SPECIALISATION AND REGIONAL SIZE

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1. Introduction

The degree to which regions and countries specialise in the production of goods and services has concerned economists for a considerable time. Recently this issue has received rather more attention as various authors have attempted to provide empirical tests of the "new economic geography". It has long been recognised that firms in an industry may benefit from locating close to each other (see, for example Marshall, 1920) due to agglomeration economies. Such economies may attract a variety of industries and have little effect on specialisation but equally there may be types of agglomeration economies that are industry specific and these may act to foster local industrial specialisation. Furthermore, in the "new economic geography" literature such spatial concentration of industries may also arise from internal factors, such as economies of scale (Krugman, 1991a, 1998; Venables, 1996). To a greater or lesser extent these factors encourage regional specialisation.

A second, well developed, theme in the literature relating to specialisation is that of central place theory (Christaller, 1966). According to this theory larger settlements are likely to provide a wider range of functions than smaller settlements. If this were the predominate factor in explaining industrial location one would expect larger settlements to be more industrially diverse than smaller ones.

A further recent development has been the concern of regional modellers, especially those concerned with constructing regional input-output tables (see, for example, Flegg et al., 1995), to capture adequately the extent of inter-regional trade. It is clear that the extent of specialisation in a region will have an effect on both the volume of trade and the pattern of that trade. There appears to be a consensus that, *ceteris paribus*, smaller regions, because they are more specialised, will engage in relatively greater amounts of trade.

There is some tentative evidence pointing to a greater variation in sectoral employment distributions at the regional level than at the national level, as the size of the region falls. For the eleven standard regions of the UK, Twomey and Tompkins (1996) found that the differences between the regional sectoral employment patterns and that of the national sectoral employment pattern appeared to be higher for the regions with smaller populations. A more systematic analysis is required, however, in order to confirm whether or not such a relationship exists in general.

In this paper, using data for Great Britain, we wish to examine the relationship between the size of a region and the degree of industrial specialisation of the region. In the following sections we discuss, in turn, the theoretical relationship between specialisation and regional size, various measures of regional industrial specialisation, the data used in the study and the empirical results. A final commentary concludes the paper.

2. Industrial specialisation and spatial concentration

The spatial concentration and dispersion of industry is a commonly observed phenomenon. In traditional trade theory (Pomfret 1991) the heterogeneous nature of the spatial economy was primarily perceived to be due to spatial variations in factor endowments. Most trade theory, however, has been fundamentally aspatial in nature. Location theory (Smith 1981), on the other hand, which is explicitly spatial in nature, has attempted to explain such factor endowment variations in terms of the relationship between transport costs,

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production theory (Isard 1951; Moses 1958) and observations of agglomeration behaviour (Hoover 1937; Chinitz 1961, 1964; Vernon 1966). This tradition, dating back to Weber (1909) and Marshall (1920), discussed the conditions under which firms within the same sector will cluster together geographically. Marshall identified the three reasons for such behaviour as the existence of local information spillovers, local non-traded input supply and local skilled labour supply (Krugman 1991a), each of which may engender positive local externalities. Local employment density may therefore be associated with local specialisation, due to the presence of agglomeration benefits which are specific to local firms within the industry in question. This is the first general conclusion of location theory regarding the question of regional specialisation.

A second strand of this location theory literature concerned the question of the heterogeneous distribution of urban centres. Within this explicitly spatial framework, the observed hierarchical structuring of the urban system was argued by central place theory (Christaller 1966; Beavon 1977) to be primarily a result of the spatial market areas required to support the provision of higher-order goods and services. Some aspects of this literature acknowledged the presence of agglomeration effects (Losch 1954). However, more modern approaches to analysing the spatial economy have emphasised the central role played by agglomeration economies in fostering continued localised growth (Krugman 1991b; Fujita and Mori 1997). These approaches have cast new light on the process of development in the spatial economy (Fujita and Krugman 1995), by integrating the role played by localised agglomeration effects with factor mobility and spatial competition between locations. The balance between centrifugal and centripetal forces provides a description of the growth over time of the urban hierarchy (Fujita and Mori 1997) which is characterised by different range of goods and services provided at each location. More specifically, the higher the rank-ordering (Mills 1980) of the urban area, the greater will be the variety of goods and services produced and provided for locally. Conversely, locations lower down the urban hierarchy will tend to be characterised by the production of a lower variety of locally-produced goods. The result of these patterns is that locations lower down the urban hierarchy will generally tend to be more specialised in their exports and more diverse in their imports than higher-order urban areas (Parr et al. 1975).

These arguments imply that, to the extent that agglomeration economies do exist, in higher-order locations the external benefits associated with spatial industrial clustering will be spread across a diverse range of sectors, whereas in lower-order sectors, the external benefits of clustering will tend to be contained within in a small number of industrial sectors. In Hoover's (1948) classification this implies that higher-order urban areas will generally exhibit greater economies of urbanisation, whereas lower-order urban areas will generally exhibit greater economies of localisation. From the point of view of local employment patterns, these arguments would also imply that in general, higher-order urban areas will exhibit a relatively diverse range of local employment activities, whereas lower-order areas will tend to exhibit a highly skewed sectoral employment distribution. In other words, in comparison with the national sectoral distribution of employment activities, higher-order centres will tend to be relatively less skewed than lower-order areas.

From orthodox urban economic theory (Mills 1980; Fujita 1989), we also know that higher-order urban areas will generally exhibit greater local population densities than lower-order urban areas. Combining this insight with the rank-ordering arguments discussed above, therefore suggests that areas with a greater distribution of local industrial sectors will also tend to be areas with a higher population density. Conversely, areas with a lower population density will tend to be areas exhibiting a lower range of local production sectors. In terms of regional specialisation and patterns of sectoral employment distribution, these are the basic predictions of modern urban-systems theory.

We now have two sets of basic conclusions concerning the relationship between regional employment specialisation and regional location. From Marshall, we know that localisation economies within a particular sector will tend to arise where employment density is high. At the same time, we also know from the urban-systems predictions that the higher is the rank-ordering of the area, and the greater is the population density of the area, the less specialised will be the area. This is because urbanisation economies will play a relatively greater role than localisation economies. The theoretical arguments underpinning the spatial heterogeneity of production are thus well developed. However, the empirical identification of the agglomeration economies which contribute to industrial clustering and dispersion is notoriously difficult. This makes the empirical results of discussions concerning the existence of agglomeration effects very sensitive to the spatial areas chosen for analysis (Cheshire and Carbonaro 1995). Similarly, it also makes attempts at modelling regional economies on the basis of national employment data also very sensitive to the spatial areas chosen for analysis.

There are three aspects to this problem. First, distinguishing between localisation economies (Marshall 1920) and urbanisation economies (Hoover 1937, 1948; Jacobs 1960) is problematic from an empirical perspective (Glaeser et al. 1992; Henderson et al. 1995). Second, distinguishing between industrial clustering which is due primarily to the existence of localised externalities from that which is due primarily to location optimisation behaviour (Isard and Kuenne 1953) is also empirically very difficult (Gordon and McCann 2000).

The third aspect to this problem concerns the question of spatial aggregation. The theoretical models discussed above do not explicitly consider the question of the spatial extent over which the agglomeration spillovers take place. Rather, agglomeration effects are assumed to operate a point in space, and the spatial extent of the market areas is determined by the interaction of the positive efficiency gains associated with localised increasing returns to scale and the negative cost effects associated with increasing distance-transport costs. However, in much of the urban and regional literature, a central problem of discussing agglomeration economies is that of identifying the spatial extent over which such agglomeration effects may take place. Indeed, the extent to which agglomeration effects are localised can vary enormously between both locations and industries, with some effects evident only at the sub-urban level (Feloy et al. 1997), some at the urban level, some at the regional level and others even at the inter-regional level (Cantwell and Iammarino 1999).

There are several reasons for this, each of which relate to Marshall's (1920) characterisation of the sources of agglomeration economies. The first reason is that the spatial extent over which informal information is shared between actors can vary between industries (Cantwell and Iammarino 1999). Secondly, the spatial area over which specialist suppliers can operate may differ between industries and locations. Thirdly, the search and job-matching processes within local labour markets may also operate over different spatial areas dependent on the extent of local employment commuting (Simpson 1992), which itself will be associated with the ranking of the local area within the urban hierarchy.

The size of the chosen unit area of analysis itself may therefore affect the empirical results of exercises aimed at analysing the structure of the local economy. This is because different spatial area definitions will include or exclude such information or labour-supply spillover effects between locations depending on the geographical boundaries of the areas of analysis. In particular, empirical observations of very small regional spatial areas will tend to exclude many such spatial interaction effects, because the industrial linkages implied by such effects will take place across regional area boundaries. On the other hand, empirical observations of very large regional spatial areas will reflect the aggregation and averaging of many different spatial interaction effects which take place over a variety of different spatial areas within the region.

Although our theoretical models provide us with some clear predictions concerning regional specialisation, the question of regional size has been largely ignored. Yet, as we see here, estimates of regional specialisation may themselves be affected by the choice of regional size. These issues are important for regional modellers. Attempts at developing local (Harris 1997) or regional input-output models (Hill and Roberts 1996), or regional computable general equilibrium models (McGregor, Swales and Yin 1996), will in part depend on the accuracy of the regional estimates of the variables employed. The absence of regional trade data means that the standard approaches to developing such estimates tend to be based on location quotient employment ratios (Mayer and Pleeter 1975; Harris and Liu 1998), which as we will see in the next section, are related to the national employment distribution. However, the above arguments concerning local specialisation and the heterogeneity of the spatial economy imply that these measures will become progressively less accurate as the size of the area of analysis falls (Flegg et al. 1995; McCann and Dewhurst 1998). This is because the smaller is the chosen region of analysis, the more it will deviate from the national employment distribution, and to the extent that agglomeration and spatial interaction effects do take place at the local level, the less appropriate will be the national employment pattern as a benchmark.

In order to understand the relationship between regional size and regional specialisation, in the next section we will discuss various measures of regional specialisation. In the subsequent sections, two of these measures will then be employed in an econometric assessment of the relationship between regional size and specialisation.

3. Measures of Specialisation

A number of measures of regional industrial specialisation have been adopted in the literature. In most, if not all cases, these are based on some transformation of the set of location quotients for the region in question. As the empirical work of the paper is based upon a set of employment data, the exposition below in based on location quotients measured in employment terms but it should be remembered that such quotients may be better derived from output data if that is available.

The location quotient for industry j in region r is defined as

$$q_{j,r} = \left(e_{j,r} / E_r \right) \Big/ \left(e_{j,T} / E_T \right)$$

where

$e_{j,r}$ is the employment in industry j in region r
$e_{j,T}$ is the employment in industry j in the nation
E_r is the total employment in region r

and E_T is the total employment in the nation.

The location quotient provides us with an index of relative regional specialisation for a single industry in a single region. One may note that this is more often referred to as the Balassa Index in the international trade literature. However, in order to discuss the specialisation of a region across industrial sectors we need to employ a measure of aggregate regional industrial specialisation.

In this paper we concentrate on two measures of aggregate regional specialisation. The first is taken from Blair, 1995, who defines an Index of Specialisation as

$$BIS = \sum_{j=1}^{n} \delta_j . \left[\left(e_{j,T} / E_T \right) - \left(e_{j,r} / E_r \right) \right]$$

where δ_j = 1 if $q_{j,r}$ <1
= 0 otherwise.

This may be written as

$$BIS = \sum_{j=1}^{n} \delta_j . \left[(1 - q_{j,r}) . \left(e_{j,T} / E_T \right) \right]$$

This index is the sum of the positive differences in the proportions of employment in industry j in the nation and in the region. As Blair remarks, equivalently one could sum the absolute value of the negative differences.

The second measure aggregate regional specialisation is that adopted by Amiti, 1998 in a study of specialisation within the European Union, in which she uses a Gini coefficient. For each region one ranks the location quotients in descending order. One may then plot the cumulative sum of the numerator against the cumulative sum of the denominator and calculate the Gini coefficient of regional specialisation as twice the area between the plotted line and the 45^{o} degree line.

4. The Data Set

In order to provide an empirical analysis of the relationship between regional specialisation and regional size we analyse employment data from the NOMIS[3] database which gives Census of Employment information broken down by sector and location for the whole of Great Britain. The data analysed here is taken from the 1995 census.

This data is available at varying degrees of spatial disaggregation. For the empirical analysis of this paper we have used information at three levels of spatial disaggregation. The most disaggregated level is that of Local Authority Districts. There are 459 of these. We also make use of data at the county and regional levels. There are 64 counties - the Shetlands, Orkneys and Western Isles being treated as one unit, distinct from the Highlands. There are eleven regions, the data for Greater London being given separately from those for The Rest of the South-East.

When all the sub-national areas are combined there are 533 observations, as Greater London occurs in the data set both as a county and as a region. In order to construct the two measures of specialisation it is necessary to utilise data at the aggregate G.B. level.

We use an industrial disaggregation at the 4-digit level (called ‘classes’ in the data set). There are 504 of these, however the last two are not relevant, being Private households with employed servants and Extra-territorial organisations and bodies, and one class, Mining of uranium and thorium ores, was reported as having no employees. A more substantive problem exists in agriculture. The figures for the agriculture sector reported in the data set are, in the main, taken from data provided by the Ministry of Agriculture and Fisheries (MAFF). Due to more stringent disclosure rules adopted by MAFF, data on employment in the agricultural sector is not available at the Local Authority District level. Thus the agriculture sector has to be omitted from all the calculations. As a result in the analysis below we use a disaggregation into 489 industries.

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[3] National On-line Manpower Information Service

In the empirical work of the following section use is also made of population densities for the areas which are taken from *Regional Trends* (1998).

5. The Empirical Relationship between Specialisation and Regional Size

From Table 1 we see that as the size of the area of analysis increases the average location quotient value varies only slightly. However, the both the average standard deviation and the average coefficient of variation of the location quotient values fall sharply as the size of the area of analysis increases. This suggests that as the size of the area of analysis falls, a greater number of sectors will cease to exhibit any significant presence in the area, thereby increasing the number of sectoral location quotient values which approach or equal zero. The result of this will be that on average the area will tend to become more specialised in aggregate terms as a smaller number of sectors will be represented within each area of analysis. As we see from Table 2, this is confirmed by both of our measures of aggregate regional industrial specialisation, which are extremely highly correlated. Table 3 shows the correlations between the two measures of aggregate regional industrial specialisation at the various levels of spatial disaggregation available.

Figures 1 and 2 show scatter diagrams for the Index of Specialisation and the Gini coefficient respectively against the value of the logarithm of total employment using all the sub-national data. In what follows we refer to the total non-agricultural employment in an area as the size of the regional economy.

Two features of Figures 1 and 2 are worthy of comment. First there is a marked and apparently linear relationship between the measures of specialisation and the logarithm of total employment. Second there are three noticeable outliers. The first is at [log(Size) = 12.426, Index = 0.705, Gini = 0.839], the second at [log(Size) = 13.068, Index = 0.474, Gini = 0.616] and the third at [log(Size) = 14.976, Index = 0.237, Gini = 0.331]. In all case the values of the index of specialisation and the Gini coefficient seem too high compared with the rest of the data. In fact these data points refer to the City of London, the City of Westminster and Greater London respectively. In each case the degree of specialisation is greater than one would expect, given the rest of the data, for a regional economy of their respective sizes. Given the peculiar nature of the economies this is perhaps not too surprising.

Notwithstanding the apparent linearity exhibited in Figures 1 and 2, there are compelling reasons for choosing to adopt a non-linear specification when modelling the relationship between specialisation and the logarithm of size. First, whereas the actual values of the dependent variable, whether the index of specialisation or the Gini coefficient, are, by construction, constrained to lie between zero and one, the fitted values from any unconstrained linear regression would not be so constrained. Second, as the size of the regional economy becomes close to zero both measures of specialisation must also become close to zero and as the size of the regional economy approaches that of the nation the values of both measures tend to one. Finally, and more pragmatically, linear specifications, in virtually all of the cases examined, fail the Ramsey RESET test for adequacy of functional form.

A common way to model variables that are constrained to lie between zero and one is to use a logistic curve (see, for example, Ramanathan, 1998, p.281-282) and that is the procedure adopted here. The logistic model may be written as

$$Y = \frac{1}{1 + \exp\{-(\alpha + \beta.X)\}}$$

with $\beta > 0$.

As X tends to $-\infty$, Y tends to zero and as X tends to $+\infty$, Y tends to one. This model may be estimated by transforming Y according to

$$Z = \log\left[\frac{Y}{1 - Y}\right]$$

and using the regression model

$$Z = \alpha + \beta.X$$

Because both the index of industrial specialisation and the Gini coefficient have the opposite limits to Y in the description above, the transformation used in this paper is

$$Z = \log\left[\frac{1 - M}{M}\right]$$

where M is the measure of specialisation.

Industrially specific agglomeration economies and similar factors, on the other hand, suggest that one might expect greater specialisation in regions where there is a denser spatial concentration of industry and rather less specialisation in regions, of the same size, where the activities are less densely concentrated. In order to capture this effect we have include the density of employment in the area, ED, (defined as the number of employees per square kilometre) as an explanatory variable in the model.

As we have seen, central place theory also suggests that larger settlements, higher up the urban rank-ordering, would tend to be less specialised than smaller settlements, because of the greater range of functions they might be expected to supply. This suggests that two regions with the same size, in terms of total employment, might be expected to differ in specialisation if one was a city region and one was a rural region. In order to capture this possible effect we have included in the regression model the density of population in the region, PD, as an additional explanatory variable, arguing that the density of population might be regarded as a reasonable proxy for the place of the region in the settlement hierarchy.

Allowing for the possibility that we will still have to treat the City of London, the City of Westminster and Greater London as special cases, the general form of the model estimated is

$$Z_r = \alpha + \beta.\log(S_r) + \gamma.f(ED_r) + \delta.g(PD_r) + \theta_1.CL + \theta_2.CW + \theta_3.GL + \varepsilon_r \quad ,$$

where S is total employment in the area, f and g are functions that have to established empirically and ε is a random error term. Only levels and logarithms of the variables ED and PD were tried. *A priori* we expect $\beta > 0$, $\partial Z/\partial ED < 0$ and $\partial Z/\partial PD > 0$.

The results of the preferred specifications of this equation are given in Table 4. The equations seem well specified, have considerable explanatory power and the parameter values accord with our *a priori* expectations. In particular, in Great Britain, regional specialisation is seen to increase with the employment density of the region and to decrease with the population density of the region, *ceteris paribus*. These results support our two initial hypotheses from location theory and central place theory. At the same time, regional specialisation is also seen to increase as the size of the region falls. This finding supports our argument which suggested that the observed measures or regional specialisation will also depend in part on the size of the area chosen as a region of analysis.

It may be noted that allowing for the effects of employment density and population density obviate the need for a City of Westminster dummy. Given their sizes, employment densities and population densities the City of London is less specialised than might be expected whereas Greater London is more specialised than might be predicted.

6. Commentary

Although the results appear convincing and are, we believe, robust, there are some caveats about the empirical exercise that should be aired.

The first concerns the sample of observations used. In the empirical work we combined Local Authority Districts, Counties and Regions. Primarily this was done to enable us to consider a wider range of regional size than would otherwise have been the case. Nonetheless this procedure introduces a complication that we have not sought to address as yet. Several districts make up a county and in turn several counties make up a region. This suggests that the measures of specialisation for individual counties and regions cannot be independent of the measures observed at the spatial levels of disaggregation within the counties and regions. Given the nature of the measures of specialisation the degree of dependence is hard if not impossible to assess. Nevertheless it may be that explicitly recognising that interdependence might qualify our results. The rather more general question of whether the results are robust with respect to the level of regional disaggregation will also be addressed in future work. As data for the agriculture sector is available at higher levels of regional disaggregation than the district level, such work may enable the effects of omitting the agricultural sector in this work to be assessed.

Second we make no allowance for any form of spatial autocorrelation. Although there does not appear to be any strong grounds for believing that the residuals should be spatially autocorrelated or that specialisation spills over from one area to contiguous areas in some manner, we recognise that the data might support such contentions, particularly at the smaller area level of analysis. In future work we hope to extend the analysis by considering an even finer spatial dissagregation, namely that of ward level data. In that case it would seem more likely that spillover effects might occur and thus the need for examining spatial correlation patterns would become more necessary.

Third, for some small district areas, the accuracy of the population density measure as a proxy for the ranking of the area within the urban hierarchy will inevitably suffer from the problem of employment commuting. From urban economic theory (Fujita 1989), the reason for this is that different areas within and around a single settlement will exhibit population density differences, dependent on their distance from the city centre. This means that central areas in some lower order cities may exhibit higher population densities than outlying areas in higher-order cites, although the former are part of a lower-order travel-to-work area. Although this may affect some of the relative area rankings, over a large number of urban centres and a large number of areas, this should not adversely affect our results.

Finally, the results use only one level of industrial disaggregation and pertain to one year only. Testing the effect of different levels of industrial disaggregation (Karaska 1968) on the results is the next stage in the research agenda. As the industrial disaggregation used here is the finest that the data allow, this work will have the added benefit of illuminating, to some degree, the effects on the analysis of having to omit the agricultural sector. Extending the analysis to cover a period of time, perhaps by considering two years reasonably well apart in time, will also enrich the results. A test of whether the parameter values of the estimated models, and indeed the models themselves, remain constant over time would be of considerable interest. Evidence of changes in the parameters over time might, for example, allow one to shed light on the degree of convergence and/or divergence of regional economies in the UK from a perspective that has not been adopted before.

7. Conclusions

Our results provide strong evidence of a negative relationship between regional specialisation and regional size. Allowing for the variations in regional specialisation predicted by location and central place theory, it is clear that measures of regional specialisation will also in part be affected by the chosen size definition of the region. Our results provide a word of caution for analyses which seek to document specialisation and agglomeration at an aggregate spatial level by splitting up a spatial area into a series of sub-areas. The empirical results themselves may not be independent of the chosen level of spatial disaggregation.

Our analysis also has implications for regional input-output modelling. Regional trade estimates based on a location quotient comparison of national and regional employment structures may become progressively more unreliable as the size of the area of analysis falls. Similarly, our argument would all but rule out the application of minimum requirements techniques (Ullman and Dacey 1960) at all but the very large regional area level.

REFERENCES

Amiti, M., 1998, "New trade theories and industrial location in the EU: A survey of evidence", *Oxford Review of Economic Policy*, Vol.14, pp 45-53

Beavon, K.S.O., 1977, *Central Place Theory: A Reinterpretation*, Longman, London

Blair, J.P., 1995, *Local Economic Development: Analysis and Practice*, Sage, Thousand Oaks, California

Cantwell, J.A. and Iammarino S., 1999, Multination Corporations and the Location of Technological Innovation in the UK regions" *Regional Studies*, Vol.33 Forthcoming

Cheshire, P. and Carbonaro, G., 1995, "Convergence-Divergence in Regional Growth Rates" in Armstrong, H.W. and Vickerman, R.W. (eds.) *Convergence and Divergence Among European Regions*, Pion, London

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

Chinitz, B., 1961, "City and Suburb", in Chinitz, B. (ed.) *City and Suburb: The Economics of Metropolitan Growth*, 3-50, Prentice-Hall, Englewood-Cliffs, New Jersey

Christaller,W., 1966, *Central Places in Southern Germany*, (translated by C.W.Baskin), Prentice-Hall, Englewood Cliffs, New Jersey

Feloy, M., Gordon, I.R., Lloyd, P.E. and Roe, P., 1997, *London Employer Survey 1996-1997*, London Training and Enterprise Councils, London

Flegg, A.T., Webber, C.D. and Eliot, M.V., 1995, "On the appropriate use of location quotients in generating regional input-output tables", *Regional Studies*, Vol.29, pp 547-562

Fujita, M., 1989, *Urban Economic Theory*, Cambridge University Press, Cambridge

Fujita, M. and Krugman, P., 1995, "When is the economy monocentric? von Thunen and Chamberlin unified", *Regional Science and Urban Economics*, 25,505-528

Fujita, M. and Mori, T., 1997, Structural Stability and Evolution of Urban Systems", *Regional Science and Urban Economics*, 27, 399-442

Glaeser, E., Kallal, H.D., Schinkmann, J.A., and Shleifer, A., 1992, "Growth in Cities" *Journal of Political Economy*, 100,1126-1152

Harris R.I.D., 1997, "The Impact of the University of Portsmouth on the Local Economy" *Urban Studies*, 34, 605-626

Harris R.I.D. and Liu, A., 1998, "Input-Output Modelling of the Regional Economy and External Trade", *Regional Studies*, 32.9, 851-862

Henderson, J.V., Kuncoro, A. and Turner, M., 1995, "Industrial Development in Cities", *Journal of Political Economy*, 103,1067-1085

Hill, S. and Roberts, A., 1996, *Welsh Input-Output Tables for 1994*, University of Wales Press, Cardiff

Hoover, E.M., 1937, *Location Theory and the Shoe and Leather Industries*, Harvard University Press

Hoover, E.M., 1948, *The Location of Economic Activity*, McGraw-Hill, New York

Isard, W., 1951, "Distance Inputs and the Space Economy. Part II: The Locational Equilibrium of the Firm" *Quarterly Journal of Economics*, 65, 373-399

Isard, W. and Kuenne, R.E., 1953, "The Impact of Steel upon the Greater New York-Philadelphia Region, *Review of Economics and Statistics*, 35, 289-301

Jacobs, J., 1960, *The Economy of Cities*, Random House, New York

Karaska, G.J., 1968, "Variation of Input-Output Coefficients for Different Levels of Aggregation" *Journal of Regional Science*, Vol.8, No.2, 215-227

Krugman, P., 1991a, *Geography and Trade*, MIT Press, Cambridge, Massachusetts

Krugman, P., 1991b, "Increasing Returns and Economic Geography" *Journal of Political Economy*, 99,183-199

Krugman, P., 1998, "What's New about the New Economic Geography" Oxford Review of Economic Policy, Vol.14, No.2, 7-17

Losch, A., 1954, *The Economics of Location*, Yale University Press, New Haven CT

Marshall, A., 1920, *Principles of Economics*, Macmillan, London

Mayer, W. and Pleeter, S., 1975, "A Theoretical Justification for the Use of Location Quotients" *Regional Science and Urban Economics*, 5,343-355

McCann, P. and Dewhurst J.H.L, 1998, "Regional Size, Industrial Location and Input-Output Expenditure Coefficients" *Regional Studies*, 32.5, 435-444

McCann, P. and Gordon, I.R., 2000, "Industrial Clusters: Complexes, Agglomeration and/or Social Networks?" *Urban Studies*, 37 Forthcoming

McGregor, P.G, Swales, J.K. and Yin, Y.P., 1996, "A long-run interpretation of regional input-output analysis" *Journal of Regional Science*, 36.3, 479-500

Mills, E.S., 1980, *Urban Economics*, Scott, Foresman and Co., Glenview, Illinois

Moses, L., 1958, "Location and the Theory of Production", *Quarterly Journal of Economics*, Vol.78, 259-272

Parr, J.B., Denike, K.G. and Mulligan, G.E., 1975, "City size models and the economic base: a recent controversy" *Journal of Regional Science*, 15, 1-15

Pomfret, R., 1991, *International Trade*, Blackwell, Oxford

Ramanathan, R., 1998, *Introductory Econometrics with applications*, The Dryden Press, Fort Worth

Simpson, W., 1992, *Urban Structure and the Labour Market*, Oxford University Press, Oxford

Twomey, J. and Tompkins, J.M., 1996, "Supply Potential in the Regions of Great Britain", *Regional Studies*, Vol.30, pp 783-790

Ullman, E. and Dacey, M., 1960, "The Minimum Requirements Approach to the Urban Economic Base" *Papers and Proceedings of the Regional Science Association*, 6, 174-194

Venables, A.J., 1996, "Equilibrium locations of vertically linked industries", *International Economic Review*, Vol.37, pp 341-359

Vernon, R., 1966, "International Investment and International Trade in the Product Cycle" *Quarterly Journal of Economics*, 80, 190-207

Weber, 1909, *Theory of the Location of Industries* Translated by Friedrich, C.J. 1929, University of Chicago Press, Chicago

Table 1: Average values of the mean location quotients, standard deviations and coefficients of variation across regions, counties and local authority districts.

Spatial Level	Average Location Quotient	Average Standard Deviation	Average Coefficient of Variation
Regions	1.0318	1.0802	104.15
Counties	1.0549	2.7142	240.89
Local Authority Districts	1.0754	5.1064	429.51

Table 2: Average Values of Size and Specialisation Measures at Various Spatial Levels

Spatial Level	Average Employment	Average Index of Specialisation	Average Gini Coefficient
Regions	1924799	0.15177	0.22733
Counties	330825	0.24823	0.36846

LA Districts	46128	0.38990	0.55283

Table 3: Correlation between the Index of Specialisation and the Gini Coefficient

Spatial Level	No. of Areas	Correlation Coefficient
Regions	12	0.9946
Counties	64	0.9957
LA Districts	459	0.9901
All Areas *	533	0.9938

* Greater London is included in both the Regions and Counties figures but only once in the All Areas figures.

Table 4. Regression Results

Specification

$$\log\left[\frac{1-M}{M}\right] = \alpha + \beta.\log(S_r) + \gamma_1.ED_r + \gamma_2.\log(ED_r) + \delta.\log(PD_r) + \theta_1.CL + \theta_3.GL$$

Number of observations = 533

		Index of Specialisation	Gini Coefficient
α	Coefficient (t-ratio)	-3.2952 (-32.27)	-4.6384 (-38.23)
β	Coefficient (t-ratio)	0.3491 (44.21)	0.4044 (43.10)
γ_1	Coefficient (t-ratio)	-0.00004115 (-5.464)	-0.00003781 (-4.226)
γ_2	Coefficient (t-ratio)	-0.1960 (-5.8106)	-0.2551 (-6.364)
δ	Coefficient (t-ratio)	0.1835 (5.417)	0.2467 (6.131)
θ_1	Coefficient (t-ratio)	2.3373 (3.991)	2.1289 (3.060)
θ_3	Coefficient (t-ratio)	-0.7272 (-5.464)	-0.7663 (-3.788)
R-squared		0.8245	0.8173
F-Statistic[a]		411.75	392.14
RESET[b]		3.499	0.540
Het[c]		2.836	0.917
Exclusion[d]		2.481	2.256

Notes

a) $F_{6,526}(0.05) \leq 2.160$

b) Ramsey's RESET test based on squared fitted values for adequacy of functional form: $F_{1,525}(0.05) \geq 3.841$

c) Test for homoskedastic errors based on regression of squared residuals on squared fitted values: $F_{1,531}(0.05) \geq 3.841$

d) F-test for exclusion of CW and PD: $F_{2,524}(0.05) \geq 2.996$

FIGURE 1 : Index of Specialisation and log Size : All sub-national units

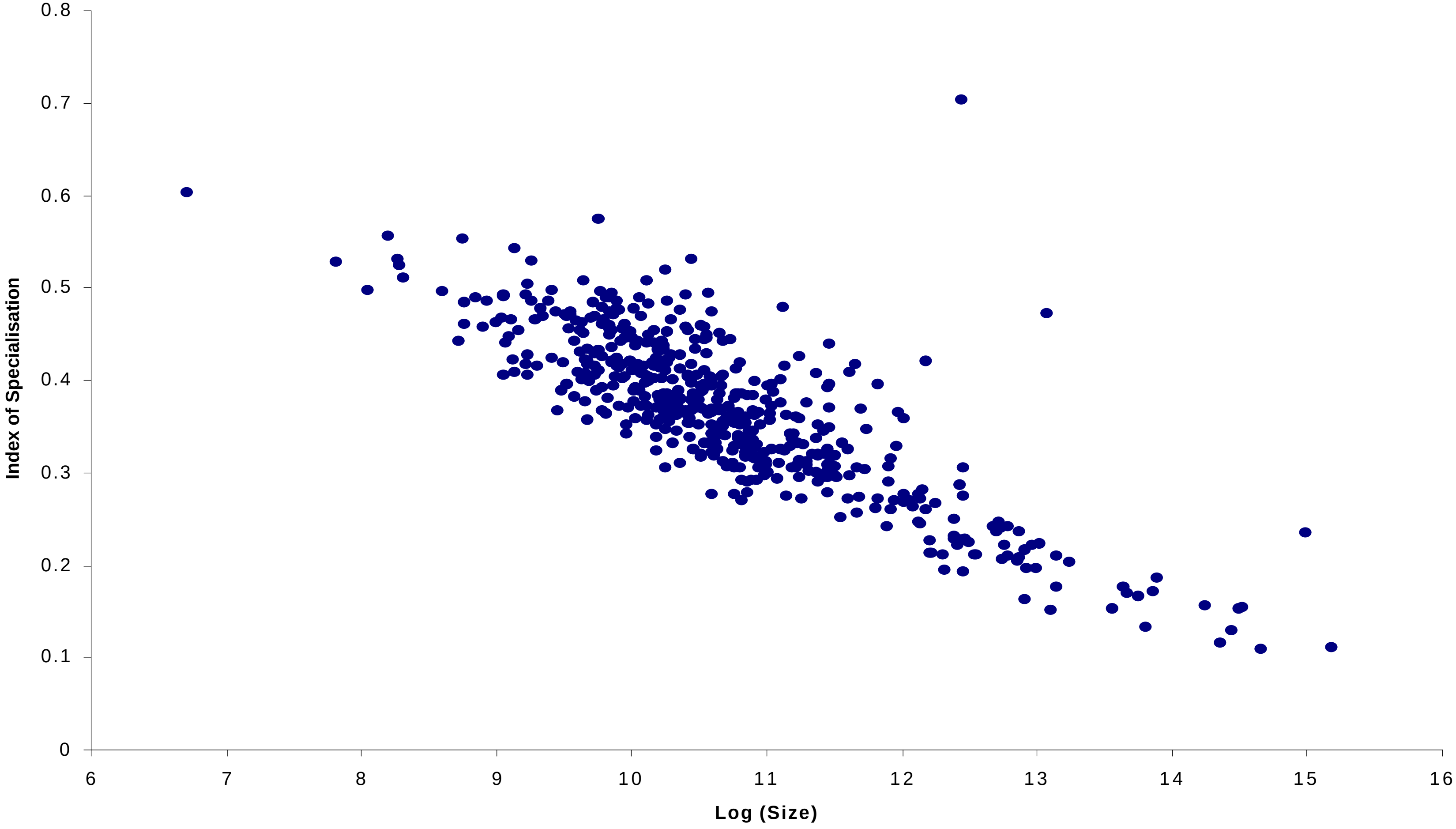

FIGURE 2 : Gini Coefficient and log Size : All sub-national units