90	0.33*	0.54***	0.45***
Age 50-54	0.36***	0.47*	0.51	0.49***	0.47***
Age 55-59	0.90	0.80	0.41	0.58**	0.39***
Age 60+	0.53	0.19**	0.34	0.68	0.42***
Male	ref	ref	ref	ref	ref
Female	0.74**	0.82	0.33***	1.05	1.28***
Single Person	ref	ref	ref	ref	ref
Lone parent with at least one resident child under 19	0.26	0.45**	2.83**	0.86	1.15
Lone parent with resident children but none under 19	0.43**	0.45**	0.80	2.20**	2.25***
Couple with at least one resident children under 19	0.05***	0.05***	0.17***	1.78**	1.48**
Couple with resident children but none under 19	0.06***	0.07***	0.16***	1.99**	2.02***
Couple with no resident children	0.17***	0.25***	0.23***	2.01**	1.57***
Other households	0.94	0.59**	1.61	4.98***	1.97***
Single	ref	ref	ref	ref	ref
Ever married	0.91***	0.67*	0.52**	0.97	0.79**
Less than third level	ref	ref	ref	ref	ref
Third level	0.54**	0.85	0.43***	0.84*	1.50***

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level.

Table 5 continued

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Employers and managers	0.37***	0.43***	0.23***	0.52***	1.04
Higher professional	0.27**	0.72	0.65	0.89	1.18
Lower professional	0.19***	0.73	0.55	0.51***	0.99
All other socio-economic groups	ref	ref	ref	ref	ref
Commerce	1.04	1.54**	0.69	1.24**	2.16***
Public administration and defence	0.80	1.05	0.45	0.88	3.51***
Education, health and social work	1.17	0.64	0.62	0.98	1.05
All other industrial groups	ref	ref	ref	ref	ref
Population density (home)	1.18	4.07***	1.50*	1.38***	2.24****
Population density (work)	1.99***	2.12***	0.59**	1.22*	5.01***
Living and working in an ED with less than 100 per cent of addresses within 2kms of a rail station	ref	ref	ref	ref	ref
Living and working in an ED with 100 per cent of addresses within 2kms of a rail station	3.38***	1.39	1.44	2.03***	2.47***
Alternative-specific variables					
Travel time			0.75***		
Travel cost			1.00		
Number of Observations			83,376		
Number of Individuals			13,896		
Log-Likelihood			-7,219.9		

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level.

Table 6: Other Urban Areas (Odds Ratios – Reference Choice is Car Owner and Motorcycle, Car Driver or Car Passenger)

	No car		One or more cars	

	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Individual-specific variables					
Age 15-24	ref	ref	ref	ref	ref
Age 25-29	0.70***	0.72**	0.88	0.66***	0.58***
Age 30-34	0.44***	0.64***	0.76*	0.52***	0.51***
Age 35-39	0.37***	0.42***	0.82	0.53***	0.60***
Age 40-44	0.37***	0.45***	0.71*	0.63***	0.52***
Age 45-49	0.41***	0.52***	0.51***	0.63***	0.46***
Age 50-54	0.50***	0.29***	0.68	0.61***	0.38***
Age 55-59	0.30***	0.65*	0.54**	0.55***	0.38***
Age 60+	0.21***	0.38***	0.56*	0.46***	0.32***
Male	ref	ref	ref	ref	ref
Female	0.66***	0.88	0.75***	1.04	1.08
Single Person	ref	ref	ref	ref	ref
Lone parent with at least one resident child under 19	0.48***	0.44***	0.77	0.78*	1.19
Lone parent with resident children but none under 19	0.52***	0.53***	0.78	1.80***	1.91***
Couple with at least one resident children under 19	0.09***	0.09***	0.22***	1.14	1.22
Couple with resident children but none under 19	0.08***	0.12***	0.11***	1.47***	2.11***
Couple with no resident children	0.28***	0.31***	0.26***	1.38***	1.74***
Other households	0.96	1.12	1.13	3.06***	2.50***
Single	ref	ref	ref	ref	ref
Ever married	1.06	0.88	0.81	0.93	0.76**
Less than third level	ref	ref	ref	ref	ref
Third level	0.68***	0.79**	0.51***	0.86***	1.10

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level

Table 6: continued

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Employers and managers	0.30***	0.33***	0.29***	0.58***	0.61***
Higher professional	0.20***	0.24***	0.17***	0.64***	0.85
Lower professional	0.32***	0.44***	0.37***	0.52***	0.81*
All other socio-economic groups	ref	ref	ref	ref	ref
Commerce	0.91	0.79**	0.77**	1.12**	1.47***
Public administration and defence	0.43***	0.56**	0.36***	0.69***	1.24
Education, health and social work	0.92	0.46***	0.43***	0.96	0.69***
All other industrial groups	ref	ref	ref	ref	ref
Population density (work)	1.07	1.64***	0.64***	1.91***	1.94***
Living and working in an ED with less than 75 per cent of addresses within 2kms of a rail station	ref	ref	ref	ref	ref
Living and working in an ED with greater than 75 per cent of addresses within 2kms of a rail station	2.25***	0.62***	1.11	1.72***	0.86
Alternative-specific variables					
Travel time			0.83***		
Travel cost			0.99***		
Number of Observations			161,394		
Number of Individuals			26,899		
Log-Likelihood			-18,554.58		

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level

Table 7: Rural Areas (Odds Ratios – Reference Choice is Car Owner and Motorcycle, Car Driver or Car Passenger)

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Individual-specific variables					
Age 15-24	ref	ref	ref	ref	ref
Age 25-29	1.06	1.52	0.83	0.73**	0.53***
Age 30-34	0.70*	0.78	0.92	0.55***	0.48***
Age 35-39	0.56**	0.32*	0.62*	0.66***	0.52***
Age 40-44	0.77	0.74	0.60*	0.61***	0.55***
Age 45-49	0.61**	0.82	0.85	0.73**	0.43***
Age 50-54	0.52**	1.07	0.82	0.62***	0.60**
Age 55-59	0.56**	0.51	0.91	0.62***	0.75
Age 60+	0.26***	0.52	0.50*	0.60***	0.68
Male	ref	ref	ref	ref	ref
Female	0.92	0.57**	0.69**	0.97	1.30***
Single Person	ref	ref	ref	ref	ref
Lone parent with at least one resident child under 19	0.43***	0.21**	0.72	0.63**	2.90***
Lone parent with resident children but none under 19	0.34***	0.45*	0.54***	1.09	3.63***
Couple with at least one resident children under 19	0.06***	0.02***	0.06***	0.90	3.10***
Couple with resident children but none under 19	0.08***	0.07***	0.07***	1.01	3.11***
Couple with no resident children	0.22***	0.07**	0.10***	1.02	3.54***
Other households	1.13	1.14	0.80	2.12***	4.33***
Single	ref	ref	ref	ref	ref
Ever married	0.97	0.95	0.81	0.81**	0.47***
Less than third level	ref	ref	ref	ref	ref
Third level	0.59***	0.50**	0.39***	0.99	0.81*

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level

Table 7: continued

	No car			One or more cars	
	On foot or bicycle	Bus or train	Motorcycle, car driver, car passenger	On foot or bicycle	Bus or train
Employers and managers	0.28***	0.39*	0.24***	0.79**	0.93
Higher professional	0.18***	1.00	0.18**	0.47***	0.95
Lower professional	0.25***	0.18*	0.58*	0.46***	0.62***
All other socio-economic groups	ref	ref	ref	ref	ref
Commerce	0.59***	0.95	0.71**	0.95	1.35***
Public administration and defence	0.30**	1.18	0.36**	0.77	2.18***
Education, health and social work	0.68**	1.34	0.75	0.85	1.06
All other industrial groups	ref	ref	ref	ref	ref
Population density (work)	0.66***	1.31	0.45***	0.63***	2.56***
Living and working in an ED with less than 75 per cent of addresses within 2kms of a rail station	ref	ref	ref	ref	ref
Living and working in an ED with greater than 75 per cent of addresses within 2kms of a rail station	3.10***	3.12**	1.16	1.21	1.75**
Alternative-specific variables					
Travel time			0.75***		
Travel cost			0.96***		
Number of Observations			211,752		
Number of Individuals			35,292		
Log-Likelihood			-8,592.00		

*** Significant at 1 per cent level; ** significant at 5 per cent level; * significant at 10 per cent level

Table 8: Travel Time Elasticities

	No car-walk/cycle	No car-public transport	No car-motor	Car-walk/cycle	Car-public transport	Car-motor
			Dublin city & county			
No car-walk/cycle	-7.1	0.2	0.0	0.7	0.5	1.7
No car-public transport	0.4	-3.0	0.0	0.7	0.5	1.7
No car-motor	0.4	0.2	-2.6	0.7	0.5	1.7
Car-walk/cycle	0.4	0.2	0.0	-5.7	0.5	1.7
Car-public transport	0.4	0.2	0.0	0.7	-2.7	1.7
Car-motor	0.4	0.2	0.0	0.7	0.5	-1.2
			Commuter			
No car-walk/cycle	-21.2	0.1	0.0	0.9	0.6	5.2
No car-public transport	0.5	-7.7	0.0	0.9	0.6	5.2
No car-motor	0.5	0.1	-6.2	0.9	0.6	5.2
Car-walk/cycle	0.5	0.1	0.0	-14.3	0.6	5.2
Car-public transport	0.5	0.1	0.0	0.9	-5.4	5.2
Car-motor	0.5	0.1	0.0	0.9	0.6	-1.3
			Other urban			
No car-walk/cycle	-7.7	0.0	0.0	1.0	0.1	1.4
No car-public transport	0.5	-1.9	0.0	1.0	0.1	1.4
No car-motor	0.5	0.0	-1.7	1.0	0.1	1.4
Car-walk/cycle	0.5	0.0	0.0	-6.8	0.1	1.4
Car-public transport	0.5	0.0	0.0	1.0	-2.0	1.4
Car-motor	0.5	0.0	0.0	1.0	0.1	-0.5
			Rural			
No car-walk/cycle	-18.8	0.0	0.0	0.6	0.1	4.3
No car-public transport	0.2	-6.0	0.0	0.6	0.1	4.3
No car-motor	0.2	0.0	-4.7	0.6	0.1	4.3
Car-walk/cycle	0.2	0.0	0.0	-15.4	0.1	4.3
Car-public transport	0.2	0.0	0.0	0.6	-4.8	4.3
Car-motor	0.2	0.0	0.0	0.6	0.1	-0.4

See http://pages.stern.nyu.edu/~wgreene/BergenMasterclass/DiscreteChoiceLab.ppt#766,117,Effects of Changes in Attributes on Probabilities for further details. Cross elasticities are identical across alternatives due to the IIA assumption.

Table 9: Travel Cost Elasticities

	No car-walk/cycle	No car-public transport	No car-motor	Car-walk/cycle	Car-public transport	Car-motor
			Dublin city & county			
No car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.1
No car-public transport	0.0	-0.1	0.0	0.0	0.0	0.1
No car-motor	0.0	0.0	0.0	0.0	0.0	0.1
Car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.1
Car-public transport	0.0	0.0	0.0	0.0	-0.1	0.1
Car-motor	0.0	0.0	0.0	0.0	0.0	-0.1
			Commuter			
No car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.0
No car-public transport	0.0	0.0	0.0	0.0	0.0	0.0
No car-motor	0.0	0.0	0.0	0.0	0.0	0.0
Car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.0
Car-public transport	0.0	0.0	0.0	0.0	0.0	0.0
Car-motor	0.0	0.0	0.0	0.0	0.0	0.0
			Other urban			
No car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.0
No car-public transport	0.0	0.0	0.0	0.0	0.0	0.0
No car-motor	0.0	0.0	0.0	0.0	0.0	0.0
Car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.0
Car-public transport	0.0	0.0	0.0	0.0	0.0	0.0
Car-motor	0.0	0.0	0.0	0.0	0.0	0.0
			Rural			
No car-walk/cycle	0.0	0.0	0.0	0.0	0.0	0.4
No car-public transport	0.0	-0.1	0.0	0.0	0.0	0.4
No car-motor	0.0	0.0	0.0	0.0	0.0	0.4
Car-walk/cycle	0.0	0.0	0.0	-0.2	0.0	0.4
Car-public transport	0.0	0.0	0.0	0.0	-0.3	0.4
Car-motor	0.0	0.0	0.0	0.0	0.0	0.0

See http://pages.stern.nyu.edu/~wgreene/BergenMasterclass/DiscreteChoiceLab.ppt#766,117,Effects of Changes in Attributes on Probabilities for further details. Cross elasticities are identical across alternatives due to the IIA assumption.

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