
Spatial Restructuring and Commuting Efficiency in Dublin

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Introduction

Within cities, transportation systems are a vital socio-economic component of society, providing a link between the spatial separations of various land uses in the built environment. As land uses evolve, the geography of travel changes. Very often this has a major impact on how efficiently individuals circulate within the city region, particularly at peak periods. Not surprisingly, transportation issues have become increasingly important in recent years, especially in terms of the environmental, economic and social sustainability of urban regions. The objective of this paper is to explore the impact of the changing location of offices and housing on commuting behaviour and commuting efficiency in the Dublin area. In addition, the relationship between duration of home ownership and commuting efficiency is examined. Three office locations were chosen for comparative analysis: the City Centre (a core location); Santry (an intermediate location); and Citywest (a suburban location).

For the purpose of this research, patterns of trip making at a particular location are considered to become more efficient as mean travel distance and mean travel time decrease relative to other locations, and vice versa. Furthermore, trip patterns are considered to become more efficient at a given location as the proportion of trips undertaken by public transport, walking and cycling increase, and vice versa. The first part of this paper reviews recent policy documents relating to land use planning, transportation planning and urban sustainability in Dublin. Then, recent trends relating to these issues are reviewed. Thereafter, the research methodology is outlined and the study results are presented. The final section discusses the results in terms of transport and urban sustainability and concludes with some general comments.

The Policy Context

Over the last ten years, planning policy documents have been placing an increased emphasis on sustainable land use development. Successive studies have recognised that sustainable development can be achieved only through the integration of land use and transportation systems. The national policy document *Sustainable Development: A Strategy for Ireland* (1997) emphasised, among other things, the importance of integrated land use and transportation development in urban areas. The document recognised the need for an increased emphasis on more sustainable trip-making through sustainable development. In order to encourage this, the strategy advocated minimising the growth in transport demand and it was recommended that this be a leading consideration in future land use planning. The strategy also supported transportation alternatives to the private car and emphasised the need to "minimise emissions...by careful land use planning to address infrastructure impacts" (Department of the Environment, 1997, 18). development can be achieved only through the integration of land use

and transportation systems. The national policy document *Sustainable Development: A Strategy for Ireland* (1997) emphasised, among other things, the importance of integrated land use and transportation development in urban areas. The document recognised the need for an increased emphasis on more sustainable trip-making through sustainable development. In order to encourage this, the strategy advocated minimising the growth in transport demand and it was recommended that this be a leading consideration in future land use planning. The strategy also supported transportation alternatives to the private car and emphasised the need to 'minimise emissions...by careful land use planning to address infrastructure impacts' (Department of the Environment, 1997, 18).

The land use planning strategy, *Strategic Planning Guidelines for the Greater Dublin Area*¹ (1999), proposed the consolidation of future growth into a limited number of locations/nodes. The planning emphasis was on encouraging mixed-use development patterns which would lead to a reduction in overall travel demand and create sustainable, public-transport friendly settlement forms. The Guidelines recognised that urban areas could not sustain increased use of the private car successfully and suggested that no alternative existed 'to a sustainable, public transport based solution' (Brady Shipman Martin, 1999, 83). The *National Spatial Strategy* (2002) also advocated the concentration of development into strategic nodes in order to integrate employment, housing and public transport in urban areas. In order to create more sustainable urban areas, the strategy recommended mixed-use and higher density development which focuses on public transport centres. It also recognised the need to minimise urban sprawl and maintain physically compact and public transport-friendly cities.

The latest *Regional Planning Guidelines for the Greater Dublin Area, 2004-2016* (2004) emphasised the need for integrated development along high quality transport corridors. The strategy recommended the preparation of integrated transport plans by local authorities for all new major settlements and suggested that local authorities require the preparation of mobility management plans for all new major development applications. Emphasis was placed in the guidelines on reducing overall travel demand and promoting sustainable public transport based development patterns. The guidelines further recommended that 'public transportation and other sustainable modes should be given precedence over the requirements of the car in all relevant policy and decision-making' (Dublin Regional Authority and Mid-East Regional Authority, 2004, 137).

Turning to recent transport plans, a fundamental proposal of the Dublin Transport Initiative (1994) was to encourage greater and more careful co-ordination between land use and transportation. It was thought that this would lead to a greater emphasis on sustainable transport development which would facilitate an overall reduction in travel demand. The study also recognised the need for major investment in public transport systems in order to encourage the use of more sustainable transport modes. This would help to alleviate Dublin's dependency on the private motor car, a point emphasised by Project Manager of the Dublin Transportation Initiative:

'...It is generally recognised that it is simply not possible, nor is it desirable, to continue to attempt to cater for the unfettered growth in the use of private

¹ The Greater Dublin Area is defined in *Strategic Planning Guidelines* (1999) as County Dublin and the Mid-East Region (Kildare, Meath and Wicklow).

motor vehicles in the urban areas of Europe. Instead, far greater consideration is being given to more sustainable transport development in cities, particularly in respect to the development of public transport provision' (Ryan, 1993, 2).

The objectives of *A Platform for Change* (2000) were largely the same as in the *Dublin Transportation Initiative*. However, a notable difference was an increased emphasis on sustainability issues, particularly the integration between land use and transport systems in order to create more sustainable travel patterns. The document underlined the importance of reducing the demand for transport, especially private transport 'by improving the reliability, availability and quality of public transport' (Dublin Transportation Office, 2000, 10). The *Strategic Rail Review* (2003) also highlighted the need for future development to occur at higher densities along rail corridors in order to promote sustainable development and enhance the use of public transport. In addition, the document asserted that the development of new rail schemes should be contingent on planning guidelines 'that support effective and efficient rail services by building up compact and sustainable settlement forms along the rail corridor' (Booz Allen Hamilton, 2003, 247).

Policy versus Practice

All of the policy documents discussed in the previous section promote the integration of land use and transport systems as well as sustainable urban development. It is against this policy framework that recent land use trends in Dublin and their implications for commuting efficiency need to be reviewed.

Spatial Restructuring and Changing Urban Form

Prior to the late 1990s, Dublin was best characterised as having an essentially monocentric urban structure where the majority of employment was located in the city centre and declined as one moved outwards. However, this classic representation of urban structure, first developed by Alonso (1964), has become increasingly inappropriate for contemporary cities, including Dublin, given the emergence in recent years of a more polycentric urban structure.

Since the economic boom of the 1990's, the landscape of Dublin's built environment has changed dramatically. This period of prosperity has been characterised by industrial restructuring and in particular, a move from manufacturing towards service-based industry (Williams and Shiels, 2002). A substantial proportion of the new service based employment has located in the suburbs. At the same time, housing development has become increasingly dispersed, giving rise to Dublin's 'edge city' phenomenon. The new urban geography of Dublin increasingly mirrors a polycentric city. The foregoing changes in urban geography have been accompanied by a change in the geography of travel; specifically, they have created geographies of travel that have become increasingly complex and dispersed. The revised pattern of journey to work flows has placed a premium on car-based travel and has rendered public transport almost redundant in many of the new peripheral employment locations (MacLaran and Killen, 2002). Public transport systems work best when they are serving a limited number of routes with high traffic flows, for example radial routes focusing on the City Centre (Killen, 1999). The recent land use trends in the Greater Dublin Area do not support the provision of a high quality public transport system.

The changing geography of service sector employment

The changing geography of office location has been well documented elsewhere (HOK and CURS, 1989, 1995, 1998, 2001; MacLaran, 1996; Bertz, 2002; MacLaran and Killen, 2002;

MacLaran and O’Connell, 2004). The following are the main trends.

Prior to 1990, the vast majority of new modern office space was located in the traditional core office locations i.e. the postal districts of Dublin 1, 2, 4, 7, and 8 (HOK and CURS, 1989). Between 1980-1990, 59% of all new floorspace developed was located in Dublin 2. Together, the postal districts of Dublin 1, 2, 4, 7, and 8 accounted for a massive 83.5% of the floorspace completed during this period.

Figure 1. Location of Office Floorspace Completions, 1990-2004

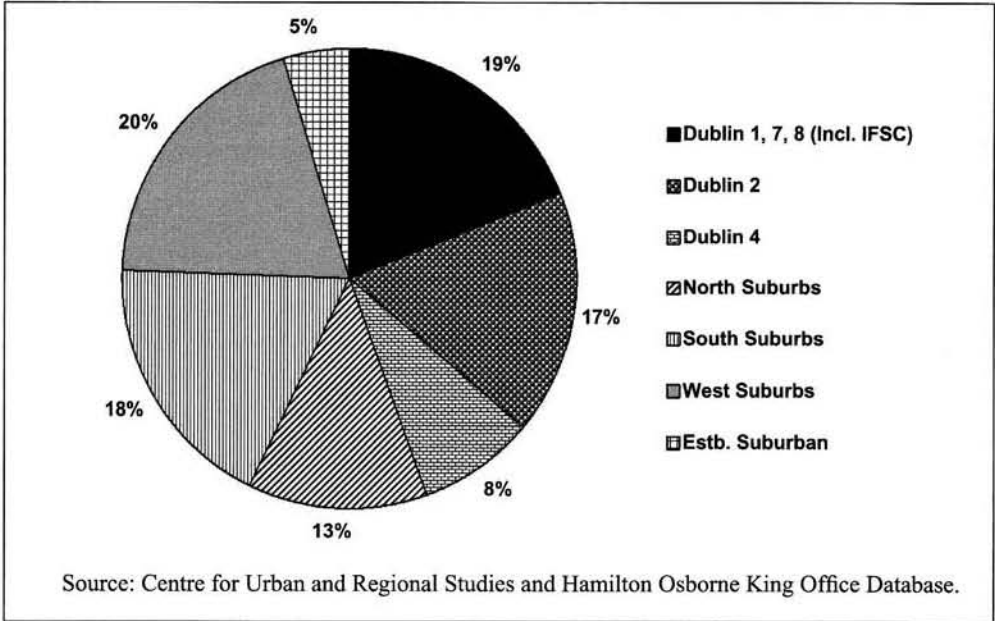


Figure 1 gives the breakdown of office floorspace completions from 1990-2004. The traditionally dominant postal district of Dublin 2 accounted for only 17% of the total floorspace developed. Together, Dublin 1, 2, 4, 7, and 8 accounted for 44% of floorspace completions during this period as compared with 83.5% in the previous decade. Figure 1 demonstrates a significant locational shift away from the traditional office locations (and particularly away from Dublin 2) to more suburban locations such as East Point, Nangor Road, Sandyford/Leopardstown, Citywest, Blanchardstown/Liffey Valley, Park West, Tallaght, Santry and Clonskeagh, most of which are poorly served by public transport. Arguably, at least some of this new ‘edge-city’ is closer in time and generalised cost to the free-standing towns of Meath and Kildare than it is to Dublin’s minor suburbs, and this is likely to promote long distance travel in the peak and off-peak periods.

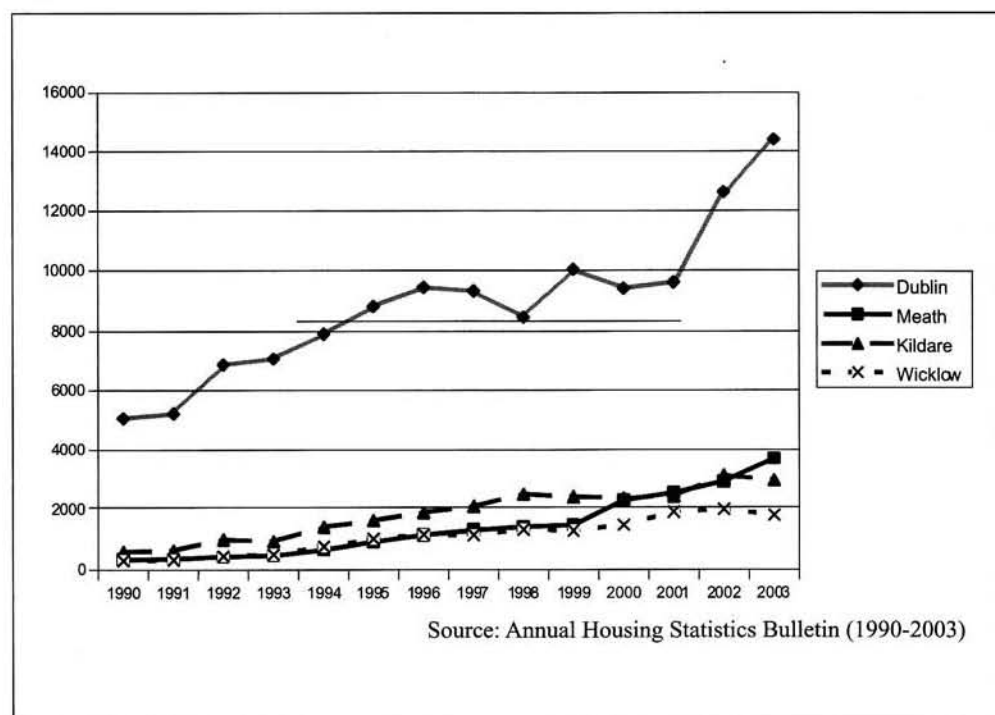
The Changing Geography of Residential Development

The last decade has seen a dispersion of residential development to newly developed outer suburbs and to the surrounding counties of the Mid-East Region (Kildare, Meath and Wicklow). Rapid increases in the population of the Greater Dublin Area (1991-1.35 million; 2002-1.54 Million) have raised the demand for housing. High land prices and planning restrictions in the City Centre area have encouraged developers to look for development land in more periph-

eral locations. Fiscal policy incentives offering preferential taxation treatment in terms of no stamp duty and first time buyer's grants to those purchasing in new housing developments, have fuelled the process (Williams and Shiels, 2000). This process has undoubtedly been facilitated by the more ready availability of private cars.

Figure 2 shows housing completions in Dublin and in the surrounding counties from 1990-2003. Comparing the 1990 figures with those of 2003 reveals a 184% increase in the number of houses completed in County Dublin; the corresponding figures for counties Kildare, Meath and Wicklow are 394%, 982% and 490% respectively which demonstrates that housing development in Dublin's surrounding counties is proceeding apace.

Figure 2. Annual House Completions in the Greater Dublin Area, 1990-2003



The increased sprawl of housing development has been encouraged by high prices in Dublin and lower prices elsewhere². A recent house-buyer survey found that 43% of respondents indicated that price was the main reason for their choice of home location while proximity to work was the main reason for only 15% of respondents (Sherry Fitzgerald, 2004). With affordability indices for one, two and three-bedroom apartments in the central city ranging from 7.5 to 24.4 times the average industrial wage in 2003 (Kelly and MacLaran, forthcoming), it should come as no surprise that individuals have purchased cheaper properties elsewhere and particularly

² According to the Annual Housing Statistics Bulletin 2003, the average house price in County Dublin was €323,548 while the corresponding figure for the whole country was €244,732.

on the periphery. The foregoing trends highlight the contradiction which exists between planning policy on the one hand and planning practice on the other. It is within this context which the research, now to be described, is based.

Study Objectives and Methodology

This research uses data from a broader study conducted in 2002 examining the relationship between land use and transport in County Dublin (Murphy, 2002). The current research has two main objectives. The first is to provide an insight into the efficiency of journey to work trips in varying types of office locations. It is hypothesised that work trip patterns will become less efficient for locations further from the City Centre. The second objective is to investigate whether a relationship exists between duration of home ownership and the efficiency of journey to work trips. It is hypothesised that trip patterns will become more inefficient for individuals who have purchased homes most recently as those homes would tend towards more peripheral locations. Three locations were chosen for comparative analysis: the City Centre was chosen because it is at the convergence of public transport routes and is the traditional core office location; Santry was chosen because it is relatively well served by public transport and represents a geographically intermediate office location; Citywest Business Campus was chosen because it is poorly served by public transport and represents a new outer suburban office location. Questionnaire surveys were administered to a random sample of clerical employees in four participating companies: EBS Building Society, Westmoreland St.; Irish Life and Permanent Plc., Lower Abbey Street; Parc-Group International, Swords Road, Santry; and Eircom Plc., Naas Road, Citywest. Choosing a specific type of worker (i.e. clerical workers) meant that any differences emerging in the results could be ascribed solely to locational factors.

Respondents were asked questions relating to place of residence, home ownership status, duration of home ownership, car availability, parking availability at work, primary and secondary mode of transport to work and normal travel time and travel distance to work. Sample sizes of 61, 50 and 50 were achieved in the City Centre, Santry and Citywest respectively. These sample sizes are above the minimum recommended sample size (30) for undertaking statistical analysis (Blalock, 1979). The methods used for analysing the data were mainly quantitative and involved the use of two statistical tests: one-way analysis of variance³ and the chi-square⁴ test as applied to contingency tables (for a review of both tests see Blalock, 1979; Burt and Barber, 1996; Salkind, 2004).

Study Results

Office Location and the Journey to Work

Travel distance and travel time to work

It was hypothesised that mean travel distance and mean travel time to work would increase as the work location moved from the City Centre outwards.

³ A one-way analysis of variance is a statistical test which tests the hypothesis that there is a significant variation in mean scores in more than two sample data sets.

⁴ The chi-square test is used to test whether observed values (empirically obtained) differ significantly from what would be expected under conditions of independence.

The mean distance travelled to work for City Centre respondents was 11.35 kilometres. The corresponding figures for Santry and Citywest respondents were 15.67 kilometres and 13.23 kilometres respectively. A one-way analysis of variance was conducted to assess whether a statistically significant variation existed in mean travel distance to work in each location. The resultant p-value of .27 is not considered to be statistically significant⁵. Therefore, with regard to office location, there is not sufficient evidence to suggest that a significant variation exists in the mean travel distance to work.

While the variation in mean distance travelled is not statistically significant, it is notable that, on average, employees working in the City Centre travelled shorter distances to work than employees working in either Santry or Citywest. The implication here is that the City Centre is a more efficient and a more sustainable work destination with respect to mean distance to work. The mean travel time to work for City Centre employees was 47.7 minutes. The corresponding figures for Santry and Citywest were 40.2 minutes and 36.4 minutes respectively. A one-way analysis of variance produced a p-value of .02 which suggests that a significant variation in mean travel time did exist between the three locations.

Taking the journey distance and journey time results together, the results show that while respondents working in the City Centre were most efficient in terms of mean distance travelled to work, they were least efficient with respect to mean travel time to work. This is likely to reflect, at least to some extent, the high congestion level on routes leading to and within the City Centre area and a greater use of slow public transport. Using the foregoing mean travel distance and mean travel time values, implied mean speeds for the journey to work were calculated for each study location. The implied mean speed for the City Centre was 14.3 Km.Hr⁻¹ while the corresponding figures for Santry and Citywest were 23.4 Km.Hr⁻¹ and 21.6 Km.Hr⁻¹ respectively. While the City Centre respondents travelled a shorter average distance to work, they did so at a much slower speed.

The results suggest that as soon as the workplace is located away from the City Centre, a trade-off occurs between travel distance to work and travel speed to work. Respondents working in suburban office locations are accepting longer commuting distances because they can travel to the workplace at higher mean speeds.

Mode of transport to work

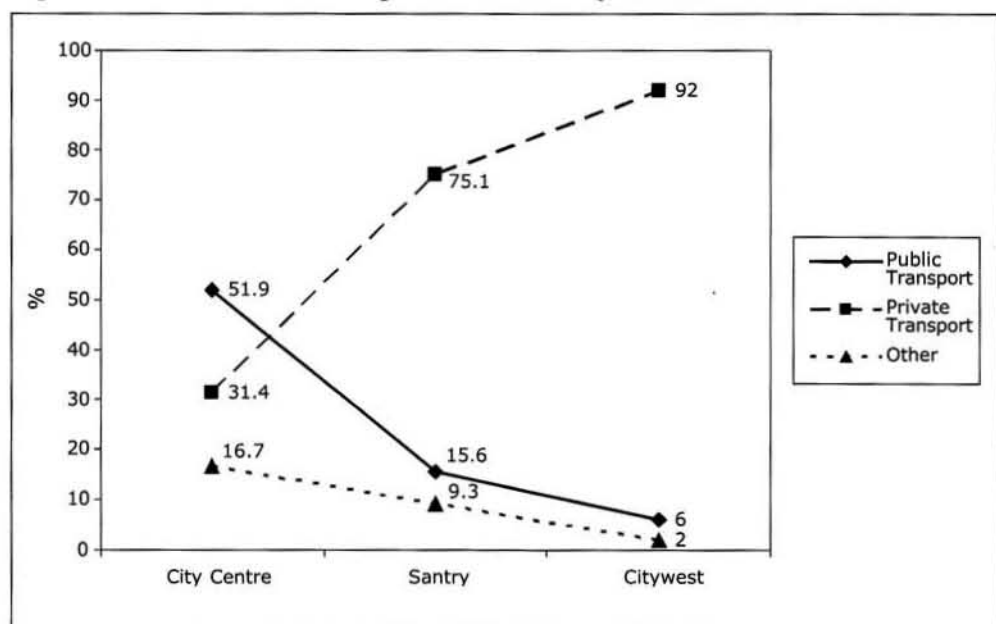
With regard to modal choice for the journey to work it was hypothesised that the use of more sustainable forms of transport (i.e. public transport, walking and cycling) would decline from the City Centre outwards.

Figure 3 shows the modal choice breakdown for each study location. It can be seen that the use of private transport (as driver or passenger) increased from the City Centre outwards. Levels of car usage were highest in Citywest and declined inwards to Santry and the City Centre. A chi-square test provided sufficient evidence (p-value=<.001) to suggest that a significant variation existed in the use of public and private transport with respect to work location.

⁵For this research, and as is generally considered the case in inference statistics, a p-value below .05 is considered to be a statistically significant result (Sterne and Davey-Smith, 2001).

The results highlight the dependency on the private car for the journey to work in suburban work locations. As Figure 3 shows, use of the so called sustainable modes declined as one moved from the core to more peripheral work locations.

Figure 3. Normal Mode of Transport for the Journey to Work



Over the entire sample, the mean travel distance for public transport users was 7.2 kilometres while the mean travel time was 43.7 minutes. The corresponding figures for private transport were 13.6 kilometres and 40.9 minutes. The implied mean speeds for public and private transport over the entire sample were thus 9.9 Km.Hr⁻¹ and 19.9 Km.Hr⁻¹ respectively. In the context of sustainability considerations, it is worrying that public transport users travelled an average of 2.8 minutes longer to complete a journey of approximately half the average distance of the private transport users.

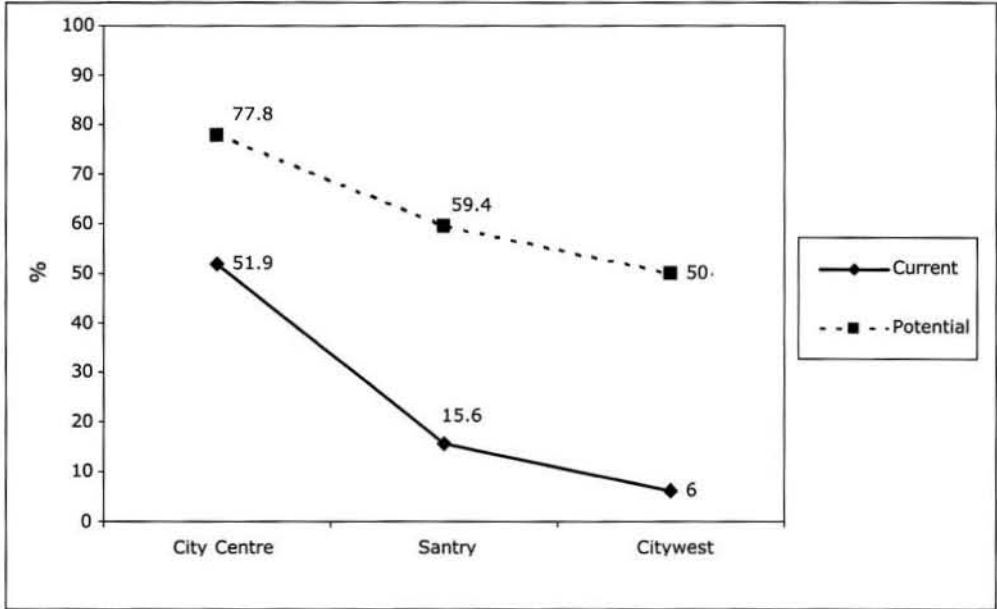
In summary, Citywest respondents were the most inefficient in terms of mode of transport to work while City Centre respondents were the most efficient. The modal choice breakdown for Santry was far more similar to that of Citywest than the City Centre. As was the case with the distance results, this suggests that as soon as the workplace is located away from the City Centre, the modal choice breakdown for work trips changes radically with travel patterns becoming increasingly unsustainable. It raises questions as to the extent to which public transport can serve outlying work locations adequately.

Public transport potential

Figure 4 shows the current and potential public transport use for the journey to work for each location. The latter is defined as the percentage of individuals in each location currently using

public transport for the journey to work plus the percentage of individuals currently using the car for whom public transport is the second choice. The difference between current public transport use and potential public transport use is indicative of the actual loss in modal share of public transport as a result of car availability.

Figure 4. Current and Potential Public Transport Use for the Journey to Work



Undoubtedly, the results reflect, at least to some extent, the geography of public transport provision in each work location; as the level of public transport provision declines so too does public transport use and public transport potential. The relative magnitude of these figures is interesting. The difference between current and potential public transport use increased from the City Centre outwards. This suggests that policies aimed at curbing car use for the journey to work would enhance public transport patronage levels in all locations and that they would have the greatest impact, in relative terms, in the outermost locations.

Duration of Home Ownership and the Journey to Work

Travel distance and travel time to work

For this part of the study, only respondents who either owned their current residence or resided in a property owned by parents were considered. Duration of home ownership was divided into three categories: 0-5 years, 5-10 years, and over 10 years. It was hypothesised that mean travel distance and mean travel time for the journey to work would be greater for individuals who had purchased homes most recently.

The mean travel distance to work in the 0-5 year category was 19.1 kilometres while the corresponding figures for the 5-10 year and over 10 year categories were 12.5 kilometres and

11.4 kilometres respectively. An analysis of variance produced a p-value of .01 indicating a statistically significant variation in mean scores. As expected, respondents who had purchased homes most recently (0-5 years) were more inefficient in terms of mean journey time to work. The results suggest that rapid house price increases over the past number of years have indeed forced individuals to purchase homes that are increasingly further away from their places of employment. This is despite the fact that these individuals were more likely to have made a residential selection with the knowledge of current employment opportunities than those in either of the other two categories. There is no doubt that this reflects the recent planning trends alluded to earlier in this paper; doubtless too, it has been accommodated by rising levels of car ownership.

The mean travel time to work in the 0-5 year category was 54.3 minutes while the corresponding figures for the 5-10 year and over 10 year categories were 40.7 minutes and 39.9 minutes respectively. The resultant analysis of variance test produced a p-value of .02 which again is a statistically significant result. Again, and as expected, respondents in the 0-5 year ownership category were the most inefficient with regard to mean travel time to work while those in the over 10 year category were the most efficient.

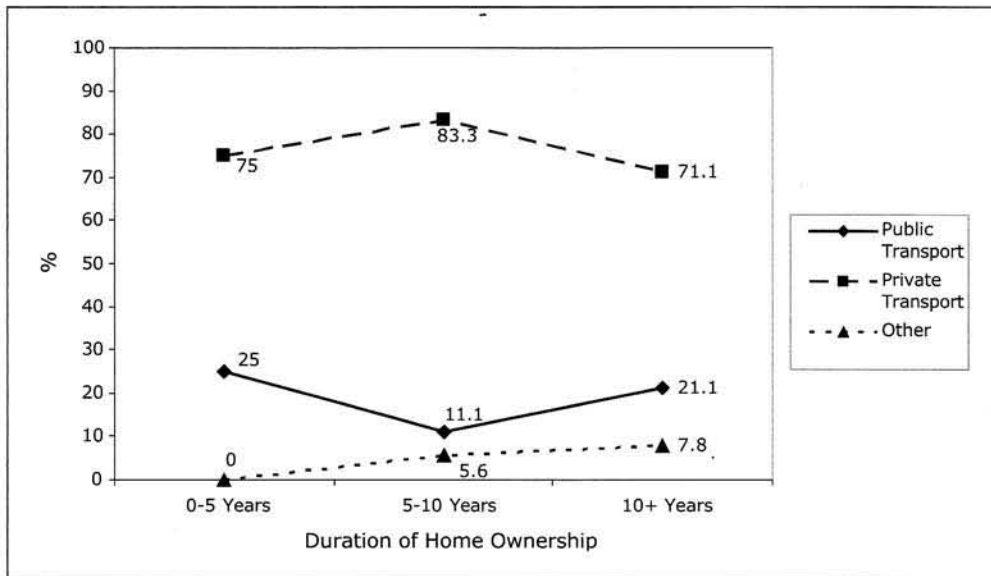
Using the foregoing mean travel distance and mean travel time values, implied mean speeds for the journey to work were calculated for each home ownership category. The implied mean speed for the 0-5 year category was 21.1 Km.Hr⁻¹ while the corresponding figures for the 5-10 year and over 10 year categories were 18.4 Km.Hr⁻¹ and 17.1 Km.Hr⁻¹ respectively. It is worrying and also counter-intuitive from a sustainability point of view that respondents who had purchased homes most recently (0-5 years) travelled greater mean distances to work and for longer periods of time, albeit at the highest mean speeds. This suggests that recent trends in the location of housing are facilitating increasingly unsustainable trip patterns for the journey to work.

Mode of transport to work

With regard to modal choice, it was hypothesised that individuals who purchased homes most recently would be less likely to use more sustainable forms of transport (public transport, walking, cycling) for the journey to work.

Viewing the results (Figure 5), it is notable that those in the 5-10 year category had the highest associated private transport use while those in the over ten year category had the lowest. Rather surprisingly, the highest associated public transport use was in the 0-5 year category. A chi-square test provided insufficient evidence (p-value=0.27) to suggest a significant variation in modal choice breakdown with respect to duration of home ownership.

Taking the foregoing results as a whole, the individuals who purchased homes most recently (0-5 years) were indeed less efficient in terms of their mean travel distances and mean travel times but not in terms of modal choice for the journey to work. Clearly, trends in the geography of housing development are having major sustainability implications with regard to work journey characteristics. The results suggest that individuals who purchased homes most recently are being forced to travel for longer periods of time and to live further away from employment opportunities which is contrary to the stated aims of current land use and transport planning policy.

Figure 5. Normal Mode of Transport for the Journey to Work

Discussion

This study offers some important insights into the efficiency of travel patterns in the Dublin area. The results confirm that recent changes in the location of service sector employment and of housing have forced a distinct change in the geography of travel. It appears that the traditional commuting patterns associated with a monocentric urban structure are becoming less common. Trends in employment and housing development have resulted in more inter-suburban commuting, reverse commuting and long distance commuting and this has been to the detriment of public transport use and provision.

The results here suggest that a significant variation exists in trip patterns with respect to work location. Individuals working in the City Centre travel shorter mean distances with public transport being the dominant mode but endure the highest associated mean travel times. Undoubtedly, this is a function of congestion in the City Centre area. Unlike many other European cities, the main mode of public transport in Dublin is the bus which, in general offers a slower trip than the car. The results here suggest the desirability of planning policies aimed at improving public transport speeds, for example through the provision of more Quality Bus Corridors and light rail transit.

The results suggest that two distinct patterns of trip making exist depending on whether or not the workplace is located in the City Centre. Respondents working in suburban office locations had less sustainable and more inefficient commuting patterns despite the fact that they enjoyed lower mean travel times and higher mean travel speeds.

The foregoing results show that respondents who had purchased homes most recently (0-5 years) had less efficient and less sustainable journey to work patterns. Worryingly, this has happened at the very time when planning policy is calling ever more strongly for development plans that will lead to more efficient and sustainable travel patterns.

Conclusions

The results here confirm that the decentralisation of employment and housing has led to significant increases in vehicle-kilometres travelled and accordingly to increases in fuel consumption and emissions. These trends run contrary to current policy for the sustainability of urban areas and shed doubt on whether Ireland can fulfil its environmental commitments as set out in the *Green Paper on Sustainable Energy* (Department of Public Enterprise, 1999) and the *National Climate Change Strategy* (Department of the Environment and Local Government, 2000).

There are also implications for the provision and use of public transport infrastructure in Dublin. As already stated, the diffusion of employment and housing to suburban areas (and beyond) has created a highly complex pattern of trip making. There is little doubt that this has increased the difficulty of providing a citywide public transport system. The results demonstrate that the private car is by far the most dominant mode of transport for the journey to work in suburban office locations. If, as current policy documents suggest, public transport is to play a much greater role in catering for the journey to work in suburban locations in the future, it is vital that future development is concentrated into a number of strategic centres/nodes. This will facilitate a less complex and more focused pattern of trip making and make the provision of public transport easier. A model such as that proposed by MacLaran and Killen (2002) would appear to be a good starting point.

Policy-makers need to give more attention to the relationship between land use and transportation and, in particular, to the ability of transport systems to shape urban development. The establishment of a regional co-ordinating body would appear important. Despite the fact that steps have been taken at government level to create new institutional arrangements for land use and transport in the Greater Dublin Area (Department of the Environment and Local Government and Department of Public Enterprise, 2001), it appears that little has happened on the ground so far to provide for the integration of land use and transport systems at the regional level.

The land use patterns we permit fix, at least to some extent, distinct patterns of travel into the built environment. In terms of sustainability, current land use trends and the corresponding implications for journey to work efficiency are undesirable. If Dublin is to become a more sustainable city in the future, it is extremely important that planning practice adheres much more strictly to planning policy.

Acknowledgements

The author would particularly like to acknowledge the advice and guidance of Dr. James Killen in the preparation of this paper. Thanks are also due to Dr. Andrew MacLaran for comments on an earlier draft and also to the Centre for Urban and Regional Studies and Hamilton Osborne King for the use of their office database. This research is funded by the HEA PRTL funded Centre for Transportation Research and Innovation for People (TRIP) as part of the NDP funding programme.

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