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1. Introduction

Complementarity between urban centres is a key element of Ireland's National Spatial Strategy and Northern Ireland's Regional Development Strategy. Both documents encourage the development of complementary roles for urban centres, at both the intra-regional and inter-regional or national scale. In addition, at the intra-regional scale, different roles and functions are accorded to different types of urban components. Although the documents do not define complementarity, in most cases the term appears to signify functional distinctiveness/specialisation of urban centres. Such complementarity can be defined at different level of functional aggregation. Both documents are vague as to the level of aggregation and provide few clear suggestions as to the different roles or functions that are accorded to the various urban components.

Expanding on and using the methodology of previous work conducted in the context of the Republic of Ireland[1], this paper is a first attempt to establish the level of specialisation and potential complementarity of urban centres on an all-Ireland basis. In this first attempt specialisation and complementarity are investigated at the level of the "industrial group". Using employment data from the Republic's 2002 Census of Population and the Northern Ireland 2001 Census we examine the levels and types of specialisation of urban centres, and explore the extent to which the prevailing spatial patterns of specialisation support the existence of groupings of complementary urban centres at regional level.

The next section starts with an analysis of the complementarity concept and the way it is employed in the two regional strategies. This is followed by an outline of the methodology used to assess complementarity in the present paper, which describes the data sets used and the methods of analysis. The results of these analyses are presented in section four, and the final section draws out some of the main implications for spatial policy and planning on the island of Ireland. It is suggested that, though there are variations between regions, current patterns of specialisation are not indicative of high levels of intra-regional inter-sectoral complementarity. If complementarity is to be encouraged by public policy therefore, there may be a need to focus efforts at the sub-sectoral level.

2. The Concept of Complementarity

The National Spatial Strategy (DELG, 2002) and the Regional Development Strategy (DRD, 2001) both aim for balanced regional development. In both documents the prescription utilises the concept of complementarity. The documents include phrases such as "complementary roles of regions", "complementary roles of urban centres", "complementary functions", "complementing positions" and "complementary development".

[1] In order to avoid any confusion Ireland is henceforth referred to as the Republic of Ireland (RoI), or, occasionally, as the South.

The concept of complementarity is mostly used in its meaning of 'difference' between urban centres or regions operating as a system. The policy is apparently based on the premise that functional difference or distinctiveness stimulates the development of the individual urban centres/regions and the urban system as a whole (Markusen and Schrock, 2006). The underlying idea is that urban centres, when operating as a system, benefit from a larger critical mass and the concomitant economies of scale / specialisation. Different economic functions concentrate in specific locations in the system to enjoy agglomeration advantages, specifically intra-industry localisation economies (Krugman, 1991). The logic therefore must involve individual components of the urban system exchanging (specialised) goods and services.

Urban centres and regions can be different or complementary in different ways. Markusen and Schrock (2006) identify three main dimensions of distinctiveness, namely, production, consumption and identity. Moreover, different types of complementarity operate in urban systems defined at different spatial scales. Both the NSS and RDS utilize the concept of complementarity at scales ranging from the national (between regions or between cities) to the regional (within regions) and the local or intra-urban (e.g., within the Belfast Metropolitan Area). At the regional scale the concept is used both in the context of the relations between towns at different levels in the urban hierarchy (complementary functions of the Gateway, Hub and Other Towns in the same region) and in the context of relations between towns at the same level in the urban hierarchy (for example the complementary functions of the Linked Gateway and Linked Hubs designated in the NSS).

However, the National Spatial Strategy (NSS) and Regional Development Strategy (RDS) provide few clear suggestions as to the different roles or functions that are accorded to the various urban/regional components (Regions, Cities, Gateways, Hubs, Small Towns, etc). The suggestions are often expressed in general terms and different component categories are sometimes accorded similar functions or roles.

In the NSS all components have service, retail, employment and residential functions. The main point of differentiation lies in the intended scale and spatial reach of the functions, but even on this point there is substantial overlap. With regard to services the thinking appears to be based on ideas from classical central place theory, with centers providing greater or narrower ranges of services for spatially more or less extensive hinterlands. The Gateways have a national and regional role with "national or regional third-level centers of learning", "regional hospitals and specialized care" and "*city-level* range of theaters, arts and sports centers and public spaces". The Hubs are strong services centers "for an extensive rural hinterland" with "local and or regional hospitals" and "*a wide range* of amenity, sporting and cultural facilities including public spaces and parks. County Towns perform "regionally strategic administrative and other service functions". Other Towns have "service functions" while Smaller Towns and Villages provide "local services". The clearest differentiation of service functions (but using a slightly incompatible categorization of urban centers) is provided by reference to a model developed by the South Tipperary County Development Board (DELG, 2002, p. 113). Even here great overlap remains particularly between Cities and County Towns and in the areas of professional services, education and health.

As regards employment there is substantial overlap between the functions of the Gateways and the Hubs. Gateways are envisaged as developing "large clusters of national/international scale enterprises, including those involved in advanced sectors". Hubs contain "a mix of local, medium-sized and larger businesses servicing local regional and national/international markets". Further differentiation is contained in the distinct infrastructure planned for the Gateways and Hubs - strategic development zones in the Gateways versus industrial and local business park in the Hubs. The strategic development zones contain the sites that are specifically developed to support large and medium-scale manufacturing activities with large utility requirements, such as pharmaceutical and semiconductor plants.

The NSS is less specific regarding the employment functions envisaged for (non-Hub) County Towns, other than that these should sustain a "good employment base" and involve "regionally strategic employment functions". The category "Other Towns" is envisaged to provide "a range of (…) opportunities of employment" and "employment in a variety of enterprises", while Smaller Towns and Villages are proposed as "the foci for (…) economic activity" in rural areas. It is suggested that Other Towns and Smaller Towns and Villages create employment in tourism and natural resources. Likewise, rural areas in general are envisaged to focus on agriculture, forestry, and fishing, together with tourism, enterprise and other sources of off-farm employment. This could lead to sectoral complementarity, although tourism is promoted in all types of urban centres, including the largest. The NSS mentions that the mix and concentration in any one of these sectors "will vary according to the potential of different places." (DELG, 2002, p. 51).

The NSS acknowledges the emergence in Ireland of clusters of innovative, technology-intensive, high value-added activities and start-ups, and the fact that these are particularly focused around the city regions and other strategic locations. It "seeks to strengthen these areas and increase their number by supporting the formation of self-sustaining clusters of economic activity in line with the national spatial structure that the NSS has established" (DELG, 2002, p. 97). While the statements on clustering contained in the NSS paint a picture of sectoral complementarity at the national scale (between regions or between cities), it is unclear what the spatial expression of clusters will be at the regional scale, i.e., what elements are destined for the various urban components that make up a city-region. Are all elements to be concentrated in the Gateways, or are certain elements to be located in Hubs, County Towns, Other Towns and Small Towns and Villages? The first scenario could lead to sectoral distinctiveness at the intra-regional scale. The latter could lead to sectoral similarity.

The picture painted in the RDS is very similar. Again, all components of the settlement system have service, retail, employment and residential functions. In relation to employment "the aim is to ensure that every town, main and small continues to generate employment and investment opportunities" (DRD, 2001, p.44). Overall though, compared to the NSS, there is a somewhat greater emphasis on the concentration of employment and other functions in the larger centres (Cities and Hubs). The Strategic Employment Locations (industrial sites to accommodate major inward investment

projects and local enterprise) are to be strategically located throughout Northern Ireland, but priority will be given to the two regional cities and the main Hubs (*Ibid.*, p. 139).

It is difficult to determine what is envisaged for the different categories at the lower end of the urban hierarchy, because the category Small Towns is sometimes defined to include all towns with less than 10,000 inhabitants (see for example DRD, 2001, p.87), which would include the Local Hubs. However, in the RDS too, the main point of differentiation lies in the intended scale and spatial remit of the functions. For example, Small Towns and Villages are envisaged to attract "small scale" inward investment, indigenous projects and "micro businesses". The RDS is less specific regarding sectoral complementarity. The plan for the Smaller Towns is that they create employment in a range of sectors, including: food processing, niche markets, rural services, "diverse indigenous investment", "wood-based employment", sea fisheries, aquaculture, rural tourism, attractions based on water resources and heritage, etc.

In summary, in both spatial strategies the allocation of activities across the various strategic elements of the urban system is subject to a certain degree of overlap, especially in relation to services. However, both documents would appear to envisage the strengthening of complementarity, at least at a relatively high level of functional/ sectoral aggregation, with the Gateways / Cities and Hubs providing employment, including for the population in their hinterlands, while the Smaller Towns and Villages in the hinterlands have a residential, local service and recreational function. This paper examines the current patterns of functional specialisation among the urban centres on the island of Ireland, within different spatial frameworks, with a view to assessing the extent to which existing conditions might facilitate the development of complementarity. This is a first and relatively basic exercise, focusing on the urban centres' sectoral structure and patterns of sectoral specialisation.

3. Methodology

3.1 The Data

3.1.1 Industries

The functions performed by towns, their levels of specialisation and of complementarity are all assessed on the basis of employment data. These data are for what the Republic of Ireland census of population refers to as 'Intermediate Industrial Groups' (N = 22), which represent a mixture of NACE categories, but which mostly correspond to 2-digit 'divisions'. For comparability between North and South, a specially commissioned census data set was obtained from the Northern Ireland Statistics and Research Agency (NISRA) in which employment was re-coded to the same industrial categories. The level of aggregation is important. At a very high level of disaggregation (e.g., NACE 4-digit 'classes') each town becomes more unique, less like any other town; at a higher level of aggregation they all become more similar. The level of aggregation in the present analysis is identical to that in Markusen & Schrock's (2006) study of specialisation in the US urban system (also 22 categories).

While the level of statistical aggregation is the same, the latter study differs from the present research in the fact that the data used relate to employment classified by occupation rather than industrial sector. This is an important difference and relates to the issue of how urban specialisation is expressed and what aspect of specialisation is important for urban economic performance. A growing number of studies are focusing more on occupational rather than industrial specialisation, amid evidence that the former is increasing while the latter is decreasing (see for example Duranton and Puga, 2005). However it is not yet clear whether occupational specialisation is more important to the economic performance of towns, and most of the literature on topics such as localisation economies as a source of urban growth still concentrates on the importance of industrial structure. For this reason we retain the more conventional approach here of focusing on the industrial specialisation.

It is important to note finally that the census data for each town are for workers *resident* in the town, as opposed to *employed* in the town. This means that towns are being characterised by the employment sector of their residents (regardless of where they work), rather than of their factories, offices and other places of work. As commuting has increased in recent years both in volume and distances travelled (Horner, 1999), there is a growing disjuncture between the geography of employment supply and the geography of employment demand. Although new data that would support an analysis of specialisation based on employed workers have recently become available for the Republic of Ireland, we do not have comparable data for the same point in time on an all-island basis. Until that gap is filled, studies will continue to rely on the place of residence data.

3.1.2 Urban Areas

The key question here is how to define the urban system, i.e., what centres of population to include. On the one hand, it could be argued that very small centres (towns under 4,500 to 5,000) should be excluded, because they are unlikely to have any significant level of employment / basic activity. Given the small scale of employment, the concept of specialisation is problematic for such towns, in the sense that, despite potentially high levels of specialisation, their role in the urban system and contribution to the national economy is relatively insignificant. There are methodological / practical problems too. Because basic employment is typically contributed by a very small number of enterprises, often indeed a single medium to large scale plant or firm, the specialisation of the town can change dramatically following a plant closure or downsizing. Small towns in the commuting hinterland of large centres, which function mainly as dormitory towns, present particular problems for the analysis. Because their resident workers travel elsewhere to work, their functional classification depends on the employment opportunities available in the destination(s) to which their residents commute. But this is a problem anyway for all centres – not just smaller ones – because of the fact that the data are based on place of residence not place of work (see above).

Despite these conceptual and methodological problems, we believe that it is desirable to include smaller settlements in the analysis because of their locally important role (especially in more peripheral regions) and their consequent importance in the two

spatial strategies. Already, increasing attention is being devoted to the key role of such centres in the South, e.g., in the various Regional Planning Guidelines. Our analysis therefore is for all places with 1,500 or more population (N = 144 in RoI; N = 75 in NI). The spatial distribution of these centres, and their relative population sizes, are illustrated in Figure 1.

[Insert Figure 1 about here.]

As well as the urban system, we need to define the urban areas themselves. This is done as much as possible on the basis of the built-up area, or what is sometimes termed the morphological urban area. This definition gives urban areas that are more extensive than administrative areas, but less extensive than functional areas / daily urban systems. However, it should be noted that slightly different definitions are used in Northern Ireland and the Republic of Ireland. In the Republic the data are for legally defined towns / cities plus their contiguous suburbs / environs, or so-called 'census towns' in the case of towns without a legal boundary. For Northern Ireland, the data are based on the unit of the 'settlement', defined mainly on the basis of Statutory Development Limits (SDLs) around towns, but which also takes account of factors such as identity or 'community sentiment' (see NISRA, 2005, for details). This unit provides a reasonable fit with the 'built-up' areas of the Republic of Ireland but there are some problematical cases that arise nevertheless (see Appendix A.1).

3.2 The Analysis

3.2.1 Concepts

The two key concepts underpinning the analysis are specialisation and complementarity. There are two dimensions of specialisation that are relevant to the analysis: first the degree or level of specialisation in the town, and second the nature or type of that specialisation. Conventionally, the *degree* of urban functional specialisation is measured by the extent to which the industrial profile of workers resident in a town corresponds to, or diverges from, the average employment profile of a wider reference area, or group of centres, to which the town belongs. The greater the degree of divergence from this average, the more specialised the town in question is said to be. Conversely, the closer the town's employment profile is to the average, the lower the degree of specialisation and the higher the level of diversification. Specialisation and diversification are thus considered to be opposite sides of the same coin[2]. The *type* of specialisation is examined by identifying each centre's dominant sector of employment and assigning it to a functional category accordingly. As with the measurement of specialisation level, the identification of the dominant function is based on a comparison of the town's employment profile to that of the reference area or group of centres.

The reference or 'normal' employment profile in studies of urban specialisation is usually the aggregate employment profile of either all the towns in the urban system, or of the national (or regional) economy as a whole. In countries such as the US or

[2] This need not always be the case: Duranton and Puga (2000), for example, set out measures of diversification and specialisation that are not the inverse of each other.

Canada, where there is a high level of urbanisation of employment, the difference between these two norms is relatively small, and studies have tended to use the urban system as a whole as the benchmark. The situation in Ireland is different. Despite on-going urbanisation, a significant component of total employment (both North and South) remains outside the urban centres, and therefore the use of an urban system norm to determine patterns and levels of specialisation gives significantly different results from those obtained using the employment profile for the economy as a whole. In the present study the latter approach is preferred. Thus, the employment patterns of towns in the Republic are compared to the aggregate pattern in the South, and likewise for Northern Ireland towns using the North's aggregate employment profile.[3] The main reason for this approach is that it is the urban centre's role in relation to the rest of the economy in which it is situated that we are interested in, not merely its role in relation to other urban areas. A second advantage of this approach is that it avoids the problem whereby the results of the analysis depend on which towns are included in the definition of the urban system.

Our interpretation of the concept of complementarity sees this as the outcome of levels and types of specialisation: we consider two towns to be complementary in so far as their sectoral employment profiles are different. More specifically, complementarity is assessed in two ways: first by checking if the towns in question belong to similar or different functional / industrial categories; secondly, by measuring the degree of difference between pairs of towns across their entire employment profiles. In both cases because our employment data are for industrial groups, complementarity is also being measured in sectoral terms. Complementarities among / between centres are explored for particular groups of centres. These groups can be defined spatially / regionally, giving rise to comparisons between neighbouring centres, including those in cross-border regions, that may be quite different in size. Alternatively, they may be defined functionally / hierarchically where the comparisons are between similarly designated, but spatially distant centres (such as Hubs, Gateways). Given that our interest is ultimately in issues of balanced regional and local development, the analyses presented here are based on groupings of towns according to spatial proximity.

3.2.2 Methods and Measures

The analysis required to operationalise the concepts outlined above has the following main components.

(i) Calculation of a measure of overall employment specialisation for each urban centre, North and South.

[3] A third possible norm is of course possible: that derived from the aggregate all-island employment pattern. This is not applied here because the focus of the analysis is mainly on specialisation and complementarity *within* rather than *across* the two jurisdictions. Interestingly however, the results for each jurisdiction do not vary greatly if an all-island norm is used. Thus, for example, only 18 per cent of all centres (13 per cent in RoI, 28 per cent in NI) are classified differently when an all-island norm is used; and the average difference across urban centres in the measure of specialisation is less than 17 per cent.

(ii) Identification of 'basic' employment in each centre in each industry, and the use of this to classify centres into functional / industrial types on the basis of the dominant function.
(iii) Analysis of regional /spatial contrasts in specialisation levels and in the distribution of functional / industrial types.
(iv) Measurement of differences in urban employment profiles for pairs of centres.

Following Markusen and Schrock (2006) specialisation is measured using the Coefficient of Specialisation (CS). Preliminary exploratory analyses on data for the Republic of Ireland found that this was the most satisfactory of a range of measures, including the Gini Coefficient, the Specialisation Index, the Relative Specialisation Index, and a modified Hirshman-Herfindahl Index, the latter three being computed according to the formulae set out in Duranton and Puga (2000)[4].

The estimation of basic employment is carried out using the Index of Surplus Workers (Mattila and Thompson, 1955), which disaggregates each industry's employment in a given town into imputed 'basic' and 'non-basic' components. Basic employment is that which is sustained by exogenous demand, i.e., demand that arises outside of the town and its immediate hinterland; non-basic employment is that which arises from endogenous demand. An alternative approach used by Markusen and Schrock classifies whole sectors as either basic or non-basic, depending on how localised employment in each sector is, as measured using the Coefficient of Localisation (CL). This approach is not used here for both conceptual and practical reasons. Conceptually, the Index of Surplus Workers approach is preferable because it allows for the possibility of basic employment locally in an industry that is not part of the economic base nationally. On practical grounds it is preferable too, because the Markusen and Schrock approach was found in preliminary analyses to give widely varying results depending on the critical or cut-off level of the CL used to identify basic sectors, and the fact that the choice of this cut-off is purely arbitrary.

The classification of centres into industrial categories is based on a simple rule: each centre is assigned to the category in which it has the greatest level of basic employment. Like all single attribute classifications, this approach undoubtedly over-simplifies matters, and can result in the assignment of centres possessing quite similar employment profiles to different categories. However, classification represents conceptually the simplest method for assessing complementarity between centres in a 'first pass' analysis.

In order to assess the extent of intra-regional complementarities between centres, it is necessary to specify a regional framework. In the absence of any obvious and more satisfactory alternative, the regions used initially for this purpose will be the NUTS 3 regions (N = 8 in RoI; N = 4 in NI, because Belfast will be merged with Outer Belfast[5]). However, it is acknowledged that the NUTS 3 framework is not ideal for this purpose: the geography of regions such as the North of Northern Ireland and the Border region in

[4] The various measures were assessed with regard to (i) their stability across different levels of sectoral aggregation and (ii) their consistency with each other.
[5] Belfast NUTS3 region corresponds to the Belfast City Council District and therefore contains only part of the Belfast urban area as defined here.

the Republic of Ireland is such that their component urban areas can hardly be said to form clusters. Using this spatial framework, assessment of complementarities is based on the extent to which the centres within a region differ in terms of their dominant function. Thus, we cross-tabulate centres by their regional location and industrial / functional type, and derive Cramer's *V* statistic as a measure of the association between the two attributes. If there are significant intra-regional complementarities (i.e., differences in function) then this will result in low values for the association measure. Conversely, higher values will indicate that industrial type co-varies with regional location, thereby indicating an absence or weakness of sectoral complementarities.

The NUTS 3 analysis outlined above is conducted separately for the two jurisdictions, as indicated earlier. A particular focus of our research however is the existence (or absence) of complementarities among groups of centres defined on a cross-border basis. For this, the final part of the analysis, differences in employment profiles between pairs of centres (e.g., Newry- Dundalk) are measured using the Dissimilarity Index (DI). DI is a widely used and robust measure of the difference between areas in their employment profiles[6]. Higher values of DI indicate greater differences and hence higher levels of sectoral complementarity. While this pair-wise analysis of complementarity, unlike the NUTS 3 analysis, is confined to a sub-set of the urban centres, it has the advantage of being based on a direct comparison between centres' employment profiles, rather than an indirect comparison with a specified norm. In addition, all of the towns' employment profiles is taken into account, not just the dominant sector.

Further details of CS, the Index of Surplus Workers, and DI are contained in the Appendix (A.2).

4. Results

4.1 Preliminary analysis of specialisation

The traditional view on the determinants of urban economic performance has tended to suggest that, in terms of the development prospects of the individual urban centre, diversification is more desirable than specialisation (Chinitz, 1961; Jacobs, 1969; Quigley, 1998). In particular, it has been argued that economic diversity acts as both a stimulus to innovation and an important source of urbanisation economies. On the other hand, the urban systems view is that higher levels of specialisation denote more strongly integrated systems. In keeping with the urban systems perspective, specialisation is seen in the present analysis as a prerequisite for complementarity between and among centres. However, even at the level of the individual urban centre there may be advantages to specialisation, in so far as it is associated with distinctiveness. Thus, Markusen and Schrock (2006) argue that in an era of intensifying competition between urban centres for mobile investment, and when centres may struggle even to retain the service demand arising in their own hinterlands, distinctiveness, in productive activities as well as in patterns of consumption and identity, can act as an important source of competitive advantage.

[6] When one of the areas in the comparison is the nation as a whole, then DI is exactly equivalent to the Coefficient of Specialisation

Prior to the spatial analysis of patterns of specialisation and complementarity (sections 4.2 and 4.3) we first examine relationships between the level of specialisation of centres, their overall size, and their dominant function. Throughout this section and section 4.2, specialisation is measured for urban centres in each jurisdiction with reference to the aggregate employment pattern for that jurisdiction.

4.1.1 Degree of Specialisation and Population Size

The relationship between the overall level of specialisation and population size of centres has long been a focus of urban systems analyses. Findings on the relationship are mixed, though most evidence suggests that specialisation decreases with population (Ullman and Dacey, 1960; Marshall, 1981; O'Donoghue and Townshend, 2005): in other words, larger centres tend to be more diversified. Duranton and Puga (2000) present this as one of their 'stylised facts' about diversity and specialisation in cities. However, there is also some evidence that the relationship may in fact be U-shaped, such that specialisation decreases with size up to a given level or range of sizes, before increasing again thereafter (Bahl et. al., 1971). In this case it is the medium sized centres that show the highest levels of diversity, with smaller and larger centres alike more specialised.

For the two Irish urban systems the relationship between size and level of specialisation (both variables are interval scaled) is measured by means of the correlation coefficient, and since the distribution of population sizes is highly skewed in both jurisdictions, Spearman's rank correlation coefficient is preferred to Pearson's more widely used measure. For both the Republic of Ireland and Northern Ireland the data suggest that the relationship is closer to the first of the scenarios outlined above: i.e., larger centres are less specialised. This is indicated by negative values of the rank correlation coefficient in both instances, with r_s = -0.36 for RoI, and r_s = -0.40 for NI. It is notable that the order of magnitude of the association is similar across the two jurisdictions. However, while r_s indicates that the relationships are both monotonic, they do not appear to be linear. Rather, in both jurisdictions there is a tendency towards an L-shaped relationship, whereby the decrease in levels of specialisation attenuates as size increases.

4.1.2 Degree and Type of Specialisation

As with the relationship between specialisation level (CS) and size, there is conflicting evidence in the urban systems literature on the relationship between the degree of specialisation and the dominant function of the urban area. However, a common finding is that centres that specialise in manufacturing tend to be more specialised, while those that are oriented primarily towards central place functions are more diversified (Maxwell, 1965). In order to test the relationship for the two Irish economies, the dominant function of each centre was identified on the basis of the industry (N=22) in which it had the greatest number of basic workers. To simplify the analysis, centres were then assigned to one of 12 broader functional categories, as indicated in Table 1.

For both jurisdictions the distribution of CS is not significantly different from normal.[7] Hence, the association between CS and functional type can be measured using the variance ratio (*F*-ratio) from Analysis of Variance (ANOVA). Although this is not a bounded statistic, and varies with the number of groups, the associated significance level (*p*) gives some indication of association.

For the Republic of Ireland there is a relatively strong relationship between function and specialisation: the *F* ratio of between-group to within-group variance in *CS* is 2.11, with a *p* of 0.023. The highest levels of specialisation occur in centres where either the textiles industry or tourism-related activities form the mainstay of the economic base (Table 1). As was found by Maxwell in his study of the Canadian urban system, centres of wholesale and retail trade tend to be the most diversified.

Table 1. Mean CS by Functional Category, Ordered by Specialisation Level, RoI

Functional Category	**Number of Centres**	**Mean *CS***
Textiles	2	0.217
Tourism	15	0.207
Public Administration & Defence	12	0.188
Food & Beverage	14	0.186
Health & Education	11	0.186
Other	15	0.177
Construction & Utility	15	0.170
Metals & Engineering	16	0.169
Banking & Business	8	0.167
Chemicals	7	0.161
Transportation	11	0.156
Trade	18	0.150

For Northern Ireland the strength of the relationship between the degree and type of specialisation is somewhat weaker, as indicated by $F = 1.77$, $p = 0.08$. However, the pattern of the relationship is broadly similar. Leaving aside the single chemicals centre (Broughshane, Ballymena LGD), the most diversified centres, as in the Republic of Ireland, are centres of transportation and trade. Aside from a single metals and engineering centre (Larne), the most specialised are textiles centres, with tourism centres also showing a relatively high degree of specialisation. One noticeable point of contrast between the two economies is urban centres where public administration and defence is the dominant basic function. In the Republic of Ireland these centres display a relatively high degree of specialisation (both relative to their counterparts in Northern Ireland and relative to centres specialising in other functions in the Republic of Ireland). This is due in part to the much higher levels of employment in this sector in towns in Northern Ireland as a whole, itself largely a legacy of the recent Troubles.[8]

[7] As assessed using the Kolmogorov-Smirnov test

[8] Public administration and defence employed just over 9 per cent of the total at work in Northern Ireland in 2001, as opposed to less than 6 per cent in the Republic of Ireland in 2002.

Table 2. Mean CS by Functional Category, Ordered by Specialisation Level, NI

Functional Category	Number	Mean *CS*
Metals & Engineering	1	0.175
Other	3	0.170
Textiles	5	0.168
Construction & Utility	18	0.166
Tourism	3	0.160
Food & Beverage	8	0.144
Health & Education	9	0.141
Banking & Business	3	0.124
Public Administration & Defence	16	0.122
Trade	4	0.120
Transportation	4	0.119
Chemicals	1	0.096

4.2 Spatial Patterns of Specialisation: Intra-Jurisdictional Comparisons

4.2.1 Regional Patterns in the Degree of Specialisation

Whereas hypothesised relationships between specialisation levels and both size and function can be derived theoretically, this is not the case with specialisation and location (in the abstract) and hence studies of urban systems have focused less on this relationship. Nevertheless, there is some empirical evidence of regional variations in specialisation levels, with the Maxwell (1965) study finding that the highest levels of specialisation in the Canadian urban system were found in the so-called 'heartland' region of southern Ontario and Quebec. This of course was associated with this region's historic role as the manufacturing belt of Canada.

There is some evidence of spatial variation in specialisation in Ireland, with more diversified centres tending to be located predominantly in the eastern part of both Northern Ireland and the Republic (Figure 2). In order to explore this further we apply ANOVA to test the variation in CS across the NUTS 3 regions. Despite the limitations of the NUTS 3 regionalisation (as noted earlier), the results show a strong degree of spatial variation in specialisation levels: indeed for both the Republic of Ireland and Northern Ireland CS shows a stronger relationship with location measured in this way than with functional type. In the Republic of Ireland the relationship is particularly strong, with $F = 5.22$, $p < .001$. The region with most diversified centres on average is the Mid-East. Specialisation is highest in the Mid-West and in the Border region (Table 3). The spatial pattern of specialisation / diversification cannot be attributed to inter-regional differences in the sizes of centres: there is in fact only a weak relationship

between regional location and size of centres, as indicated by the Kruskal-Wallis test ($H = 4.97$, $p = .663$)[9].

[Insert Figure 2 about here]

Table 3. Mean CS by Region, Ordered by Specialisation level, RoI

Region	Number	Mean CS
Mid-West	11	0.208
Border	19	0.197
West	15	0.186
South East	17	0.182
Dublin	12	0.179
South West	26	0.178
Midland	12	0.169
Mid East	32	0.142

In Northern Ireland the association between regional location and specialisation, while not as strong, is still significant, with F = 3.89, p = .012. The most diversified region is Belfast (including Outer Belfast); the most specialised is the North of Northern Ireland, followed by the West and South (Table 4). As in the Republic of Ireland, differences in specialisation between regions cannot be attributed to differences in size, as the urban sizes show little systematic variation between regions.

Table 4. Mean CS by Region, Ordered by Specialisation level, NI

Region	Number	Mean CS
North	20	0.171
West and South	14	0.152
East	32	0.133
Belfast (inc Outer Belfast)	9	0.124

Not alone is the specialisation / location strong for both jurisdictions, there is also a clear and consistent spatial pattern evident, in that the general tendency is for more peripheral and disadvantaged regions to contain the most specialised centres. Thus two of the three regions in the more disadvantaged Border Midland and West (BMW) region in the Republic of Ireland are also two of the three most specialised regions, and the rank order of Northern Ireland's regions in terms of specialisation is inversely related to their order in terms of GVA per capita. This finding, which is consistent with previous research on the urban system of the west of Ireland (McCafferty, 2002), is somewhat surprising, given that centres in more peripheral and less developed regions might be expected to be oriented mainly towards central place functions, and thereby to display higher levels of diversity. From a spatial policy point of view, the results might be considered encouraging in relation to the potential for exploitation of inter-urban complementarity in peripheral disadvantaged regions. However, while high levels of specialisation might be a necessary condition for complementarity, they are not a

[9] Kruskal-Wallis is used here rather than the *F*-ratio because of the skewed (non-normal) distribution of urban populations.

sufficient condition. In particular, the strength of inter-urban complementarity will depend on the nature of the specialisations involved, and it is therefore to this consideration that we turn next.

4.2.2 Regional Patterns in the Type of Specialisation

In terms of assessing the degree of inter-sectoral complementarity at regional level the crucial relationship is that between the dominant function of a centre and its regional location. If location and function are closely related, i.e., like functional types of centres are located together, then the degree of inter-sectoral complementarity within regions is necessarily restricted. In order to systematically assess the strength of the location-function relationship we first use Cramer's *V* as a measure of association derived from the cross-tabulation of centres on the two variables. Cramer's *V* is a chi-square based measure of association suitable for nominal variables. The value of the statistic varies between 0 and 1, with higher values indicating a stronger association.

For both jurisdictions, the data indicate a moderately strong relationship, with $V = 0.39$ for the Republic of Ireland and $V = 0.50$ for Northern Ireland. The respective *p* values are < 0.001 (RoI) and 0.007 (NI), but because the conditions for drawing inferences from the data are not met, these must be treated with a degree of caution[10].

In order to throw more light on spatial patterns of industrial / functional specialisation, and to go beyond the NUTS 3 analysis, we present a series of maps showing the distribution of the various types of centres across the island as a whole. Figure 3 illustrates the distribution of all functional types, while Figures 4 to 9 depict separately the distribution of some of the functional types that exhibit the highest levels of spatial clustering. Particularly strong clustering is evident in both jurisdictions for centres of transportation (Figure 4) and banking and business (Figure 5), which are concentrated around the two capital cities, Belfast and Dublin. A different pattern of concentration is evident in relation to tourism centres in the Republic (Figure 6), where 7 out of 15 centres that are so designated are located in the South West region. Centres of public administration and defence cluster in the Midland / Mid-East regions of the Republic as well as around Belfast and Derry in the North (Figure 7). Finally, centres specialising in two of the more traditional sectors also show evidence of clustering. Thus 7 out of the 15 food and beverages centres in the Republic are located in the Golden Vale region of north Munster, while 5 out of 8 such centres in Northern Ireland are located in the East Region (Figure 8). In the clothing and textiles sector Derry and neighbouring towns on both sides of the border make up 4 out of 7 specialist centres on the island of Ireland as a whole (Figure 9).

In summary, the cross-tabulation and maps indicate that there is a strong tendency for centres that are specialised in a particular function to be located close to each other. This location pattern would appear to restrict the extent of intra-regional sectoral complementarity in both Northern Ireland and the Republic, whether in relation to the NUTS 3 regions or more generally. In the final part of the analysis we examine the extent of sectoral complementarity for a number of selected cross-border regions.

[10] Specifically, a high proportion of the cells in the cross-tabulations have expected frequencies less than 5. This is a result of the large number of categories, particularly on the functional type variable (N = 12)

[Insert Figures 3-9 about here]

4.3 Complementarities in Cross-Border Regions

In order to assess the degree of complementarity between / among centres in cross-border areas, a different approach to the above is used. Instead of comparing the functional category of centres, we use the Dissimilarity Index to measure differences between pairs of centres. This is both a more direct and a more comprehensive approach than that based on comparison of dominant industry only, in that the actual relative distribution of employment across all industrial categories is taken into account.

For illustrative purposes, four cross-border groups of centres are examined, as detailed in the table below (Table 5). We refer to these as the North, West, Central, and East Border groups. While only the first of these (though excluding Strabane) has formally designated status (as a Gateway in the NSS), all four are of key importance in the development of spatial planning on an all-island basis. In addition to the four cross-border regions, the Athlone-Mullingar-Tullamore urban cluster is included in the analysis for reference purposes, as a cluster that has been formally designated as a polycentric Gateway in the NSS.

While it is difficult to interpret the absolute level of the Dissimilarity Index, the levels recorded in the table appear to be relatively low[11]. In relative terms, the table indicates that the North Border group contains the most similar urban centres, followed by the Midland Gateway. All three of the other cross-border regions have higher levels of dissimilarity on average. Within all of the three- or four-centre cross-border clusters it is noticeable that the average dissimilarity level is pushed up by the smaller towns (Strabane, Bundoran and Keady), with the larger centres (Derry, Letterkenny, Enniskillen, Sligo, Monaghan and Armagh) generally exhibiting higher levels of similarity. This result is consistent with the earlier finding that larger centres are likely to be more diversified (and hence similar to each other). However, it takes that finding further, by showing that large centre similarity applies on a cross-border basis also.

Within the North Border cluster, the degree of dissimilarity is lower for the two main urban centres of Derry and Letterkenny than it is for any other pair of centres within the selected clusters. In terms of dominant function, both centres are classified (on the basis of an all-island norm) as centres of health and education, but both also have important basic employment in the textiles and clothing sector[12] (Fig. 1). In terms of the approach adopted in this paper, these two key centres in the north-western Gateway show little evidence of inter-sectoral complementarity. However, closer consideration of this example raises more fundamental questions relating to the nature of complementarity. The northwest's textiles and clothing sector is characterised by the location of a number of large producers in several urban centres throughout the region. Some of these companies have facilities in or close to both Derry and Letterkenny. The question that

[11] Technically the upper limit of DI is 100, but this value can only occur in the highly unlikely circumstance where the two centres in question have all of their employment in different industries, i.e., there is no employment sector in town A that also has employees in town B.

[12] As noted earlier, Derry is classified as a centre of textiles and clothing when compared to the aggregate Northern Ireland employment profile.

arises therefore is whether this geographical clustering might not be conducive to the development of inter-firm or indeed intra-firm linkages, based on complementarity at the intra-sectoral rather than inter-sectoral level.

Table 5. Dissimilarity Matrix for Selected Urban Clusters

***Cluster/* Town**	**Town**				**Average DI for centre**	**Group Average**
North Border	Derry	Letter-kenny	Strabane			16.18
Derry		11.92	15.33		13.63	
Letterkenny	11.92		21.29		16.61	
Strabane	15.33	21.29			18.31	
West Border	Enniskillen	Sligo	Bundoran	Bally-shannon		22.28
Enniskillen		19.35	27.54	18.70	21.86	
Sligo	19.35		26.37	22.39	22.70	
Bundoran	27.54	26.37		19.34	24.42	
Ballyshannon	18.70	22.39	19.34		20.14	
Central Border	Monaghan	Armagh	Castle-blaney	Keady		20.93
Monaghan		17.54	14.15	24.05	18.58	
Armagh	17.54		22.11	21.06	20.24	
Castleblaney	14.15	22.11		26.64	20.97	
Keady	24.05	21.06	26.64		23.92	
East Border	Dundalk	Newry				17.87
Dundalk		17.87			17.87	
Newry	17.87				17.87	
Midland Gateway	Athlone	Mullingar	Tullamore			16.25
Athlone		19.09	17.15		18.12	
Mullingar	19.09		12.52		15.81	
Tullamore	17.15	12.52			14.84	

5. Conclusions

The analysis has revealed that urban industrial specialisation on the island of Ireland follows a strong geographical pattern, with a tendency for particular types of centres to cluster at regional level. This has implications for the extent of sectoral complementarities between / among regional groupings of centres. The analysis has indicated that, within the NUTS 3 regions and for selected strategically important cross-border clusters, there is evidence of a strong degree of similarity in dominant functions and in the sectoral distribution of employment.

The key question that arises from the findings is whether the observed pattern of industrial specialisation is more or less conducive to the development of complementarities between centres? If complementarities are to arise from *differences*

in the sectoral profile of urban employment, and there is some suggestion in the policy documents that this is the case, then the analysis suggests that the scope for such complementarities may be quite limited. On the other hand, if complementarities (e.g., at the level of the firm or the plant) are promoted by *similarities* in dominant function / sectoral employment patterns, as suggested by the Porter (1998) model of industrial development, then there may be a better basis for the development of linkages between centres. Further research to examine the latter idea in more depth would of course require the collection of firm-level employment data for urban centres. However, before such detailed work is undertaken there is a more urgent need for further clarification and development of the theoretical notion of inter-urban complementarity as a policy prescription.

References

Bahl, R.W., Firestine, R. and Phares, D., 1971. Industrial diversity in urban areas: alternative measures and inter-metropolitan comparisons. *Economic Geography*, 47(3), 414-415.

Chinitz, B., 1961. Contrasts in agglomeration: New York and Pittsburg. *American Economic Review*, 51, 279-289.

DELG (Department for the Environment and Local Government), 2002. *The national spatial strategy 2002-202.* Dublin: The Stationary Office.

DRD (Department for Regional Development), 2001. *Shaping our future, the regional development strategy for Northern Ireland 2025.* Belfast: DRD

Duranton, G. and Puga, D., 2000. Diversity and specialisation in cities: why, where and when does it matter? *Urban Studies*, 37(3), 533-555.

Duranton, G. and Puga, D., 2005. From sectoral to functional specialisation. *Journal of Urban Economics*, 57(2), 343-370.

Horner, A.A., 1999. The tiger stirring: aspects of commuting in the Republic of Ireland, 1986-1996, *Irish Geography*, 32(2), 99-111.

Jacobs, J., 1969. *The economy of cities*. New York: Random House.

Krugman, P., 1991. *Geography and trade.* Leuven/Cambridge: Leuven University Press/The MIT Press.

Markusen, A., & Schrock, G., 2006. The distinctive city: divergent patterns in growth, hierarchy and specialisation. *Urban Studies*, 43(8), 1301-1323.

Marshall, J.U. 1981. Industrial diversification in the Canadian urban system. *Canadian Geographer*, 25(4), 316-332.

Mattila, J. and Thompson, J., 1955. The measurement of the economic base of the metropolitan area. *Land Economics* (August), 215-228.

Maxwell, 1965. The functional structure of Canadian cities: a classification of cities. *Geographical Bulletin*, 7(2), 79-104.

McCafferty, D., 2002. Balanced regional development, polycentrism and the urban system of the west of Ireland. *In*: J. McDonagh ed., *Economy, Society and Peripherality: Experiences from the West of Ireland.* Galway: Arlen House.

McCafferty, D., 2007. Urban systems. *In*: B. Bartley and R. Kitchin eds., *Understanding contemporary Ireland.* London: Pluto Press.

NISRA (Northern Ireland Statistics and Research Agency), 2005. *Statistical classification and delineation of settlements.* Report of the inter-departmental rural-urban definition group. Belfast: National Statistics.

O'Donoghue, D. and Townshend, I., 2005. Diversification, specialization, convergence and divergence of sectoral employment structures in the British urban system, 1991-2001, *Regional Studies*, 39(5), 589-601.

Porter, M., 1998. *The competitive advantage of nations*. Hampshire: Palgrave.

Quigley, J.M., 1998. Urban diversity and economic growth. *Journal of Economic Perspectives*, 12(2), 127-137.

Ullman, E.L and Dacey, M.F., 1960. The minimum requirements approach to the urban economic base. *Papers and Proceedings of the Regional Science Association*, 6, 175-194.

Appendix

A.1 Definition of urban areas

The use of 'settlements' in Northern Ireland gives a reasonable approximation to the built-up areas in the Republic of Ireland in most cases, but there are some problems in the case of Belfast. The settlement of Belfast, or Belfast Urban Area, had a population in 2001 of 276,000 and a total at work of 100,000. This unit however understates the size of Belfast in morphological terms, as it excludes a number of contiguous urban areas, some of which are quite large, including Castlereagh, Newtownabbey and Lisburn. Although there is a green wedge between the town of Lisburn and Belfast, the settlement of Lisburn (Lisburn Urban Area) includes the areas of Poleglass and Dunmurry which are suburbs of Belfast.

As an alternative definition of the capital city, the NI census also reports data for the unit know as Belfast Metropolitan Urban Area (BMUA, 2001 population 580,000, total at work 235,000). However, BMUA includes not just the above three settlements but also the settlements of Bangor, Carrickfergus and Carryduff, as well as a number of much smaller settlements, which are not contiguous with Belfast. This has the effect of overstating the size of Belfast compared to morphologicaly-defined towns in the Republic of Ireland.

In response to this, McCafferty (2007) used a third definition of Belfast which included Castlereagh, Newtownabbey and Lisburn, as well as Holywood, and Greenisland, but excluded all non-contiguous settlements within the BMUA, namely Bangor, Carrickfergus, Carryduff, Crawfordsburn and Groomsport, Helen's Bay, Milltown, and Seahill. It is this unit (2001 population 482,000; total at work 190,000) that is used in the present analysis also.

Applying the same principle of basing urban definition as closely as possible on the morphological urban area, Derry is defined as the settlement of Londonderry (population 84,000; total at work 28,000), i.e., excluding the neighbouring but non-contiguous settlements of Culmore, Strathfoyle and New Buildings which together with Londonderry constitute the Derry Urban Area.

A.2 Measures of specialisation

The following notation is used:

Eij = employment in urban area i in industry / activity j
$Ei.$ = total employment in urban area i in all industries
$E.j$ = total employment in the reference area (e.g., state or region) in activity j
$E..$ = total employment in the reference area in all industries
m = number of industries

The Coefficient of Specialisation

The coefficient of specialisation for urban area i is defined as:

$$CS = \frac{1}{2} \sum_{j=1m} \left| \frac{Eij}{Ei.} - \frac{E.j}{E..} \right|$$

The Index of Surplus Workers:

The number of basic workers in town i in industry j is estimated as:

$$Bij = Eij - \left(\frac{E.j}{E..} \right) \times Ei.$$

The Dissimilarity Index

For two towns i and k, the index is given by:

$$DI = 100 \times \frac{1}{2} \sum_{j=1}^{m} \left| \frac{Eij}{Ei.} - \frac{Ekj}{Ek.} \right|$$

Figure 1.

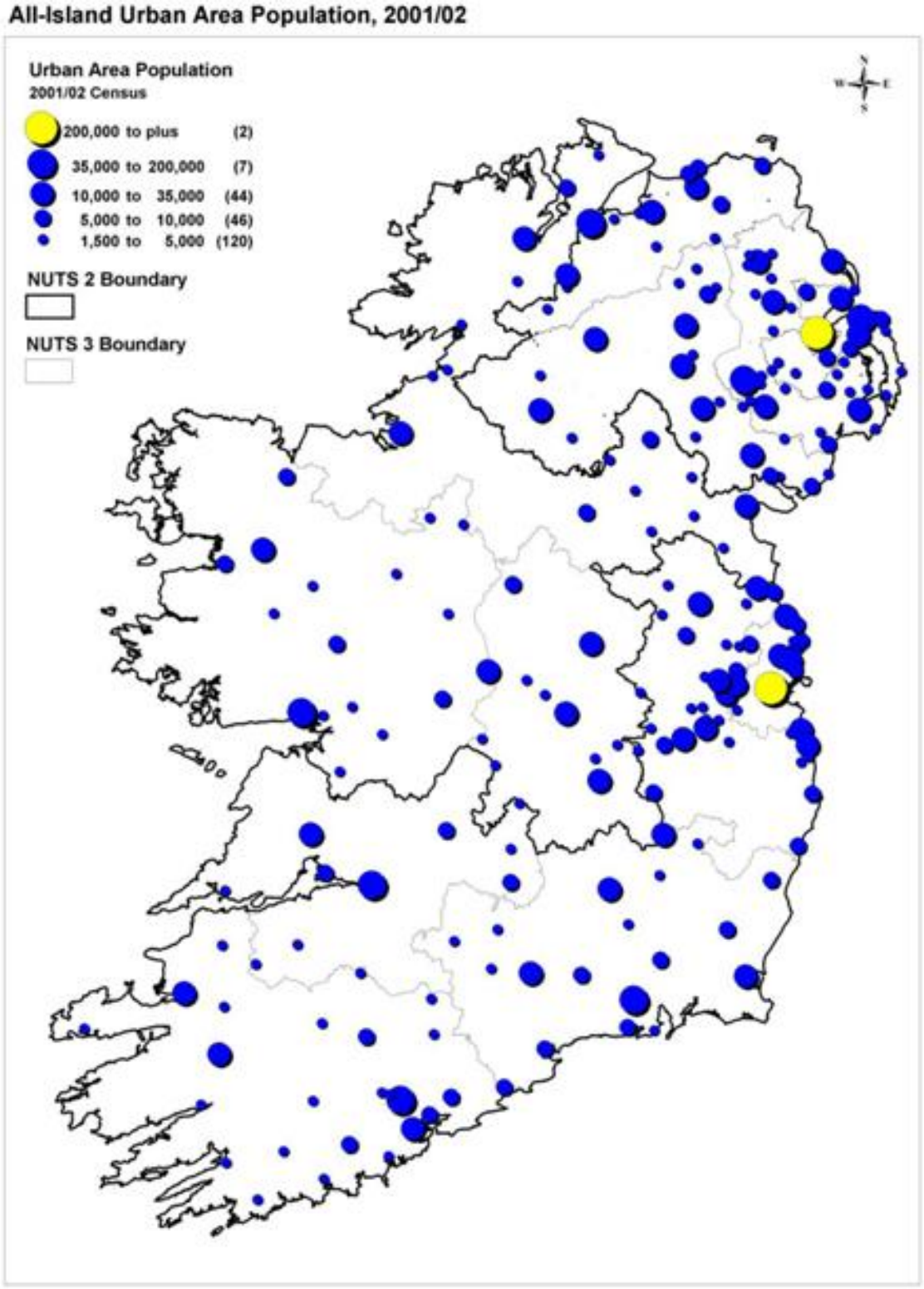

All-Island Urban Area Population, 2001/02
Urban Area Population
2001/02 Census
200,000 to plus (2)
35,000 to 200,000 (7)
10,000 to 35,000 (44)
5,000 to 10,000 (46)
1,500 to 5,000 (120)
NUTS 2 Boundary
NUTS 3 Boundary

Figure 2.

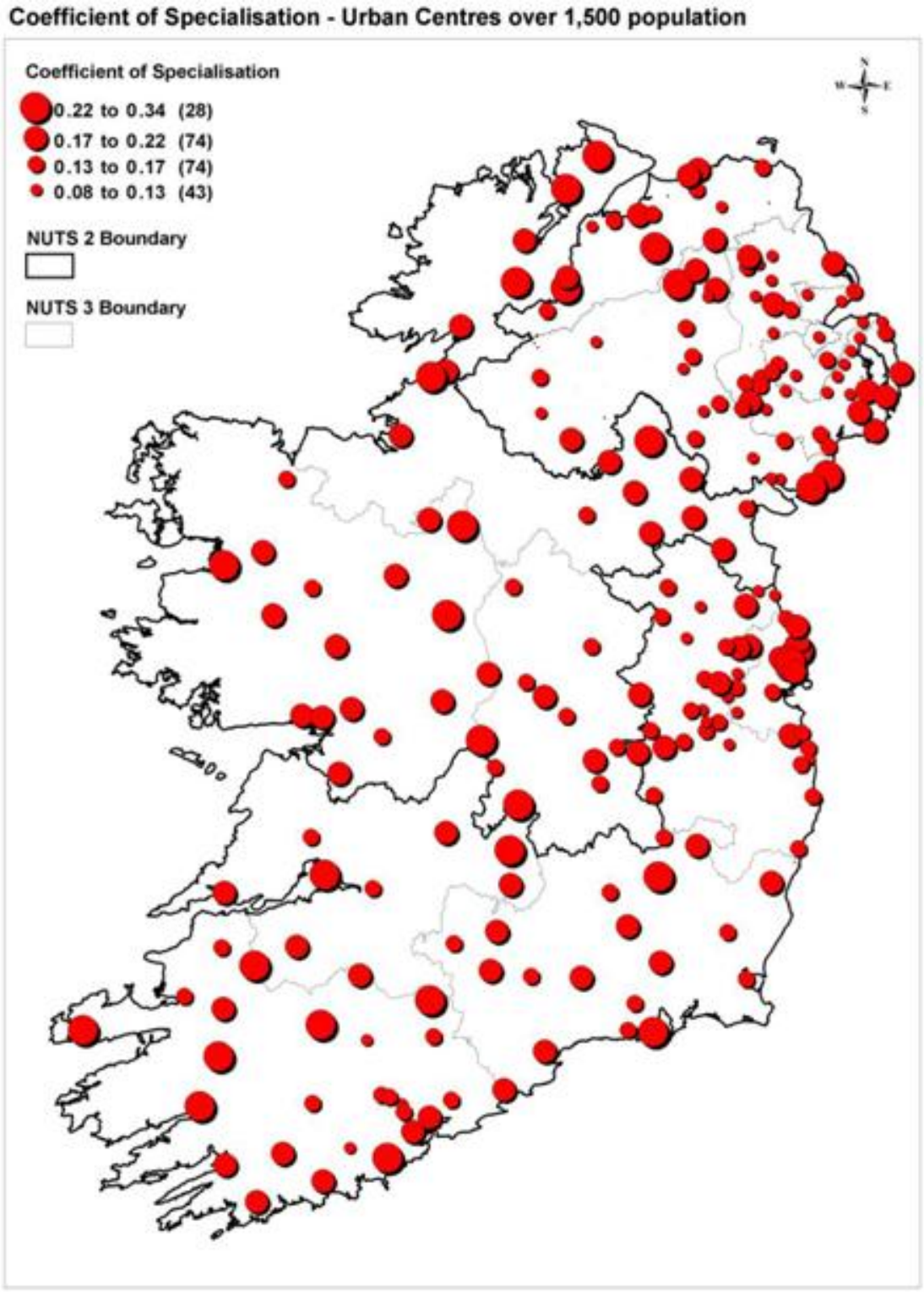

Coefficient of Specialisation - Urban Centres over 1,500 population
Coefficient of Specialisation
0.22 to 0.34 (28)
0.17 to 0.22 (74)
0.13 to 0.17 (74)
0.08 to 0.13 (43)
NUTS 2 Boundary
NUTS 3 Boundary

Figure 3.

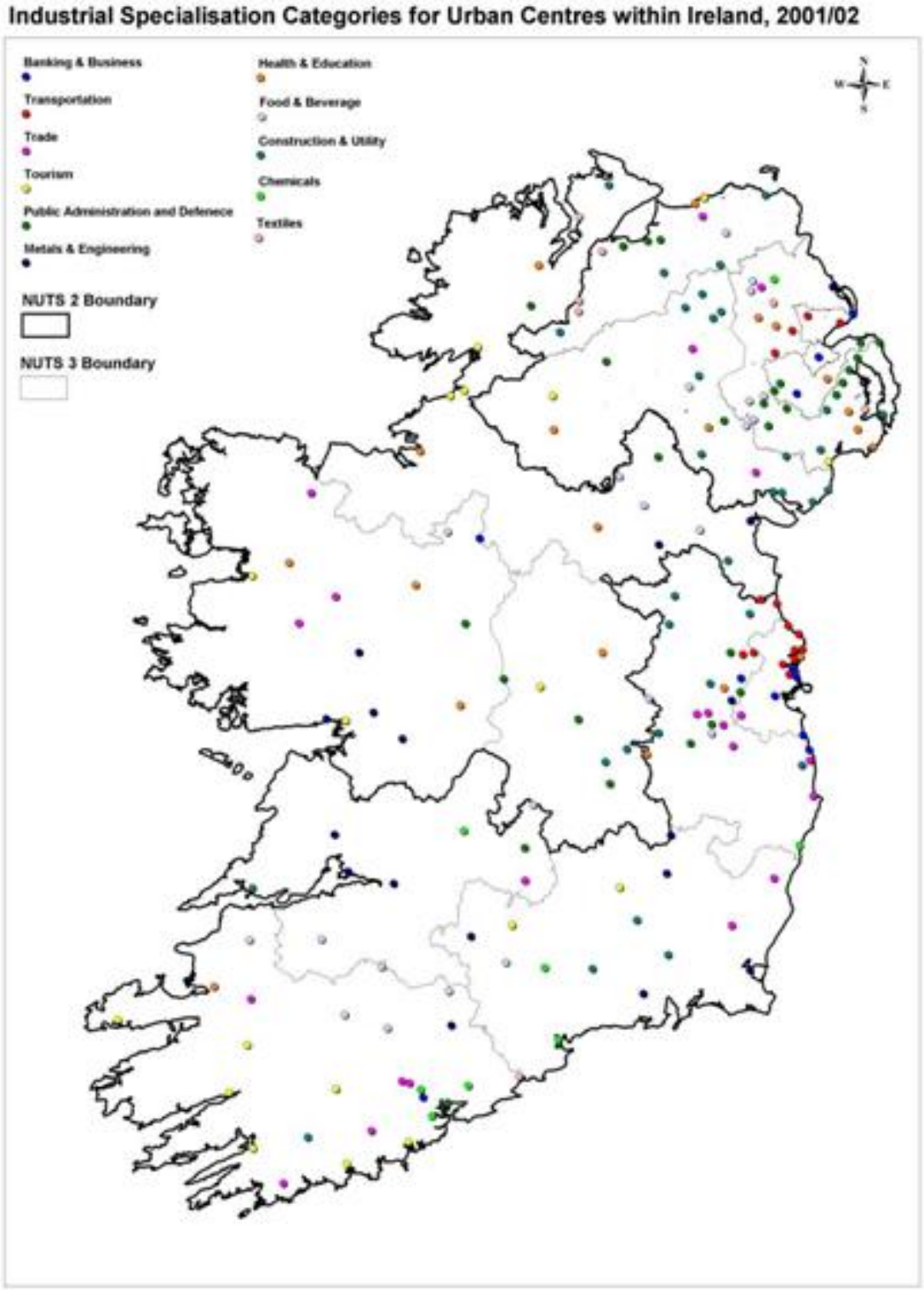

Industrial Specialisation Categories for Urban Centres within Ireland, 2001/02
Banking & Business
Transportation
Trade
Tourism
Public Administration and Defence
Metals & Engineering
Health & Education
Food & Beverage
Construction & Utility
Chemicals
Textiles
NUTS 2 Boundary
NUTS 3 Boundary

Figure 4.

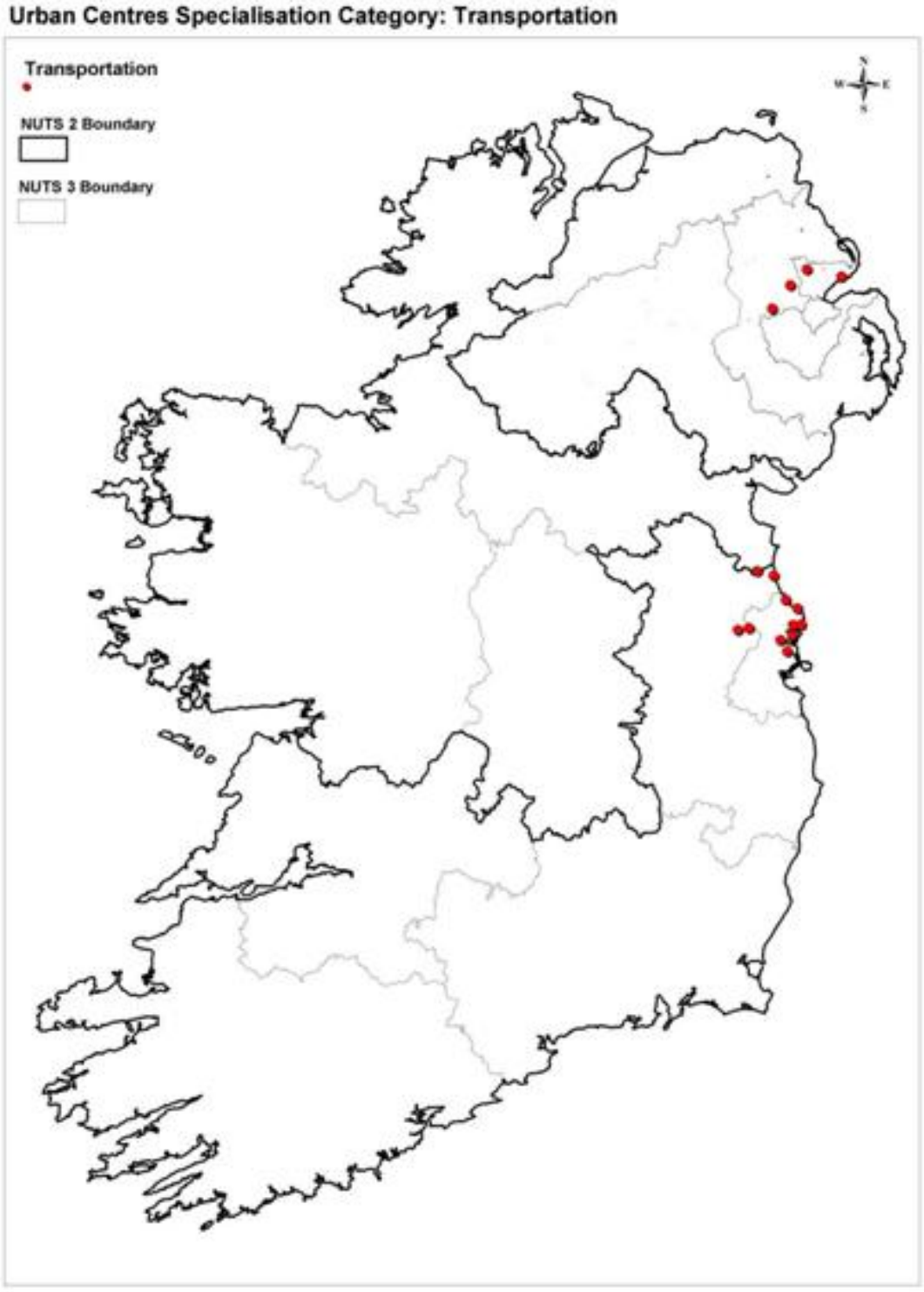

Urban Centres Specialisation Category: Transportation
Transportation
NUTS 2 Boundary
NUTS 3 Boundary

Figure 5.

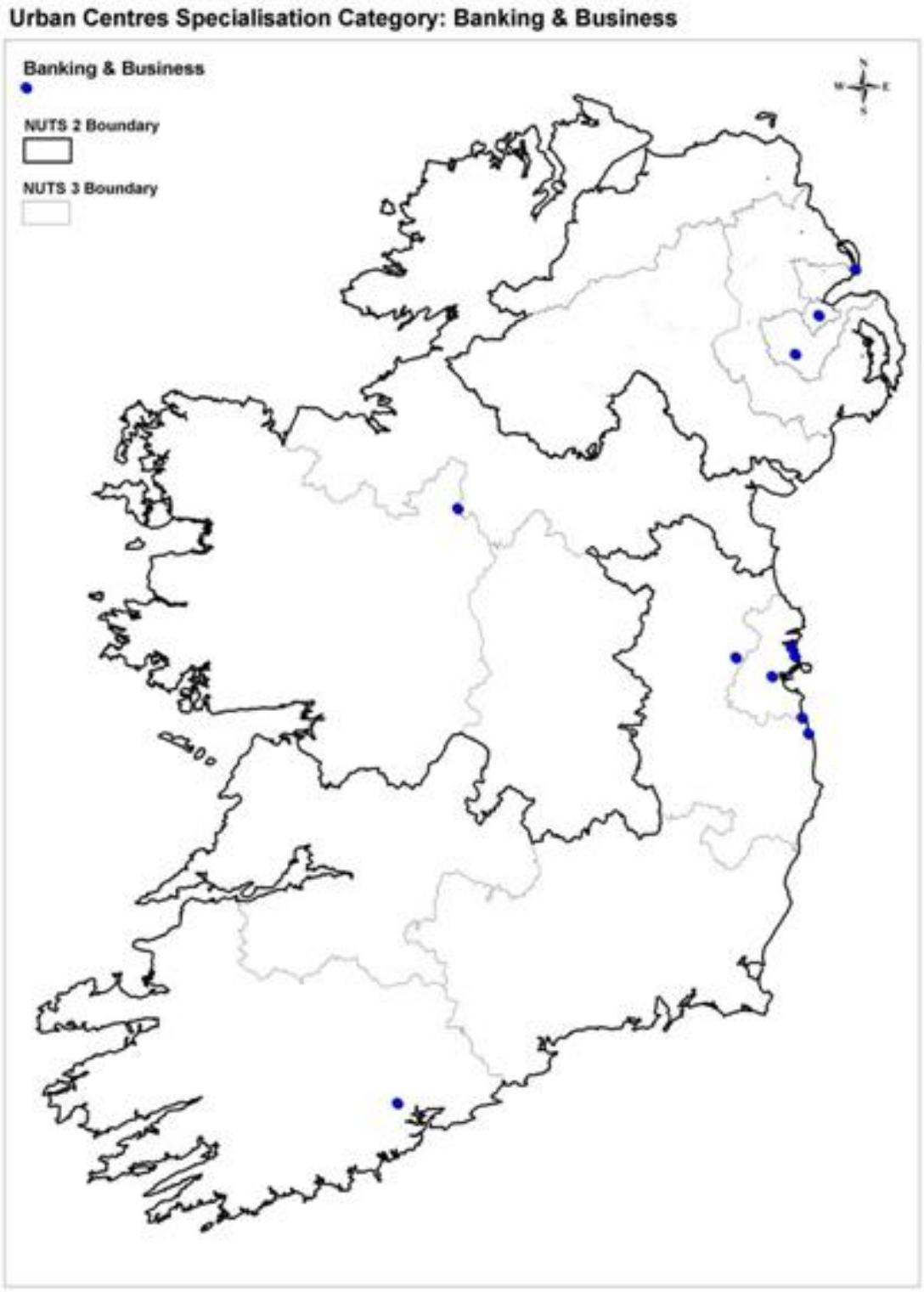

Urban Centres Specialisation Category: Banking & Business
Banking & Business
NUTS 2 Boundary
NUTS 3 Boundary

Figure 6.

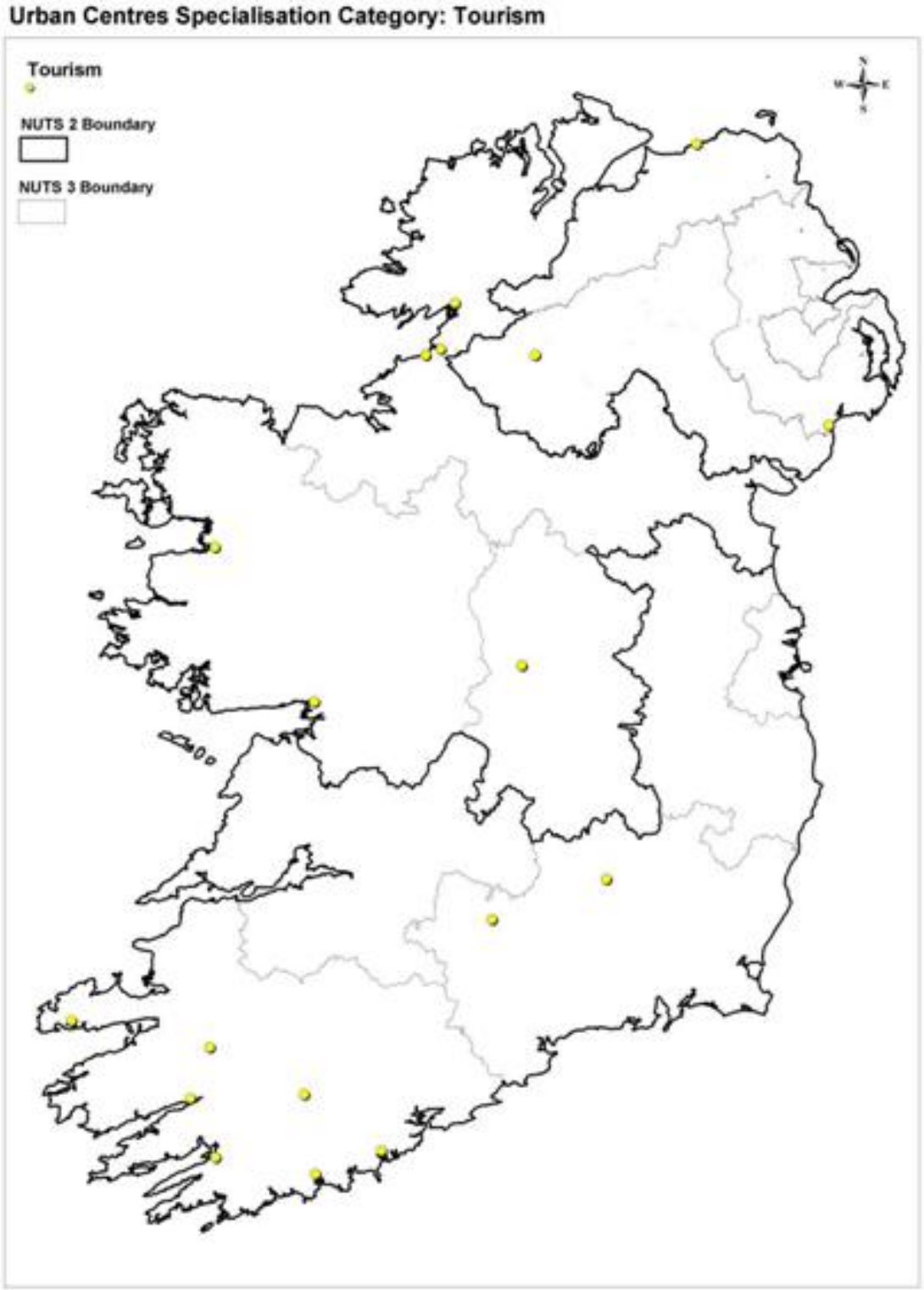

Urban Centres Specialisation Category: Tourism
Tourism
NUTS 2 Boundary
NUTS 3 Boundary

Figure 7.

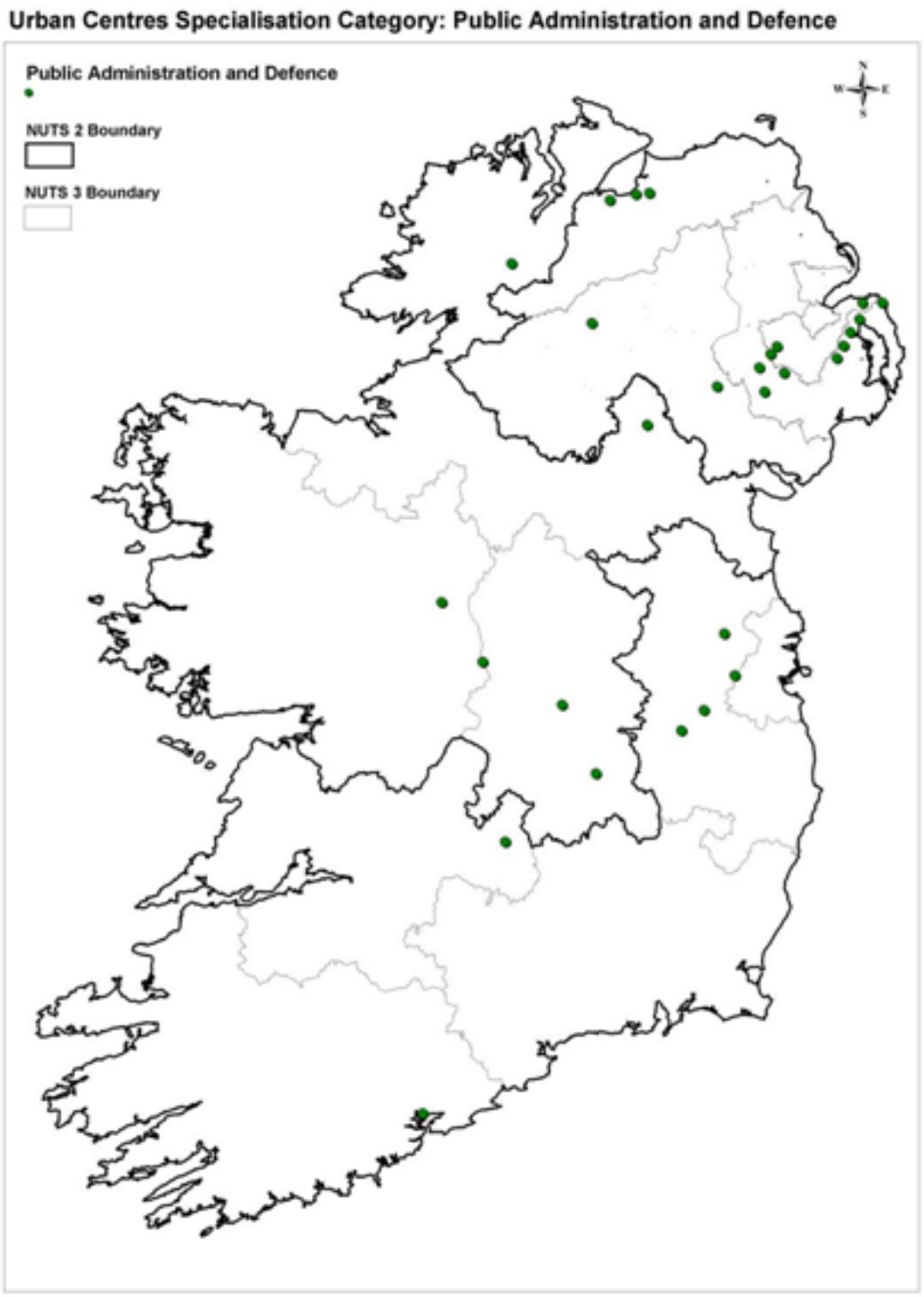

Urban Centres Specialisation Category: Public Administration and Defence
Public Administration and Defence
NUTS 2 Boundary
NUTS 3 Boundary

Figure 8.

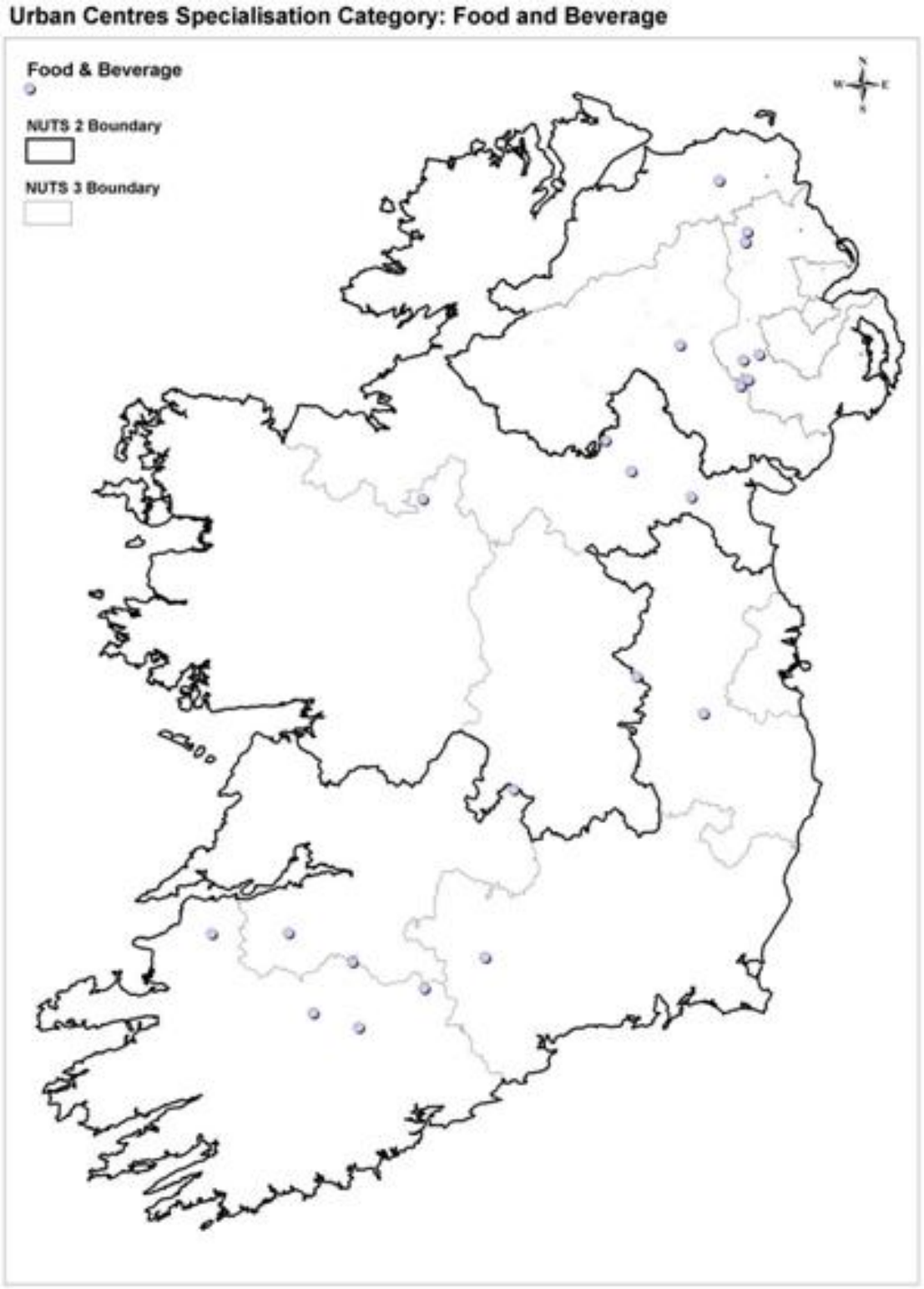
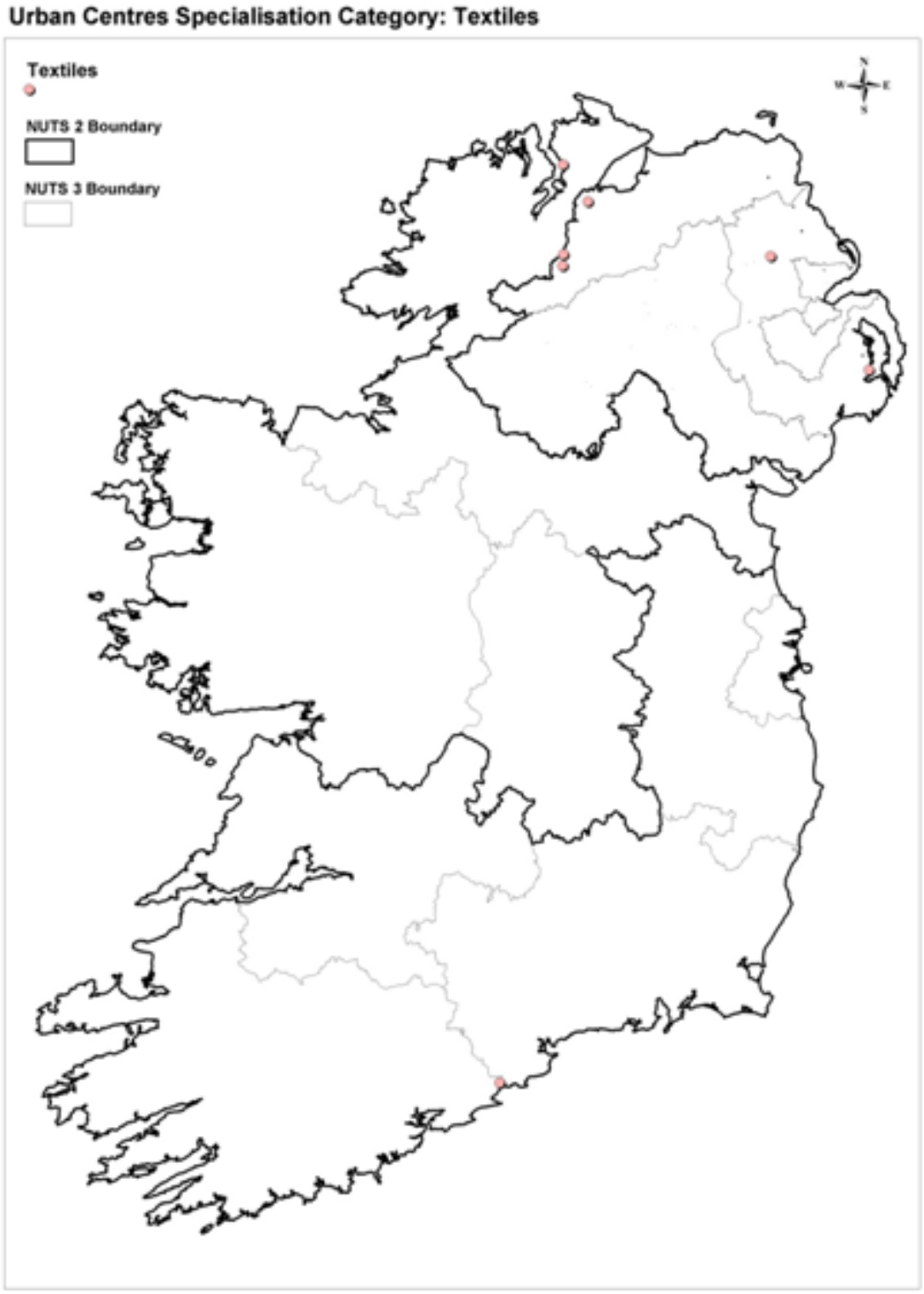

Urban Centres Specialisation Category: Food and Beverage
Food & Beverage
NUTS 2 Boundary
NUTS 3 Boundary

Figure 9.


Urban Centres Specialisation Category: Textiles
Textiles
NUTS 2 Boundary
NUTS 3 Boundary