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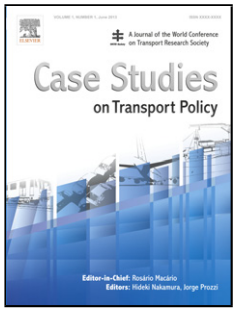

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The Green Fields of Ireland: The Legacy of Dublin's Housing Boom and the Impact on Commuting

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Abstract

Dublin, like many other international cities has experienced a significant housing boom in the past decade. This boom has seen an unprecedented increase in the numbers of houses built and in the density of housing at the periphery of the city. In addition, Dublin has become a more dispersed city with centres of employment no longer being focussed only in the Central Business District (CBD). At the same time, the provision of public transport infrastructure, while it has improved, has not kept pace with the increase in housing stock, leading to high levels of car dependency in these peripheral suburban areas. This paper seeks to examine how commuting patterns have changed as a result of this increasing in housing stock. The results presented in this paper shows that even within the same electoral districts, commuters living in housing built after 2001 are more likely to drive than those living in older housing. This paper analyses the modal choices of commuters living in both new and older housing and describes the factors that may be leading to higher levels of car dependency in those living in newer housing. The case study presented in this paper shows a city region in transition and documents the impact that a housing boom has had upon commuting patterns.

1. Introduction and background

This paper outlines how Dublin's suburbs have grown and changed over the last decade, leading to an increase in housing in the periphery of the city, where public transport infrastructure has not always been provided. Those living in new houses are more likely to be car dependent than those living in pre 2001 housing. Much of the new housing construction has taken place at the periphery of the city and so higher car dependency amongst those living in these houses is to be expected. One of the primary research questions addressed in this paper is to determine if those living in newer housing have longer and less sustainable commutes. Some of the results estimated in this research show that even within the same areas those living in newer homes (built after 2001) are more likely to drive than are their neighbours living in older homes (CSO, 2012). In this paper, an attempt is made to explore the issues and to examine why this might be. For that reason, the paper does not consider public transport availability to different suburbs: it self-evident that in newer suburbs located in the periphery of the city centre and without access to public transport that reliance on the motor car will be higher than in older suburbs located near good quality public transport. What is of interest in this paper is the fact that even within the same suburbs, with the same access to public transport, those living in newer homes have longer

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trips and higher levels of car use than those living in older homes within those same suburbs. It is postulated that some of the higher levels of car dependency seen in people living in newer homes may relate to issues such as life stage (younger people with children) and also with their work destinations, which may be more dispersed and less likely to be focussed in the city centre. At the same time as the housing boom in Dublin, there was also a significant increase in the numbers of people working in the Greater Dublin Area (GDA) between 2000 and 2008. That growth in employment and jobs has not, however, taken place only in the city but employment in more dispersed and there a number of employment centres in the GDA that did not exist prior to 2000. Between 2006 and 2011 there has been a 7% increase population in the GDA (CSO, 2012).

2. Literature review

The relationships between urban sprawl and increased travel time and unsustainable trip patterns has been well documented in the literature (McDonnell and Caulfield, 2011; Travisi et al 2012; Zhao, 2010; García-Palomares, 2010; and Muñiz and Galindo, 2005). The evolution of cities from monocentric to polycentric with many employment centres and where commuting travel patterns are more complex is also well-documented (Garcia- Lopez and Muniz, 2010; Bento et al, 2005; Kloosterman and Musterd, 2001; Lee, 2007). In cities with many employment centres, the demand for more flexible transport and more orbital transport routes are high.

Bertolini et al (2005) emphasise the need for integrated transport and land use planning in bringing about more sustainable travel, but state that while this is widely acknowledged, in reality that integration is rarely realised in city planning. While Handy (1996) also stresses that land use policies are important in developing more sustainable travel, pricing policies may be the most effective method of promoting sustainable car use in the short term. Handy et al (2005) further adds to the research in this area by conducting a quasi-longitudinal study into the relationships between neighborhood characteristics and travel patterns in North California. While the authors indicate that the findings of the study are preliminary, they do show that if land use policies are used to locate residents closer to destinations and provide viable alternatives to driving, it can lead to a switch to more sustainable modes. Banister (2011) also stresses this conclusion that mixed-use developments will reduce trip lengths and car dependency.

Availability of public transport is also an important factor in determining modal choice and in reducing reliance on the private car (Guiliano and Dargay, 2006). However, simply locating housing close to public transport does not result in public transport use (van Wee, 2005). In Dublin, as the research outlined in this paper will demonstrate, even within a suburb where the same public transport is available to all homes, those living in newer homes are more likely to drive than those living in older homes so factors other than public transport availability must play a role in determining decisions to use or not use the car in these areas.

Bento et al (2005) discuss how density, road network and city shape affect commuting patterns and trip lengths, postulating it is not only population density but also population centrality that impacts upon trips length. Cities where populations are closer to the city centre will have shorter trips lengths and less dispersed employment. In their study of American cities, Bento et al (2005) found that compact cities lead to lower levels of car ownership and use.

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Cervero and Kockelman (1997) examine the impacts the 3 D's (density, diversity and design) have upon commuting patterns in San Francisco. The findings show that residential density, mixed land-use and pedestrian orientated design all result in increased trip rates for sustainable modes. However, other researchers also point to the fact that cities and urban form are evolving away from the traditional city with a strong central business district to cities with many employment centres. Researchers point out that in cities with many employment centres it may not be sufficient to provide mixed land-use and pedestrian oriented design to encourage more sustainable travel: if employment centres are sufficiently diverse, travel patterns will be more complex, particularly with the growth of two-income households where both members could be travelling to alternative destinations (Kloosterman and Musterd, 2001). In these cities, destinations are more varied. Garcia-Lopez and Muniz (2010) in their study of employment distribution in Barcelona state that most modern cities are polycentric and give the example of Barcelona where employment is becoming more decentralized and scattered. This is a pattern they claim is repeated in many cities in the developed world and leads to more varied destinations for work trips. Kloosterman and Musterd (2001) also discuss this phenomenon and its impact on commuting patterns. They describe that the development of these cities with more than one centre of employment lead to greater cross-commuting and more traffic congestion in all directions at peak hours. Horner (2004) states that more research is required to assess the impacts of job-housing balance and more dispersed, polycentric cities on commuting, congestion and travel.

The increased greenfield housing and its impact upon travel patterns is not unique in Ireland. Metz (2012) shows that in the United Kingdom that the majority of green field developments have taken place on the outskirts of towns and cities and that individuals living in these areas are largely dependent upon the car for travel. Chen et al (2005) report the findings of a study on the rapid growth of new housing developments in Beijing. The results show large increases in car ownership and subsequent congestion in these new developments. Caulfield (2012) also found that those living in lower density housing in Dublin were shown to have much higher car ownership rates and are more reliant on the car for work trips.

Bart (2010) identifies parking controls as one of major tools to alleviate the negative impacts of new housing and retail developments. The research presented highlights how limiting the numbers of new parking spaces in new developments can be used encourage sustainable modes in these developments.

The case study presented in this paper adds to the field of research in this area by showing how the housing boom in Dublin has had an adverse effect on commuting and sustainable travel patterns. The results from Dublin will be of interest to other city regions experiencing the same economic conditions and to regions under going a property bubble and may provide lessons in how best to plan minimise the negative impacts seen in Dublin.

3. Housing in the Greater Dublin Area and Travel to Work

A breakdown of the housing stock in the GDA is presented in Table 1. The results show that in the five-year period from 2001-2006 17% of the housing stock in the GDA has been constructed. This is the same percentage of housing as was constructed in the decade immediately prior to 2001, demonstrating a doubling in the

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rate of house construction during the boom time in Dublin. Figure 1 maps the percentage of new housing, built after 2001, for each of the electoral districts in the GDA. The results show that the highest concentrations of new housing tend to be dispersed and on the outskirts of the GDA. Much of this new housing is at a higher density to the older, more traditional Dublin suburbs, and comprises apartments and duplexes, which were rarely seen in older suburban developments. Due to the breakdown of the property market and construction industry in Ireland there is now a large stock of unfinished and unoccupied housing in the GDA. Figures show that there were almost 90,000 unfinished housing units in the GDA in 2011, this accounts for 75% of all unoccupied housing units (Mac Coille and McNamara, 2012).

Table 1: Housing stock in the GDA

Year constructed	N	%
Before 1970	225,831	32
1971 – 1990	178,215	25
1991 – 2000	116,334	16
2001 – 2006	119,421	17
After 2006	74,181	10
Total	713,982	100

INSERT FIG 1 HERE

The construction of new, high-density housing in the periphery of the GDA has significant and obvious implications for the modal choices and travel patterns of those living in these new houses. Many of these new housing developments are not linked to Dublin city centre by any rail network, and provision of new public transport infrastructure to new areas has generally lagged behind the construction of housing. This has lead to quite high levels of car use and car dependency in the "boom time" suburbs. However, even within the same electoral districts or geographical areas, those living in housing built after 2001 are more likely to drive than those living in houses in that area built before 2001.

Table 2 presents the results of a cross-tabulation conducted to determine what impacts the year in which housing was built might have on travel time to work. The work locations that were chosen were either the CBD or non-CBD work destinations. The chi-square analysis conducted on the research shows both cross-tabulations presented in Table 1 show the difference between the results to be statistically significant. The results show little variation in the non-CBD work trip destination. However, there is a trend showing that those living in newer housing were marginally more likely to have longer trips than those in older housing.

The results, when examining the CBD destination work trips, show that those living in houses built before 1970 are the least likely to have journeys of over 20 minutes, with only 55% having a commute longer than 20 minutes, compared to 71% of all of those living in housing built after 2006. This result shows that those with a commute destination of the CBD and living in newer housing stock have longer travel times.

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TABLE 2 Impact of housing on departure time

	Before 1970		**1971-90**		**1991-00**		**2001-05**		**2006-11**	
Travel to work – Destination non-CBD*										
Travel Time	N	%	N	%	N	%	N	%	N	%
Less than 5 mins	11800	11	10519	10	6365	9	6032	8	3676	8
6-10 mins	15044	14	17775	17	9968	14	10160	14	5903	13
11-15 mins	14170	13	15773	15	8937	13	9147	12	5499	12
16 - 20 mins	17193	16	17455	16	10570	15	10719	15	6493	15
21 - 30 mins	24109	22	21684	20	15109	22	15664	21	9733	22
31 mins +	28020	25	23253	22	18413	27	22034	30	13015	29
Total	110336	100	106459	100	69362	100	73756	100	44319	100
Travel to work – Destination CBD**										
Travel Time	N	%	N	%	N	%	N	%	N	%
Less than 5 mins	4491	5	1350	2	1019	3	919	2	697	3
6-10 mins	10242	11	3588	6	2509	6	2173	5	1709	6
11-15 mins	11834	12	4606	8	3258	8	2751	7	2170	8
16 - 20 mins	15910	17	7244	12	4864	12	4044	10	3087	12
21 - 30 mins	23632	25	13925	24	9341	23	8385	21	5718	21
31 mins +	28830	30	27756	47	19372	48	21398	54	13215	50
Total	94939	100	58469	100	40363	100	39670	100	26596	100

*P<.000, Chi-square = 2,705, 20 degrees of freedom

**P<.000, Chi-square = 11,158, 20 degrees of freedom

The year in which housing was built is cross-tabulated against mode of transport to work and presented in Table 3. The chi-squared statistics presented with the results in Table 3 show the difference between the results to be statistically significant. One can see that in a comparison between the two sets of results that those that have a non-CBD work trip had a higher proportion of individuals driving alone to work. The results show that 68% those living housing built between 2006-11 with a non-CBD work destination dove to work alone compared to 56% of those living in housing built before 1970. The results also show a difference in those walking or cycling to work in the CBD. Over 30% of those living in housing built before 1970 walk or cycle to work compared to 19% of those living in housing built between 2006-11.

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TABLE 3 Impact of housing on mode choice

	Before 1970		**1971-90**		**1991-00**		**2001-06**		**2006-11**	
Travel to work – Destination non-CBD*										
Travel Time	N	%	N	%	N	%	N	%	**N**	%
Walk	13,075	11	11007	10	5406	7	5640	7	3637	8
Cycle	4,246	3	2397	2	1485	2	1220	2	777	2
Bus	9,817	8	6372	6	3818	5	3854	5	2601	6
Rail	4,577	4	2567	2	1880	3	1968	3	1499	3
Motorcycle	814	1	625	1	399	1	393	1	216	0
Drive-alone	68,120	56	73546	64	49981	68	53664	69	31391	68
Drive-passenger	4,312	4	4746	4	2441	3	3079	4	1762	4
Van	7,374	6	7858	7	4656	6	4860	6	2891	6
Other inc lorry	881	1	835	1	551	1	428	1	278	1
Work from home	9,177	7	4956	4	2992	4	2162	3	1186	3
Total	122,393	100	114909	100	73609	100	77268	100	46238	100
Travel to work – Destination CBD**										
Travel Time	N	%	N	%	N	%	N	%	**N**	%
Walk	20143	21	5490	9	6187	15	4649	12	3776	14
Cycle	9702	10	3040	5	2003	5	1601	4	1250	5
Bus	16602	17	10934	18	6298	15	6689	17	4696	17
Rail	9194	10	8211	14	5366	13	6469	16	4729	18
Motorcycle	1140	1	875	1	529	1	427	1	258	1
Drive-alone	35973	37	28110	47	18853	46	18634	46	11058	41
Drive-passenger	2545	3	1809	3	996	2	1104	3	802	3
Van	1106	1	901	2	537	1	529	1	266	1
Other inc lorry	79	0	49	0	43	0	32	0	14	0
Work from home	1	0	0	0	0	0	0	0	0	0
Total	96485	100	59419	100	40812	100	40134	100	26849	100

*P<.000, Chi-square = 10,786, 40 degrees of freedom
**P<.000, Chi-square = 9,677 40 degrees of freedom

Table 4 presents a cross-tabulation between household composition and the year in which housing was built. The estimated chi-squared statistics show that the differences between the values estimated are statistically significant. The results presented in the table show that for most of the household composition variables that the percentages of each living in housing built over the different time periods examined were more or less the same. The one exception is for the variable that measures couples with children above the age of 19. The results show that housing built in the first two time periods has a higher percentage of households with older children living at home. It should also be noted that there is a higher percentage of couples with no children living in housing built after 2001.

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TABLE 4 Household composition and year built

	Before 1970		1971-90		1991-00		2001-06		2006-11	
Household Composition	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Single Person	21,180	11	12,349	7	9,926	8	12,830	10	9,476	12
Lone parent with at least one resident child aged 19 or under	8,891	5	9,428	5	5,382	4	5,547	4	3,791	5
Lone parent with resident children but none aged 19 or under	12,100	6	10,551	6	2,231	2	1,503	1	798	1
Couple with at least one resident child aged 19 or under	66,495	34	64,786	35	59,667	49	54,557	43	26,255	34
Couple with resident children but none aged 19 or under	29,035	15	40,177	22	7,594	6	2,987	2	1,502	2
Couple with no resident children	33,790	17	30,101	16	20,280	17	28,477	23	22,226	28
Other Households	24,283	12	17,580	10	17,004	14	20,322	16	14,023	18
Total	195,774	100	184,972	100	122,084	100	126,223	100	78,071	100

*P<.000, Chi-square =7,134, 24 degrees of freedom

4. Dataset and methodology

4.1 Data

The data used in this paper was taken from the 2011 census of Ireland (CSO, 2012). Each record in the dataset relates to an individual. In the dataset while a number of individuals may be related to the same household it is not possible to determine this from the data. The data used represents individuals' most frequent mode of transport used to travel to work. The dataset contains 1.7 million respondents in Ireland and 713,982 responses in the GDA. As the data collected is taken from the census it is the population of individuals in the GDA and is not a sample of the population. As the The census of Ireland collects a number of variables that are related to transport namely, mode of transport used to commute to work, travel time for the commute trip and the number of cars per household. While this is the most comprehensive database collected in Ireland on individuals' trips, it is worth noting that work based trips typically account for a quarter of all trips taken in Ireland (CSO, 2009). It should be noted at this stage that distance travelled was not a variable collected in this dataset.

4.2 Model formulation

To measure the impact that the age of housing stock has on transportation characteristics in the GDA a number of multinomial logit regression models were estimated. The dataset was split between those trips with a CBD destination and those with out a CBD destination. The variables used in the model are defined in Table 5. The model takes the following format:

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Equation 1

$$\text{logit}(p) = \log \frac{p}{1-p} = a + \beta I + \delta T + e$$

where p is the probability that the event occurs or the choice variable (in this case that the individual lives in housing built in the particular time period), βI is the set individual specific characteristics (such as age and gender), δT is the set of transport characteristics (such as departure time and travel time) and e is a random error term. In the model the choice variable or the dependent variable takes five levels: these are that an individual lives in a house "built before 1970", "built 1971-90", "built 1991-00", "built 2001-05" and "built after 2006". The model then tests the independent variables presented in Table 5 against the choice or dependent variable. The variables presented in Table 5 were taken from and were defined in the census of Ireland. The variables that were chosen to examine were selected, as they were the variables that would most suitable test the thesis of this paper.

TABLE 5 Definition of variables

Variable	Definition
Number of cars	
One	= 1 if number of cars = One
Two	= 1 if number of cars = Two
Three	= 1 if number of cars = Three
Four or more	= 1 if number of cars = Four or more
None	Reference category if number of cars = none
Travel time	
Less than 5 mins	= 1 if travel time = Less than 5 mins
6-10 mins	= 1 if travel time = 6-10 mins
11-15 mins	= 1 if travel time = 11-15 mins
16 - 20 mins	= 1 if travel time = 16 - 20 mins
21 - 30 mins	= 1 if travel time = 21 - 30 mins
31 mins +	Reference category if travel time = 31 mins +
Socio Economic Group (SEG)	
Employers and managers	= 1 if SEG = Employers and managers
Higher professional	= 1 if SEG = Higher professional
Lower professional	= 1 if SEG = Lower professional
Non-manual	= 1 if SEG = Non-manual
Manual	= 1 if SEG = Manual
Semi-skilled	= 1 if SEG = Semi-skilled
Unskilled	= 1 if SEG = Unskilled
Self employed	= 1 if SEG = Self employed
Farmer	= 1 if SEG = Farmer
Agricultural workers	= 1 if SEG = Agricultural workers
Other	Reference category if SEG = Other
Household composition (HC)	
Single Person	= 1 if HC = Single Person
Lone parent with at least one resident child aged 19 or under	= 1 if HC = Lone parent with at least one resident child aged 19 or under
Lone parent with resident children but none aged 19 or under	= 1 if HC = Lone parent with resident children but none aged 19 or under
Couple with at least one resident child aged 19 or under	= 1 if HC = Couple with at least one resident child aged 19 or under

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Couple with resident children but none aged 19 or under	= 1 if HC = Couple with resident children but none aged 19 or under
Couple with no resident children	= 1 if HC = Couple with no resident children
Other Households	Reference category if HC = Other Households
Mode	
Walk	= 1 if mode = Walk
Cycle	= 1 if mode = Cycle
Bus	= 1 if mode = Bus
Rail	= 1 if mode = Rail
Motorcycle	= 1 if mode = Motorcycle
Drive-alone	= 1 if mode = Drive – alone
Drive-Passenger	= 1 if mode = Drive – passenger
Van	= 1 if mode = Van
Other inc lorry	= 1 if mode = Other inc lorry
Work from home	Reference category if mode = Work from home
Departure Time (DT)	
Not stated	= 1 if DT = Not stated
Before 06:30	= 1 if DT = Before 06:30
06:30-07:00	= 1 if DT = 06:30-07:00
07:01-07:30	= 1 if DT = 07:01-07:30
07:31-08:00	= 1 if DT = 07:31-08:00
08:01-08:30	= 1 if DT = 08:01-08:30
08:31-09:00	= 1 if DT = 08:31-09:00
09:01-09:30	= 1 if DT =09:01-09:30
After 09:30	Reference category if DT = After 09:30

5. Model results

5.1 Model results – destination non-CBD

The first model estimated examines the impacts the year of housing has on those with a non-CBD work trip. Therefore this model examines those that travel to work in one of the employment centres outside of Dublin City centre. This first set of results examines car ownership levels across the different housing groups (see Table 6). The results show that those living in housing built after 2006 who have a non-CBD destination were more likely to have more cars per household. The results show that those living in housing built after 2006 were almost twice as likely to own four or more cars compared to their counterparts living in housing built housing built in the 1971-90 period. The second set of results show for travel time that those living in housing built from 1971-90 were more likely to have shorter travel times compared to living in housing built after 2006.

The results for the socio-economic variables estimated in the model show little variance across the four housing groups examined. The findings for the family composition variables show that those living in the newer housing stock were more likely to either have no children or children aged under 19. This finding would seem to make intuitive sense in that those likely to be purchasing newer housing are young people and couples with either no children or young children.

The results for the mode of transport used show, as expected, that the probability of someone living in housing stock built after 2001 were almost twice as likely to drive to work alone compared to someone living in housing built in the 1971-90 period. The results for mode of transport used also shows that those living in housing built in the 1971-90 period were almost twice as likely to travel to work by

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bus and almost four times more likely to cycle to work compared to those living in housing built after 2006.

The final set of variables presented in Table 6 examine the impacts of the year housing was built on departure time. The results show that those living in newer housing stock and not traveling into the CBD were shown to depart earlier than those living in older housing stock.

TABLE 6 Model results – work trip non-CBD destination

		Housing built 1971-90	Housing built 1991-00	Housing built 2001-2005	Housing built after 2006
	Intercept	-1.878**	-1.529**	-1.291	-1.706
Number of cars	One	.413**	.134**	.316**	.261**
	Two	.591*	.425**	.409**	.245**
	Three	.736**	.283*	.086**	.290**
	Four or more	.143**	.267**	.274**	.394*
	None	0[b]	0[b]	0[b]	0[b]
Travel time	Less than 5 mins	.137**	-.053**	-.221**	-.147**
	6-10 mins	.269**	-.020**	-.162**	-.146**
	11-15 mins	.221**	-.053**	-.217**	-.176**
	16 - 20 mins	.138**	-.097**	-.262**	-.218**
	21 - 30 mins	.041**	.072**	.218**	-.158**
	31 mins +	0[b]	0[b]	0[b]	0[b]
Socio-economic group	Employers and managers	.111**	.345**	.187*	.191**
	Higher professional	-.047**	.218**	.075**	.127**
	Lower professional	.155**	.323**	.201**	.191**
	Non-manual	.379**	.409**	.339**	.377**
	Manual	.259**	.196**	.133**	.159**
	Semi-skilled	.223**	.201**	.161*	.163**
	Unskilled	.215*	.111*	.013**	.021*
	Self employed	.078*	.130**	-.109*	-.220**
	Farmer	-.242**	-.249**	-.240*	-.149**
	Agricultural workers	-.207**	-.186**	-.154*	-.133**
	Other	0[b]	0[b]	0[b]	0[b]
Household composition	Single Person	.197**	-.095**	-.190*	-.101*
	Lone parent with at least one resident child aged 19 or under	.686**	.181**	-.179**	-.164**
	Lone parent with resident children but none aged 19 or under	.501**	-1.036**	-1.711**	-1.927**
	Couple with at least one resident child aged 19 or under	.190*	.387**	.435**	.238**
	Couple with resident children but none aged 19 or under	.835**	-.712**	-1.798**	-2.017**
	Couple with no resident children	.441**	-.081**	-.015**	.188**
	Other Households	0[b]	0[b]	0[b]	0[b]
Means of travel	Walk	.540**	.236**	.462**	.469**
	Cycle	.232**	.030**	-.046*	-.071**

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	Bus	.472**	.234**	.266**	.290**
	Rail	.342**	.203*	.282**	.406**
	Motorcycle	.402**	.306**	.441**	.286**
	Drive-alone	.450**	.577**	.925**	.929**
	Drive-Passenger	.676**	.508**	.909*	.833*
	Van	.635**	.488**	.855*	.943**
	Other inc lorry	.546*	.509*	.483**	.653*
	Work from home	0[b]	0[b]	0[b]	0[b]
Departure time	Not stated	-.226*	-.184**	-.043**	-.054**
	Before 06:30	-.031*	.116**	.290**	.265**
	06:30-07:00	.014**	.084*	.155**	.171**
	07:01-07:30	.027**	.042*	.082**	.145**
	07:31-08:00	.006**	.035*	.032**	.056*
	08:01-08:30	.001*	.045**	-.065**	.002*
	08:31-09:00	.021**	.076**	-.042**	-.040*
	09:01-09:30	.031**	.002*	-.091*	-.131*
	After 09:30	0[b]	0[b]	0[b]	0[b]
N					464,186
-2 log-likelihood at convergence					63141.43
Nagelkerke R2					.135
Chi-squared statistic					54957.67
Degrees of freedom					172

** Significant at a 99% level
* Significant at a 95% level

Table 7 presents results similar to those presented in Table 6, with the exception that these findings examine those making work trips into the CBD. The first set of results examines car ownership levels. The results presented demonstrate similar patterns to those presented in Table 6. This result would stand to reason, as there is no apparent reason that these results would vary between the two different work trip destinations. The results show the same pattern that those living in housing built after 2006 were twice as likely to own four or more cars compared to those living in housing built in the 1970-90 period. The findings for travel time also show that those living in newer housing stock are twice as likely to have a commute time of 21-30 minutes compared to those living in housing stock built in the 1971-90 period.

As with the results for socio-economic confidents presented in Table 6, the results shown in Table 6 show no real pattern that could be attributed to the year the house was built. The family structure findings show that those living in the oldest housing stock were shown to be most likely to be families with no children under the age of 19 and/or lone parents. The findings also show that those families with younger children were most likely to live in newer housing stock, as found in the results presented in Table 6. The findings for mode of transport used show that those living in newer housing were almost five time less likely to use public transport twice as unlikely to walk or cycle to work in the CBD compared to those living in housing built in the 1971-90 period. These findings also mirror those shown in Table 6. The last set of variables presented in Table 7 examines the impacts of housing stock on the departure time for a work trip into the CBD. The findings show, as one might expect, that those living in newer housing stock where shown to be most likely to depart earlier to travel to work.

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TABLE 7 Model results – work trip CBD destination

		Housing built 1971-90	Housing built 1991-00	Housing built 2001-2005	Housing built after 2006
	Intercept	-.728**	.074*	-.035**	-.639**
Number of cars	One	.255**	-.122**	.088**	.064**
	Two	.437**	.080**	.084**	.102**
	Three	.542**	-052**	.484**	.668**
	Four or more	.517**	.121**	.756**	.973*
	None	0[b]	0[b]	0[b]	0[b]
Travel time	Less than 5 mins	-.772**	-.982**	-1.029**	-.891**
	6-10 mins	-.752**	-.930**	-1.091**	-.888**
	11-15 mins	.676**	.828**	-1.042**	-.837**
	16 - 20 mins	.593**	.749**	.994**	.804**
	21 - 30 mins	.391**	.513**	.688**	.601*
	31 mins +	0[b]	0[b]	0[b]	0[b]
Socio-economic group	Employers and managers	.157**	.176**	.070**	.127**
	Higher professional	.329**	.046**	.043**	.112**
	Lower professional	.108**	.174**	.180**	.207**
	Non-manual	.015**	.166**	.161**	.208**
	Manual	.085**	.010**	.037**	-.010**
	Semi-skilled	-.069**	-.206**	-.032*	-.017**
	Unskilled	-.055**	-.353**	-.217**	-.225*
	Self employed	-.240**	-.043*	-.204**	-.179**
	Farmer	-.814*	-.618*	-.496**	-.584**
	Agricultural workers	-.004*	-.396**	-.140**	-.479*
	Other	0[b]	0[b]	0[b]	0[b]
Household composition	Single Person	.070**	-.204**	-.245**	-.322**
	Lone parent with at least one resident child aged 19 or under	.204**	-.446**	-.617**	-.669**
	Lone parent with resident children but none aged 19 or under	.132**	-1.417**	2.054**	2.348**
	Couple with at least one resident child aged 19 or under	.044**	-.121**	-.487**	-.858**
	Couple with resident children but none aged 19 or under	.448*	-1.213**	-1.375**	-2.628**
	Couple with no resident children	.156**	-.108**	.038**	.003**
	Other Households	0[b]	0[b]	0[b]	0[b]
Means of travel	Walk	.261**	.493**	-.982**	-.229**
	Cycle	.231**	.406**	-.426**	-.114**
	Bus	.100**	.905*	-.818**	-.464**
	Rail	.345**	.604**	-.332**	.341*
	Motorcycle	.515**	.297**	.139**	.559**
	Drive-alone	.343**	.154**	.407**	.498**
	Drive-Passenger	.318**	.166**	.187**	.437**
	Van	.218**	.311**	.056**	.417*
	Other inc lorry	.064**	.163**	.222*	.351*

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	Work from home	0[b]	0[b]	0[b]	0[b]
Departure time	Not stated	-.178**	-.071**	.034**	.020*
	Before 06:30	.195**	.328**	.540**	.522**
	06:30-07:00	.190**	.294**	.464**	.439**
	07:01-07:30	.205**	.173**	.295**	.272**
	07:31-08:00	.086**	.015**	.046**	.049**
	08:01-08:30	.056**	-.133**	-.189**	-.134**
	08:31-09:00	.057**	-.094**	-.174**	-.116**
	09:01-09:30	-.114**	-.200**	-.249*	-.297**
	After 09:30	0[b]	0[b]	0[b]	0[b]
N					272,754
-2 log-likelihood at convergence					20885.45
Nagelkerke R2					.168
Chi-squared statistic					44902.18
Degrees of freedom					172

** Significant at a 99% level
* Significant at a 95% level

6. Discussion and conclusions

It is apparent from the analysis of the data presented in this paper that in Dublin, those living in newer housing stock have longer commute times that those living in older houses. In particular those living in houses built before 1970 are least likely to have longer journeys. Those living in newer houses also are more like to start their commuting trips earlier and drive alone to work. Thus, it would appear that those living in newer homes have less sustainable commuting patterns and higher levels of car dependency than those living in older homes, in particular than those living in homes built before 1970. At the start of this paper, it was postulated that those living in newer homes would have longer journeys as much of the newer homes had been built on the periphery of Dublin. However, the analysis shows that in all parts of Dublin, those in newer homes have longer journeys and are more car-dependent.

Dublin, like many other cities as described in this paper's literature review (Kloosterman and Musterd, 2001; Garcia-Lopez and Muniz 2010) has become a more dispersed city with employment moving away from traditional CBD out into the suburbs. However, this dispersal of employment does not explain why those living in newer homes, within the same suburbs, have longer, more car dependent journeys than their neighbours living in older houses. Their journeys are longer, they depart earlier and are more likely to drive alone to work both to CBD and non-CBD destinations, especially when compared to those living in homes built before 1970. The question must be asked, therefore, have we designed newer homes and developments in such a way as they actually encourage car use and car dependency? It was not possible in this work to look at the locations of newer developments in relation to public transport stops and to compare this to the location of older developments and their proximity to public transport stops. However, future work should examine whether new and older developments located within the same areas, have varying levels of accessibility to public transport as the disparity between the levels of car use in newer and older houses is very marked.

In further support of the conclusion that in new developments car dependency has been encouraged, the numbers of cars per household in newer homes is at a higher level than for those in older homes. In particular, newer housing stock are much more

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likely to be multiple car households, and are more likely to have 4 or more cars per households. Provision has been made in the design of these new homes and estates for multiple car ownership, where nearly every adult in the house has access to his or her own car, leading to less likelihood of other more sustainable modes being chosen for trips even when those more sustainable modes are accessible and available. The results also show that households in newer housing stock are more likely to be couples with no children and couples with children under the age of 19. As these families mature the children when they come to car driving ages may result in increasing the car ownership levels in these households. This natural progression will further escalate the unsustainable commuting patterns in these areas.

The next stages in this work will include more detailed analysis of the particular circumstances of those living in newer homes to investigate what factors, not revealed by aggregate data, may be leading to higher levels of car dependency, fewer propensities to choose green modes and more unsustainable travel.

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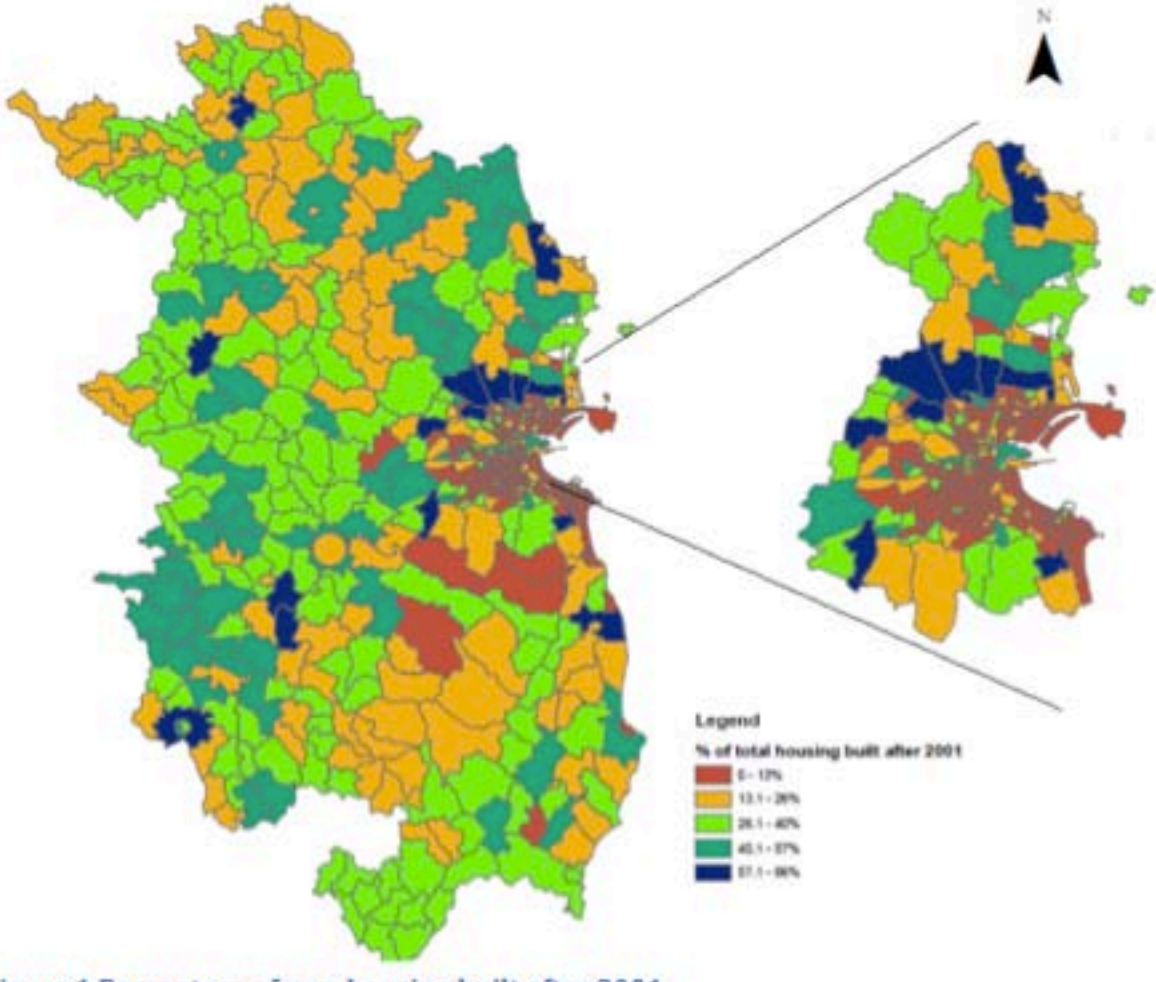

Figure 1 Percentage of new housing built after 2001