Identifying Travel to Work Areas 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 uses an alternative technique based on an intramax algorithm to identify regional and local TTWAs. This circumvents some of the issues associated with the Coombes algorithm and enables a multi-level spatial hierarchy of TTWAs to be identified. It does however raise the question of just how many travel to work areas does Ireland have.

3. **Data and Methods**

Based on the 15% sample from the POWSAR dataset, approximately 220,000 individual records are available for analysis. In addition to 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.

The flows between each of the 3440+ enumeration districts which data was available for were calculated. These data were input into Flowmap, a piece of software designed by Tom de Jong of Utrecht University to assist spatial

planning in developing countries. The software has subsequently been developed and its functionality enhanced. One of these functions is the identification of areas based on the use of an intramax algorithm applied to flow data. The challenge, in the Irish context, is to identify the appropriate number of regional areas to select. A policy approach would suggest that 18 regions should be defined as this number corresponds to the Gateway and Hub cities and towns listed in the National Spatial Strategy. Alternative approaches were also adopted to assess whether it was possible to overcome this issue and produce a definitive set of TTWAs for Ireland. In the first instance 3,200 TTWAs were created and a frequency analysis applied to the entire dataset to identify the dominant interaction between enumeration districts. A second approach involved the identification of statistically significant, at the 95% and 98% intervals, samples from the total population of 3200. These were randomly selected from the population and frequency analysis undertaken to identify the number of TTWAs. Spatial analysis was subsequently used to assess differences between the various approaches.

4. Results

Applying the policy approach highlights a number of issues, not least of which is the small number problems that potentially misrepresent the significance of in rural areas. Figure 1 highlights the sub-division of larger urban centres, particularly Dublin into a number of small TTWAs whilst the significance of urban centres in more remote areas is disguised. The statistical approach to identifying TTWAs yields a more robust regionalisation though these are not without their own set of problems.

5. Discussion and Conclusion

Based on the modelling some doubt was cast on the appropriateness of a number of the Gateways and 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 used of sample data. The particularly heterogeneous nature of the ED 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.

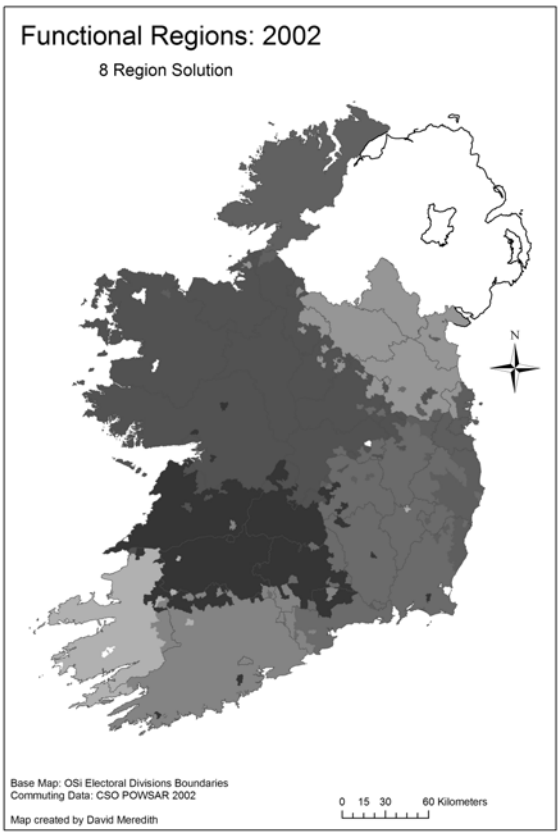

Figure 1. Draft Travel Catchment Areas (TCAs)

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