Modelling Commuting Catchments in Ireland: A Hierarchical Approach using GIS.

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1. Introduction

Over recent years there has emerged an increased awareness of the importance of strategic spatial planning and of the extent to which concepts such as place and space really matter (Faludi, 2000). An enhanced understanding of the geography of living and the economy requires not only a knowledge of where people and objects are but also of how those places relate to one another to create functional spaces. This requires fundamentally sound data on movement patterns, of which the most important is probably the daily journey to work (Horner, 1999, McCabe, 2006 Pers Comm). In this paper we examine spatial modelling approaches to commuting patterns using data from the CSO 2002 Census of Population (CSO 2003a, CSO 2003b. CSO 2004a). This is a particularly apposite time to undertake this research. A number of national strategic initiatives including the next Irish National Development Plan and the current National Spatial Strategy provide a clear policy context for the study (Morgenroth and Fitzgerald, 2006). Additionally it is the specific intent of the CSO in providing this data set to stimulate geo-computational analysis and modelling. This research aims to map travel to work flows in 2002 from the 15% national anonymised individual sample (known as the POWSAR data set) and secondly to investigate the technical production of new Travel Catchments Areas (TCAs) for the state as a whole.

2. Literature Review

Sample travel to work data has been utilised in a number of developed economies to identify commuting and other economic catchments (Ball 1980, Coombes, Green and Openshaw 1986, Coombes 2002). With the advent of improved geo-computational power and the development of GIS, the Spatial Data Modelling elements of such investigations have been particularly enhanced (Longley et. al., 2005, Langford and Higgs, 2006). One of the most widely used algorithms used in the production of travel to work areas is the work of Coombes, Green and Openshaw (1986) which identified a series of Travel-to-Work areas (TTWAs) in England and Wales. The algorithm primarily focused on the notion of minimum thresholds of 75% workers living in the catchment area and an associated measure of self-containment in the commuting

population. While successful in developing a single set of TTWAs, the Coombes algorithm, as it has come to be known, is limited by some of the specific conditions used within the process (Morgenroth and Fizgerald, 2006). Interestingly, the method was also used to identify eighteen separate TTWA areas for Northern Ireland (Hastings, 2004). Unpublished research by Morgenroth (Pers. Comm.) at a regional level in Ireland attempted to test the applicability of the Coombes algorithm in the West of the country. However, a number of issues arose concerning the use of the POWSAR data, especially related to small number problems and non-contiguity of the areal building blocks (Electoral Divisions or EDs) used. In both cases there are a number of ongoing problems which relate to a) the technical rule-base used in the algorithm and b) the single level at which such models operate. The research reported here attempts to re-work the original algorithm and to do so in a multi-level spatial hierarchy to get around some of the problems associated with generating a set of TCAs for the Republic of Ireland.

3. Data and Methods

Based on the 15% sample from the POWSAR dataset, approximately 220,000 individual records are available for analysis. In addition ot the home and work location, each record pertains to an anonymised individual and contains a range of demographic and socio-economic information. These include variables such as mode of travel, socio-economic group, age, gender, housing occupancy and travel and departure times.

As an initial modelling stage the proportions of the workforce in each of the 3440+ enumeration districts that travelled within prescribed distance bands were calculated and mapped. For each town along a hierarchical scale from city to large town to small town, a set of core and peripheral catchments were individually drawn. The Coombes algorithm was then used to amalgamate the individual towns and cities (employment cores) and calculate a three-level hierarchy for the country as a whole. The middle level was based on a set of urban Gateways and Hubs identified within the National Spatial Strategy to provide a form of spatial validation of the policy initiative. While the Coombes algorithm provides a single level top-down approach, the approach taken here was of a multi-level bottom up comparison and the results identified some interesting variations and problematic aspects unique to Ireland.

4. Results

The output initially identified those parts of the country that are beyond the commuting hinterlands of the Gateways and Hubs. At the smallest scale, the catchments of the major cities (Dublin plus 5 others) were plotted but were essentially unsatisfactory, incorrectly assigning large numbers of EDs, which had no real economic connection with the centre to which they were allocated. Even with the introduction of a medium scale, based on the 22 Gateways and Hubs identified in the NSS, large gaps or unallocated areas existed although the continuity of the surface was stronger when compared to the 6-centre solution. Figure 1 below identifies the largest scale analysis of TCAs in 2002 and clearly identifies 43 different centres at this scale.

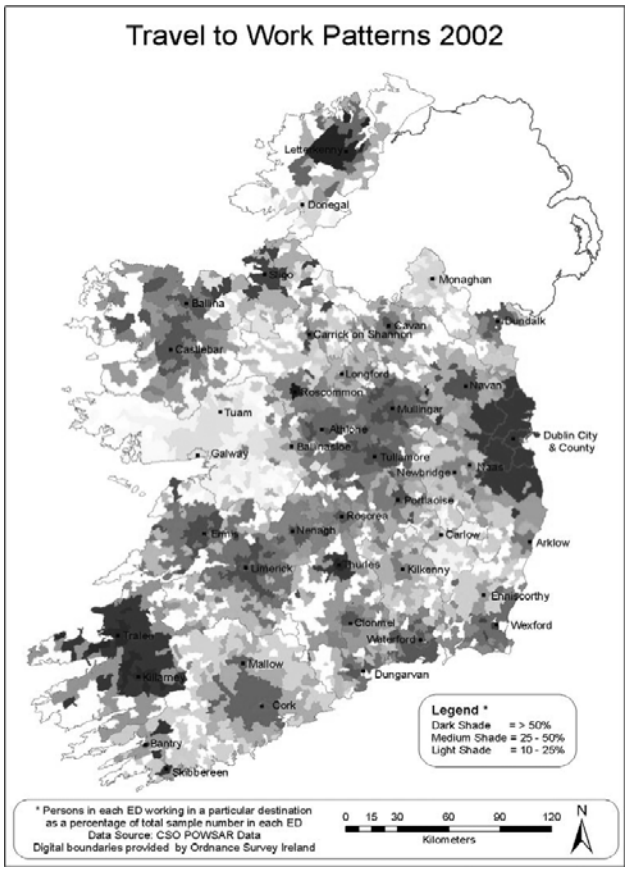

Figure 1. Draft Travel Catchment Areas (TCAs)

5. Discussion and Conclusion

Based on the modelling some doubt was cast on the appropriateness of a number of the hubs; there were also a number of areas identified as not being within the hinterland of either a Gateway or a Hub. The scale of analysis was partially responsible for the anomalies, as was the use of sample data. The particularly heterogeneous nature of EDs in Ireland presented some difficulties in running the algorithm due to small number problems in rural areas and also clustering problems in urban areas, where a number of quite different work locations within individual EDs threw up a number of anomalies. We conclude by identifying some policy implications arising from this research.

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