

ORIGINS, DESTINATIONS AND CATCHMENTS: MAPPING TRAVEL TO WORK IN IRELAND IN 2002

Professor Jim Walsh*
Dr. Ronan Foley**
Dr. Adrian Kavanagh**and Aisling McElwain**

**Vice-President, NUI Maynooth*
***Department of Geography and NIRSA, NUI Maynooth*

(read before the Society, 20 October 2005)

Abstract: 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. An enhanced understanding of the geography of living and of the economy requires not only a knowledge of where people and objects are but also of how those places relate to one another. This requires fundamentally sound data on movement patterns, of which the most important is probably the daily journey to work (Horner, 1999). In this paper we explore for the first time several aspects of the journey to work using data from the CSO 2002 Census of Population (CSO 2003a, CSO 2003b, CSO 2004a). While the approach at this stage is mainly descriptive supported by detailed mapping it is timely and it will hopefully contribute to discussion in a number of areas of public policy. These include the estimation of regional per capita levels of output (per capita GVA), the extent of the catchment areas of the National Spatial Strategy Gateways and hubs, the environmental sustainability of new trip patterns, and the impact of longer and more stressful journey times on quality of life.

Keywords: Spatial Planning, catchment areas, commuting
JEL Classifications: R10, R12

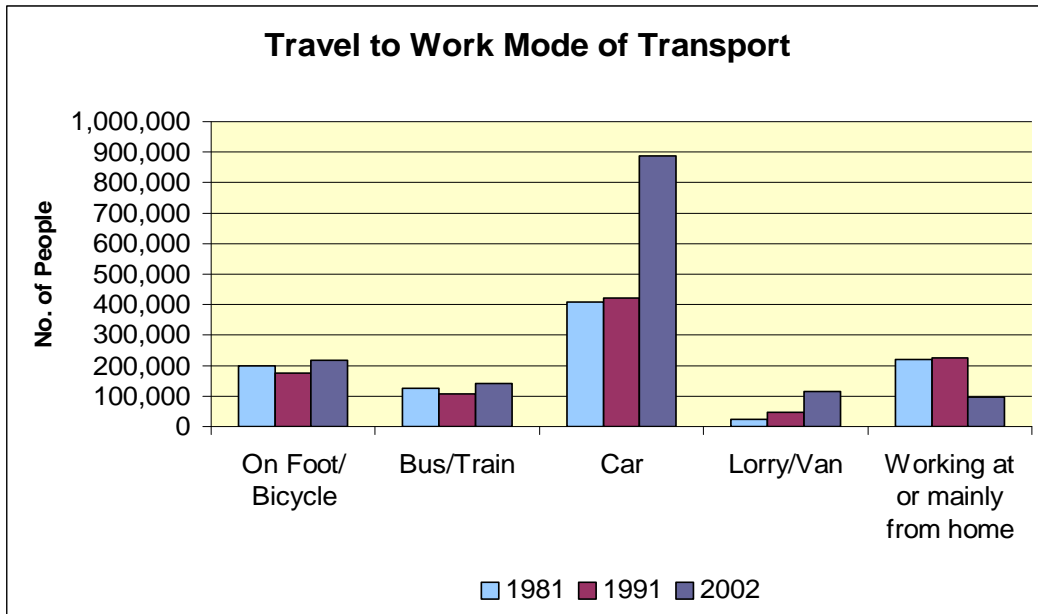
1. INTRODUCTION

Before proceeding directly to the travel to work data there are some additional contextual points to note. The most striking is that the total number of persons recorded at work in 2002 was just over 1.6 million compared with a little over 1.1 million in 1991 giving an increase of 473,424 or 41.6% which can be contrasted with an increase of only 7,113 (0.6%) over the period 1981-1991. Moreover the shift in the size of the workforce was accompanied by a sectoral shift towards services and substantially increased female participation rates in employment that is mainly concentrated in the larger towns and cities. While there are some exceptions to this generalisation the most notable are the growth of employment amongst rural dwellers, especially among females in service occupations in those rural areas with strong tourism and related sectors, and secondly among rural resident males working in building and construction and related support industries which are frequently located in the expanding urban centres.

Another feature of the social and economic adjustments in the 1990s that had a bearing on journey to work patterns was the increase in car ownership levels. Between 1991 and 2002 the proportion of households with at least one car increased from 59.5% to 78.3%. In absolute terms the number of households with at least two cars increased by more than five times from 87,174 to 478,660 and

the total number of cars owned by private households increased from 445,226 to 1,601,619 or by 360%! With this very substantial increase in the number of cars it is no surprise then that the largest change in the modes of transport to work has been in relation to motorcars (Figure 1). Thus by 2002, just over 55% of workers drove to work by car compared with 39% of a much smaller workforce in 1991. By contrast, the usage of public transport (bus or train) decreased 9.4% in 1991 to 8.8% in 2002 even though the actual number of users increased by 31% from 107,211 to 140,381.

Figure 1. Means of travel to work 1981-2002



The data on travel to work collected by the CSO through the Census of Population provides information on the distance travelled in miles, the length of the journey time in minutes, the starting time in the morning, and the mode of transport used. Similar information is collected on trips to school and college by students. In this paper we focus only on travel to work patterns. In Part 1 we discuss the main patterns in relation to the distances travelled and also the geography of journey times. We then relate these via regression analysis in order to identify more clearly the effects of congestion. This analysis in this part is reliant on data pertaining to individuals coded by their place of residence only. In Part 2 we utilise a sample selected from the Census returns, which contains information on both the place of residence and the place of work of all sample members. This enables us to identify for the first time the extent and intensity of interaction in the hinterlands of the principal twins and cities including the NSS Gateways and Hubs. In Part 3 we draw some conclusions and identify some policy implications. Throughout Parts 1 and 2 we will illustrate the potential offered by Geographical Information Systems (GIS) as a tool for data management and analysis to inform spatial planning in Ireland generally.

2. DISTANCE AND DURATION OF JOURNEY TO WORK

Data on travel to work has been routinely collected by the CSO from the individual census returns. In the most recent census of 2002, information is recorded on the distance people travel to work

and the time that journey takes (Questions 29 and 30). It is important to note that these are self-reported questions and reflect the individual's perceptions and experience rather than any objective measure. As a secondary coding act, the results are aggregated into a number of standard distance and time classes for reporting purposes. A further aggregation is undertaken to get from individual records to totals for geographical units of which the most basic published unit is the enumeration district (ED). The 3,440 EDs are further aggregated into totals for larger units such as urban districts, counties and regions.

2.1 Distance travelled to work

The number of persons at work classified by distance travelled is summarised in Table 1. The notable features for 2002 are that 644,551 or 40% of the total either travel less than five miles. However, at the other end of the spectrum are 282,026 who travel more than 15 miles of whom just over 93,000 (5.8% of the total) travel more than 30 miles each way. Taking 30 miles as a measure of long distance commuting, there was a fourfold increase in the numbers involved between 1991 and 2002.

Table 1. Number of persons at work classified by distance travelled to work 1981-2002

Distance (miles)	1981	1991	2002
0	167,617	197,650	73,094
1 – 4	422,654	408,013	571,457
5 – 9	188,667	197,192	302,105
10 – 14	78,489	87,473	176,499
15+	76,049	93,227	282,026*
Not stated	196,868	153,902	205,700
Total	1130,344	1137,457	1610,881

Source: CSO Census 2002, Volume 9. Travel to Work, School and College

* includes 93,087 who travel more than 30 miles

The overall average distance travelled was 9.8 miles with as expected a significant differential between urban and rural areas; 7.8 versus 13.3 miles respectively. Compared to previous censuses there was a significant lengthening of the average journey especially in the 1990s (Table 2). The overall average doubled but for rural residents the average increased by 150% from 5.3 miles in 1991 to 13.3 miles. The expansion of the built up area of the urban centres is reflected in an increase in the average distance travelled by urban residents from 4.4 miles in 1991 to 7.7 miles in 2002 which was only short of the average for rural residents in the mid 1990s.

Table 2 Average distance travelled to work in miles 1981 -2002

Year	Urban areas	Rural areas	State
1981	4.0	4.5	4.2
1986	4.1	4.8	4.4
1991	4.4	5.3	4.8
1996	5.7	8.2	6.7
2002	7.8	13.3	9.8

Source: CSO Census 2002, Principal Socio-economic Results.

The geography of commuting distances can be illustrated by mapping at ED level the percentage of workers travelling within specified distance bands. The ratios upon which the following maps are based are calculated without reference to the persons who do not travel to work or those for whom there was no information; together they account for almost 283,000 or 17.3% of all workers. When one maps a ratio such as persons travelling 5-9 miles as a percentage of the total

workers resident in an ED it is to be expected that a doughnut shaped pattern will emerge around the principal towns as it is in them that most of the employment is concentrated. Thus when one is considering the following map sequence one must keep in mind the geographical distribution of the towns in Ireland.

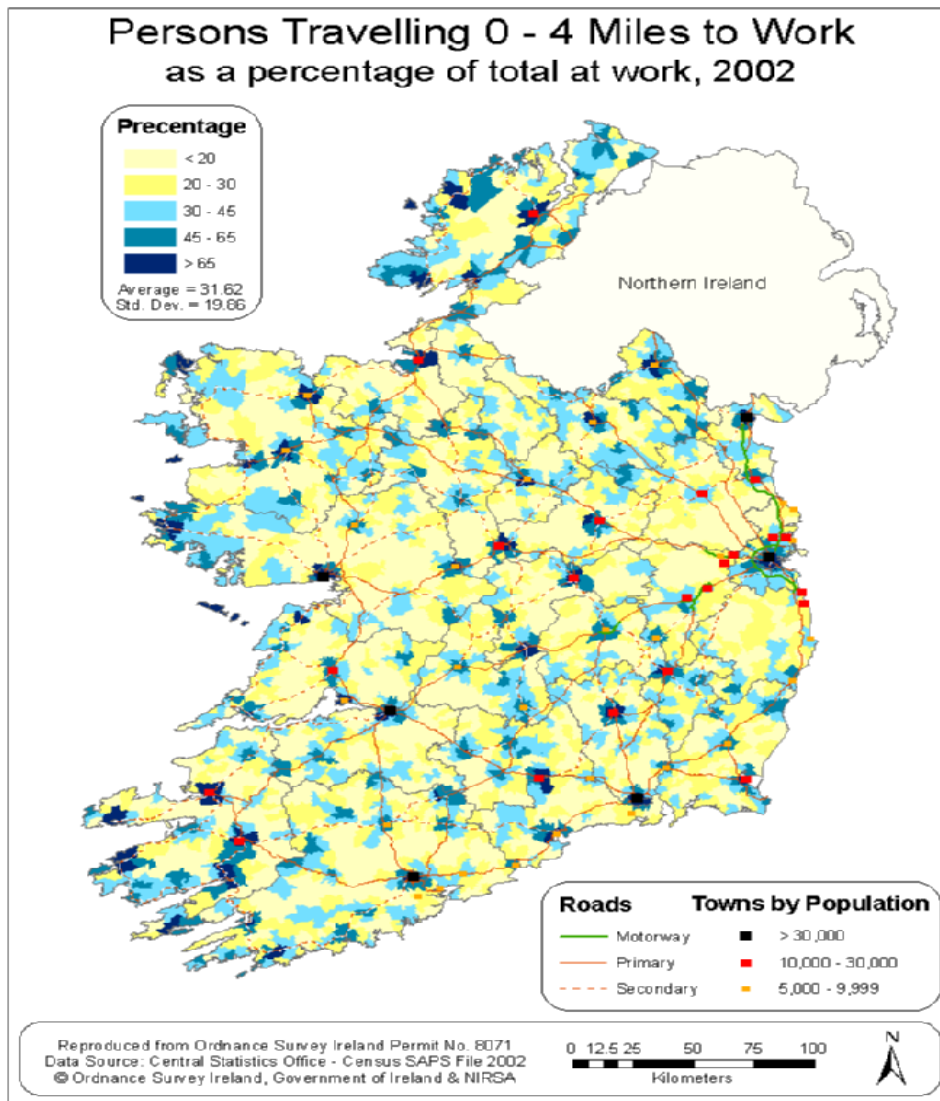
Map 1 shows the distribution of persons travelling less than five miles to work. This category accounts for almost 47% of workers residing in urban areas and 30% of the total resident in rural areas. As expected the map consists of several tightly constrained zones around the main towns. In addition high percentages occur in or near many coastal areas in the southwest, west and Donegal. This contrasts markedly with the patterns along the southeast coastal areas where somewhat longer distances are the norm.

Almost identical percentages of the workforce in urban (18.9%) and rural (18.6%) areas travel between 5 and 9 miles to work. Map 2 provides another doughnut shaped pattern with wider radii. In addition to the cities the map establishes the importance of medium size towns especially in the midlands and southeast. By contrast there is an absence of such areas from east Galway, most of Clare apart from the hinterland of Ennis, northwest Mayo and much of the Mid East region. While there are some medium sized towns in Meath and Kildare they are predominantly commuter oriented rather than providers of local employment opportunities.

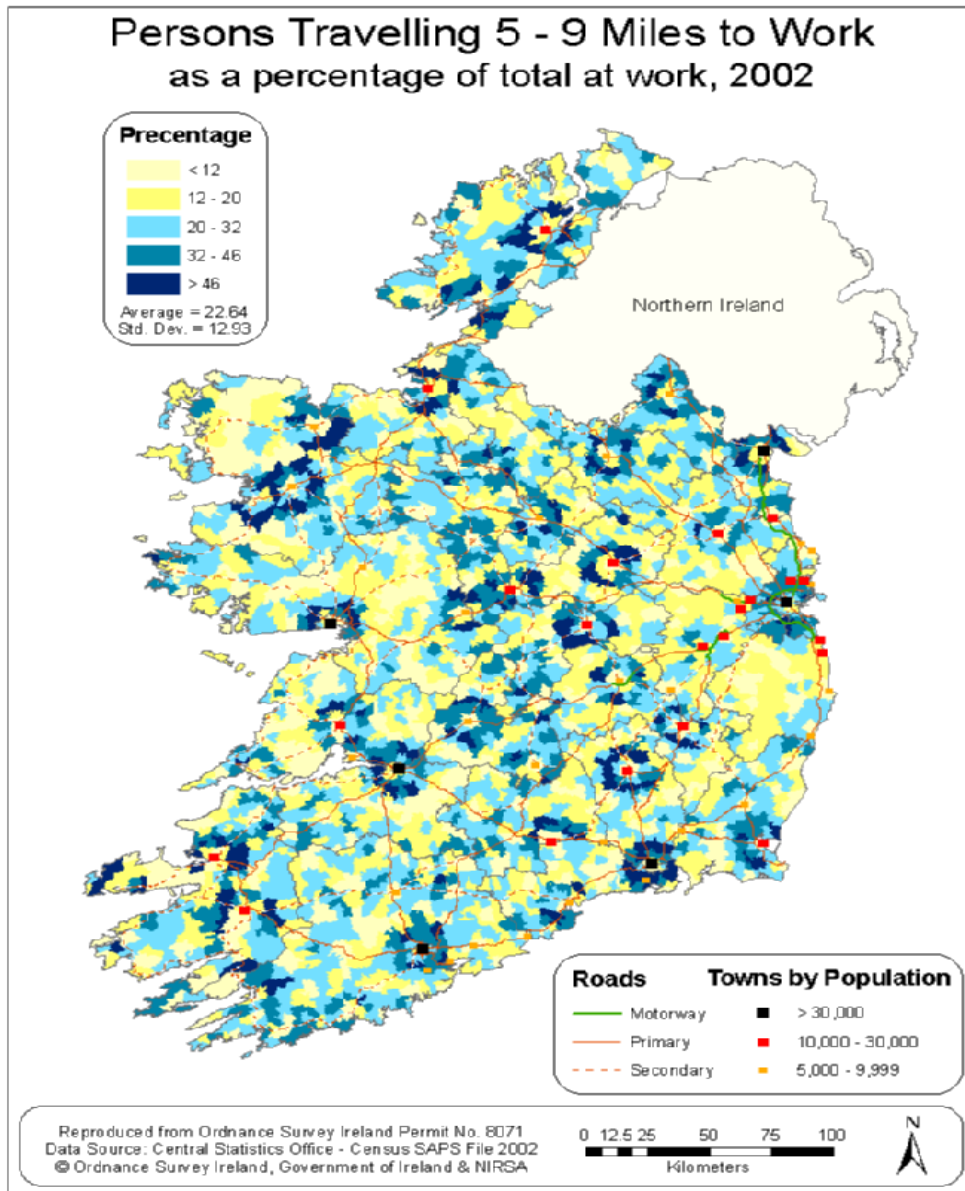
Long distance commuting patterns are clearly more associated with the hinterlands of the larger towns and cities where more employment opportunities are available. As expected the share of the workforce travelling these 15-29 miles is much higher in rural areas at 16.3% compared with 8.9% for the workforce residing in urban areas. Map 3 depicting the relative distribution of persons travelling 15-29 miles exhibits well defined arcs focused on Dublin, Cork, Limerick, Waterford, Kilkenny, Athlone and Sligo where over 43% of the workforce are in this category. EDs with high percentages of workers travelling between 15-29 are notably less evident in the Midlands reflecting the weaker attraction of towns in the region as employment destinations.

The distribution of persons travelling 30 miles or more to work is almost exclusively focused on the Dublin with additional distinctive bands of EDs on the outer edges of the hinterlands of Cork, Limerick, Galway and to a lesser extent Sligo and Castlebar. The most extensive band of long distance commuters is undoubtedly the arc extending around the outer perimeter of the Dublin city region with proportions in excess of 17% throughout north Wexford, Carlow, Laois, east Offaly, Westmeath, south Cavan and Louth, Map 4. There are several towns where approximately one-fifth of the workforce travel more than 30 miles each way to work. These include Carlow, Gorey, Athy, Portlaoise, Wicklow, Mullingar, and Navan. In fact Navan has by far the highest percentage of long distance commuters at 29.2% of those who provided an estimate of the distance they travel. This can be contrasted with the figure of only 6.1% in the Naas, the county town of neighbouring Kildare, which indicates very clearly the role of the local economy as a source of employment.

Map 1. Percentage of Persons Travelling 0-4 miles to work, 2002

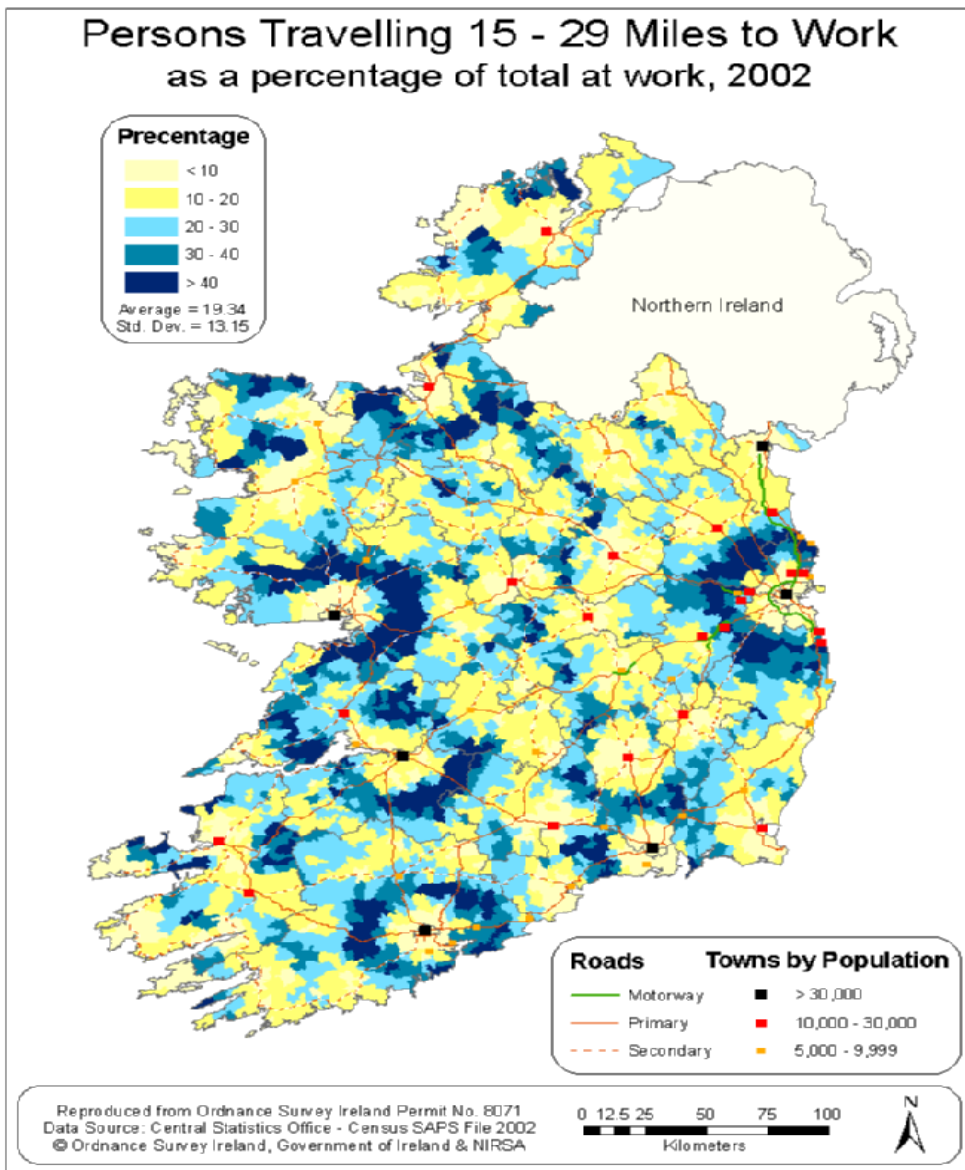


Map 2. Percentage of Persons Travelling 5-9 miles to work, 2002



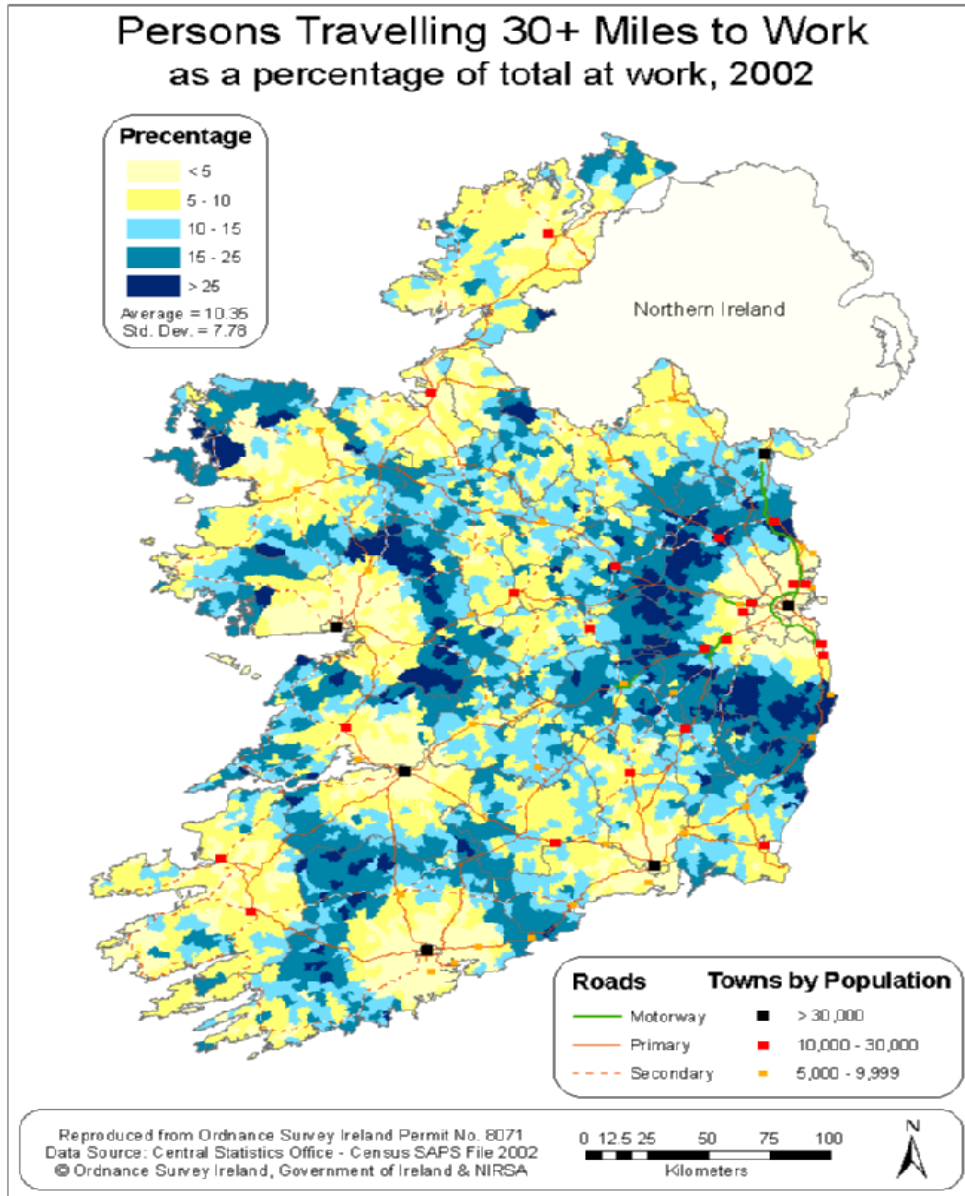
Map XX

Map 3. Percentage of Persons Travelling 15-29 miles to work, 2002



Map XX

Map 4. Percentage of Persons Travelling 30 or more miles to work, 2002



Map XX

In summary, most provincial towns are sufficiently strong ‘attractors’ to draw in significant numbers of workers within their immediate hinterlands (within ten miles of these towns), but only the cities (especially Dublin) have sufficient ‘pull factors’ to draw in workers from larger distances out, as the electoral division maps show.

2.2 Travel times

For the first time ever the 2002 Census of Population included a question on the length of the journey to work, measured in travel time minutes. The average journey time to work was 27 minutes in April 2002. Even though urban residents travel significantly shorter distances to work on average compared with their rural counterparts (Table 2) the effect of congestion is to almost equalise the average journey times for urban and rural residents: 28 minutes for urban residents and 26 for workers residing in rural areas. The frequency distributions of journey time for urban and rural workers are summarised on Table 3.

Table 3. Percentage distribution of urban & rural workers by journey time 2002

Journey time (mins.)	Urban areas	Rural areas
< 15	25.2	27.9
15-29	27.7	29.3
30-59	26.4	21.2
60-89	7.5	5.2
90 +	2.5	3.1
Not stated	10.6	13.4

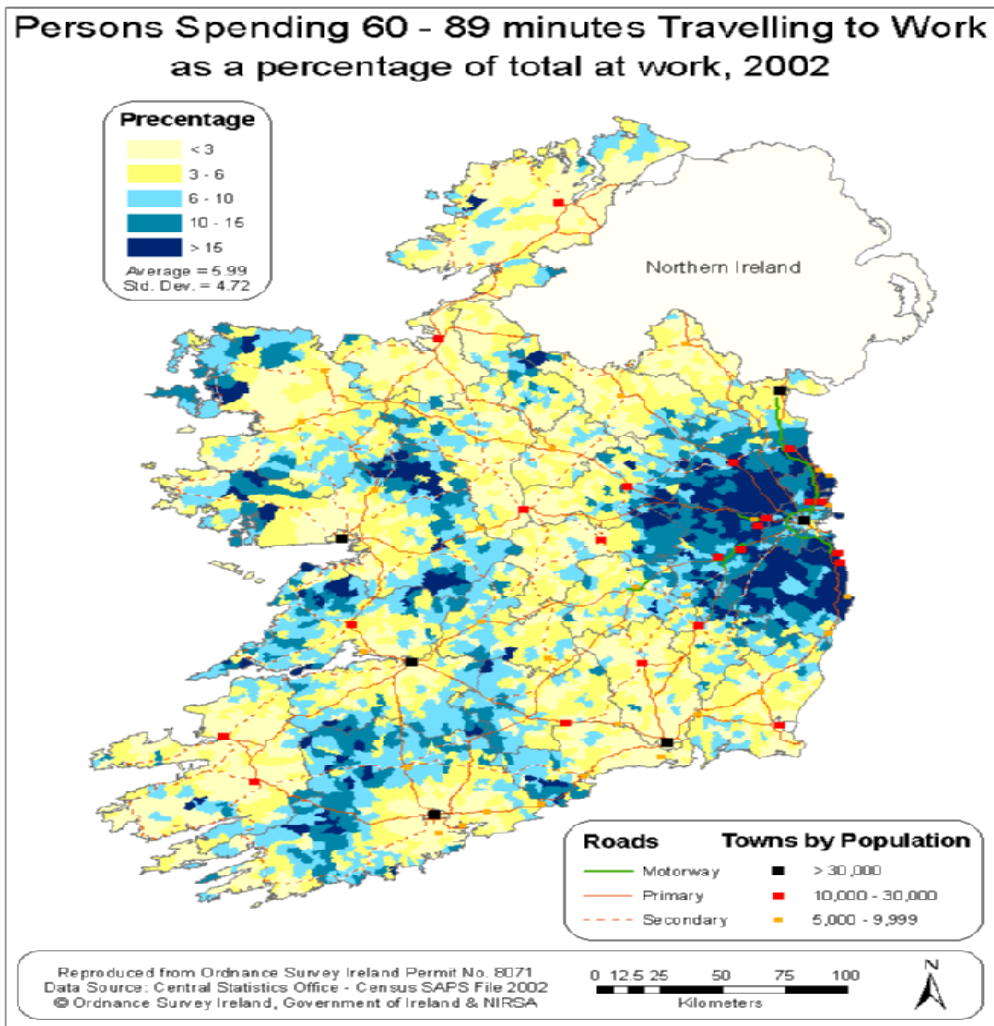
Source: CSO Census 2002, Principal Socio-economic Results

Almost 53% of workers residing in urban areas and 57% of those in rural areas spend under 30 minutes on their journey to work. At the other end of the spectrum the journey time for 10% of urban residents is more than one hour while the comparable figure for rural workers is 8.3%.

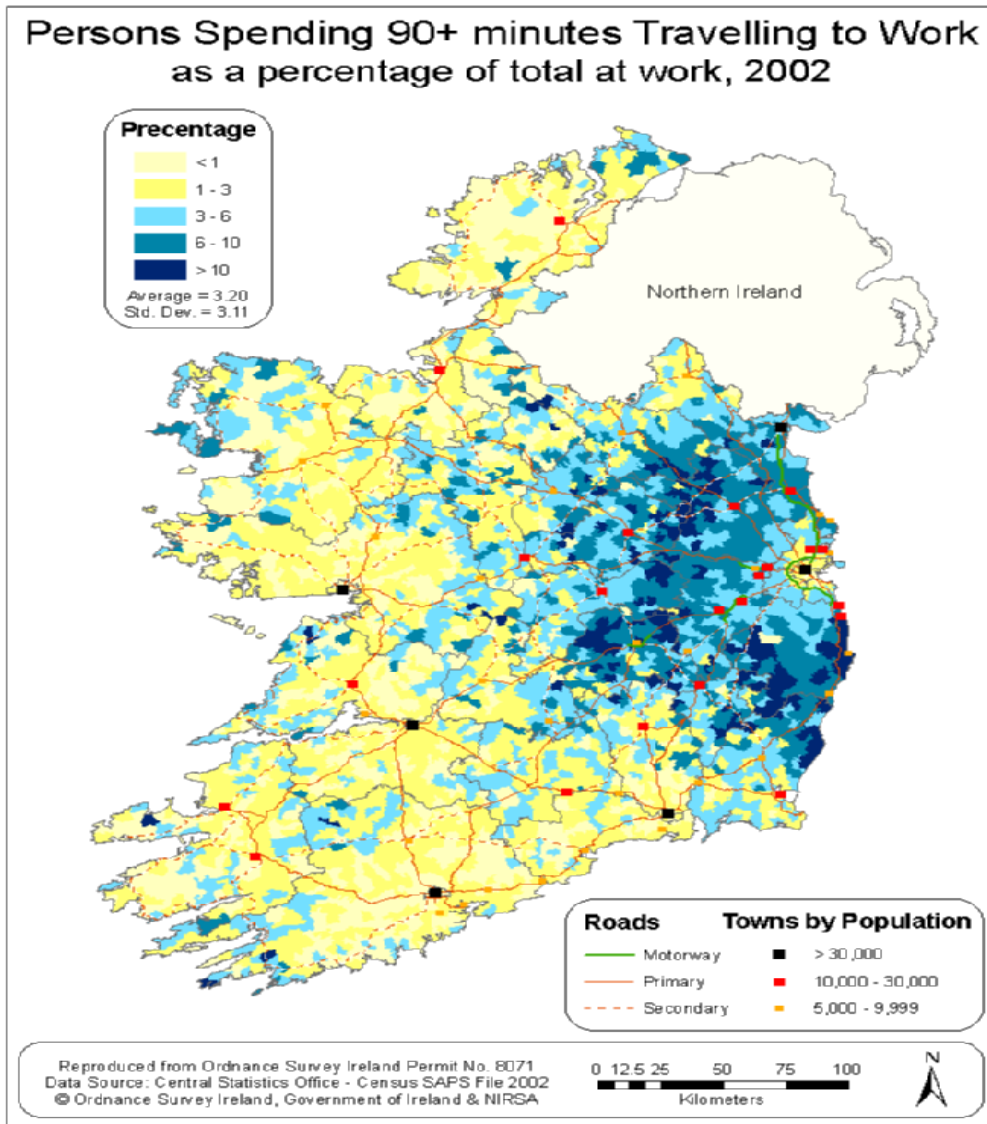
Here we consider the geographical distributions of workers with long journey times. The workers spending 60-90 minutes on their journeys to work are mostly concentrated in the two contrasting types of areas: the outer edges of the catchment areas for Cork, Limerick and Galway corresponding with the distribution of workers travelling more than 30 miles; and secondly the Greater Dublin commuter belt especially along less distant but more congested routes in south Meath and Wicklow (Map 5). Comparatively few workers are making journeys of this duration in the southeast, the midlands and the Border counties.

Almost 41,500 workers have journey times in excess of 90 minutes, of which 52.6% reside in Dublin and the three surrounding counties. Indeed the issue of very long distance commuting is almost an exclusively Dublin generated problem as illustrated by Map 6. Between 10 and 25% of workers in parts of south Wicklow, south Kildare, east Offaly and north Meath have journey times in excess of 90 minutes. Closer to Dublin city but beyond the M50 ring road there are many districts where congestion generated from local residential areas combined with converging inbound traffic along the main routes contributes to lengthy delays that add to the journey times.

Map 5. Percentage of Persons spending 60-89 minutes travelling to work, 2002



Map 6. Percentage Persons spending over 90 minutes travelling to work, 2002

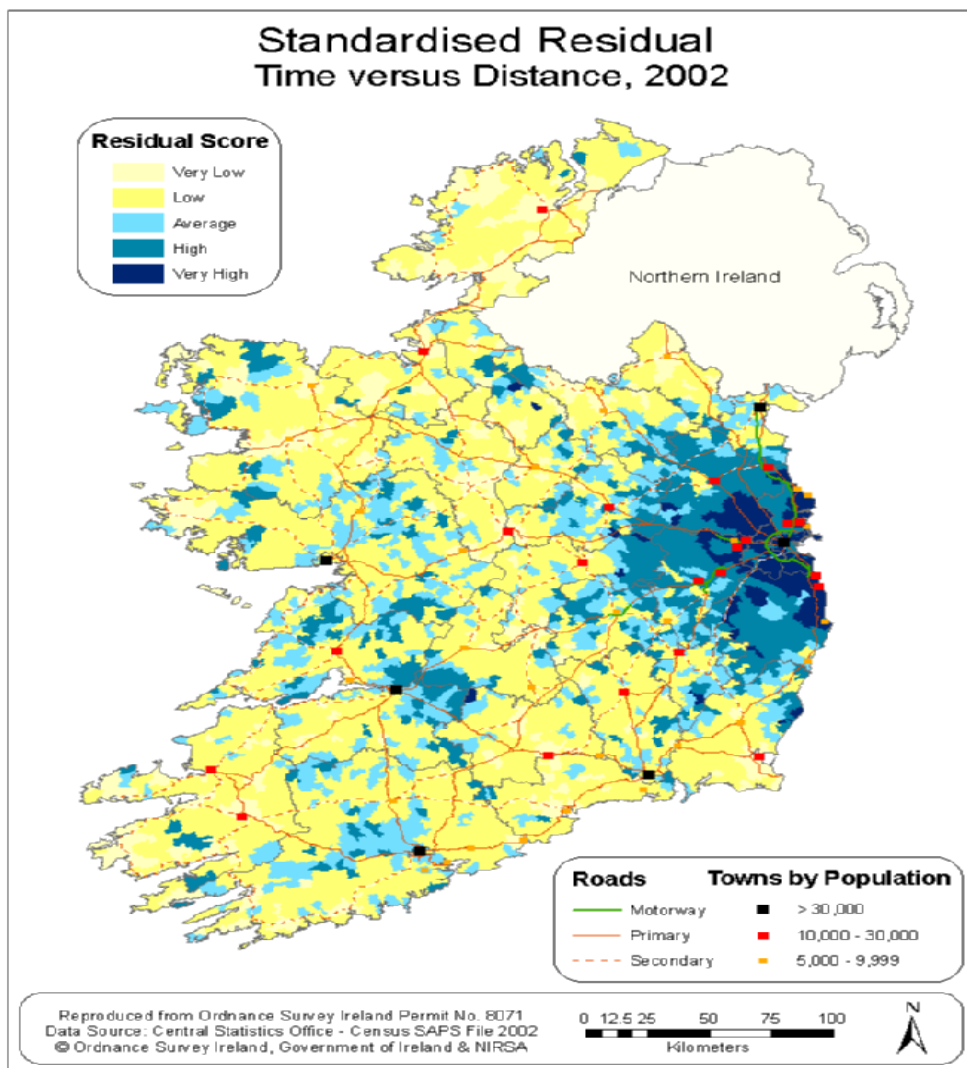


Map XX

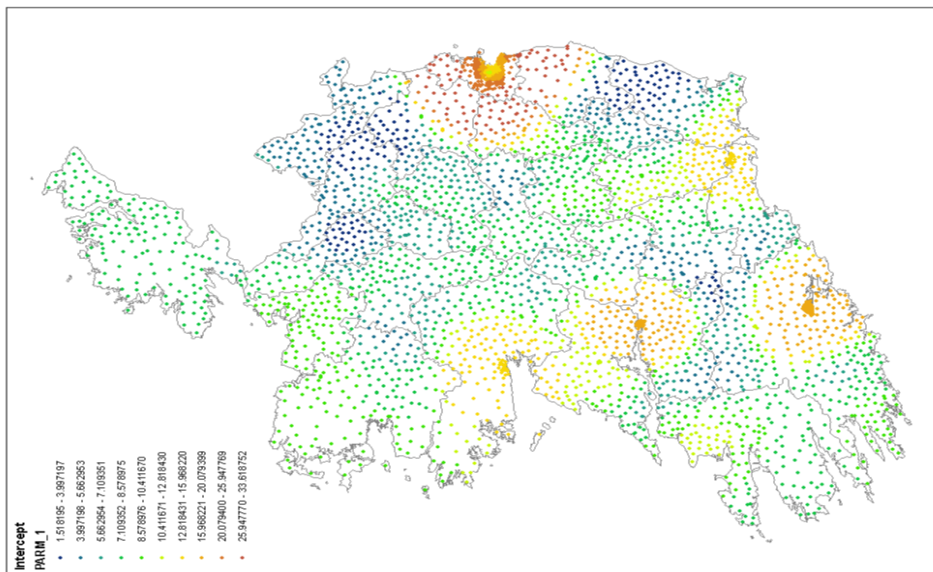
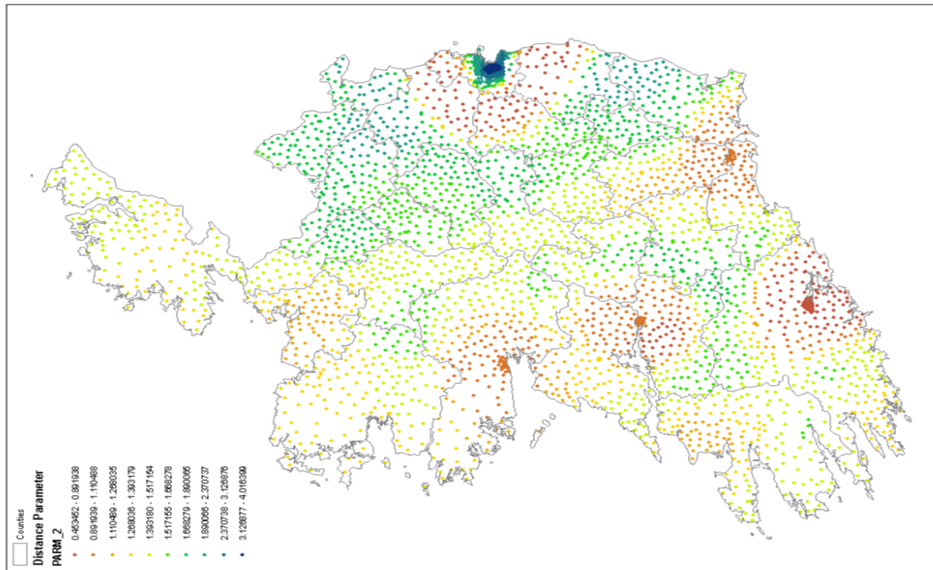
The relationship between journey time and distance has been assessed by regressing average journey time against the average distance travelled by workers in each ED. The map of the residuals from the regression demonstrates as expected that journey times take longer than might be expected especially in the Greater Dublin hinterland and also along key routes leading into Cork, Limerick and Galway (Map 7). The converse, indicating shorter than anticipated journey times, are mostly associated with rural areas where average travel speeds tend to be higher notwithstanding the quality of the road infrastructure.

A more sophisticated analysis that takes account of local sources of variation has been undertaken using the technique of Geographically Weighted Regression (GWR). The distributions of the constant and slope parameters for models calibrated for each ED confirm some similarities between the cities in relation to the constant coefficients (confirming very low average speeds over short distances) but there appear to be differences in relation to the slope coefficients, measuring acceleration, between Dublin within the canals and the situation on the other cities (Map 8). This may simply reflect the size of Dublin and the effects arising from congestion spread over a larger geographical area. The map also confirms the very long journey times endured by commuters from the outer edges of the Greater Dublin region as they become ensnared in the congestion that builds up on the access routes to the cities.

Map 7. Standardised Residuals of average journey time against average distance travelled to work, 2002



Map 8. Geographically Weighted Regression of Travel Time v Distance, 2002



3 TRAVEL TO WORK AREAS BASED ON POWSAR

In this part, we use the Place of Work Sample of Anonymised Records (POWSAR) which has been prepared by the CSO from an anonymised national sample of approximately 13.5% of working individuals aged over 15 (CSO 2004b). The data relate primarily to travel to work but there are also recorded many valuable additional attribute variables. This data set is a relatively large sample size when compared to other countries¹. Additionally, and unlike other anonymised samples, it focuses on a particular topic, travel to and location of work. Two other elements are also unusual about the data set. Firstly it records geography to the same spatial resolution as the overall census results, namely the ED. Secondly it records data for both the home and the place of work of the individuals in the samples, thereby providing the first ever set of origin-destination data collected for the entire State. This differs significantly from the aforementioned ED level aggregations, which only contain origin related data and no destination information of any sort.

The POWSAR data is an extremely rich dataset and makes possible a large amount of analysis of labour force patterns, links between employment and social class, home working, household type and work patterns as well as allowing cross-tabulation between work mobility, age, gender and migration. This paper is only the start of what is hoped will be a developing use of the dataset to illustrate the geography of workers and mobility in the early years of this century.

3.1 *Structure of POWSAR*

The POWSAR data has been generously provided by the CSO, for use by the Department of Geography and the National Centre for GeoComputation (NCG) at the NUI Maynooth. The full sample contains a total of 220,470 individual records sampled across the whole country. The sample includes only persons who at the time of the census:

- were enumerated in a private household
- were 15 years old or over
- were enumerated at home
- indicated that their Present Principal Status was working for payment or profit.

The sample size is approximately 13.43% of the population recorded at work in April 2002. Due to the size and number of records it was originally stored in SPSS format and converted to DBF format for use within the GIS. Summary tables were developed in Excel.

The codes and descriptions of the POWSAR variables are listed in Table 1 below. Most of the variables are self evident from the description but there are a number which need further comment. The data for Travel records eleven codes including 'working mainly at home' and 'unknown'. Similarly the Seg uses the predefined census categories, 11 in total. Dep_time records seven separate half-hourly interval, starting from 7.00 am. The Wgtpersons variable is a means of aggregating the sample data to give an estimate of totals for the entire population.

¹ The UK has only recently upgraded its Sample of Anonymised Records (SAR) from an individual survey of 2% in 1991 to 3% in 2001.

Table 4: Codes and Descriptions of POWSAR variables.

CODE	DESCRIPTION
PlanningReg	Planning Region
County	Home County
ED	Home Enumeration District
Town	Home Town (if over 1,500 people)
ResidentPersons	Number of residents in household
HouseholdComposition	Household composition – 5 classes
YearBuilt	Year accommodation was built
NatureofOccupancy	Type of household tenure
Cars_or_vans	Number of available cars and vans
Sex	Gender
Age5gpr	Five year age-groups
MarStat	Marital Status
ResOneYearFlag	Whether resident have moved in last year
Travel	Mode of travel to work, school of college
Dep_time	Time of departure
Jrn_miles	Journey distance in miles
Jrn_mins	Journey time in minutes
POW_ed	ED location code for workplace
POWTownCty	Town or county code for workplace
Seg	Socio-Economic Group code
IndustrialGroup	Industrial Group (8 codes)
ILOHours	Hours worked in previous week
Wgtpersons	Grossing Factor (Number of persons assigned to record in sample)

2.2 POWSAR Geography

The size of the sample varies from county to county and from town to town. While it was the original intention of the CSO to select a 30% sample, resource constraints led to this number being halved to a target of around 15%, still a very considerable number. Four main levels of geography are contained within the sample. The Planning Region (n=8) is recorded, as is the County (n=34). The ED is also recorded. There are 3,440 of these across the country with an average sample size per ED of 64, indicating the robustness of the dataset in statistical terms. A final level of geography is the Census Town where the sampled individual lives. A total of 183 towns are coded. This ‘town’ list also includes a code recorded as, ‘all other towns less than 1,500’ for individual rural counties, which has been slightly problematic when creating town-to-town matrices.

As noted above, the total sample size was 220,470 persons. As well as recording the ED code for the place of residence, this field also contains codes of the letters B (Place of work address blank or uncodeable), M (Mobile Worker) and W (Works mainly at or from home). The W code is usable in two ways. It can be linked to the home ED as it identifies individuals who work in the same ED in which they live. It also provides a record of respondents who stated they were home workers and it has been valuable to observe these data separately. The numbers of respondents, coded as B and M are 13,888 and 20,599 respectively. This represented in turn, 6.3% of the sample who were uncoded and 9.3% who were mobile workers. At county level the B (blank or uncoded) proportions ranged from 4.1% in Kilkenny to 11.0% in Donegal. The Mobile group may provide some interesting results but they are not discussed in any depth in this paper due to the lack of ‘geography’ associated with them when compared with the rest of the sample. The smallest proportions of mobile workers were recorded in the cities (averaging around 7% with a low of

5.8% in Dún Laoghaire-Rathdown) with the highest proportions recorded in rural counties such as Leitrim (13.4%).

When these missing and mobile workers are excluded the sample size for origin-destination workers is 185, 803. As a county sample, this averages out at 13.45% with a range from 12.7% in Dublin and Galway cities to 14.1% in Louth. Numerically, the samples range from 1,019 in Leitrim to 24,237 in Dublin City. The average county sample size is 5,465.

The initial detailed analysis of the data is based on four separate of matrices, created from the dataset, which show the volumes of persons moving across and within individual counties. These are attached as appendices to the paper and are listed in turn here;

- Numerical County to County Movement (Appendix 1)
- Summary data on Flows into Counties (Appendix 2)
- Summary data on Flows out of Counties (Appendix 3)
- Numerical Data on County to Town flows (Appendix 4)

These are briefly discussed later.

3.2.1 Data preparation and GIS data management

The initial analysis required a considerable amount of data development and data mining work to extract and geo-reference the raw data for use in a Geographical Information System (GIS) (Longley et. al, 2005). The primary geo-referencing work involved assigning ED centroid co-ordinates to both the place of work (POW) and place of residence (POR). Once the raw dataset had these two sets of X and Y co-ordinates assigned, the GIS was able to use an internal algorithm to map these as a digital cartographic point layer. As the initial geo-referencing assigned all individuals within an ED to the same point, a second stage of GIS modelling was required which dispersed the individuals around the centroid. This had the dual benefit of improving the visualisation and providing an inbuilt random distribution to provide additional data protection.

The data was then analysed in two forms. The first used a spider-mapping algorithm to show the visual spread of mobility between home and workplace. The second approach used point-in-polygon modelling within the GIS to produce a count of the total numbers associated with each ED. This data was further analysed by cross-tabulations within the GIS to support the process of defining town catchments. While space prevents a detailed discussion here and the process is still incomplete, the principal approach was to identify for any one ED, where the majority of its residents worked. This 'dominant' place of work (taken from the POWTownCty variable) was then coded against those individuals and they were assigned to the catchment of that place of work. In this way individual EDs in the country were assigned to specific catchments. This was not an unproblematic process and issues regularly arose around ED's with no clear dominant place of work as well as issues of spatial non-contiguity where islands of ED's for one catchment were isolated within catchments for another town.

Notwithstanding these problems, it was possible for the first time, to identify a set of exploratory urban employment catchments at a number of scales. It is best to define these as operating on three different levels. Level 1 is focused solely on the main cities of Dublin, Cork, Galway, Limerick and Waterford. It is felt that it is useful to identify the first layer of catchments at a national level to see how extensive they are. The main technical process is designed around the identification of the dominant employment location for each ED. Once this dominant location is identified, the ED is 'assigned' to that town's Travel Catchment Area (TCA).

A second order of analysis has been undertaken in relation to Gateways and hubs identified in the National Spatial Strategy (NSS). These incorporate the main cities from the previous level plus an additional set of: 1) Gateways such as Sligo, Letterkenny, Tullamore-Mullingar-Athlone and Dundalk and 2) hubs in the form of Ballina-Castlebar, Tuam, Ennis, Tralee-Killarney, Mallow, Kilkenny, Wexford, Cavan and Monaghan. A third level of analysis has attempted to address gaps left on the map after catchment areas for the Gateways and hubs have been delimited. These gaps were identified in a number of rural counties including Roscommon and Galway and in parts of the Southeast. The process at this stage has simply identified what can be described as a set of Level 1, Level 2 and Level 3 TCAs all of which are identified from the POWSAR data. The final process of assignation of EDs to TCAs will depend on the level of analysis. It is unlikely that the Level 1 will provide sufficient coverage of the country as a whole. Level 2 is valuable as it relates specifically to the NSS. Level 3 is, however, arguably more comprehensive in terms of providing a set of full national TCAs, which are developed out of high-level sample data.

3.2.3 Initial Results

Again, space prevents extensive reporting of results but instead a number of local exemplars are presented to show how the data have been analysed and visualised within and outside the GIS. Some preliminary results are presented as examples of what can be achieved. The two datasets are outlined in different formats to give a flavour of how the results can be presented.

The Midlands Hub

Analysis was carried out on the three towns of Athlone, Mullingar and Tullamore. For each of these towns, the respondents who listed it as their place of work were extracted from the original POWSAR data set. The results of both processes are summarised below in graphical and tabular form. The graphical files are attached separately while the numerical results are listed in the table below. There are two distinct datasets used in the analysis. The first is a listing from the POWSAR data of all of the sampled population who WORKED in the towns. The second is a separate listing of all of the sampled population who LIVED in each town. By tabulating in this way, a rudimentary set of comparative profiles of each of the adjacent towns can be built up which helps identify extremely localised patterns of employment mobility. For example, approximately half of those who work in Athlone or Mullingar live with five kilometres of the towns. It is also very noteworthy that approximately half or the workers living in either Mullingar or Tullamore do not work in the towns.

Table 5. Preliminary Results from POWSAR data: Midland Gateway Towns

Town	Athlone	Mullingar	Tullamore
2002 Population	15,936	15,621	11,098
Persons at work	5,749	6,372	4,597
Size of Sample A (Work in Town)	858	995	924
Average Distance Travelled (in km)	13.75	11.45	13.85
Maximum Distance Travelled (in km)	192.1	169.3	173.5
% of Sample who live within 5 km of town	49.1%	49.6%	40.2%
% of Sample who live within 10 km of town	67.4%	60.3%	52.3%
Size of Sample B (Live in Town)	793	882	599
Number who live and work in town	339	433	319
% Living and working in town	42.7%	49.1%	53.3%

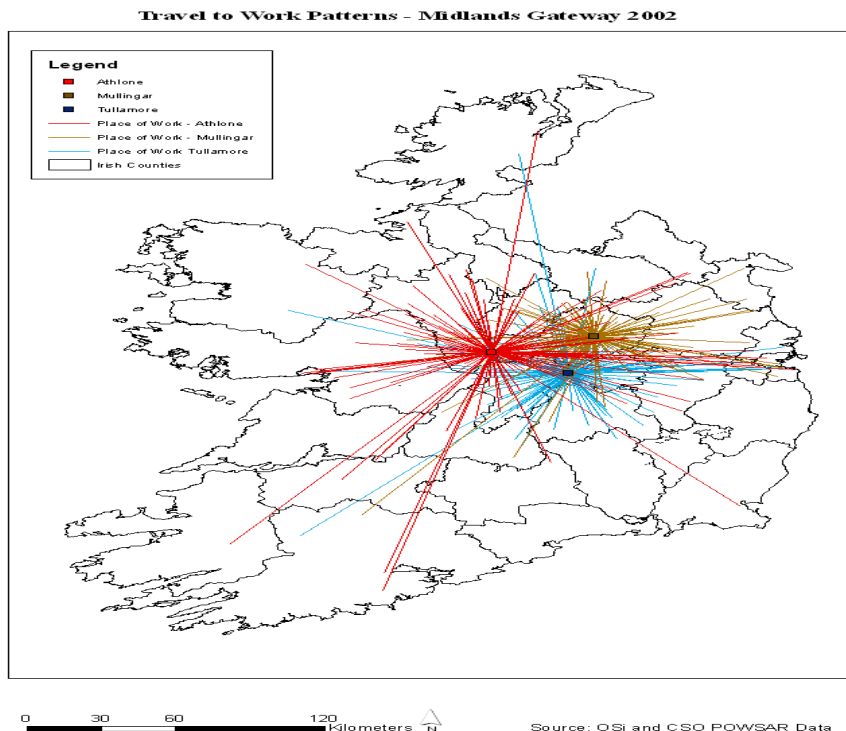
The graphical versions were created within the GIS and visualise the origin-destination process through a set of 'spider-diagrams'. Again this is a process, which is only really feasible within a GIS system where precise location co-ordinates are used alongside the systems analytical properties. Map 9 shows the travel to work flows of all three towns together and from it one can get a sense of which are the more centralised (arguably Tullamore) and which are the more dispersed (possibly Athlone).

Limerick City

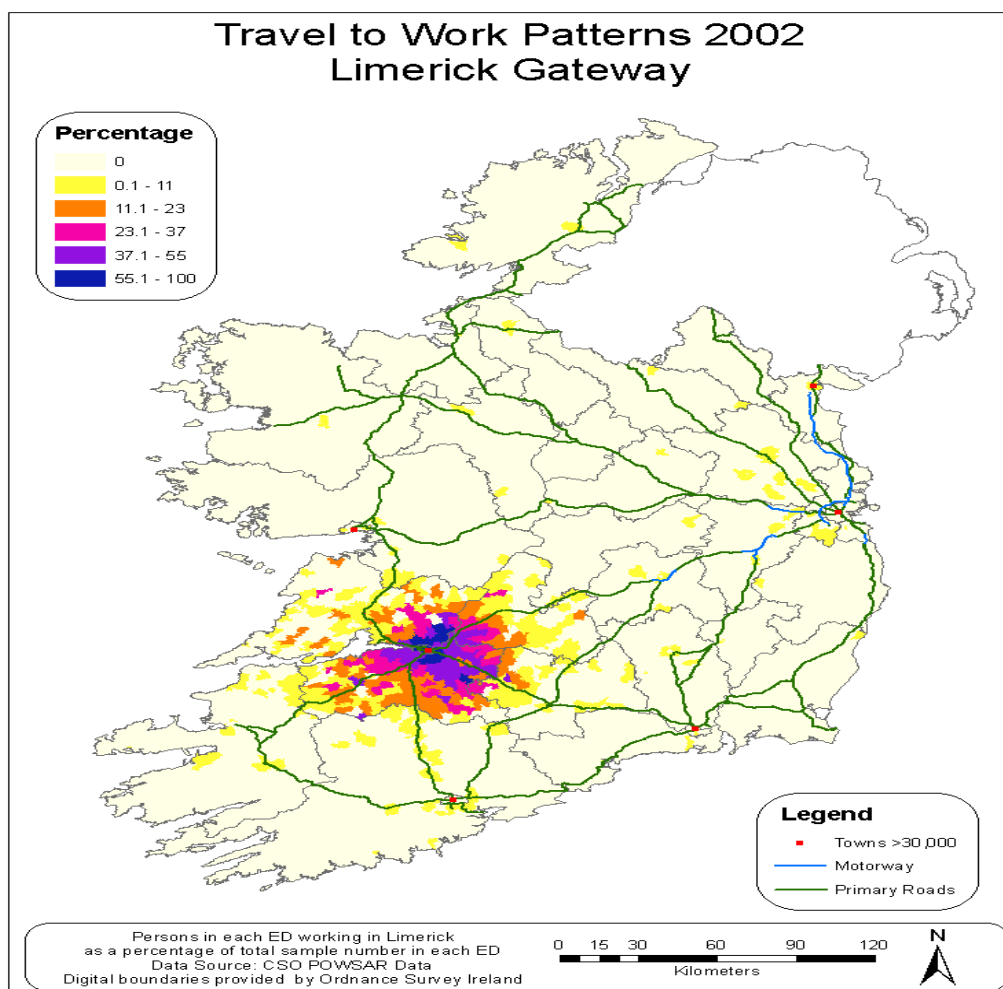
The data for Limerick was also modelled in the same way but a number of extra considerations had to be factored in. These related primarily to the additional complexity of modelling a city with a relatively large number of EDs. As such a more area-based cartography was used to sum individuals who worked in Limerick against their home ED's. This was carried out within the GIS using a combination of a spatial join and a point-in-polygon routine. On Map 10 the data for individual ED's is based on the proportion of that ED's sample who stated that they worked in Limerick City.

By mapping the data as a choropleth map (as opposed to the spider mapping carried out in the previous example), two factors are brought out. The first is the concentration of the largest numbers of workers in the ED's nearest the city and the relatively low numbers living in more distant ED's. The choropleth map approach is therefore able to identify the core catchment area, which accounts for well over 90% of Limerick's workers. Secondly, the choropleth mapping also identifies some dispersed EDs throughout the country from which workers travel to Limerick city.

Map 9: Spider Diagram of Travel to Work Flows in the Midlands Hub



Map 10: Choropleth Map of Commuting Flows in Limerick



The data indicate that approximately 37% of the total workers were Limerick City residents, but this figure may well be an underestimate as it does not include residents of a number of suburban EDs. Indeed Limerick is well known as having a significant part of its built-up area within county Limerick and also county Clare. Similar maps have been constructed to illustrate the extent of the worker catchment areas for Dublin, Cork, Galway, Waterford, Limerick and the midland Athlone-Tullamore-Midland Gateway (Maps 11-15 and Map 17). An additional map illustrates the extent of the proposed 'Atlantic City' linking Galway, Limerick, Cork and possibly Waterford as a potential second polycentric network on the island to rival the Dublin-Belfast corridor (Map 16).

Intensity of interactions

The second main thrust of the analysis is to use this large sample to help create for the first time ever a map of Travel Catchments Areas (TCA) across the country as a whole. Given the ability to map both origins and destinations, it is possible to note the dominance of any one town or city as a place of work for individuals within any ED nationally. There are a number of statistical and geographical elements that made this a complex and as yet, an unfinished process. Following the

assignment of EDs to selected urban destination zones it is possible to produce a set of maps that reflect the intensity of interaction within each catchment area. For each catchment three levels of intensity of interaction have been selected which are represented by variations in the intensity of the shading on the following maps. The darkest shading represents those 'CORE' EDs, which had greater than 50% of their sampled population working in the catchment area urban centre. A medium shading represented 'INTERMEDIATE' EDs with 25 to 49% of the sample population working in the town while the lightest shading represented 'PERIPHERAL' EDs with values of between 10 and 24%. The choice of these cut-off points was based partially on observations of the data modelled for individual cities and towns. The issue of duplication of assignment of EDs arose only in a small number of cases, which must be due in part to the spacing between urban centres in Ireland. Duplication of assignment or overlapping catchment areas is much more likely to be an issue in regions with extensive areas of high population density which is not the norm in Ireland. Where equal numbers of workers from an ED commuted to two or more destinations the ED was assigned to one destination by taking account of the travel to work patterns of neighbouring EDs. By selecting a cut-off minimum of 10% many, though not all, of these problems were overcome. Applying the rules summarised above Map 18 identifies the intensity of interactions within the catchments of all the NSS Gateways and Hubs. There are a few points to note in relation to the map. The core area for Dublin includes all of the old county plus much of north Wicklow, northeast Kildare, plus east and south Meath. Linking the EDs identified as comprising the core back to the CSO Census 2002 SAPS files it is possible to estimate the population total and other attributes of these areas. Thus the core area population in 2002 was 1,274,830, some 90,350 (7.6%) more than in 1996. The estimated population of the total catchment area for Dublin is 1,642,256 or 42% of the total. The population increase in the area between 1996-2002 was 150,503 or 51.7% of the increase for the State with the highest rate of increase in the intermediate zone at 26.2%. Similarly, it is estimated that the Dublin catchment area includes a workforce of more than 730,000 or 44.6 % of the total in the State and the area accounted for just under half (49.4%) of the growth in the workforce. Estimates of the 2002 population and the level of change between 1996-2002 for each of the Gateways and Hubs are contained in the following table.

Table 6: Estimates of 2002 population and changes 1996-2002 for Gateways and Hubs.

Gateway / Hub	Population 2002	Change 1996-2002	% Change
Dublin	1,642,256	150,503	10.1
Cork	382,490	25,761	7.2
Galway	184,371	19,796	12.0
Limerick/Ennis	260,686	20,192	8.4
Waterford	110,954	10,329	10.3
Athlone	41,128	2,423	6.3
Tullamore	47,361	3,423	7.8
Mullingar	46,439	6,419	16.0
ATM	134,928	11,975	9.7
Sligo	68,176	2785	4.3
Dundalk	62,701	3,781	6.4
Letterkenny	59,851	5,572	10.3
Tralee/Killarney	117,135	5,565	5.0
Castlebar/Ballina	97,848	5,605	6.1
Kilkenny	67,854	4,508	7.1
Wexford	62,123	6,225	11.1
Cavan	35,974	1,934	5.7
Monaghan	30,092	558	1.9
Mallow	21,139	1,348	6.8
Tuam	18,401	343	1.9
Ireland	3,917,203	291,116	8.0

Taken together the Gateways and their catchments included 73% of total population in 2002 and they accounted for 83% of the total population increase between 1996 and 2002. The comparable figures for the Hubs are 10% of the total population and 8% of the population increase. Therefore, the remaining areas beyond the catchments of the combined Gateways and Hubs included 17% of the total population and 9% of the population increase 1996-2002 which are significantly large numbers.

Table 6 demonstrates some notable differences between the Gateways and hubs in the rate of population change which may be regarded as a proxy index of their overall performance in recent times. Cork is the only one of the first rank Gateways with a population growth less than the national average of 8.0%. When compared against the increase for all Gateways (9.2%) the Limerick / Ennis Gateway increase of 8.4% is less than might be expected. The highest level of increase was in Galway followed by the Mullingar component of the Midland Gateway, though in this case a major influence is the extent of commuting to Dublin. The remaining components of the Midland Gateway along with Sligo and Dundalk have growth rates that are significantly below average. The same holds true for each of the Hubs with the exception of Wexford. The levels of increase in the Monaghan and Tuam Hubs are particularly low.

Another notable aspect of Map 18, which shows the hinterlands of all the Gateways and Hubs, is that there are extensive areas from which people do not travel in any significant numbers to either a Gateway or a Hub. These include most of Tipperary, west Waterford, Carlow, north Wexford, Laois, north Roscommon, Longford, south Leitrim, west Cavan and the remoter parts along the west coast from Donegal to west Cork. While population densities in many of these areas are low the total numbers involved are relatively large amounting to almost 666,000 for the State. Clearly in many of these areas small traditional market towns have a significant role as places of employment. These towns include Carlow, Arklow, Clonmel, Thurles, Nenagh, Portlaoise, Dungarvan, Bantry, Skibbereen, Clifden and Dingle Donegal, Carrick-on-Shannon, Longford and Roscommon. Their local roles are evident when their catchments are added to the Gateways and Hubs map, (Map 19).

2.3 Further insights from POWSAR

As identified previously, there are a number of statistical outputs related to the POWSAR data set. These include four separate tables, listed fully in the Appendices, which identify flows between different geographical units. The full tables are summarised here to pick out the key observed patterns and numerical results. The first table relates a simple numerical count of the sample workers that travel within and between the 34 local authority areas (Appendix 1). This table records a list of how many individuals from a specific county work in any other county and also identifies the national share as recorded in the sample for each individual county. So for example, the total number from the sample for Dublin City is 38,027, which is 17.35% of the national total. Of that total, the number of Dublin City based workers who live in other counties is also recorded. For example, 1,459 of the Meath sample of residents and 1,837 of the Kildare sample of residents are recorded as working in Dublin City. The second and third table are closely related to the first and record respectively, the percentage data for the row and column denominators. So for example the numbers listed above for Meath and Kildare residents respectively suggest that they form 3.8% and 4.8% of the Dublin City workforce (Appendix 2). The next Table (Appendix 3) records the percentage of all Meath and Kildare residents who work in Dublin City. In this case 18.1% of all Meath residents are recorded as working in Dublin City whereas the proportion for Kildare is slightly smaller at 17.9%.

It is important to note the relationship between home location and the percentage of the sample working 'within county' as recorded in Appendix 3. The three 'suburban' counties around Dublin City all recorded less than 50% of their populations actually working in the county, emphasising their role as commuting counties. Donegal on the other hand had over 98% of its' sample population working in the county. Other counties recording over 90% 'in-county' work patterns included the geographically remote counties of Kerry and Mayo. Interestingly both Cork and Limerick cities are net exporters of workers to workplaces in the adjoining counties. The pattern of the home county being the dominant work location is also recorded in Appendix 3. Again there is some variation within this, especially in and around the urban counties. Dublin City is still the dominant destination for the neighbouring counties of Fingal (40.1%), South Dublin (36.2%) and Dun Laoghaire-Rathdown (38.5%). At the other end of the scale, the highest proportions recorded as working 'in-county' are in the cities of Waterford (73.0%), Galway (71.7%) and Cork (70.5%), emphasising, their higher levels of containment.

The final table records data on County to Town flows (Appendix 4). This records the flows in numerical terms from counties to individual towns. While the larger cities exhibit similar patterns to the county level mapping, the ability to look at work flows to individual towns is something which has not been previously possible. Looking at the data for the towns of Leixlip and Naas in County Kildare, we can see that the sample sizes are 980 and 827 respectively. Less than half, 487, of those working in Leixlip actually live in Kildare with the remainder being drawn from eighteen different counties. This contrasts with data for county towns such as Portlaoise and Roscommon where typically much higher proportions are recorded from 'in-county'. So for example the proportion of Portlaoise's workers who are from County Laois is 80.3% and for Roscommon, the equivalent figure is 83.4%. The potential for this type of mapping to inform economic and development planning at a local sub-county level is considerable.

3. CONCLUSIONS AND IMPLICATIONS

The description, mapping and analysis of travel to work data have revealed some insights that have relevance for a number of areas of public policy. Here we focus on just a few.

The first is the evidence that the travel to work for the Greater Dublin area is very extensive. While this has been known for some time from previous work it has not been possible prior to the availability of the POWSAR data to estimate the number share of the Dublin workforce coming from adjoining counties. This has direct relevance for the standardisation of the CSO estimates of Regional Accounts. We estimate that 12.6% of the workforce actually working in the four Dublin Local Authorities commutes from the three neighbouring counties. This proportion is large enough to significantly distort estimates of per capita GVA for Dublin and also for the Mid East region. With the expansion of the commuter zone beyond the GDA counties into Louth, plus parts of the Midland and Southeast regions the per capita GVA estimates for the GDA are also somewhat inflated as we estimate that 4.7% of the GDA workforce comes from outside the region. These correction factors have relevance in the context of regional policy where per capita GVA is frequently used as a measure of the disparities between regions.

A second issue arising from the mapping of the Gateway and hub town hinterlands relates to the differentials in the population growth rates. The below average growth rates of Cork and Limerick/Ennis should be a cause for concern. Even more so is the very weak position of some of the Hub towns while at the same time there are other areas which are not within the catchment areas of either a Gateway or a hub town. Clearly there are major challenges to overcome if the goals of the National Spatial Strategy are to be achieved. Some radical and proactive support

initiatives will be required in order to break away from established trends. This is particularly true in relation to the novel proposal for a linked Gateway in the Midland region. These challenges have an added urgency in light of the recently published CSO regional population projections.

The POWSAR sample taken in conjunction with the CSO small area statistics (SAPS) offers the potential to undertake some analysis of the size and diversity of regional/local labour markets. This could be a very useful input to strategies for regional development. The matrices of flows of workers could form a very useful component of future formal models of the regional economies.

A third area of concern arising from the mapping of the length and duration of journeys to work relates to the environmental sustainability and the impacts on quality of life for the increasing numbers of long distance commuters. The impacts are not only confined to the very long distance commuters because, as already demonstrated, very long journey times are also being experienced over some of the shorter distances due to the build up of congestion as the primary routes converge on Dublin.

Finally, the mapping has highlighted the spatial information gaps that arise from the presence of the Border. There is clearly a need to explore how data on movement patterns in Northern Ireland can be reconciled with the data now available from the CSO. Cross-border commuting and other associated behavioural patterns such as retailing have implications for the viability of towns and their hinterlands on both sides of the Border.

3.1 Further work

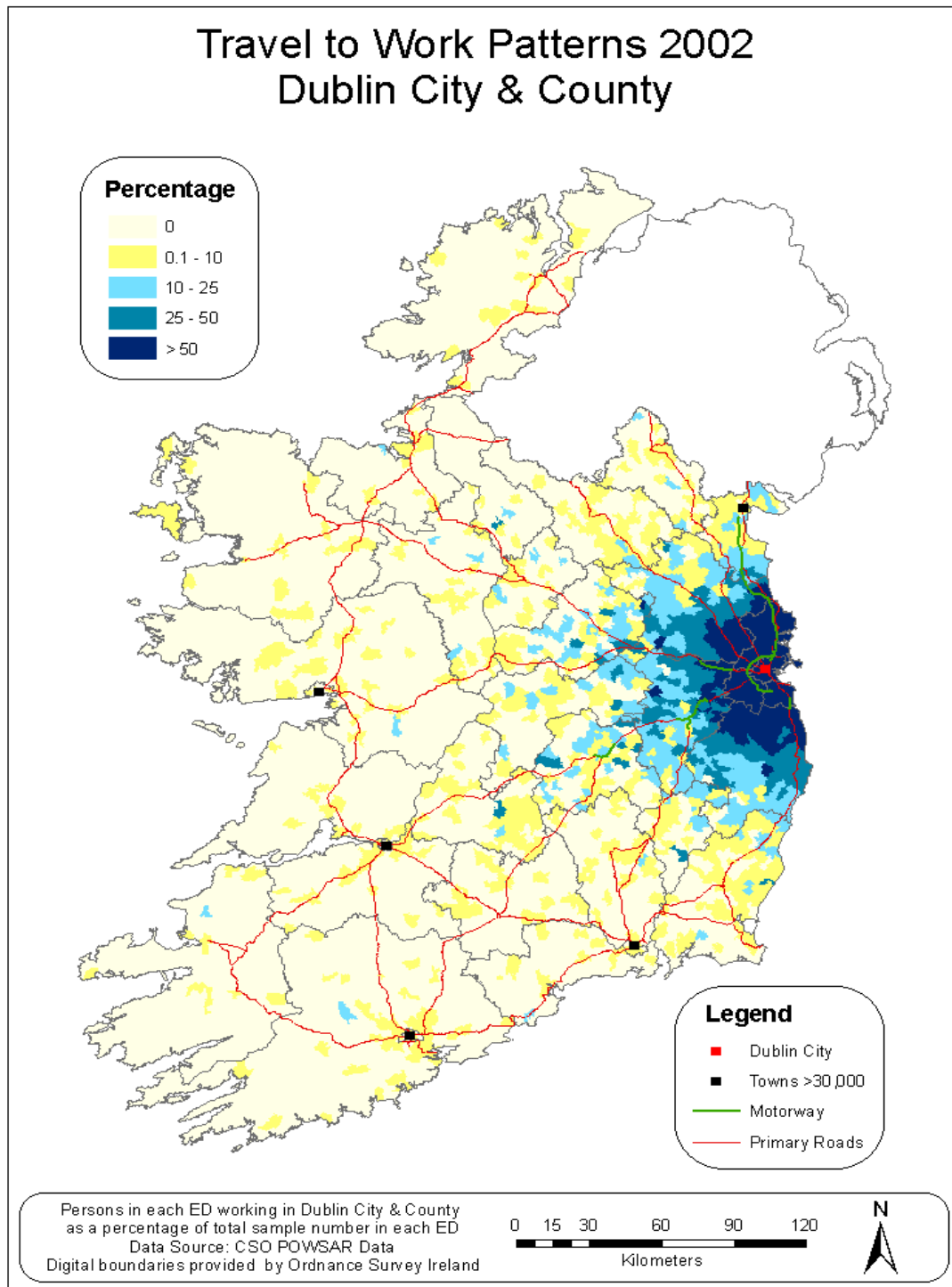
There are three stages for the further technical development of the work to date. Initially, a final assignation of ED's to create a full set of Level 1, 2 and 3 TCAs needs to be carried out. It is the intention to investigate the potential of GIS-based algorithms to automate this process (Coombes et. al. 1986). In Great Britain and Northern Ireland a national set of Travel to Work Areas (TTWAs) were created by the National Statistics Office in 1984 and updated for 1998. These TTWA's were based around specific criteria for proportions of people living and working in those areas. Interestingly, the method identified 18 separate TTWA areas for Northern Ireland (Hastings 2004). Once these defined TCAs have been created it should be possible to start profiling the TCAs at either Level 2 or Level 3, whichever is most appropriate. This will allow the incorporation of the rich additional data variables listed in Table 1 such as Gender, Age, Tenure and SEG. Profiling those individuals from the sample who had lived elsewhere in the previous year might also help understand spatio-temporal patterns of mobility, employment and the housing market. As a final stage, the ability to code the data by town means that profiling by individual town is also feasible, something which has been partially touched upon earlier.

There are a number of strategic planning advantages to this as clarification of TCA's may form the basis for associated social, industrial and economic analysis within the wider setting of the NSS to put some logical geography around what is currently a point based initiative. By identifying more accurately the catchments, the logic and robustness of the identified gateways and hubs might be testable against other area-based measures. This in turn might form an appropriate spatial unit to realistically test the plan against over the next decade. The second profiling stage would augment the process by enabling comparisons between TCAs, which would prove invaluable to the equitable planning in the non-metropolitan parts of the country. It would also enable comparisons linking back to both the full 2002 Census data and to regional/county level plans. By modelling at individual town level, the differences between similar sized towns in different regions might provide additional knowledge on local economies and the potential for sub-regional development.

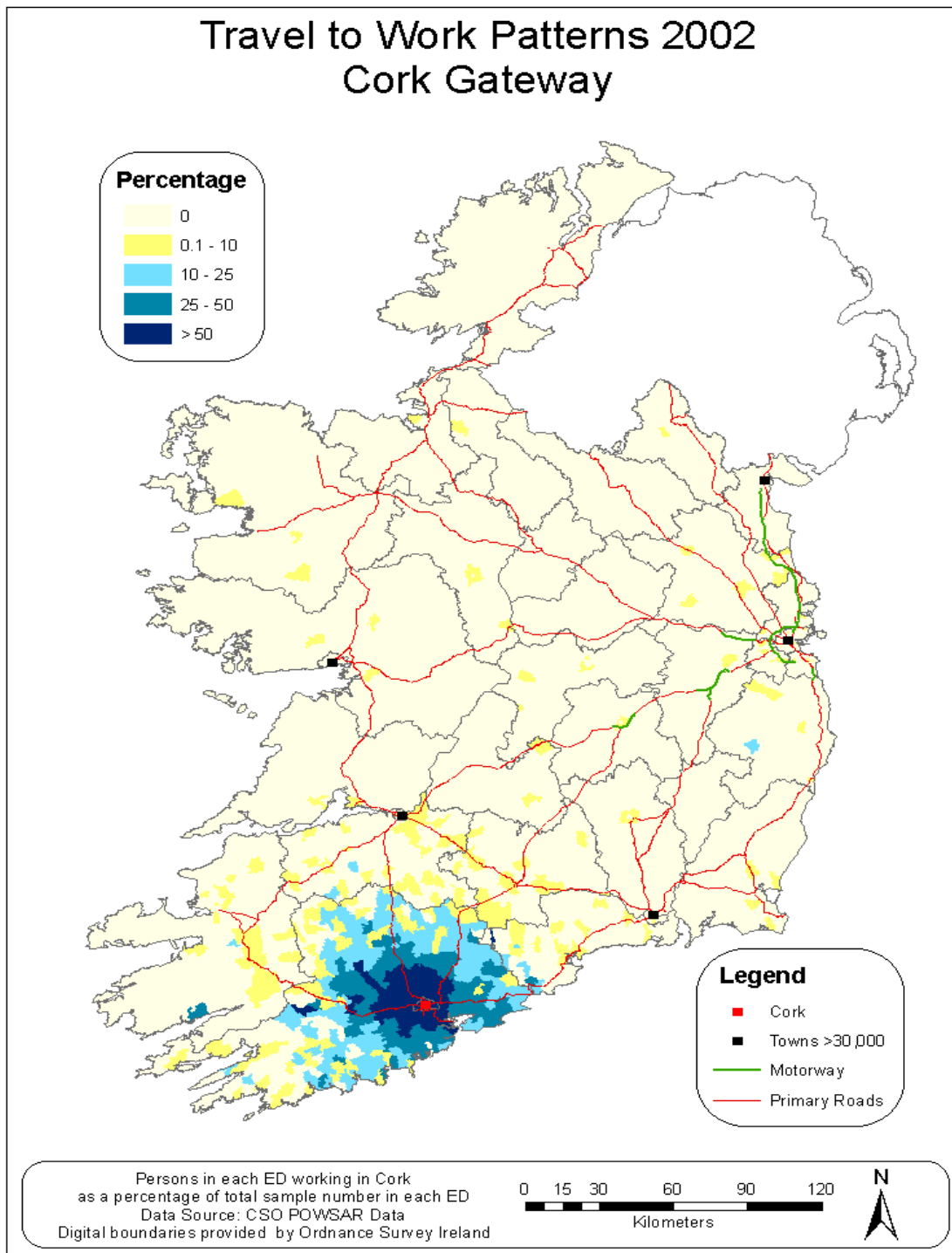
REFERENCES

- Central Statistics Office (2003a)** Principal Demographic Results. Dublin, Stationary Office.
- Central Statistics Office (2003b)** Principal Socio-economic Results. Dublin, Stationary Office.
- Central Statistics Office (2004a)**. Volume 9 – Travel to Work, School and College. Dublin, Stationary Office.
- Central Statistics Office (2004b)** Census of Population 2002 Place of Work Sample of Anonymised Records (POWSAR) User Guide. Dublin, Stationary Office.
- Coombes, M. G., A. E. Green and S. Openshaw (1986)** ‘An Efficient Algorithm to Generate Official Statistical Reporting Areas’, *Journal of the Operational Research Society*, 37(10), 943-53.
- Hastings, D. (2004)** Local Areas Jobs Densities, Labour Market Trends, August, 331-338.
- Horner, A. A. (1999)** The Tiger Stirring: Aspects of Commuting in the Republic of Ireland 1981-1996, *Irish Geography*, 32, 2, 99-111.
- Longley, M., M. Goodchild, D. Maguire and D. Rhind (2005)** Geographic Information Systems and Science (2nd Edition.). Chichester, John Wiley.

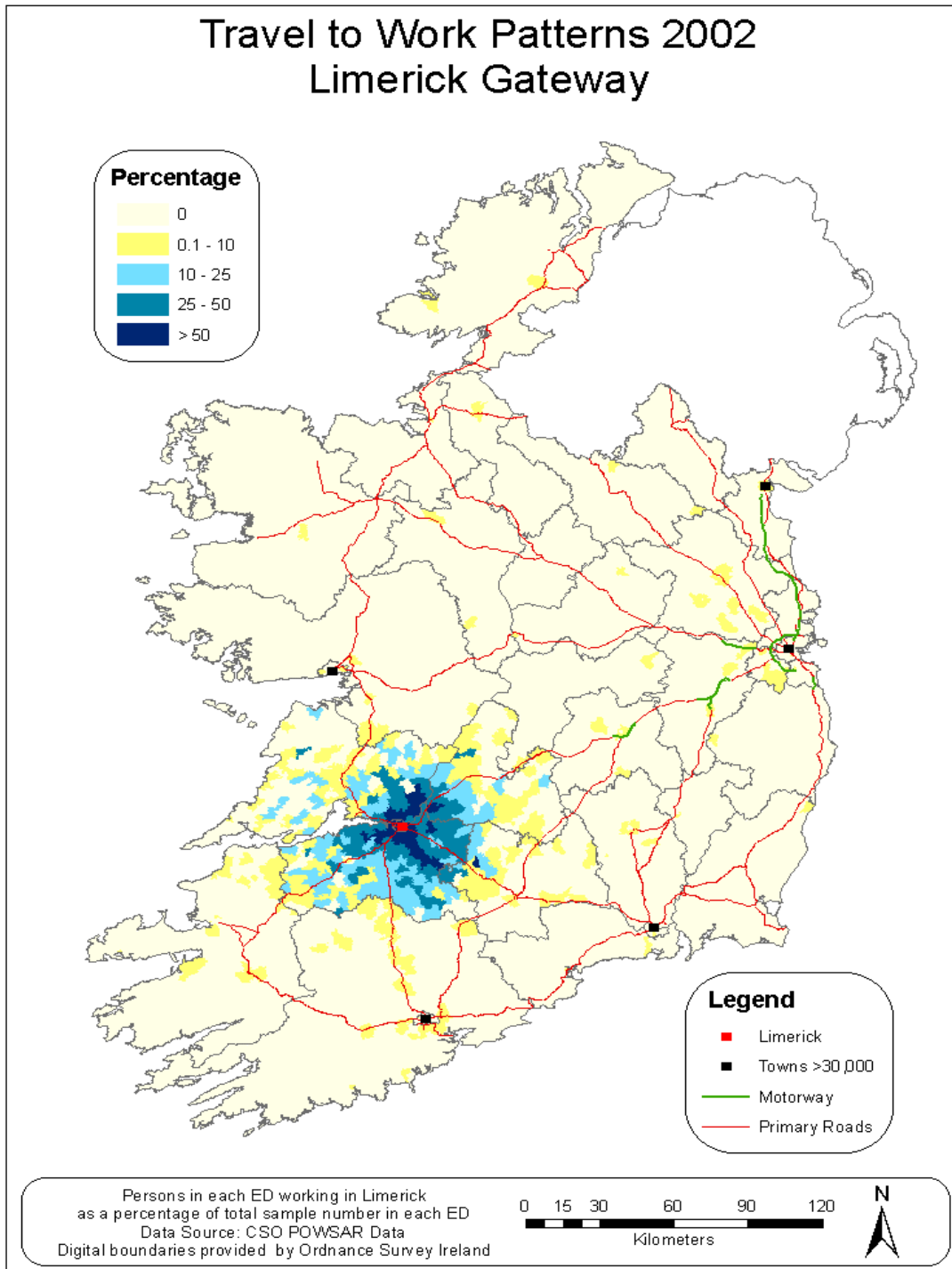
Map 11: Choropleth Map of Commuting Flows in Dublin City & County



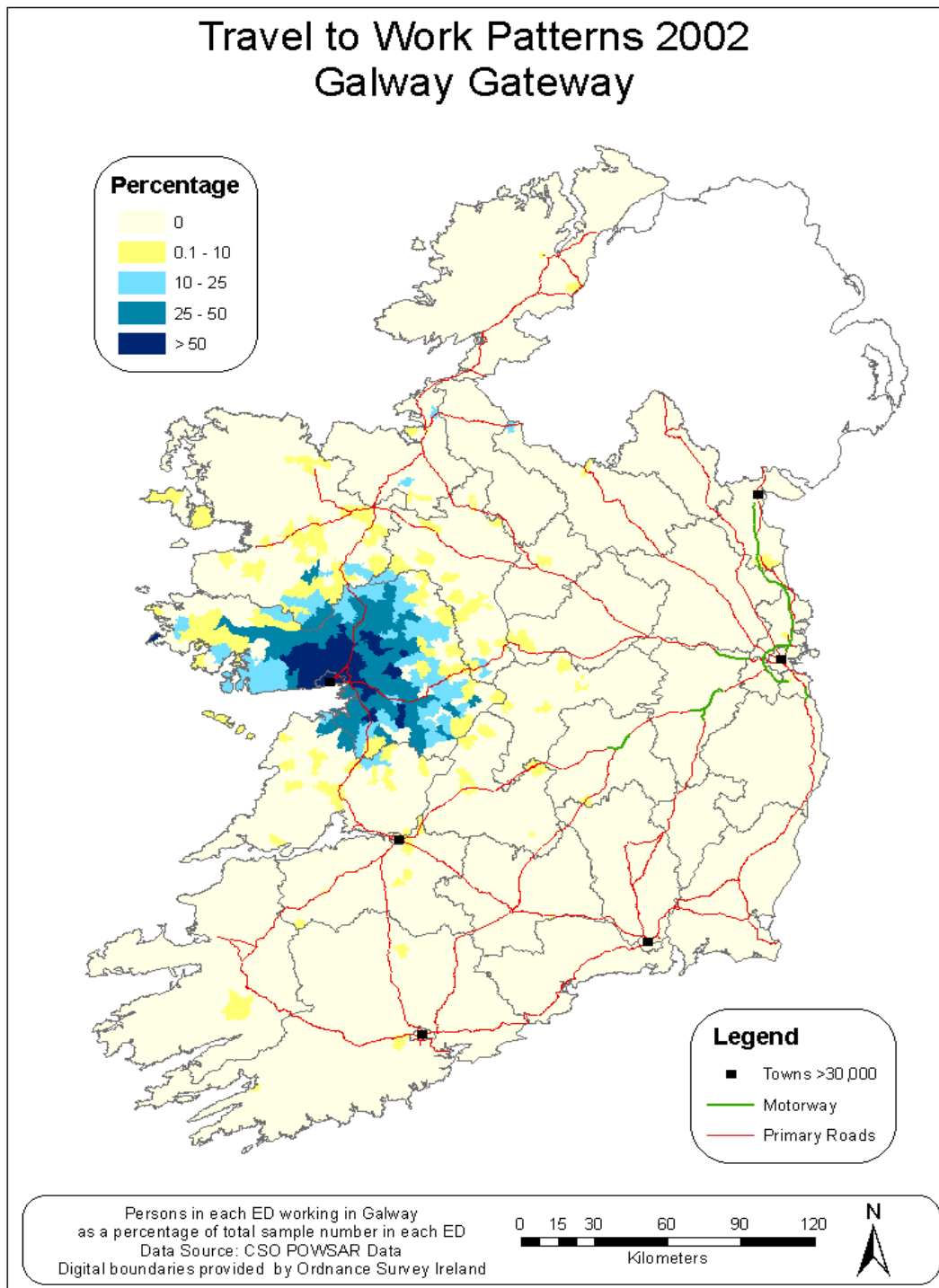
Map 12: Choropleth Map of Commuting Flows in Cork



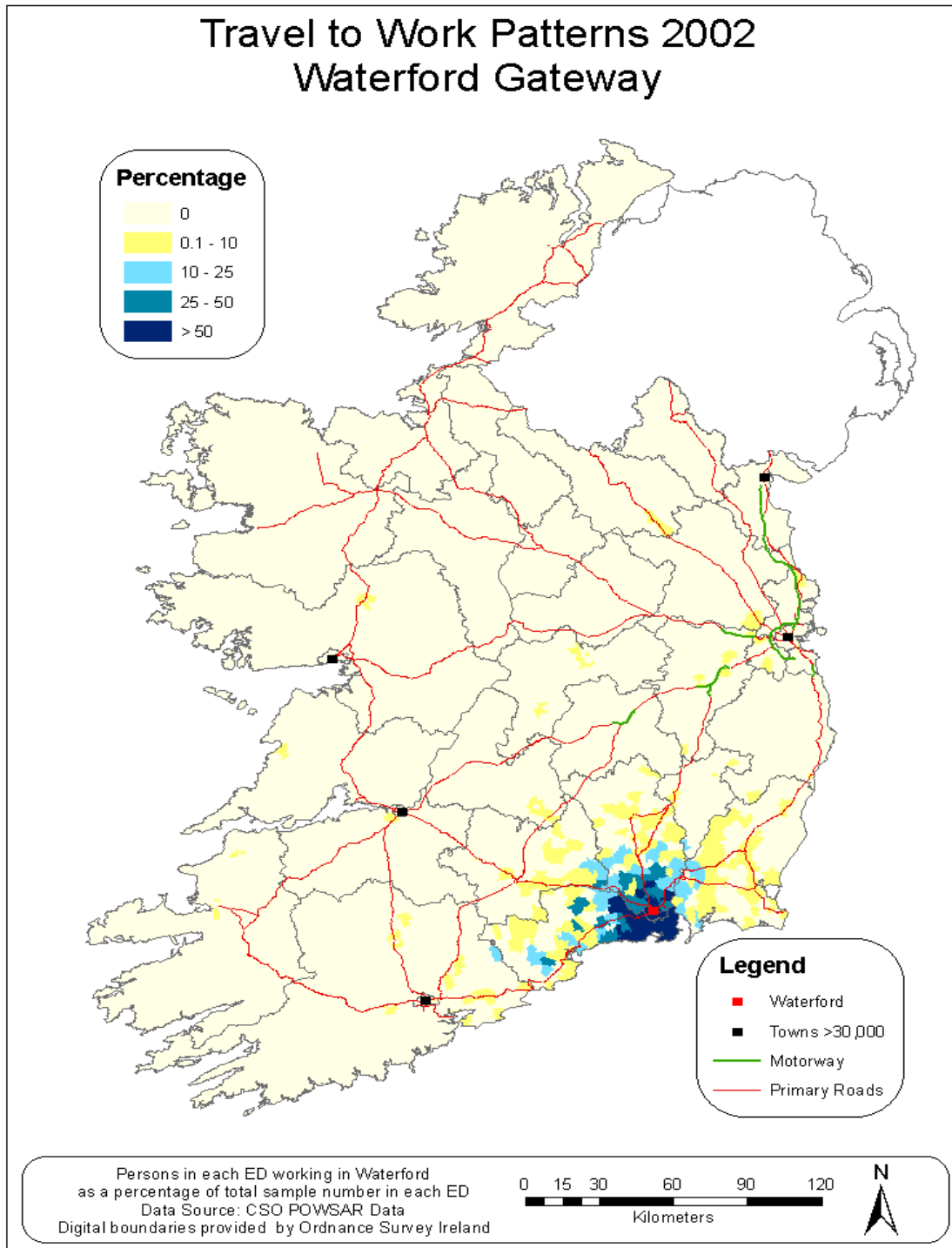
Map 13: Choropleth Map of Commuting Flows in Limerick



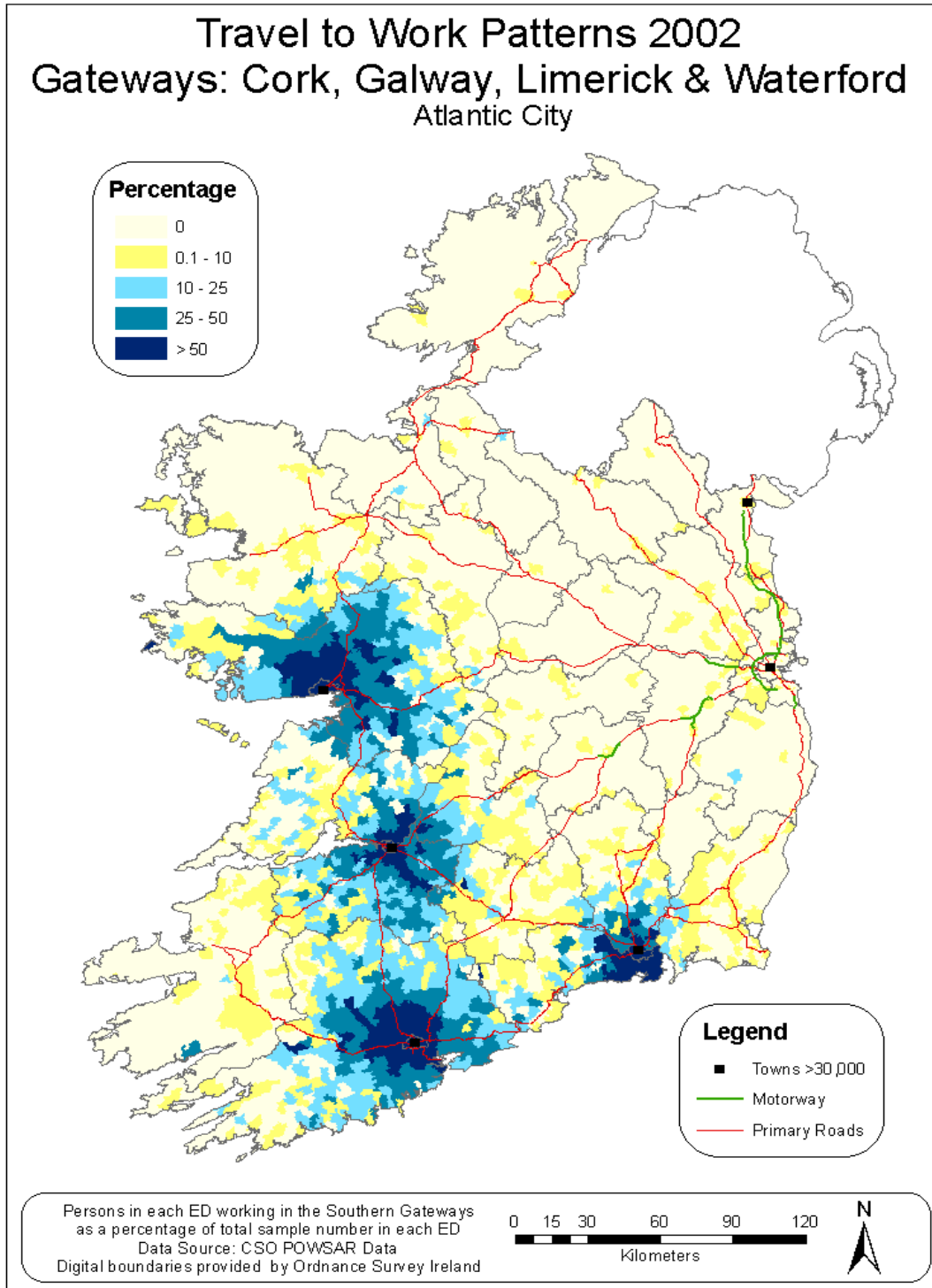
Map 14: Choropleth Map of Commuting Flows in Galway



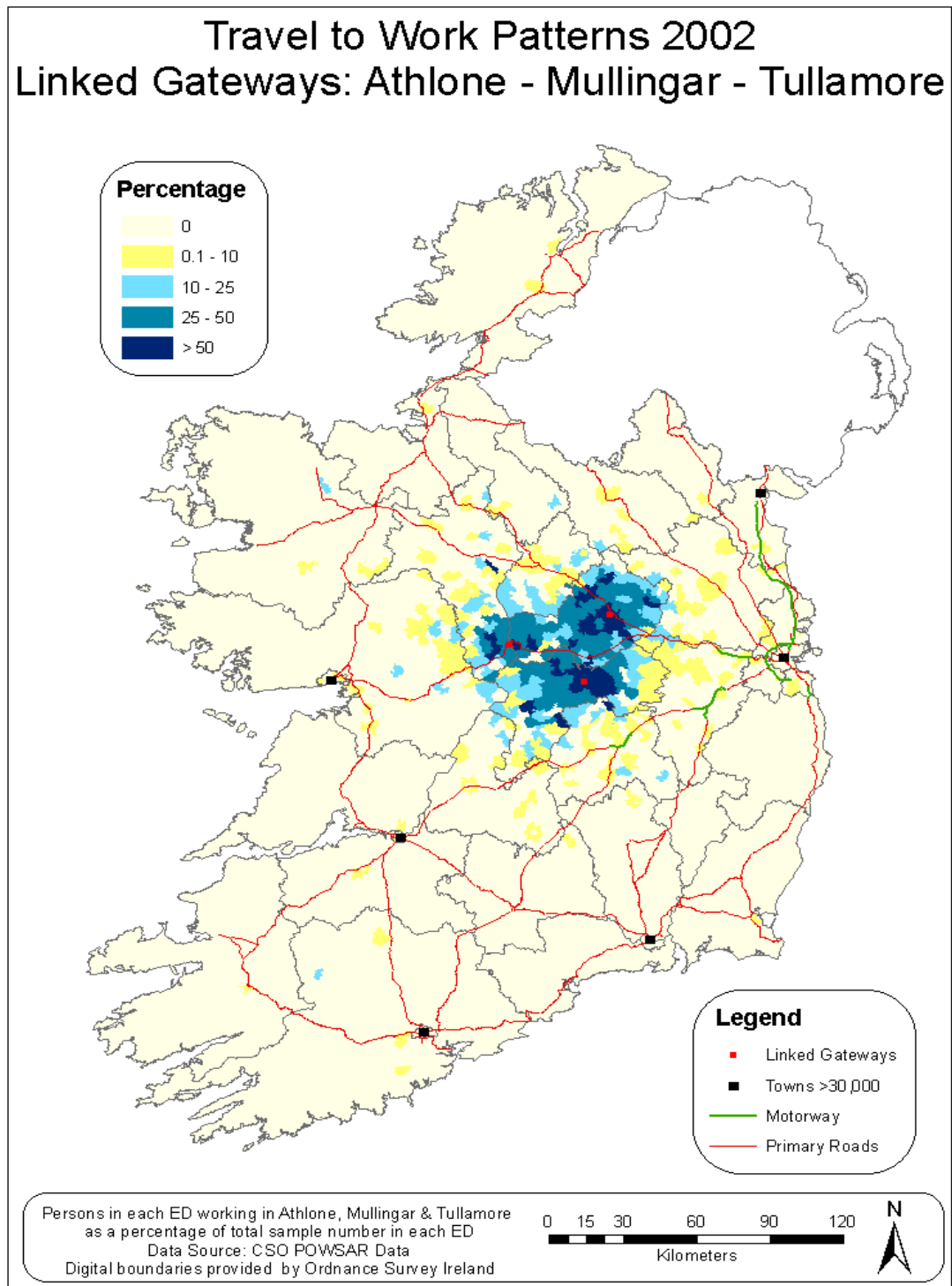
Map 15: Choropleth Map of Commuting Flows in Waterford



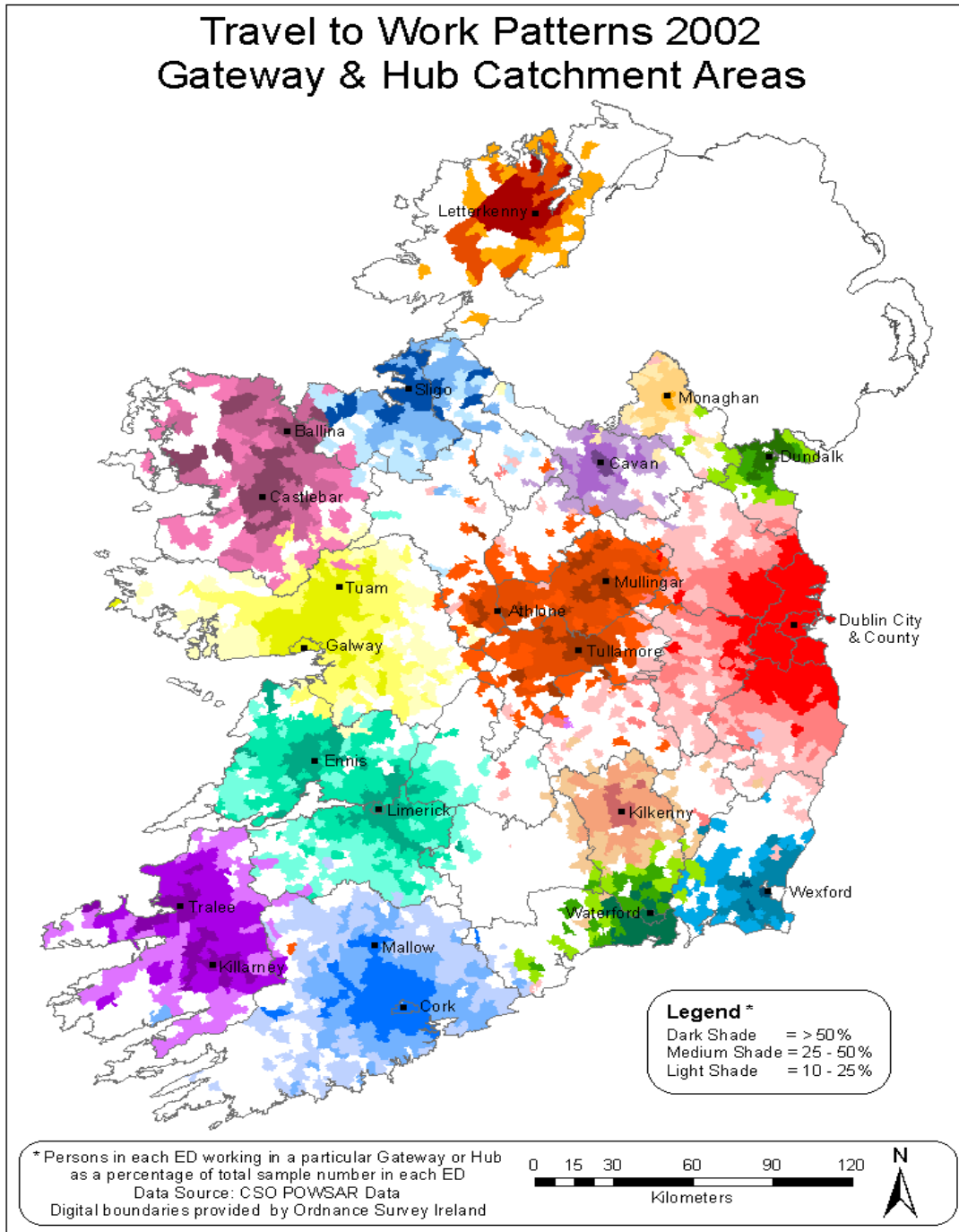
Map 16: Choropleth Map of Commuting Flows in Atlantic City



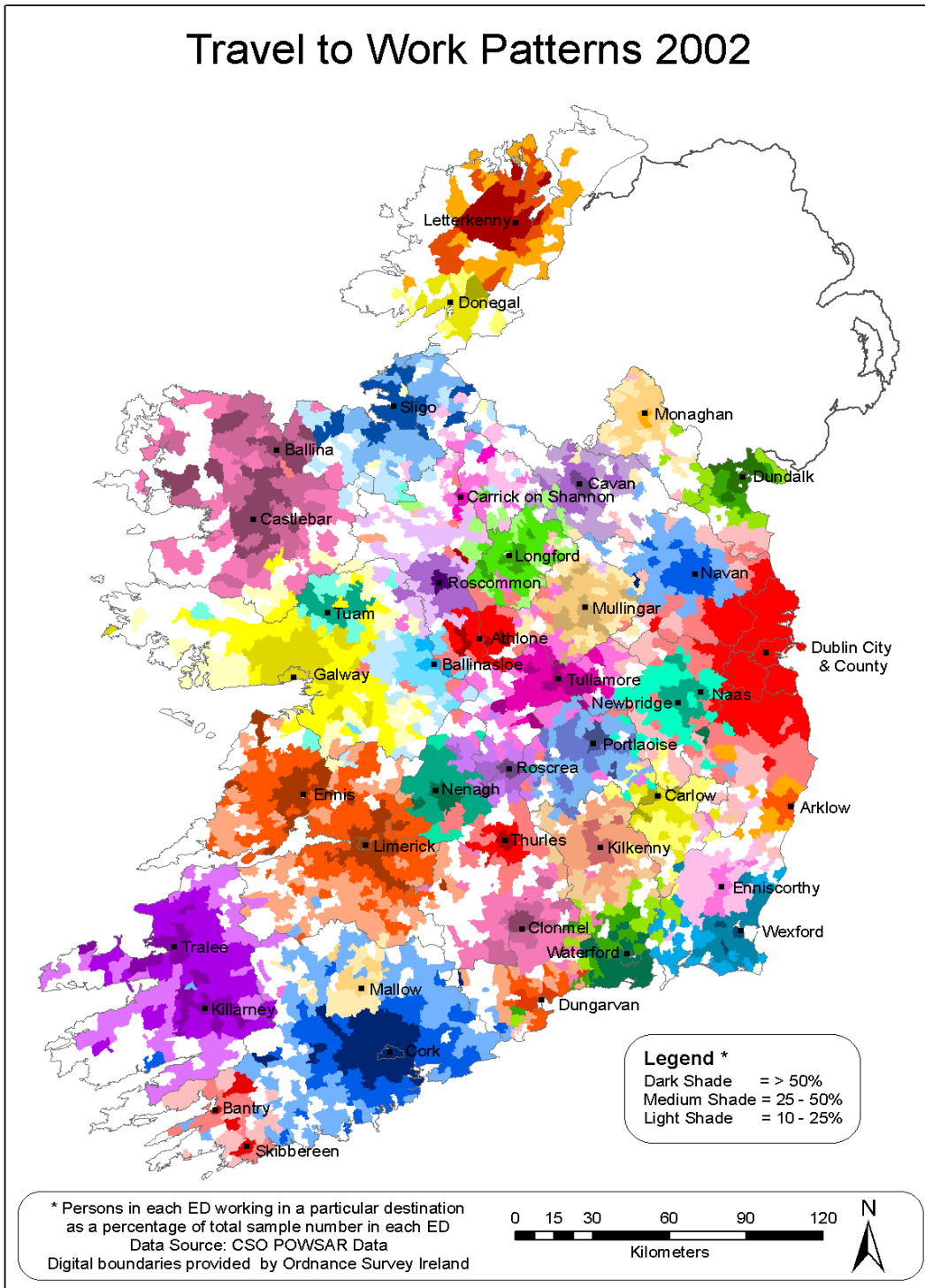
Map 17: Choropleth Map of Commuting Flows in Midland Gateways



Map 18: Choropleth Map of Travel to Work Patterns for Gateways & Hubs



Map 19: National Travel to Work Patterns, 2002



Appendix 1: County to County Flows - Origins and Destinations

	CW	D	SD	DF	DLR	KE	KK	LS	LD	LH	MH	OY	WH	WX	WW	CE	C	CCY	KY	LK
Carlow	1,261	54	51	12	9	99	125	43	0	1	0	0	0	70	89	0	0	2	0	1
Dublin City	7	17,543	1,759	2,129	1,375	161	5	13	3	26	75	4	3	6	100	2	14	6	2	8
South Dublin	3	5,496	4,949	470	851	368	2	11	0	10	38	5	4	4	82	2	9	2	1	8
Fingal	0	5,117	531	4,229	276	98	2	5	1	63	170	4	1	2	23	1	3	0	1	
Dun Laoghaire-Rathdown	2	4,387	636	204	3,945	41	0	3	0	5	9	2	4	7	351	0	6	0	3	2
Kildare	61	1,837	1,183	304	192	4,112	25	59	6	11	96	52	22	4	130	0	1	3	1	4
Kilkenny	74	29	8	7	4	22	2,430	30	0	1	3	2	0	81	4	1	3	0	0	4
Laoighis	148	144	67	16	13	214	84	1,389	0	1	6	111	9	2	5	1	1	4	0	3
Longford	0	23	3	3	2	2	2	876	0	6	9	91	0	1	0	0	0	0	0	
Louth	1	338	58	220	45	19	2	1	0	3,425	190	0	5	0	2	0	0	1	1	2
Meath	3	1,459	262	730	92	168	6	4	2	367	2,677	10	62	1	6	0	5	1	0	5
Offaly	4	90	48	20	9	114	2	114	6	2	14	1,678	181	1	10	3	3	1	0	2
Westmeath	0	155	64	32	14	56	1	5	67	5	111	130	2,201	1	2	0	1	0	0	3
Wexford	40	62	25	8	53	14	55	1	0	1	1	0	1	3,815	190	1	4	4	2	1
Wicklow	50	976	244	66	762	93	4	0	0	0	7	0	1	58	2,609	0	4	1	0	1
Clare	0	13	4	2	3	0	0	1	0	0	1	0	1	1	0	3,335	3	7	1	653
Cork City	0	16	6	3	3	4	1	1	0	2	1	0	1	0	0	3	4,421	620	4	2
Cork County	1	38	18	8	10	5	2	2	0	2	1	2	4	5	2	17	6,093	7,090	84	40
Kerry	1	9	2	2	2	1	0	2	0	0	1	0	2	1	0	7	23	119	4,390	22
Limerick City	0	6	1	0	0	0	0	1	0	1	0	0	2	1	0	266	5	5	5	1,617
Limerick County	0	14	9	2	1	2	2	5	0	2	0	3	1	4	0	347	41	185	82	2,028
Tipperary North	1	38	8	3	3	12	37	24	1	0	0	41	6	0	1	52	3	2	1	193
Tipperary South	2	14	3	4	3	7	126	7	0	0	1	0	2	6	1	8	29	56	3	76
Waterford City	1	12	1	2	4	1	111	0	0	0	0	0	0	20	0	0	2	2	0	2
Waterford County	1	7	4	1	1	1	47	2	0	0	0	0	0	13	2	2	37	94	0	3
Galway City	1	10	4	3	1	1	1	1	2	2	0	2	7	0	1	8		1	0	7
Galway County	1	20	5	1	4	4	0	0	8	0	5	34	53	0	1	47	3	3	2	6
Leitrim	0	9	0	1	2	0	0	42	0	1	1	1	5	0	1	1	3	1	0	1
Mayo	0	15	5	0	3	5	2	0	4	1	1	1	5	0	1	1	3	1	0	1
Roscommon	0	15	8	5	2	5	0	0	90	0	1	17	287	0	0	3	2	1	0	2
Sligo	0	9	2	3	3	1	0	1	3	1	1	0	1	0	2	1	1	0	1	1
Cavan	0	29	11	17	5	5	0	0	30	14	138	2	12	0	2	0	0	0	0	2
Donegal	0	10	9	1	3	0	0	0	0	1	0	1	1	0	1	1		1	1	2
Monaghan	1	33	4	7	5	2	0	0	1	119	28	0	3	0	0	0	1	2	0	
Sum Column	1,664	38,027	9,992	8,514	7,699	5,639	3,074	1,727	1,142	4,063	3,583	2,111	2,976	4,103	3,618	4,109	10,722	8,214	4,586	4,702
% Share of National Sample	0.75%	17.25%	4.53%	3.90%	3.49%	2.56%	1.39%	0.78%	0.52%	1.84%	1.63%	0.96%	1.35%	1.86%	1.64%	1.86%	4.86%	3.73%	2.08%	2.13%

Appendix 1: County to County Flows - Origins and Destinations

	LKY	TN	TS	WD	WDY	GY	GY	LM	MO	RN	SO	CN	DL	MN	B	M	W	SUMROW	meCoTot	
Carlow	1	0	3	7	1	0	0	2	0	0	0	0	0	1	138	242	264	2,476	1,525	
Dublin City	2	2	0	2	3	3	1	3	1	0	0	5	0	4	2,363	1,908	970	28,508	18,513	
South Dublin	1	1	0	5	1	1	3	1	0	1	3	3	0	2	1,065	1,207	556	15,165	5,505	
Fingal	1	0	0	1	1	1	0	2	1	1	6	0	4	729	930	569	12,773	4,798		
Dun Laoghaire-Rathdown	0	2	1	2	0	2	0	1	1	0	0	1	2	531	661	595	11,406	4,541		
Kildare	0	6	0	5	2		3	0	2	0	0	0	1	616	870	640	10,248	4,752		
Kilkenny	1	11	65	410	19		0	0	1	0	0	1	0	183	523	566	4,483	2,996		
Laoighis	3	56	8		1	1	2	0	0	0	0	0	0	175	370	415	3,250	1,804		
Longford	0	0	0		0	1	1	16	0	42	1	29	0	3	143	194	174	1,624	1,050	
Louth	1	0	1		0	2	0	1	0	0	1	12	0	65	341	549	309	5,592	3,734	
Meath	0	0	0	1	0	2	2	2	3	0	133	0	21	462	868	719	8,073	3,396		
Offaly	2	108	10	3	0	4	19	0	0	19	0	1	1	1	243	328	380	3,421	2,058	
Westmeath	0	1	0		0	4	13	1	0	109	1	7	1	1	260	428	361	4,035	2,562	
Wexford	1	3	3	139	15		0	0	0	0	0	0	1	1	262	832	724	6,259	4,539	
Wicklow	0	0	2	2	0		2	0	1	0	0	0	1	0	422	680	479	6,465	3,088	
Clare	167	13	4	1	0	34	44	0	1	0	2	0	0	0	282	549	607	5,729	3,942	
Cork City	2	1	4	2	4		1	0	0	0	0	0	0	0	416	489	263	6,270	4,684	
Cork County	104	5	29	15	28	3	2	0	2	1	1	0	0	0	991	1,925	2,064	18,594	9,154	
Kerry	131	2	0	2	0	1	0	0	0	0	0	2	0	0	421	824	873	6,840	5,263	
Limerick City	468	14	6		0	1	2	0	0	1	0	0	0	0	163	166	97	2,828	1,714	
Limerick County	2,394	47	53	1	0	7	2	0	0	1	0	1	0	1	392	618	739	6,983	3,133	
Tipperary North	77	1,643	95	2	0	7	13	0	1	2	0	0	0	0	262	327	473	3,328	2,116	
Tipperary South	63	113	2,325	81	65	1	2	0	1	0	1	0	0	0	213	476	528	4,217	2,853	
Waterford City	1	1	20	1,787	100		0	0	0	0	0	0	0	0	136	156	90	2,449	1,877	
Waterford County	1	1	136	733	1,113		0	0	0	0	0	0	0	0	130	354	395	3,078	1,508	
Galway City	1	0	1		0	2,572	320	1	15	3	3	0	2	0	188	255	176	3,589	2,748	
Galway County	2	18	1	1	1	1,874	2,811	1	79	91	3	1	3	1	457	964	891	7,396	3,702	
Leitrim	0	0	1		0		0	528	6	52	124	45	23	1	117	176	178	1,312	706	
Mayo	2	1	0		0	104	107	6	3,675	48	87	1	1	1	271	728	759	5,840	4,434	
Roscommon	0	2	0		0	18	115	124	50	1,123	46	4	4	0	133	375	407	2,839	1,530	
Sligo	0	0	0		0	7	2	48	114	55	2,113	1	23	0	190	289	319	3,192	2,432	
Cavan	0	0	0	1	0	2	0	31	0	3	3	1,583	3	90	234	349	386	2,952	1,969	
Donegal	0	1	0		1	2	0	13	5	0	34	3	4,175	0	705	845	580	6,396	4,755	
Monaghan	0	0	0		0		0	0	1	0	3	90	1	1,628	254	324	353	2,860	1,981	
Sum Column	3,426	2,052	2,768	3,203	1,355	4,652	3,467	778	3,960	1,555	2,428	1,927	4,241	1,827	13,888	20,779	17,899	220,470	125,362	
% Share of National Sample	1.55%	0.93%	1.26%	1.45%	0.61%	2.11%	1.57%	0.35%	1.80%	0.71%	1.10%	0.87%	1.92%	0.83%	6.30%	9.42%	8.12%	100.00%		

B: Place of work address blank or uncodeable
W: Works mainly at or from home
M: Mobile worker

Appendix 2: County to County Flows - Column Denominators

	CW	D	SD	DF	DLR	KE	KK	LS	LD	LH	MH	OY
Carlow	75.8%	0.1%	0.5%	0.1%	0.1%	1.8%	4.1%	2.5%	0.0%	0.0%	0.0%	0.0%
Dublin City	0.4%	46.1%	17.6%	25.0%	17.9%	2.9%	0.2%	0.8%	0.3%	0.6%	2.1%	0.2%
South Dublin	0.2%	14.5%	49.5%	5.5%	11.1%	6.5%	0.1%	0.6%	0.0%	0.2%	1.1%	0.2%
Fingal	0.0%	13.5%	5.3%	49.7%	3.6%	1.7%	0.1%	0.3%	0.1%	1.6%	4.7%	0.2%
Dun Laoghaire-Rathdown	0.1%	11.5%	6.4%	2.4%	51.2%	0.7%	0.0%	0.2%	0.0%	0.1%	0.3%	0.1%
Kildare	3.7%	4.8%	11.8%	3.6%	2.5%	72.9%	0.8%	3.4%	0.5%	0.3%	2.7%	2.5%
Kilkenny	4.4%	0.1%	0.1%	0.1%	0.1%	0.4%	79.1%	1.7%	0.0%	0.0%	0.1%	0.1%
Laoighis	8.9%	0.4%	0.7%	0.2%	0.2%	3.8%	2.7%	80.4%	0.0%	0.0%	0.2%	5.3%
Longford	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	76.7%	0.0%	0.2%	0.4%
Louth	0.1%	0.9%	0.6%	2.6%	0.6%	0.3%	0.1%	0.1%	0.0%	84.3%	5.3%	0.0%
Meath	0.2%	3.8%	2.6%	8.6%	1.2%	3.0%	0.2%	0.2%	0.2%	9.0%	74.7%	0.5%
Offaly	0.2%	0.2%	0.5%	0.2%	0.1%	2.0%	0.1%	6.6%	0.5%	0.0%	0.4%	79.5%
Westmeath	0.0%	0.4%	0.6%	0.4%	0.2%	1.0%	0.0%	0.3%	5.9%	0.1%	3.1%	6.2%
Wexford	2.4%	0.2%	0.3%	0.1%	0.7%	0.2%	1.8%	0.1%	0.0%	0.0%	0.0%	0.0%
Wicklow	3.0%	2.6%	2.4%	0.8%	9.9%	1.6%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%
Clare	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Cork City	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Cork County	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%
Kerry	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Limerick City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Limerick County	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.1%
Tipperary North	0.1%	0.1%	0.1%	0.0%	0.0%	0.2%	1.2%	1.4%	0.1%	0.0%	0.0%	1.9%
Tipperary South	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	4.1%	0.4%	0.0%	0.0%	0.0%	0.0%
Waterford City	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%
Waterford County	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%	0.1%	0.0%	0.0%	0.0%	0.0%
Galway City	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.1%
Galway County	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.7%	0.0%	0.1%	1.6%
Leitrim	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%	0.0%	0.0%
Mayo	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%
Roscommon	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	7.9%	0.0%	0.0%	0.8%
Sligo	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%
Cavan	0.0%	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	2.6%	0.3%	3.9%	0.1%
Donegal	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Monaghan	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	2.9%	0.8%	0.0%

Appendix 2: County to County Flows - Column Denominators

	WH	WX	WW	CE	C	CCY	KY	LK	LKY	TN	TS	WD
Carlow	0.0%	1.7%	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%
Dublin City	0.1%	0.1%	2.8%	0.0%	0.1%	0.1%	0.0%	0.2%	0.1%	0.1%	0.0%	0.1%
South Dublin	0.1%	0.1%	2.3%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.2%
Fingal	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dun Laoghaire-Rathdov	0.1%	0.2%	9.7%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%
Kildare	0.7%	0.1%	3.6%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.3%	0.0%	0.2%
Kilkenny	0.0%	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.5%	2.3%	12.8%
Laoighis	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	2.7%	0.3%	0.0%
Longford	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Louth	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Meath	2.1%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Offaly	6.1%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	5.3%	0.4%	0.1%
Westmeath	74%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Wexford	0.0%	93%	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	4.3%
Wicklow	0.0%	1.4%	72.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Clare	0.0%	0.0%	0.0%	81.2%	0.0%	0.1%	0.0%	13.9%	4.9%	0.6%	0.1%	0.0%
Cork City	0.0%	0.0%	0.0%	0.1%	41.2%	7.5%	0.1%	0.0%	0.1%	0.0%	0.1%	0.1%
Cork County	0.1%	0.1%	0.1%	0.4%	56.8%	86.3%	1.8%	0.9%	3.0%	0.2%	1.0%	0.5%
Kerry	0.1%	0.0%	0.0%	0.2%	0.2%	1.4%	95.7%	0.5%	3.8%	0.1%	0.0%	0.1%
Limerick City	0.1%	0.0%	0.0%	6.5%	0.0%	0.1%	0.1%	34.4%	13.7%	0.7%	0.2%	0.0%
Limerick County	0.0%	0.1%	0.0%	8.4%	0.4%	2.3%	1.8%	43.1%	69.9%	2.3%	1.9%	0.0%
Tipperary North	0.2%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	4.1%	2.2%	80.1%	3.4%	0.1%
Tipperary South	0.1%	0.1%	0.0%	0.2%	0.3%	0.7%	0.1%	1.6%	1.8%	5.5%	84.0%	2.5%
Waterford City	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	55.8%
Waterford County	0.0%	0.3%	0.1%	0.0%	0.3%	1.1%	0.0%	0.1%	0.0%	0.0%	4.9%	22.9%
Galway City	0.2%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Galway County	1.8%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.1%	0.1%	0.9%	0.0%	0.0%
Leitrim	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mayo	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Roscommon	9.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Sligo	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cavan	0.4%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Donegal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Monaghan	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sum	100%	100%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix 2: County to County Flows - Column Denominators

	WDY	GY	GYG	LM	MO	RN	SO	CN	DL	MN	B	M
Carlow	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	5.6%	9.8%
Dublin City	0.2%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.3%	0.0%	0.2%	8.3%	6.7%
South Dublin	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	0.2%	0.0%	0.1%	7.0%	6.8%
Fingal	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.3%	0.0%	0.2%	5.7%	7.3%
Dun Laoghaire-Rathdov	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	4.7%	5.8%
Kildare	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	6.0%	8.5%
Kilkenny	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	4.1%	11.7%
Laoighis	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	11.4%
Longford	0.0%	0.0%	0.0%	2.1%	0.0%	2.7%	0.0%	1.5%	0.0%	0.2%	8.8%	11.9%
Louth	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.6%	0.0%	3.6%	6.1%	9.8%
Meath	0.0%	0.0%	0.1%	0.3%	0.1%	0.2%	0.0%	6.9%	0.0%	1.1%	5.7%	10.8%
Offaly	0.0%	0.1%	0.5%	0.0%	0.0%	1.2%	0.0%	0.1%	0.0%	0.1%	7.1%	9.6%
Westmeath	0.0%	0.1%	0.4%	0.1%	0.0%	7.0%	0.0%	0.4%	0.0%	0.1%	6.4%	10.6%
Wexford	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	4.2%	13.3%
Wicklow	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.5%	10.5%
Clare	0.0%	0.7%	1.3%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	4.9%	9.6%
Cork City	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.6%	7.8%
Cork County	2.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	5.3%	10.4%
Kerry	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	6.2%	12.0%
Limerick City	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	5.8%	5.9%
Limerick County	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	8.9%
Tipperary North	0.0%	0.2%	0.4%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	7.9%	9.8%
Tipperary South	4.8%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.1%	11.3%
Waterford City	7.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	6.4%
Waterford County	82.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	11.5%
Galway City	0.0%	55.3%	9.2%	0.1%	0.4%	0.2%	0.1%	0.0%	0.0%	0.0%	5.2%	7.1%
Galway County	0.1%	40.3%	81.1%	0.1%	2.0%	5.9%	0.1%	0.1%	0.1%	0.1%	6.2%	13.0%
Leitrim	0.0%	0.0%	0.0%	67.9%	0.2%	3.3%	5.1%	2.3%	0.5%	0.1%	8.9%	13.4%
Mayo	0.0%	2.2%	3.1%	0.8%	92.8%	3.1%	3.6%	0.1%	0.0%	0.1%	4.6%	12.5%
Roscommon	0.0%	0.4%	3.3%	15.9%	1.3%	72.2%	1.9%	0.2%	0.1%	0.0%	4.7%	13.2%
Sligo	0.0%	0.2%	0.1%	6.2%	2.9%	3.5%	87.0%	0.1%	0.5%	0.0%	6.0%	9.1%
Cavan	0.0%	0.0%	0.0%	4.0%	0.0%	0.2%	0.1%	82.1%	0.1%	4.9%	7.9%	11.8%
Donegal	0.1%	0.0%	0.0%	1.7%	0.1%	0.0%	1.4%	0.2%	98.4%	0.0%	11.0%	13.2%
Monaghan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	4.7%	0.0%	89.1%	8.9%	11.3%
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%		
										Average	6.16%	10.04%
B: Work address blank/uncodable W: Works mainly at or from home M: Mobile worker												

Appendix 3: County to County Flows - Row Denominators

	CW	D	SD	DF	DLR	KE	KK	LS	LD	LH	MH	OY	WH
Carlow	50.9%	2.2%	2.1%	0.5%	0.4%	4.0%	5.0%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Dublin City	0.0%	61.5%	6.2%	7.5%	4.8%	0.6%	0.0%	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%
South Dublin	0.0%	36.2%	32.6%	3.1%	5.6%	2.4%	0.0%	0.1%	0.0%	0.1%	0.3%	0.0%	0.0%
Fingal	0.0%	40.1%	4.2%	####	2.2%	0.8%	0.0%	0.0%	0.0%	0.5%	1.3%	0.0%	0.0%
Dun Laoghaire-Rathdo	0.0%	38.5%	5.6%	1.8%	34.6%	0.4%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Kildare	0.6%	17.9%	11.5%	3.0%	1.9%	40.1%	0.2%	0.6%	0.1%	0.1%	0.9%	0.5%	0.2%
Kilkenny	1.7%	0.6%	0.2%	0.2%	0.1%	0.5%	54.2%	0.7%	0.0%	0.0%	0.1%	0.0%	0.0%
Laoighis	4.6%	4.4%	2.1%	0.5%	0.4%	6.6%	2.6%	42.7%	0.0%	0.0%	0.2%	3.4%	0.3%
Longford	0.0%	1.4%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	53.9%	0.0%	0.4%	0.6%	5.6%
Louth	0.0%	6.0%	1.0%	3.9%	0.8%	0.3%	0.0%	0.0%	0.0%	61.2%	3.4%	0.0%	0.1%
Meath	0.0%	18.1%	3.2%	9.0%	1.1%	2.1%	0.1%	0.0%	0.0%	4.5%	33.2%	0.1%	0.8%
Offaly	0.1%	2.6%	1.4%	0.6%	0.3%	3.3%	0.1%	3.3%	0.2%	0.1%	0.4%	49.0%	5.3%
Westmeath	0.0%	3.8%	1.6%	0.8%	0.3%	1.4%	0.0%	0.1%	1.7%	0.1%	2.8%	3.2%	54.5%
Wexford	0.6%	1.0%	0.4%	0.1%	0.8%	0.2%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wicklow	0.8%	15.1%	3.8%	1.0%	11.8%	1.4%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Clare	0.0%	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cork City	0.0%	0.3%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cork County	0.0%	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kerry	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Limerick City	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Limerick County	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Tipperary North	0.0%	1.1%	0.2%	0.1%	0.1%	0.4%	1.1%	0.7%	0.0%	0.0%	0.0%	1.2%	0.2%
Tipperary South	0.0%	0.3%	0.1%	0.1%	0.1%	0.2%	3.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Waterford City	0.0%	0.5%	0.0%	0.1%	0.2%	0.0%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Waterford County	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	1.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Galway City	0.0%	0.3%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.2%
Galway County	0.0%	0.3%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.5%	0.7%
Leitrim	0.0%	0.7%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	3.2%	0.0%	0.1%	0.1%	0.2%
Mayo	0.0%	0.3%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
Roscommon	0.0%	0.5%	0.3%	0.2%	0.1%	0.2%	0.0%	0.0%	3.2%	0.0%	0.0%	0.6%	10.1%
Sligo	0.0%	0.3%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Cavan	0.0%	1.0%	0.4%	0.6%	0.2%	0.2%	0.0%	0.0%	1.0%	0.5%	4.7%	0.1%	0.4%
Donegal	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Monaghan	0.0%	1.2%	0.1%	0.2%	0.2%	0.1%	0.0%	0.0%	0.0%	4.2%	1.0%	0.0%	0.1%

Appendix 3: County to County Flows - Row Denominators

	WX	WW	CE	C	CCY	KY	LK	LKY	TN	TS	WD	WDY
Carlow	2.8%	3.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	0.0%
Dublin City	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
South Dublin	0.0%	0.5%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Fingal	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dun Laoghaire-Rathdo	0.1%	3.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kildare	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Kilkenny	1.8%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.2%	1.4%	9.1%	0.4%
Laoghis	0.1%	0.2%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	1.7%	0.2%	0.0%	0.0%
Longford	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Louth	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Meath	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Offaly	0.0%	0.3%	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%	3.2%	0.3%	0.1%	0.0%
Westmeath	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Wexford	61.0%	3.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.2%
Wicklow	0.9%	40.4%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Clare	0.0%	0.0%	58.2%	0.1%	0.1%	0.0%	11.4%	2.9%	0.2%	0.1%	0.0%	0.0%
Cork City	0.0%	0.0%	0.0%	70.5%	9.9%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%
Cork County	0.0%	0.0%	0.1%	32.8%	38.1%	0.5%	0.2%	0.6%	0.0%	0.2%	0.1%	0.2%
Kerry	0.0%	0.0%	0.1%	0.3%	1.7%	64.2%	0.3%	1.9%	0.0%	0.0%	0.0%	0.0%
Limerick City	0.0%	0.0%	9.4%	0.2%	0.2%	0.2%	57.2%	16.5%	0.5%	0.2%	0.0%	0.0%
Limerick County	0.1%	0.0%	5.0%	0.6%	2.6%	1.2%	29.0%	34.3%	0.7%	0.8%	0.0%	0.0%
Tipperary North	0.0%	0.0%	1.6%	0.1%	0.1%	0.0%	5.8%	2.3%	49.4%	2.9%	0.1%	0.0%
Tipperary South	0.1%	0.0%	0.2%	0.7%	1.3%	0.1%	1.8%	1.5%	2.7%	55.1%	1.9%	1.5%
Waterford City	0.8%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.8%	73.0%	4.1%
Waterford County	0.4%	0.1%	0.1%	1.2%	3.1%	0.0%	0.1%	0.0%	0.0%	4.4%	23.8%	36.2%
Galway City	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Galway County	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%
Leitrim	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
Mayo	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Roscommon	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%
Sligo	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cavan	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Donegal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Monaghan	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Appendix 3: County to County Flows - Row Denominators

	GY	GYG	LM	MO	RN	SO	CN	DL	MN	B	M	W	UMROV
Carlow	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	9.8%	10.7%	100.0%
Dublin City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.3%	6.7%	3.4%	100.0%
South Dublin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.0%	8.0%	3.7%	100.0%
Fingal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.7%	7.3%	4.5%	100.0%
Dun Laoghaire-Rathdo	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.7%	5.8%	5.2%	100.0%
Kildare	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.0%	8.5%	6.2%	100.0%
Kilkenny	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.1%	11.7%	12.6%	100.0%
Laoighis	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	11.4%	12.8%	100.0%
Longford	0.1%	0.1%	1.0%	0.0%	2.6%	0.1%	1.8%	0.0%	0.2%	8.8%	11.9%	10.7%	100.0%
Louth	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	1.2%	6.1%	9.8%	5.5%	100.0%
Meath	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.3%	5.7%	10.8%	8.9%	100.0%
Offaly	0.1%	0.6%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	7.1%	9.6%	11.1%	100.0%
Westmeath	0.1%	0.3%	0.0%	0.0%	2.7%	0.0%	0.2%	0.0%	0.0%	6.4%	10.6%	8.9%	100.0%
Wexford	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	13.3%	11.6%	100.0%
Wicklow	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.5%	10.5%	7.4%	100.0%
Clare	0.6%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.9%	9.6%	10.6%	100.0%
Cork City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.6%	7.8%	4.2%	100.0%
Cork County	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.3%	10.4%	11.1%	100.0%
Kerry	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.2%	12.0%	12.8%	100.0%
Limerick City	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.8%	5.9%	3.4%	100.0%
Limerick County	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	8.9%	10.6%	100.0%
Tipperary North	0.2%	0.4%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	7.9%	9.8%	14.2%	100.0%
Tipperary South	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.1%	11.3%	12.5%	100.0%
Waterford City	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	6.4%	3.7%	100.0%
Waterford County	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	11.5%	12.8%	100.0%
Galway City	71.7%	8.9%	0.0%	0.4%	0.1%	0.1%	0.0%	0.1%	0.0%	5.2%	7.1%	4.9%	100.0%
Galway County	25.3%	38.0%	0.0%	1.1%	1.2%	0.0%	0.0%	0.0%	0.0%	6.2%	13.0%	12.0%	100.0%
Leitrim	0.0%	0.0%	40.2%	0.5%	4.0%	9.5%	3.4%	1.8%	0.1%	8.9%	13.4%	13.6%	100.0%
Mayo	1.8%	1.8%	0.1%	62.9%	0.8%	1.5%	0.0%	0.0%	0.0%	4.6%	12.5%	13.0%	100.0%
Roscommon	0.6%	4.1%	4.4%	1.8%	39.6%	1.6%	0.1%	0.1%	0.0%	4.7%	13.2%	14.3%	100.0%
Sligo	0.2%	0.1%	1.5%	3.6%	1.7%	66.2%	0.0%	0.7%	0.0%	6.0%	9.1%	10.0%	100.0%
Cavan	0.1%	0.0%	1.1%	0.0%	0.1%	0.1%	53.6%	0.1%	3.0%	7.9%	11.8%	13.1%	100.0%
Donegal	0.0%	0.0%	0.2%	0.1%	0.0%	0.5%	0.0%	65.3%	0.0%	11.0%	13.2%	9.1%	100.0%
Monaghan	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	3.1%	0.0%	56.9%	8.9%	11.3%	12.3%	100.0%

B: Place of work address blank c
W: Works mainly at or from hon
M: Mobile worker

Appendix 4: County to Town Flows - Row Denominators															
County	Carlow outside towns pop 1,500+	Carlow	Muinebeag	Tullow	Dublin City	Dublin Suburbs South Dublin	Fingal outside towns pop 1,500+	Balbriggan	Donabate	Dublin Suburbs Fingal	Lusk	Malahide	Portmarnock	Portrane	
Carlow	314	720	105	122	54	51	5			6					
Dublin City	1	6			17543	1759	1096	10	13	803	5	46	17	5	
South Dublin		2		1	5496	4949	242	1	3	202	1	4		1	
Fingal					5117	531	1712	176	39	1335	49	156	64	91	
Dun Laoghaire-Rathdown	1	1			4387	636	123	1		62		3	2	1	
Kildare	7	45		9	1837	1183	140	2	3	144		2	1		
Kilkenny	20	43	11		29	8	5			1			1		
Laoighis	13	125	6	4	144	67	9	1		6					
Longford					23	3	2			1					
Louth		1			338	58	135	20	1	30		10	1	4	
Meath		2	1		1459	262	339	17	6	293	6	8	2	6	
Offaly		3	1		90	48	10			10					
Westmeath					155	64	12	1		16				1	
Wexford	15	16	5	4	62	25	4			4					
Wicklow	16	20	1	13	976	244	38		2	24		1			
Clare					13	4				1					
Cork City					16	6	1			2					
Cork County				1	38	18	3			5					
Kerry	1				9	2	1			1					
Limerick City					6	1									
Limerick County					14	9	2								
Tipperary North		1			38	8	2								
Tipperary South	1	1			14	3	3			1					
Waterford City		1			12	1				2					
Waterford County	1				7	4	1								
Galway City	1				10	4	2								
Galway County		1			20	5	1								
Leitrim					9										
Mayo					15	5									
Roscommon					15	8	4			1					
Sligo					9	2	1			2					
Cavan					29	11	10			6					
Donegal					10	9	1								
Monaghan				1	33	4	4	1		1				1	
Sum	391	988	130	155	38,027	9,992	3,908	230	67	2,959	61	230	88	110	
% Share of National Sample	0.18%	0.45%	0.06%	0.07%	17.25%	4.53%	1.77%	0.1%	0.03%	1.34%	0.03%	0.1%	0.04%	0.05%	

Appendix 4: County to Town Flows - Row Denominators														
County	Rush	Steweries	Swords	Kinsealy-Driman	Dún Laoghaire-Rathdown outside towns pop 1,500+	Dublin Suburbs Duinlaoire-Rathdown	Kildare outside towns pop 1,500+	Athy	Monasterevan	Celbridge	Clane	Kilcock	Leixlip	Maynooth
Carlow	1					9	59	15		1			3	
Dublin City	2	6	125	1	11	1364	35	1	1	8	2	2	80	12
South Dublin		2	14		11	840	90			25	3	9	175	19
Fingal	74	103	423	7	3	273	18		1	4			55	7
Dun Laoghaire-Rathdown	1		11		37	3908	14	1		3	1		16	2
Kildare		3	9			192	1338	197	59	228	130	63	487	175
Kilkenny						4	7	4			1		4	
Laoighis						13	70	46	28	3	2	1	12	1
Longford						2	1						1	
Louth		6	13			45	3		1	1			12	1
Meath	1	5	47			92	40			11	2	19	64	21
Offaly						9	47	4	4	1	1	1	22	4
Westmeath			2			14	16	1		4	1	1	27	4
Wexford						53	6	1					2	1
Wicklow			1		18	744	47	3			1		8	2
Clare			1			3								
Cork City						3	1			1			1	
Cork County						10	2							
Kerry						2	1							
Limerick City														
Limerick County						1							1	
Tipperary North			1			3	4			2			2	
Tipperary South						3	1	1	1	1			1	
Waterford City						4	1							
Waterford County						1	1							
Galway City			1			1								1
Galway County						4	1			1				
Leitrim						1	1			1				
Mayo						3				1			1	1
Roscommon						2							1	3
Sligo						3							1	
Cavan			1			5	1						3	
Donegal						3								
Monaghan						5							1	
Sum	79	125	649	8	80	7,619	1,805	274	95	296	144	96	980	254
% Share of National Sample	0.04%	0.06%	0.29%	0.0%	0.04%	3.46%	0.82%	0.12%	0.04%	####	0.07%	0.04%	0.44%	0.12%

Appendix 4: County to Town Flows - Row Denominators														
County	Rathangan	Naas	Droichead Nua	Kildare	Kill	Prosperous	Sallins	Kilkenny outside towns pop 1,500+	Kilkenny	Thomastown	Laoighis outside towns pop 1,500+	Mountmellick	Portllington	Portlaoise
Carlow		9	7	5				63	60	2	24			19
Dublin City		12	7	1				4	1		3	1		9
South Dublin	1	28	14	2	1	1		2			3			8
Fingal		8	4	1				2			1	1		3
Dun Laoghaire-Rathdown		3	1								1	1		1
Kildare	34	700	540	111	16	10	24	10	15		19	2	8	30
Kilkenny		2	3	1				1160	1188	82	16			14
Laoighis	2	20	14	14			1	63	21		525	111	52	701
Longford									2					2
Louth					1			2						1
Meath		8	2	1				4	2		1			3
Offaly	5	8	12	5				2			24	11	26	53
Westmeath		1	1						1		2			3
Wexford		1	3					33	22					1
Wicklow		18	12		1		1	2	2					
Clare											1			
Cork City		1						1						1
Cork County		1		2				1	1					2
Kerry														2
Limerick City											1			
Limerick County		1						1	1		1	1		3
Tipperary North	2	2						26	11		14		1	9
Tipperary South			2					84	41	1	1			6
Waterford City								105	6					
Waterford County								36	10	1	1			1
Galway City									1					1
Galway County		2												
Leitrim														
Mayo				1	1			1	1					
Roscommon				1										
Sligo												1		
Cavan		1												
Donegal														
Monaghan		1												
Sum	44	827	622	145	20	11	26	1,602	1,386	86	638	129	87	873
% Share of National Sample	0.02%	0.38%	0.28%	0.07%	0.01%	0.0%	0.01%	0.73%	0.63%	0.04%	0.29%	0.06%	0.04%	0.40%

Appendix 4: County to Town Flows - Row Denominators														
County	Longford outside towns pop 1500+	Longford	Louth outside towns pop 1500+	Ardee	Drogheda	Dundalk	Meath outside towns pop 1500+	Ashtbourne	Dunboyne	Dunshaughlin	Ratoath	Ceannanus Mor (Kells)	Duleek	Laytown-Bettystown-Mornington
Carlow				1										
Dublin City	2	1	2	1	13	10	35	8	17	3	2		1	1
South Dublin				2	4	4	26	5	4	1				
Fingal		1	8	3	41	11	110	18	8	5		3		2
Dun Laoghaire-Rathdown					4	1	6		1			1		
Kildare	1	5	2	1	6	2	82		3	2		1		
Kilkenny					1			1	1					
Laoighis					1		2	1	1					
Longford	378	498					1							
Louth			641	187	1047	1550	110	6	1	5	1	6	7	18
Meath	2		36	22	275	34	1087	75	54	92	25	138	26	35
Offaly	1	5				2	12							
Westmeath	44	23	2		2	1	82	1				4		
Wexford					1			1						
Wicklow							4		1					
Clare							1							
Cork City					2		1							
Cork County			1		1		1							
Kerry														
Limerick City						1								
Limerick County					2									
Tipperary North		1												
Tipperary South										1				
Waterford City														
Waterford County														
Galway City		2			2									
Galway County	4	4					4							
Leitrim	17	25												
Mayo	1	3				1		1						
Roscommon	32	58					1							
Sligo	1	2	1					1						
Cavan	15	15	1	1	4	8	69	2	2			27	1	1
Donegal						1								
Monaghan	1		23	17	8	71	21					3		
Sum	499	643	717	235	1,414	1,697	1,655	120	93	112	28	184	36	57
% Share of National Sample	0.23%	0.29%	0.33%	0.11%	0.64%	0.77%	0.75%	0.05%	0.04%	0.05%	0.01%	0.08%	0.02%	0.03%

Appendix 4: County to Town Flows - Row Denominators														
County	Navan	Trim	Athboy	Offaly outside towns pop 1500+	Birr (Pt)	Banagher	Edenderry	Tullamore	Clara	Westmeath outside towns pop 1500+	Athlone	Moate	Mullingar	Wexford outside towns pop 1500+
Carlow														50
Dublin City	8			3			1				2		1	3
South Dublin	2			1			1	3		1	2	1		3
Fingal	19	4	1	2			1	1			1			1
Dun Laoghaire-Rathdown	1							2			1		3	3
Kildare	5	3		11			29	12		7	5		10	3
Kilkenny	1			1				1						18
Laoighis	2			38	4		9	59	1	5	1		3	
Longford				2			1	5	1	39	22	1	29	
Louth	32	4								2			3	
Meath	914	174	57	1			6	1	2	33	1	1	27	1
Offaly	1	1		454	215	29	148	753	79	75	55	22	29	1
Westmeath	12	7	5	41	3	1	12	64	9	784	493	48	876	
Wexford											1			1662
Wicklow	1	1								1				27
Clare											1			1
Cork City										1				
Cork County								1	1	1	2		1	4
Kerry	1									1	1			1
Limerick City										1	1			1
Limerick County				3							1			3
Tipperary North				12	18	3	2	6		2	2		2	
Tipperary South											1	1		3
Waterford City														7
Waterford County														7
Galway City					1			1			6		1	
Galway County		1		15	4	7		6	2	21	29	2	1	
Leitrim	1							1			2		1	
Mayo								1		2	3			
Roscommon				10	1		1	5		59	218	6	4	
Sligo											1			
Cavan	34		2				1	1		5	3		4	
Donegal								1			1			
Monaghan	4									1	2			
Sum	1,038	195	65	594	246	40	212	924	95	1,041	858	82	995	1,799
% Share of National Sample	0.47%	0.09%	0.03%	0.27%	####	0.02%	0.1%	0.42%	0.04%	0.47%	0.39%	0.04%	0.45%	0.82%

Appendix 4: County to Town Flows - Row Denominators														
County	Enniscorthy	Gorey	New Ross	Wexford	Wicklow outside towns pop 1,500+	Blessington	Bray	Greystones	Enniskerry	Arlow	Wicklow	Kilcoole	Newtown Mount Kennedy	Clare outside towns pop 1,500+
Carlow	11	3	4	2	84					2	3			
Dublin City	2			1	16	2	79			1	1	1		2
South Dublin				1	24	10	44	1	1		1	1		
Fingal				1	3		16	2	1		1			1
Dun Laoghaire-Rathdown		2	1	1	57	2	253	18	4	5	8	1	3	
Kildare	1				67	23	37	1		2				
Kilkenny	5		49	9	2		1			1				1
Laoighis	1	1			2		2				1			1
Longford						1								
Louth							2							
Meath					2		2	2						
Offaly					3		5				2			3
Westmeath			1				2							
Wexford	509	282	222	1140	79	1	23	5		68	9		5	1
Wicklow	7	18		6	894	48	851	140	16	336	247	24	53	
Clare														1865
Cork City														3
Cork County			1		1						1			15
Kerry														6
Limerick City														229
Limerick County				1										281
Tipperary North							1							43
Tipperary South			3		1									4
Waterford City	4		8	1										
Waterford County	2		4		1		1							2
Galway City					1									4
Galway County							1							28
Leitrim														
Mayo					1									1
Roscommon														2
Sligo								2						1
Cavan							2							
Donegal							1							1
Monaghan														
Sum	542	306	293	1,163	1,238	87	1,323	171	22	415	274	27	61	2,494
% Share of National Sample	0.25%	0.14%	0.13%	0.53%	0.56%	0.04%	0.60%	0.08%	0.01%	####	0.12%	####	0.03%	1.13%

Appendix 4: County to Town Flows - Row Denominators															
County	Ennis	Shannon	Kilrush	Cork City	Cork County outside towns pop 1500+	Bandon	Bantry	Cionakilty	Cobh	Blarney	Carrigaline	Passage West	Dunn anway	Ferryoy	Macroom
Carlow					1										
Dublin City				14	5		1								
South Dublin	1		1	9									1	1	
Fingal				3											
Dun Laoghaire-Rathdown				6											
Kildare				1	1									2	
Kilkenny				3											
Laoighis				1	4										
Longford															
Louth					1										
Meath				5	1										
Offaly				3	1										
Westmeath				1											
Wexford				4	2										
Wicklow				4					1						
Clare	1071	262	137	3	5						1				
Cork City				4421	480	7	1	4	12		34	7	6	18	6
Cork County	2			6093	4107	217	189	197	165	13	179	49	105	230	181
Kerry		1		23	103	2	2						1		3
Limerick City	5	32		5	3										
Limerick County	31	33	2	41	86		1			1				3	1
Tipperary North	4	4	1	3	1									1	
Tipperary South	3	1		29	18									7	
Waterford City				2											
Waterford County				37	45	1								8	
Galway City	3	1			1										
Galway County	19			3	1										
Leitrim				1											
Mayo				3	1										
Roscommon	1			2	1										
Sligo				1											
Cavan															
Donegal					1										
Monaghan				1	2										
Sum	1,140	334	141	10,722	4,871	227	194	201	178	14	214	56	113	270	191
% Share of National Sample	0.52%	0.15%	0.06%	4.86%	2.21%	0.1%	0.09%	0.09%	0.08%	####	0.1%	0.03%	0.05%	0.12%	0.09%

Appendix 4: County to Town Flows - Row Denominators														
County	Mallow	Rathluiric (or Chadleville)	Midleton	Mitchelstown	Skibbereen	Youghal	Kerry outside towns pop 1,500+	Dingle	Kenmare	Killarney	Listowel	Tralee	Castletisland	Limerick City
Carlow						1								1
Dublin City										2				8
South Dublin							1							8
Fingal											1			
Dun Laoghaire-Rathdown												3		2
Kildare							1							4
Kilkenny														4
Laoighis										1				3
Longford														
Louth							1							2
Meath														5
Offaly														2
Westmeath														3
Wexford						2	1			1				1
Wicklow														1
Clare		1						1						653
Cork City	11	3	20	4	1	6	1			3				2
Cork County	375	142	333	215	165	228	37	2	2	19	1	18	5	40
Kerry	4		2		1	1	1414	167	101	761	278	1512	157	22
Limerick City				2			2			1		2		1617
Limerick County	6	50	1	36			34			6	16	20	6	2028
Tipperary North												1		193
Tipperary South	3	1		26		1	1			2				76
Waterford City	1					1								2
Waterford County	1		4	4		31								3
Galway City														7
Galway County		1		1			1	1						6
Leitrim														1
Mayo														1
Roscommon														2
Sligo												1		1
Cavan														2
Donegal							1							2
Monaghan														
Sum	401	198	360	288	167	271	1,495	171	103	796	296	1,557	168	4,702
% Share of National Sample	0.18%	0.09%	0.16%	0.13%	0.08%	0.12%	0.68%	0.08%	0.05%	0.36%	0.13%	0.71%	0.08%	2.13%

Appendix 4: County to Town Flows - Row Denominators

County	Limerick County outside towns pop 1500+	Abbeyfeale	Newcastle West	Tipperary North outside towns pop 1500+	Nenagh	Roscrea	Templemore	Thurles	Tipperary South outside towns pop 1500+	Carrick-on-Suir	Cashel	Cahir	Clonmel	Tipperary
Carlow	1								1				2	
Dublin City	2				1		1							
South Dublin			1					1						
Fingal	1													
Dun Laoghaire-Rathdown				1			1		1					
Kildare				1		2	2	1						
Kilkenny		1		3			2	6	16	17	1	2	29	
Laoighis	3			24	4	17	5	6	1	2	1	1	3	
Longford														
Louth			1										1	
Meath														
Offaly	1		1	31	18	53	3	3	2			2	3	3
Westmeath					1									
Wexford	1					1	2		1				2	
Wicklow												1	1	
Clare	164	2	1	5	8				2	1			1	
Cork City	1		1				1		2			1		1
Cork County	98		6	2	2			1	9		2	6	10	2
Kerry	80	29	22				1	1						
Limerick City	463	2	3	5	9				2		1		1	2
Limerick County	2116	55	223	27	17		1	2	25		1		7	20
Tipperary North	75		2	436	527	204	108	368	48	1	13	1	25	7
Tipperary South	63			42	10	4	7	50	902	139	168	108	766	242
Waterford City	1							1	5	7			8	
Waterford County	1			1					44	23	1	2	66	
Galway City	1								1					
Galway County	2			6	10			2					1	
Leitrim									1					
Mayo	2			1										
Roscommon				1				1						
Sligo														
Cavan														
Donegal								1						
Monaghan														
Sum	3,076	89	261	586	607	281	134	444	1,063	190	188	124	926	277
% Share of National Sample	1.40%	0.04%	0.12%	0.27%	0.28%	0.13%	0.06%	0.2%	0.48%	0.09%	0.09%	0.06%	0.42%	0.13%

Appendix 4: County to Town Flows - Row Denominators														
County	Waterford City	Waterford County outside towns pop 1 500+	Dungarvan	Dunmore East	Tramore	Galway City	Galway County outside towns pop 1 500+	Ballinasloe	Oranmore	Athenry	Tuan	Leitrim outside towns pop 1 500+	Carrick-On-Shannon	Mayo outside towns pop 1 500+
Carlow	7				1							2		
Dublin City	2	2	1			3	1					2	1	
South Dublin	5	1				1	2				1	1		
Fingal	1				1	1								
Dun Laoghaire-Rathdown	2					2								
Kildare	5	1	1				3							
Kilkenny	410	14	3		2									1
Laoighis		1				1	2							
Longford						1					1	15	1	
Louth						2							1	
Meath	1						1	1				1	1	2
Offaly	3					4	4	15						
Westmeath						4	5	8					1	
Wexford	139	10	2	1	2									
Wicklow	2						2							
Clare	1					34	41	1	1		1			
Cork City	2	3	1				1							
Cork County	15	19	9			3	2							1
Kerry	2					1								
Limerick City						1	2							
Limerick County	1					7	2							
Tipperary North	2					7	13							
Tipperary South	81	57	6		2	1	2							
Waterford City	1787	50	17	2	31									
Waterford County	733	559	434	18	102									
Galway City						2572	272	7	12	6	23		1	3
Galway County	1	1				1874	2091	338	37	92	253	1		43
Leitrim												368	160	5
Mayo						104	79		3	1	24	5	1	1438
Roscommon						18	32	77			6	49	75	43
Sligo						7	1				1	38	10	55
Cavan	1					2						28	3	
Donegal		1				2						13		2
Monaghan														
Sum	3,203	719	474	21	141	4,652	2,558	447	53	99	310	523	255	1,593
% Share of National Sample	1.45%	0.33%	###	0.01%	0.06%	2.11%	1.16%	0.2%	0.02%	0.04%	0.14%	0.24%	0.12%	0.72%

Appendix 4: County to Town Flows - Row Denominators														
County	Ballina	Ballinrobe	Castlebar	Claremorris	Westport	Roscommon outside towns pop 1500+	Boyle	Castleroa	Roscommon	Sligo outside towns pop 1500+	Sligo	Cavan outside towns pop 1500+	Ballieborough	Cavan and Env
Carlow														
Dublin City	1											4		1
South Dublin							1				3		1	2
Fingal	1		1					1			1	6		
Dun Laoghaire-Rathdown	1					1								
Kildare			1	1										
Kilkenny												1		
Laoighis														
Longford						28	3		11		1	14		15
Louth											1	11	1	
Meath						1	1		1			113	8	11
Offaly						16	1		2					1
Westmeath						97		2	10		1	5	1	1
Wexford														
Wicklow			1											
Clare			1								2			
Cork City														
Cork County			1			1				1				
Kerry														2
Limerick City						1								
Limerick County											1			
Tipperary North			1			1		1						
Tipperary South	1									1				
Waterford City														
Waterford County														
Galway City		1	10	1					3	1	2			
Galway County	3	7	17	6	3	40	3	17	31	2	1	1		
Leitrim	1					43	5	2	2	25	99	36		9
Mayo	553	104	1049	131	400	32		12	4	50	37	1		
Roscommon	1	1	3		2	585	112	113	313	12	34	3		1
Sligo	49	1	7	1	1	19	31	3	2	649	1464	1		
Cavan						2			1	1	2	1005	54	473
Donegal					3					3	31	3		
Monaghan		1								2	1	49	2	25
Sum	611	115	1,092	140	409	867	157	151	380	747	1,681	1,253	67	541
% Share of National Sample	0.28%	0.05%	0.50%	0.06%	0.19%	0.39%	0.07%	0.07%	0.17%	0.34%	0.76%	0.57%	0.03%	0.25%

Appendix 4: County to Town Flows - Row Denominators																		
County	Cootehill	Donegal outside towns pop 1,500+	Bundoran	Ballyshannon	Donegal	Buncrana	Carndonagh	Letterkenny	Ballybofey-Stranorlar	Monaghan outside towns pop 1,500+	Carrickmacross	Castletroy	Clonsilla	Monaghan	B	M	W	SUM
Carlow														1	138	242	264	2,476
Dublin City											1	3			2363	1908	970	28,508
South Dublin												2			1065	1207	556	15,165
Fingal										1	1	1		1	729	930	569	12,773
Dun Laoghaire-Rathdown		1								1	1				531	661	595	11,406
Kildare												1			616	870	640	10,248
Kilkenny															183	523	566	4,483
Laoighis															175	370	415	3,250
Longford										1				2	143	194	174	1,624
Louth										28	24	4	1	8	341	549	309	5,592
Meath	1									2	16			3	462	868	719	8,073
Offaly							1							1	243	328	380	3,421
Westmeath		1									1				260	428	361	4,035
Wexford		1												1	262	832	724	6,259
Wicklow		1													422	680	479	6,465
Clare															282	549	607	5,729
Cork City															416	489	263	6,270
Cork County															991	1925	2064	18,594
Kerry															421	824	873	6,840
Limerick City															163	166	97	2,828
Limerick County		1													392	618	739	6,983
Tipperary North															262	327	473	3,328
Tipperary South															213	476	528	4,217
Waterford City															136	156	90	2,449
Waterford County															130	354	395	3,078
Galway City				1				1							188	255	176	3,589
Galway County		2						1						1	457	964	891	7,396
Leitrim		4	9	8	1			1					1		117	176	178	1,312
Mayo		1												1	271	728	759	5,840
Roscommon		1		1	2										133	375	407	2,839
Sligo		7	6	8	2										190	289	319	3,192
Cavan	51		1	1				1		48	18	3	7	14	234	349	386	2,952
Donegal		2023	48	138	211	259	128	1081	263						705	845	580	6,372
Monaghan	14				1					666	216	159	72	515	254	324	353	2,860
Sum	66	2,043	64	157	217	259	129	1,084	264	747	278	173	81	548	13,888	20,779	17,899	220,446
% Share of National Sample	0.03%	0.93%	0.03%	0.07%	###	0.12%	0.06%	0.49%	0.12%	0.34%	0.13%	0.08%	0.04%	0.25%	6.30%	9.43%	8.12%	100.00%

First vote of thanks on: Origins, Destinations and Catchments: Mapping Travel to Work in Ireland in 2002

By Professor J.A. Walsh, Dr. R. Foley, Dr. A. Kavanagh and Ms. A. McElwain

Professor Brendan Walsh (UCD)

The authors and the CSO deserve our thanks for preparation and analysis of the place of work data. This will allow us to define meaningful cities and towns in terms of their commuting catchment areas – along the lines of the Standard Metropolitan Areas that have been long in use in the United States. These are indispensable for describing the spatial distribution of employment and will afford us a more meaningful picture of the pattern of economic activity than has been available up to now.

I am less sure about the value of classifying certain (favoured) settlements into Gateways and Hubs. It is not clear whether to be assigned to one of these categories a settlement should have reached predetermined criteria or whether being so assigned is a policy decision from which certain consequences (such as preferential treatment for future infrastructure investments) will flow.

The authors at times seem anxious to cover the whole country with Gateways and Hubs – decrying any lacunae that their maps reveal. They seem to wish to be able to say that no matter where you live in the Republic, there's a city or town to which you can commute. But most people work close to where they live. This is true even of those living in the smaller towns near Dublin or Galway. I am unclear as to whether the authors regard this as a Good or a Bad Thing! On the one hand, they lament the extent of the Dublin Gateway, and in particular the long commuting times this implies for some, but on the other hand they also lament the small extent of the Waterford Gateway, and the absence of Gateways from some areas of the country. What is the optimal number of Gateways and by what criteria should this be decided? What policy instruments should be used to foster the growth of these Gateways and how effective are they relative to the working out of underlying comparative advantages?

On a point of detail, I think it is misleading to talk of the Galway-Limerick-Ennis-Cork corridor. The authors show a map that indicates that the commuting areas of these towns can be defined so that they overlap. But this says nothing about the intensity of travel and interaction between these three areas, which is implied by the label corridor.

Finally, I cannot refrain from raising fundamental questions about the National Spatial Strategy. What problem is it designed to tackle? Is the goal to try to shape of the spatial distribution of economic activity and its growth to conform to some idealised Plan? If so, what instruments can be used to achieve this goal? Can it seriously challenge the political imperatives that are so influential in Irish planning and infrastructure allocation?

Not only the country as a whole but most if not all of the regions may be characterised by shortages as fully employed. Any remaining differentials in unemployment rates between the regions may plausibly be attributed to structural features, such as population density and remoteness. Income differentials have narrowed, especially if due allowance is made for regional cost-of-living disparities. Our largest urban centre remains quite small by European standards – barely able to offer the range and depth of specialised labour force and services demanded by the sophisticated employers we wish to attract to the country. The same aspects of the current Irish situation tend to be overlooked by regional policy enthusiasts.

Before proceeding directly to the travel to work data there are some additional contextual points to note. The most striking is that the total number of persons recorded at work in 2002 was just over 1.6 million compared with a little over 1.1 million in 1991 giving an increase of 473,424 or 41.6% which can be contrasted with an increase of only 7,113 (0.6%) over the period 1981-1991. Moreover the shift in the size of the workforce was accompanied by a sectoral shift towards services and substantially increased female participation rates in employment that is mainly concentrated in the larger towns and cities. While there are some exceptions to this generalisation the most notable are the growth of employment amongst rural dwellers, especially among females in service occupations in those rural areas with strong tourism and related sectors, and secondly among rural resident males working in building and construction and related support industries which are frequently located in the expanding urban centres.

Second Vote of thanks on: Origins, Destinations and Catchments: Mapping Travel to Work in Ireland in 2002

By Professor J.A. Walsh, Dr. R. Foley, Dr. A. Kavanagh and Ms. A. McElwain

By Dr. Edgar L.W. Morgenroth, Economic and Social Research Institute

It gives me great pleasure to propose the vote of thanks to the authors. The subject area of this paper is a particularly important research area as it deals with a topic that is high on the policy agenda, since long-distance commuting impacts on the quality of life of an increasing number of people. As a long distance commuter myself, I also have a strong personal interest in this topic.

Much of the analysis of the paper is based on the CSO Place of Work Sample of Anonymised Records (POWSAR) without which a detailed analysis of origin and destinations of commuting would be difficult. The CSO deserve great credit for making this data available to researchers.

The paper is essentially split into two parts. First it describes trends in commuting and secondly it identifies the extent of the commuting hinterlands of the gateways and hubs identified in the National Spatial Strategy. My comments deal with these sections in turn. The first part of the analysis updates earlier work by Horner (1999) and Keane (2003), which also noted that the 'Celtic Tiger' had significantly increased commuting and changed commuting patterns. This analysis shows that long distance commuting, defined as the proportion of workers commuting in excess of 15 miles, has become more widespread, increasing from 6.7% in 1981 to 17.5% in 2002. Since the number of workers has also increased sharply from 1.1 million to 1.6 million over the same time period the total number of long distance commuters has almost quadrupled over this period. Not shown in the paper is that 17% of worker take longer than 45 minutes to get to work. This highlights why the issue of long distance commuting is important in determining the quality of life but also in terms of economic impact since there are obvious costs to this pattern of commuting.

The mapping of the data from the CSO Small Area Population Statistics (SAPS), which is carried out at the Electoral District (ED) level highlights a number of well known phenomena. Individuals travel longer distances to the larger towns and cities and in particular to Dublin. Thus, the analysis shows that larger towns and cities appear to cast a significantly larger commuting shadow than smaller ones. This finding is also supported by the mapping of travel times.

The strong correlation between travel times and distances is also investigated using regression analysis, where the residuals (the unexplained variation) are significantly larger for urban location particularly in the larger towns and cities. Unfortunately no analysis is provided to fully explain these variations and this would clearly be an interesting task for another research paper. For example the impact of public transport availability or travel mode on travel times might yield important insights for the returns to providing new public transport routes. Similarly, the nature of the roads is likely impact on travel times.

Given that the results of mapping, the natural progression of the analysis is to identify the travel to work areas for the major destinations. The authors aim at providing such an analysis for the gateways and hubs identified in the NSS. To my knowledge this task has not previously been attempted although work on Dublin (Morgenroth, 2001) using a novel data source and the West region using the POWSAR (Morgenroth, 2005) is available. While there has been little research in this field in Ireland, it has been an established field in most other countries. For example Travel to work areas are redefined after every census in the US and Germany (Johnson, 1995, Johnson and Kort, 2004, Buttler, 1975).

The tasks involved in calculating the travel to work areas is clearly outlined. First, the authors give a thorough description of the POWSAR data. Their second task was to prepare the data for use in a Geographical Information System (GIS). This was then used to analyse the data using a mapping algorithm to visualise the spread and mobility between home and work and by producing counts of individuals associated with a particular ED.

A shortcoming of the findings is that not all ED's have been attached to particular destination centres. In this respect the analysis is incomplete. This is surprising since the authors themselves highlight the use of travel to work areas for the construction of economic data on the basis of functional rather than administrative regions, which is more meaningful. For example the unemployment rate in Dublin is not indicative of the state of the labour market in the functional Dublin area which is significantly larger incorporating not just the Mid-East but also Louth and parts of Wexford, Laois, Offaly, Westmeath, Cavan and Monaghan. The general approach to the definition of travel to work areas is surprising as established methodologies are available, which are based on a straightforward, if cumbersome to implement, algorithm (see Coombes and Openshaw, 1982, Coombes, Green and Openshaw, 1986). Indeed it is surprising that the only reference to the wider literature on defining travel-to-work areas is to the latter reference. A number of different approaches have been used to identify functional regions, which are not discussed. These include the use of cluster analysis where functional regions are defined according to similarities across a set of relevant variables (Barkley, Henry, Bao, Brooks, 1995) or the use of spatial interaction models where the functional areas are estimated using a gravity model (Fik and Mulligan, 1990, Morgenroth 2001).

In the literature it is customary to let the data select which centres become foci. Here the foci around which the travel-to-work areas are being built up are pre-selected e.g. the ones identified in the NSS. This is a significant shortcoming since the original choice of NSS centres could not draw on such a rich data analysis as is possible with the POWSAR. Thus, an opportunity to test the rationale behind the selection of the NSS centres has been missed.

The other serious limitation of this paper is the lack of policy analysis. In its present form with large ‘unattached islands’ that are not part of any travel-to-work area these are of limited use for policy, but more importantly the causal behavioural relationships cannot be identified from these travel-to-work areas. Clearly, the level of long distance commuting is of concern but why has it increased so strongly? A simple cross tabulation of the POWSA reveals that those individuals that moved residence recently commute longer distances than those that did not move, suggesting that individuals choose to commute longer which stands in contrast with the international literature (see Clark, Huang and Withers, 2003). My own suspicion is that these trends are linked to the housing market and the quality of life available in the major cities and this clearly needs further work.

In conclusion, this paper provides important additional research on travel-to-work areas, extending previous descriptive analysis and work on the extent of some of these areas. In doing so it highlights important areas for further research including the analysis of travel-to-work areas where the foci are chosen endogenously by the data rather than predetermined by the authors. Furthermore, it is clear that in order to address the commuting problem it will be necessary to alleviate the root causes, which have yet to be identified.

References:

- Barkley, D., Henry, M., Bao, S., and K. Brooks (1995) “How Functional are Economic Areas? Tests for intra-regional spatial association using spatial data analysis”, *Papers in Regional Science*, Vol. 74(4) pp. 297-316
- Buttler, G. (1975) “Die Abgrenzung Regionaler Arbeitsmärkte mit Hilfe von Klassifikationsverfahren” *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung*. Nürnberg: Institut für Arbeitsmarkt- und Berufsforschung.
- Clark, W., Huang, Y, and S. Withers, (2003) “ Does Commuting Distance Matter? Commuting Tolerance and Residential Change” *Regional Science and Urban Economics*, Vol. 33(2) pp. 199-221.
- Coombes, M.G., and S. Openshaw (1982) “The use and definition of travel-to-work areas in Great Britain: Some Comments” *Regional Studies*, Vol. 16(2) pp.141-149.
- Coombes, M.G., Green, A.E. and Openshaw, S. (1986) ‘An Efficient Algorithm to Generate Official Statistical Reporting Areas’, *Journal of the Operational Research Society*, 37(10), 943-53.
- Fik, T J and G. Mulligan (1990)” Spatial Flows and Competing Central Places: Towards a General Theory of Hierarchical Interaction”, *Environment and Planning A*, Vol. 22(4) pp. 527-49
- Horner, A.A. (1999) *The Tiger Stirring: Aspects of Commuting in the Republic of Ireland 1981-1996*, *Irish Geography*, 32, 2, 99-111.
- Johnson, K. P. (1995) “Redefinition of the BEA Economic Areas”, *Survey of Current Business*. Bureau of Economic Analysis.
- Johnson, K.P., and J.R. Kort (2004) “2004 Redefinition of the BEA Economic Areas”, *Survey of Current Business*. Bureau of Economic Analysis.
- Keane, M.J. (2003) “Census Commuting Data and Travel to Work Areas: An Exploratory Analysis” in E. O’Leary (ed.) *Irish Regional Development: A New Agenda*. Dublin: The Liffey Press.
- Morgenroth, E. (2001) “Analysis of the Economic, Employment and Social Profile of the Greater Dublin Region”. Dublin: Economic and Social Research Institute. ESRI Books and Monographs Series Paper No. 161, 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: ESRI.
- Morgenroth (2005) “Functional Regions in the West: An Analysis of Spatial Mismatch” presented at the Regional Studies Association Irish Branch Half Day Seminar in University College Galway