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Core – Periphery Analysis
A Tale of Two Nations

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CORE-PERIPHERY ANALYSIS: A TALE OF TWO NATIONS

ABSTRACT

Bias, unreliability and omission have been documented in traditional sources of trade data; the lack of service data in trade statistics is the most frequently cited shortcoming. Current trade liberalization is likely to exacerbate these deficiencies. This paper develops and applies a location quotient based methodology for analysing core-periphery dualism, thus obviating the use of trade data. Our application to the European Union shows agglomeration in core areas of high technology, large scale manufacturing, and producer service industries. Peripheral countries are shown to specialize in agriculture, extractives, low technology manufacturing, and standardized production. Detailed examination of two peripheral economies, Ireland and Denmark, finds that each departs from the mean of peripheral nations. A comparison of proxied trade data to actual trade data indicates that the location quotient method is a statistically viable means of proxying trade patterns.

Key Words: Core Periphery European Union Location Quotient Ireland Denmark

INTRODUCTION

Over the last two decades a considerable literature has been developed that analyses the existence and implications of core-periphery dualism among the nations of the European Union (EU). This dualism associates a position of economic and developmental superiority with the core nations, those that are geographically central to major markets. The superiority is evidenced by a greater concentration of high-technology industries, producer services, job creation potential and overall development potential in the core economies (Keeble, et al, 1988; Cuddy and Keane, 1990). The relative disadvantages of the peripheral nations, according to this type of analysis, stem from the implications of their locations and their sizes for transportation costs, industrial agglomeration, and scale economies.

In most core-periphery analyses, definitions of cores and peripheries are expressed in terms of production and trade. Dicken (1992), for example, identifies the core as the location of rapid industrialisation, from which industrial goods were exported. The periphery produced and exported food and raw materials. Changes in the nature of this system are also described in terms of production and trade. Increasing proportions of manufacturing activity have been located in peripheral, newly industrialising countries (NICs). "This is especially evident in the changing pattern of trade in certain manufactured goods" (Dicken, 1990, p.44).

This - at least partial - reliance on international trade data in the analysis of the relations between cores and peripheries has implications for such research on Europe. In Europe, there are two reasons for developing alternatives to data that are based upon the flows of goods and services between countries. First, the data on these flows are notoriously deficient. Among these deficiencies are: the invisibility of services and the resultant inaccuracy - or unavailability - of service trade data (Molle, 1990, pp.326-328); intra-firm trade and the data-skewing effects of transfer pricing (Holland, 1987, pp.232-3); and the inability of trade data to account for domestically produced inputs (Kennedy, 1991). Second, one of the three main objectives of the completion of the Single European Market (SEM) is the removal of physical barriers. This means the elimination of customs posts. Prior to this elimination, trade data in the EU were obtained through the monitoring of goods passing through customs posts. They are now based on the even less reliable method of surveying companies. According to

Baker et al (1994), following the changes in collection methods "there are doubts concerning the accuracy of trade data throughout Europe".

In our previous work (Mack and Jacobson, 1993) we modified and applied a simple location quotient (LQ) procedure to identify the nature and direction of trade flows between core and periphery economies of the EU and between Objective One and the remaining regions of the EU. By examining the location quotients and the changes in location quotients when the base was shifted, industrial sectors were classified as residentiary, exports or imports. Our findings showed that all of the core-periphery relationships found by traditional techniques were confirmed by using employment-based comparisons. Similar findings were obtained in a comparison of Objective One regions. Comparison of the rank ordering of net exports derived by this method to a rank ordering of net exports obtained from extant trade data showed a strong correlation for extractive and manufacturing industries, the only industries for which traditional export data were available. The strength of this relationship implied that this is a viable means of estimating service industry exports and that the problems hypothesized about traditional data -- that they obscure intra-industry trade, intra-firm trade and transfer pricing -- were not indicated for extractive and manufacturing industries at this level of industrial and national aggregation.

These results indicated that the next step of analysis should entail a disaggregation by country to search for some of the hypothesized aberrations in trade data which aggregation may have obscured. Accordingly, this paper applies the same methodology -- based on location quotients -- to provide a proxy for the trade flows of two geographically peripheral nations, Ireland and Denmark. The two nations were selected for in-depth analysis as they have economic performances which are, respectively, among the worst and among the best of the peripheral nations. We begin with a review of the shortcomings of existing international trade data, an explanation of the use of the location quotient methodology in the arena of international analysis, and a detailed review of the results of our previous analysis of the European Union (EU). We then use the location quotient measures to examine the nature of trade flows of the two subject nations vis-a-vis the rest of the EU. The trade flows as estimated by the location quotient method are compared to standard net export data as possible evidence of profit switching transfer pricing or other trade abnormalities that may skew data. Our findings confirm the core-periphery relationships found by traditional

techniques. Finally, we make a sector by sector comparison of core-periphery trade patterns calculated with the location quotient method to those developed from available trade data, finding the results to be remarkably similar.

THE PROBLEM OF DATA DEFICIENCY

In this section we review the deficiencies of traditional trade data in incorporating trade in the service sectors. In a setting of increasing integration, existing problems with trade data accuracy will likely be exacerbated. EC-1992 liberalization is expected to markedly increase trade in service activities; given the panoply of difficulties discussed below of tracking service trade, these increases in activities will also increase the absolute and relative amount of service trade not accounted for in the statistics.

Services are estimated to account for about 20% of world trade (Riddle, 1986). Yet national "trade balances" reported on the current account include extractive and manufacturing activities, but no services. The data that are reported on services suffer from too much aggregation relative to the fine disaggregation of manufacturing. They also are expressed as net exports; that is, they do not differentiate between a nation's imports and exports.

The measurement of international trade in services is plagued with a number of other problems, each contributing elements of inaccuracy to the many different sources of accounts. The first problem is definitional - exactly which activities should be considered to be services? Although numerous attempts have been made to define services by their attributes ofintangibility, perishability, and simultaneity of production and consumption, services are most frequently defined in the negative, as those sectors which are not agriculture, manufacturing or mining (Riddle, 1986). Those problems of classification that affect manufacturing categorization are multiplied for services; consider, for example, the difficulties associated with the treatment of goods that have mixed service and manufacture characteristics. Feketekuty (1988) notes the differing definitions of services as used by policy makers, businessmen and statisticians and comments on their resultant differences in measurement. This causes problems particularly over time as, in some measures of services, growth is exaggerated by 'splintering'. This is where certain functions (e.g. cleaning, designing) which had been carried out within firms in manufacturing become independent, and, as a result appear as services (Molle, 1990, p.321).

A second set of service data problems stems from the delivery mechanisms; they are the direct cause of many service activities slipping through the net of statistical measures. Specifically, services are delivered in a number of ways that defy the traditional measures of border crossings: they are delivered in person, via mails, telephone calls, and faxes. In face to face deliveries either the provider or the consumer may travel. Like manufacturing, service trade can be defined either on a basis of location or ownership. In-house services provided by divisions of multinational corporations (MNCs) located in different countries often escape enumeration in international trade statistics. Even arms-length trade in services is more difficult to detect than that in goods.

PREVIOUS RESEARCH

In our previous work (Mack and Jacobson, 1993) we modified and applied a simple location quotient procedure to identify the nature and direction of trade flows between core and periphery economies of the EU and between Objective One and the remaining regions of the EU. By examining the location quotients and the changes in location quotients when the base was shifted, industrial sectors were classified as residentiary, exports or imports.

The initial purpose of using this technique was to circumvent the deficiencies of traditional trade data in the analysis of the core-periphery dualism. By using location quotients some of the data deficiencies arising from poor tracking of services, input linkages, intra-industry and intra-firm trade, and transfer pricing could be by-passed. Our findings showed that all of the core-periphery relationships found by traditional techniques were confirmed by using employment-based comparisons. These relationships included: agglomeration in core areas of high technology, large scale manufacturing, and producer services; specialization by peripheral countries in agriculture, extractives, low-technology manufacturing, and standardized production; importation of producer services by the periphery; provision of consumer and government services on a residentiary basis in both the periphery and the core. Similar findings were obtained in a comparison between Objective One, and other EU regions. The trade patterns of Objective One regions vis-a-vis the remaining EU regions closely paralleled the core-periphery patterns, both for manufacturing and services.

Comparison of the rank ordering of net exports derived by this method to a rank ordering of net exports obtained from extant data showed a strong correlation for extractive and manufacturing industries, the only industries for which traditional export data were available. We have shown above that either trade in services is not included in international trade data, or, at best, unreliable. The strength of the relationship between trade as measured by our LQ method, and trade using traditional data, suggested that -- particularly in the absence of alternatives -- the LQ method this is a viable means of estimating service industry exports. The correlation also implied that the problems hypothesized about traditional data -- that they obscure intra-industry trade, intra-firm trade and transfer pricing -- were not indicated for extractive and manufacturing industries at this level of industrial and national aggregation.

These results indicated that the next step of analysis should entail a disaggregation by industry and country to search for some of the hypothesized aberrations in trade data which aggregation may have obscured.

Methodology

The problem of finding a proxy for trade flows is related to the identification of basic and export sectors among the industrial sectors of core and peripheral regions within an economy. The approach in this article is the common location quotient technique with a modification to isolate exports to areas beyond the region's hinterland (Keil and Mack 1986). We will use the terms locality, place or region interchangeably to denote the geographic location of focus, whether it be a nation or a region within a nation. The term European Union (EU) will refer to the aggregation of the 12 countries.

A location quotient (LQ) is a simple measure of spatial concentration based upon either employment or income. Using the notation of Table 1:

$$LQ_{ip} = \frac{e_{ip} / e_{op}}{E_{io} / E_{oo}}$$

Table 1

Notation

Employment in Industry i	Total Employment
e_{ic} = all core places	e_{oc} = all core places
e_{ip} = a peripheral place	e_{op} = a peripheral place
E_{io} = total base	E_{oo} = total base

For further clarification, $$E_{io} = \sum_{p=1}^{16} e_{ip} + \sum_{c=1}^{38} e_{ic}$$ 2 is the aggregation of all employment in

industry i, that is in all 16 peripheral and 38 core regions; and $$E_{oo} = \sum_{i=1}^{58} E_{io}$$ 3 is total

employment in all industries in all regions.

Basic and non-basic industries are identified by considering the mean and standard deviation of the location quotient for an industry, measured across a large number of places. Non-basic industries are those with average LQs near 1 and with small standard deviations; LQs for basic industries have a much larger standard deviation, as the pattern of exports and imports imparts a range of values alternatively above and below 1.

The problems associated with the application of this method have been discussed in the literature for decades. Norcliff (1982) developed an excellent synopsis of both theoretical considerations and empirical evaluations. He found the theoretical basis to be sound and explained that the differences in empirical evaluations between the LQ methodology and other methods of estimating base stem from problems in the LQ methodologies used. Empirical evaluations of accuracy by Tiebout (1962), Greytak (1969), Leigh (1970), Gibson and Worden (1981) and Mathur and Rosen (1974) have indicated varying degrees of underestimation of economic base with the resultant overestimation of multipliers. Techniques to correct the sources of this underestimation of export base were developed by Isserman (1977a and 1977b) who demonstrated that disaggregation of industries to the three and four digit SIC level and

inclusion of service and government exports would lessen these biases. He also recommended a bracketing approach, using both LQ and econometric techniques. Difficulties associated with the assumption of a closed national economy were approached by Norcliffe (1982) with an incorporation of national consumption data to correct the tendency of the LQ technique to underestimate the level of basicness of those regional industries in which the nation was an exporter.

Assumptions of the consistency of production functions and consumer preferences across places are admittedly even more difficult to justify in a multinational context than in the context of interregional differences within a country. Similarly, the assumption of a closed system where the base represents the universe of places also becomes more problematic as one moves to the international arena. Although one can turn a blind eye to some of these problems in light of the estimated 30% shortfall (Riddle 1986) in coverage of international trade in services, these questions evoke the need for empirical examination of the accuracy of the LQ method in the international setting and of the use of Norcliffe's adjustment in such international LQ analyses. As will be noted in the closing section of this paper, such attempts are the first steps in the list of future inquiries.

Urban Agglomeration and the Location Quotient

The existence of a hierarchical relationship between core and peripheral places means that the location of some industrial activities is not a decision made independently of the nature of the place. In particular, core areas may offer some industries external economies through the concentration of larger numbers of other, related industries in the area. The resulting economies of agglomeration are manifested through the concentration of many forms of business in core places and in the sales of these products by industries in core places to peripheral areas. Because of these agglomerative economies, core places exhibit location quotients larger than 1 in these lines of business; peripheral places have smaller LQs. When is this variation in LQs the result of agglomeration and when is it due to exports and imports that arise from some comparative advantage derived from factors other than being in a core place? An answer to this question is readily available in the form of a correction for economies of agglomeration. We move beyond the traditional location quotient method of export identification by first observing the effects of changing the base of the location quotient. Such changes in the base are made because the traditional calculation of location

quotients on an all inclusive base (such as a group of nations) will obscure the nature of export trade in peripheral places. The changes in location quotients which result from changing the base can reveal these obscured trading patterns.

Consider a large economy composed of several regions that vary in population size and in the ratio of peripheral population to core population. If we pare the core areas from the base and recalculate the location quotients for the industries in peripheral places, we gain location quotients whose size and standard deviations indicate trading patterns more fully. Again, using the notation of Table 1, it can be shown that shifting from a total base to a peripheral base changes the location quotient for a peripherally located industry as follows:

$$L'Q_{ip} = LQ_{ip} - \Delta LQ_{ip}$$

(1)

where:

$$\Delta LQ_{ip} = \frac{e_{ip} / e_{op}}{E_{io} / E_{oo}} - \frac{e_{ip} / e_{op}}{(E_{io} - e_{ic}) / (E_{oo} - e_{oc})}$$

(2)

which after some algebraic manipulation, reduces to:

$$\Delta LQ_{ip} = \frac{LQ_{ip} [(E_{io} e_{oc} - E_{oo} e_{ic}) / E_{oo}]}{E_{io} - e_{ic}}$$

(3)

Since $e_{ic} < E_{io}$, the denominator of this term must be non-negative and would rarely in practice be zero. By multiplying the numerator and denominator of (3) by $E_{oo}/(E_{io}e_{op})$ the equation can be reduced to the more elegant:

$$\Delta LQ_{ip} = \frac{LQ_{ip}(1 - LQ_{ic})}{(E_{oo} / e_{oc}) - LQ_{ic}}$$

(4)

From equation (4), it can be seen that the sign of LQ_{ip} will depend only on LQ_{ic} -- whether it is greater than, less than, or equal to one. For example, if there is core agglomeration ($LQ_{ic} > 1$), shedding the core from the base will increase the peripheral location quotients; if basic activity flows from the peripheral to the core areas ($LQ_{ic} <$

1), shedding the core from the base will decrease the peripheral location quotients. There will be no change in the location quotients of purely residentiary activity ($LQ_{ic} = 1$) when the core is shed from the base.

There are overlapping measures that indicate the extent of trade activities after the shift in base: residential activity is indicated by relatively low standard deviations for an industry across all places, whereas exports and imports are indicated by large standard deviations for the industry across places. Finally, the degree of agglomeration in core places is indicated by the magnitude of the negative change in LQs when the base is shifted.

Differences Between LQ-Determined Specializations and Trade Flows

By using the LQ method described above, we can delineate categories of imports and exports that include service trade and account for intermediate linkages. As for the inclusion of service industries, as long as employment is dedicated to these industries, the degree of exportation, importation, and core agglomeration will be indicated when the method is applied. The method of delivery is not of consequence, nor, as we will explain below, is the use of services as inputs into the production of goods and services that are exported. Thus an LQ greater than unity after the core is shed from the denominator is indicative of a basic activity, production of which ultimately brings funds into the place and contributes to economic growth.

The method includes in the delineation of basic and export activities those intermediate inputs which are domestically produced and excludes those inputs that are imported. Thus an industry which produces an input to an exported good (for example, glass containers sold to package exported foods and beverages) would be included as a basic industry and export; on the other hand, if inputs to the electronics industry are imported, those input industries will be carried as imports, and they would not be a part of the economic base of the place. In summary, the use of this method incorporates linkages and registers the benefits of export industries with high levels of domestic linkages.

Note that many of the complications posed by intra-industry and intra-firm trade are avoided by the use of this method. This is because the export categorization is determined through use of data on either employment or earnings, not on recorded

trade flows. Thus, for example, the use by firms of profit-switching transfer pricing will not enter the calculations.

APPLICATION OF THE METHOD

This location quotient methodology was used in an analysis of industry exports for the aggregation of EU peripheral nations, for Ireland, and for Denmark. In order to prepare the data for location quotients, two aggregations of European regions were used: a peripheral category, comprised of Denmark, Greece, Ireland, Portugal and Spain, and a core category including the remaining EU nations, with the exception of Italy for which adequately disaggregated regional data were not available. The data base used was the 1991 Eurostat regional employment set at the two digit NACE classification for the 66 regions of the NUTS 1 level of geographic disaggregation (54 if Italy is excluded). In the data set Denmark and Ireland were each treated as a single region; this presented no problems, given the homogeneity of income levels within each of the countries. The exclusion of Italy is fortuitous, because given its regional diversity, it could not comfortably be included either as a core or peripheral country. (Northern Italy would be core, Mezzogiorno periphery.)

The first step in the core-periphery analysis was the aggregation of regional data for all
 regions, and, separately, for all 16 peripheral regions[1]. Location quotients were then calculated for each two-digit NACE industry in each region. As discussed in the methodology section, means and standard deviations of LQs were calculated for each industry of each region across the total EU and across the peripheral nations. The base was then shifted, dropping the core from the denominator[2], and the means and standard deviations for the industries of the peripheral regions were then calculated. Location quotients for each of the 54 sub-national regions were calculated to estimate trade by industry.

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[1] The aggregation for all 54 regions is obtained from: $\sum_{c=1}^{38} e_{ic} + \sum_{p=1}^{16} e_{ip}$ **Error! Main Document Only.**, where there are 38 core and 16 peripheral regions, for each industry, i.

[2] In this case $E_{io} = \sum_{p=1}^{16} e_{ip}$ **Error! Main Document Only.**

Table 2 summarizes the results of those calculations. Looking first at the LQs of the peripheral regions on the total EU base (column 1), it is evident that relative to the core nations, the peripherals export Agricultural, Forestry, Fisheries, and primary extractive materials. Among manufactured goods, LQs are greater than unity for those manufactured goods which are generally deemed to be of low technology and standardized production: Food, drink and tobacco; Textiles; Footwear and clothing; Timber and wooden furniture. High technology and large scale manufactures are imported from the core nations, as evidenced by LQs of less than one. A similar dualism is evident among the services: in the peripheral nations Retail distribution, Educational and, as would be expected, Public administration and defence, are residentiary (as indicated by LQs that are within 10% of unity), whereas all categories of producer and business services (with LQs significantly below unity) show importation from the core. The primary services in which LQs for the peripherals exceed the mean are the categories of transportation services: Land and Sea transportation, as well as the Hotels and tourism support services. Repair of goods and vehicles and Personal services are also above unity. All of these conform to the traditional roles of peripheral nations vis-a-vis the core; furthermore, the magnitude of the transportation specialization LQs in the periphery underscores the costs of physical peripherality.

Table 2

Mean LQs, Irish LQs, Danish LQs AND ΔLQs

NACE CATEGORIES	C1	C2	C3	C4	C5	C6	C7
	MLQS 16/54	MLQS 16/16	LQI /54	LQI /16	LQD /54	LQD /16	STD 54
01 Agriculture	3.41	1.35	2.63	1.04	1.00	0.40	1.92
02 Forestry	2.21	0.85	5.72	2.17	3.70	1.40	1.94
03 Fishing	9.99	1.56	3.84	0.53	4.46	0.61	10.43
11 Solid Fuels	0.44	1.15	0.00	0.00	0.00	0.00	2.84
12 Coke Ovens	0.00	0.00	0.00	0.00	0.00	0.00	4.35
13 Petroleum & Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	2.84
14 Oil Refining	0.46	0.30	0.00	0.00	1.51	3.15	2.24
15 Nuclear Fuels	0.00	0.00	0.00	0.00	0.00	0.00	5.03
16 Electricity, Gas, Steam	0.54	0.81	1.36	1.88	0.83	1.15	0.45
17 Water Supply	0.67	0.65	0.00	0.00	0.00	0.00	1.61
21 Extraction of Metal Ores	1.44	0.50	0.00	0.00	0.00	0.00	3.75
22 Production of Metals	0.45	0.87	0.00	0.00	0.33	0.59	1.44
23 Other Minerals, Peat Extr.	2.60	0.85	7.37	2.25	0.00	0.00	2.30
24 Non-met. Mineral Prods.	1.02	0.86	1.52	1.06	0.88	0.61	0.61
25 Chemicals	0.39	0.76	0.67	1.15	0.49	0.84	0.62
31 Metal Articles	0.66	0.88	0.61	0.72	0.82	0.96	0.64
32 Mechanical Engineering	0.30	0.85	0.43	1.03	1.14	2.76	0.60
33 Office & Data-proc. Mach.	0.18	1.18	1.92	10.13	0.00	0.00	0.90
34 Electrical Engineering	0.34	0.88	0.71	1.55	0.65	1.41	0.51
35 Motor Vehicles, Parts, Accs.	0.34	0.91	0.00	0.00	0.11	0.25	0.85
36 Other Transport Manufacturing	0.63	0.79	0.46	0.56	0.96	1.15	1.02
37 Instrument Engineering	0.27	1.01	2.15	6.53	0.60	1.82	0.91
41 Food, Drink, Tobacco	1.24	1.05	1.56	1.24	1.60	1.27	0.45
43 Textile	1.84	1.25	1.04	0.62	0.33	0.19	2.20
44 Leather, Leather Goods	0.99	0.70	0.00	0.00	0.00	0.00	1.54
45 Footwear, Clothing	1.46	0.79	0.88	0.41	0.72	0.33	0.99
46 Timber, Wooden Furniture	1.17	0.96	1.02	0.78	0.95	0.72	0.51
47 Paper, Pap. Prods., Prnt., Publ.	0.50	0.79	0.78	1.10	1.21	1.70	0.44
48 Rubber, Plastics	0.56	0.85	0.96	1.28	0.85	1.14	0.72
49 Other Manufacturing	0.68	0.73	1.33	1.19	1.95	1.74	1.13

Table 2 (Cont.)

Mean LQs, Irish LQs, Danish LQs AND ∆LQs

NACE CATEGORIES	C1 MLQS 16/54	C2 MLQS 16/16	C3 LQI /54	C4 LQI /16	C5 LQD /54	C6 LQD /16	C7 STD 54
50 Building, Civil Engineering	1.36	1.10	1.04	0.85	0.86	0.70	0.28
61 Wholesale Distribution	0.81	0.96	1.00	1.09	1.40	1.54	0.39
62 Scrap, Waste Materials	0.23	0.55	0.00	0.00	0.00	0.00	2.58
63 Agents	0.80	0.59	0.00	0.00	0.56	0.59	1.53
64 Retail Distribution	1.10	1.02	0.98	0.92	0.69	0.64	0.15
66 Hotels, Catering	1.66	1.08	1.48	1.07	0.71	0.52	0.64
67 Repair of Goods & Vehicles	1.40	0.94	0.78	0.49	0.95	0.60	0.55
71 Railways	0.43	0.89	0.58	1.03	1.13	2.03	0.83
72 Other Land Transport	1.46	0.95	0.97	0.65	1.13	0.75	0.49
74 Sea Transport	1.95	0.53	0.00	0.00	5.39	2.42	2.29
75 Air Transport	0.93	1.04	2.06	2.03	1.58	1.55	1.37
76 Transport Supporting Services	1.01	0.87	1.23	0.92	1.92	1.44	1.55
77 Travel Agents, Freight Brokers	0.35	0.83	0.52	1.55	0.66	1.93	0.92
79 Communication	0.54	0.88	0.92	1.41	1.09	1.65	0.38
81 Banking, Finance	0.61	0.88	1.01	1.29	1.11	1.42	0.52
82 Insurance	0.41	0.80	1.05	1.89	0.88	1.58	0.64
83 Fin. Aux., Rl. Est., Bus. Svcs.	0.49	0.86	0.92	1.55	0.90	1.51	0.44
84 Renting of Movables	0.06	0.62	0.00	0.00	0.59	4.43	1.07
85 Owner Let Real Estate	0.13	0.70	0.00	0.00	1.70	6.37	0.98
91 Public Admin., Defence	0.93	1.09	0.73	0.89	0.81	0.98	0.34
92 Sanitary Services	0.83	0.95	0.76	0.78	1.31	1.34	0.71
93 Education	0.95	1.04	0.91	1.01	1.64	1.80	0.27
94 R&D	0.32	0.84	0.96	2.06	0.65	1.39	0.89
95 Medical Services	0.65	0.95	1.12	1.63	1.11	1.61	0.31
96 Other Services	0.33	0.82	0.39	0.84	1.99	4.25	0.51
97 Recreation, Cultural Services	0.75	0.91	1.22	1.36	1.35	1.50	0.51
98 Personal Services	1.50	1.10	0.93	0.59	0.51	0.32	0.55
99 Domestic Services	0.19	0.85	1.08	3.70	1.78	6.09	1.15

After the base shift is made to adjust for the agglomeration of some industries to core places, what profile of the peripheral region remains? A glance down the mean LQs on the revised base (column 2) shows significant changes in the first three industries, the extractive sectors. Although Agriculture and Fishing clearly remain as exports, the LQ for Forestry drops to the import level when the core nations are stripped from the base, implying that specialization in Forestry is not the bailiwick of the peripherals. However, there is little change in the manufacturing sectors: several of the low tech industries drop below the absolute margin of exportation and most of the services categorized as exports relative to the core drop toward the residentiary classification. This implies that after the adjustment for agglomeration is made and the comparison is based upon the activities of peripheral nations, these nations manifest expected levels of transportation services, that is, "expected" by the standards of peripheral places.

Standard deviations of LQs across all places are shown in column 7 of Table 2; this is an overlap measure, the magnitude of which indicates the degree to which the products of a given industry are traded around the EU. Based on our previous work, we use 0.40 as an arbitrary cut-off point to delineate the traded from the non-traded industries. Accordingly, the output of most of the industries is traded. Those that are deemed residentiary by a standard deviation of less than .40 are: Building, civil engineering; Wholesale and Retail distribution; Communications; Public administration; Education; and Medical services. Extremely high standard deviations, such as those for Fishing, Textiles, Extraction of metal ores, and Other minerals and peat extraction, imply not only trade across places, but additionally imply the likelihood that only one or two countries are exporters of the commodities.

Prior to examining the results for Ireland and Denmark, it should be noted that we were not expecting to find the "smoothness" of data for these single country disaggregations as we did for the aggregation of peripheral nations in our previous analysis. That is, in the aggregations we found that the peripherals in aggregation exported low technology and standardized manufactures, imported high technology and large scale manufactures, imported producer and business services, and provided distributional and consumer services on a residentiary basis -- without exception. On the other hand, when examining these two individual economies, we expect that each will exhibit some, but not all, of these traits. We are particularly

curious as to whether Ireland, the less dynamic of the two peripheral economies[3] exhibits more of these peripheral traits.

Looking first at the LQs of Ireland on the total EU base (column 3), it is evident that relative to the core nations, it exports agricultural and primary extractive materials (Agriculture, Forestry, Fishing, Peat extraction, and Mineral products). Among manufactured goods, LQs are greater than one for those manufactured goods which are generally deemed to be of low technology and standardized production: Food, drink and tobacco, Textiles, and Timber and wooden furniture, though with the latter two only just exceeding unity. The other low technology goods -- Footwear and clothing -- are imported. High technology and large scale manufactures are generally imported from the core nations, as evidenced by LQs of less than one. Ireland's exceptions are the export of Office and data-processing machinery, Instrument engineering, and Other manufacturing, all of which are dominated by subsidiaries of MNCs.

A similar dualism is evident among Ireland's services where, like the aggregations of peripheral regions, most of the Wholesale, Retail, Educational and consumer services are residentiary (as indicated by LQs within 10% of unity), and most producer and business services categories -- such as Travel agents and freight brokers, Communication, Financial auxiliaries and business services, and Other services -- show LQs less than unity, i.e. importation from the core. Among the services in which Ireland's LQs exceed the peripheral mean are two categories of transportation services (Air, and Transportation support), as well as Cultural services, and Hotels and catering. All of these conform to the traditional roles of peripheral nations vis-a-vis the core; furthermore, the magnitude of the transportation specialization LQs in the periphery underscores the costs of physical peripherality. Producer and business services in which Ireland unexpectedly[4] exceeds the peripheral means are: Banking and finance, Insurance, and R&D, but the LQs in these cases are not high enough for exports. They exceed the means because of a higher presence of MNC subsidiaries in these services in Ireland than in other peripheral countries.

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[3] particularly in terms of the performance of indigenous firms

[4] at least in terms of the traditional roles of the peripherals

Next the base shift is made to adjust for agglomeration. A glance down the mean LQs on the revised base (column 4) shows the change in the extractive and manufacturing sectors; both Agriculture and Fishing drop below the absolute margin of exportation and most of the services categorized as exports relative to the core drop toward the residentiary classification. Among the exceptions is Air transport, which becomes more emphatically an export relative to the peripheral base. This implies that after the adjustment for agglomeration is made and the comparison is based upon the activities of peripheral nations, Ireland manifests expected levels of the other transportation services, that is, "expected" by the standards of peripheral places. The adjustment for agglomeration also emphasizes the exportation of Office and data processing machinery and Instrument engineering: with LQs of 10.13 and 6.53 these industries are clearly exporting relative to the rest of the peripherals. Rubber and plastics also move into the exportables category with the shift in base. Most interestingly, Ireland is exporting many producer and business services relative to the mean of the peripherals -- this exportation of Travel agents and freight brokers, Communications, Banking and finance, Insurance, as well as R&D and Medical services is normally considered to be in the purview of core nations.

The portrayal of Denmark in Table 2 more closely approximates the mean of the core nations than that of the peripherals. Column 5 shows that Denmark exports in four extractive industries relative to the core; this drops to only two extractive exports (Forestry and Oil refining) after the base is shifted and Denmark is compared to the peripherals (column 6).   Like Ireland there is a mixture of low technology products that Denmark exports (Food, drink and tobacco, Paper, paper products, printing and publishing), along with high technology industries: Mechanical engineering, Electrical engineering, Other transport manufacturing, and Instruments.

Where Denmark differs significantly from Ireland is in services. Of the 26 services listed, Denmark exports 13 relative to the core; this number increases to 18 when the shift to a peripheral base is used. After the shift Denmark is also shown to be exporting in every one of the 12 categories of business services except one, that of Other land transport. This stands in contrast to Ireland's exporting only half of the business services. (Business services are NACE 71-85).

COMPARISON TO EXISTING TRADE DATA

To compare exports as proxied by the LQ method to actual data, net export data for 20 two-digit NACE-CLIO categories of extractive and manufacturing industries in Ireland and 21 in Denmark were aggregated from three-digit Eurostat data. These in turn were rank ordered as net exports. This rank ordering was compared to the rank ordering of net exports calculated by means of the simple location quotient methodology using the EU base. We used the EU base rather than the peripheral base because the former was more inclusive of the total picture of EU trade. Results are presented for Ireland and Denmark respectively in Tables 3 and 4. Note that even with the extreme values for the Fishing industry, the Spearman rank order correlation coefficient of .487 for Ireland and .504 for Denmark are both significant at the .05 level.

Table 3

Irish LQ/54 and X-M Rank Orders and Spearman Correlation

NACE CATEGORIES	C1 LQIR/54 Rank Order	C2 X-M Rank Order	C3 $(C1-C2)^2$
23 Other Minerals, Peat Extr.	1	8	49
02 Forestry	2	9	49
03 Fishing	3	7	16
01 Agriculture	4	11	49
37 Instrument Engineering	5	6	1
33 Mfg. Office and Data-proc. Machinery	6	2	16
41 Food, Drink and Tobacco	7	1	36
24 Mfg. of Non-metallic Mineral Prods.	8	12	16
16 Electricity, Gas, Steam	9	10	1
49 Other Manufacturing	10	5	25
43 Textiles	11	16	25
46 Timber, Wooden Furniture	12	14	4
48 Rubber, Plastics	13	13	0
45 Footwear, Clothing	14	18	16
47 Paper, Pap. Prods., Printing and Publ.	15	20	25
34 Electrical Engineering	16	4	144
25 Chemicals	17	3	196
31 Metal Articles	18	15	9
36 Other Transport Manufacturing	19	17	4
32 Mechanical Engineering	20	19	1
		$(C1-C2)^2 = 682$	
		Rs = 0.487	

Table 4

Danish LQ/54 and X-M Rank Orders and Spearman Correlation

NACE CATEGORIES	C1 LQDK/54 Rank Order	C2 X-M Rank Order	C3 $(C1-C2)^2$
03 Fishing	1	6	25
02 Forestry	2	12	100
49 Other Manufacturing	3	3	0
41 Food, Drink, Tobacco	4	1	9
14 Oil Refining	5	16	121
47 Paper, Pap. Prods., Printing, Publ.	6	18	144
32 Mechanical Engineering	7	2	25
01 Agriculture	8	5	9
36 Other Transport Manufacturing	9	14	25
46 Timber, Wooden Furniture	10	4	36
24 Mfg. of Non-metallic Mineral Prods.	11	10	1
48 Rubber, Plastics	12	7	25
16 Electricity, Gas, Steam	13	13	0
31 Metal Articles	14	11	9
45 Footwear, Clothing	15	17	4
34 Electrical Engineering	16	8	64
37 Instrument Engineering	17	9	64
25 Chemicals	18	19	1
22 Production of Metals	19	21	4
43 Textile	20	15	25
35 Motor Vehicles, Parts, Accessories	21	20	1
		$(C1-C2)^2 = 692$	
		Rs = 0.504	

These are acceptable enough levels of correlation for the extractive and manufacturing industries, to suggest viability of the location quotient based estimates of international trade in the service sector, where trade data do not exist. This is particularly important in view of our finding that both Ireland and Denmark differed significantly from the mean of peripheral nations only in the service industries. The strength of the correlation also implies that at this national level of disaggregation there is little indication of distortion of traditional trade statistics by large magnitudes of intra-industry trade, intra-firm trade, or profit switching[5].

CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

In this study we modified and applied a simple location quotient procedure to identify the nature and direction of trade flows for Ireland and Denmark vis-a-vis the remaining regions of the EU. By examining the location quotients and the changes in location quotients when the base was shifted, sectors were classified as residentiary, exporting or importing.

The initial purpose of using this technique was to circumvent the deficiencies of traditional trade data in the analysis of the two economies with respect to traditional notions of core-periphery dualism. By using location quotients some of the data deficiencies potentially arising from poor tracking of services could be by-passed. Our findings confirmed the portrayal of the peripheral economy drawn by using traditional comparisons. These relationships included: agglomeration in core areas of high technology, large scale manufacturing, and business services; general specialization by peripheral countries in agriculture, extractives, low technology manufacturing, and standardized production. Our findings for Ireland and Denmark broke with traditional analyses on the matter of business services: both Ireland and Denmark were net exporters of a number of these services. Denmark, in exporting 11 out of 12 business services had a service industry profile which more closely approximated that of the typical core nation.

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[5] Arguably, for Ireland, the much higher rank order of Chemicals in terms of traditional trade data than in terms of LQ, is indicative of profit switching transfer pricing (PSTP); similar arguments could be made in the cases of Food, drink and tobacco, and Office and data-processing machinery. Without these distortions, the correlation would be even better. For other evidence of PSTP in Ireland, see, for example, Stewart (1989).

Comparison of the rank ordering of net exports derived by this method to a rank ordering of net exports obtained from extant data showed a strong correlation for extractive and manufacturing industries, the only industries for which traditional export data are available. The strength of this relationship implies that this is a viable means of estimating service industry exports.

Results of this research indicate several agendas for future analysis. First, a disaggregation by industry and country may confirm some of the hypothesized aberrations in trade data which aggregation may have obscured. Another area for future research is the use of a greater stratification of the hierarchical core-periphery relationship, that is, the core may be divided into inner core and outer core; the same may be done for the periphery. The search for trade flows up and down this more complete hierarchy can then be conducted. Finally, if data permit, the use of Norcliffe's consumption-based location quotients may make these indicators of trade flow even more accurate by controlling for the tendency of the location quotient technique to underestimate exports.

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