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The Presence of Porter's Sectoral Clustering in Irish Manufacturing

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Abstract: Industrial clustering is seen by Porter (1990) as a dynamic process of national sectoral linkages and regional proximity that can systematically interact and reinforce each other, and which is central to international competitiveness. This article examines the extent to which Porter-type industrial clustering is currently present in Irish manufacturing, and its association, if any, with industrial performance. It also comments on the implications for industrial policy. National linkages between manufacturing sectors are not substantial; and spatial concentrations in two urban centres is more an effect of general urban economies than of sectoral linkages. Little association has been found between the clustering that is currently present in Ireland and various aspects of industrial performance.

I INTRODUCTION

The Culliton Report (1992) sees sectoral clustering as an important element of industrial structure, and considers that building industrial clusters should be an important objective of industrial policy. In adopting this view, the Industrial Policy Review Group were heavily influenced by Porter (1990). Porter sees industrial clustering as a dynamic process of national sectoral linkages and regional proximity that can systematically interact and reinforce each other, and which is central to international competitiveness. This article examines the extent to which Porter-type industrial clustering is currently present in Irish manufacturing, and its association, if any, with industrial performance. It also comments on the implications for industrial policy.

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For Porter, "clustering" can mean the vertical and horizontal linkages between firms in the same or different industries. Vertical linkages occur when firms buy from or sell to each other; horizontal linkages occur when they have similar customers, technologies, distribution channels, etc. "Clustering" can also mean the spatial concentration of firms in a town or region; they can be from the same or related sectors.

While such clustering does lead to static external economies of specialisation and efficiencies, it more importantly leads to dynamic economies involving faster access to information on innovations, customer needs, etc., and greater spurs to improvement through competitive pressures. The overall process is dynamic and cumulative, in that various types of clustering interact and systematically reinforce each other.

Porter's methodology for demonstrating the links between clustering and international competitiveness is to:

(a) construct clustering charts of those industrial sectors whose share of world exports is greater than the country's average share, and who seem initially related in some way; and
(b) build detailed and extensive case studies of internationally competitive industries in which the dynamics of clustering are revealed.

II THE PRESENCE OF SECTORAL CLUSTERING

2.1 National Sectoral Linkages

To construct a Porter-type cluster chart for the Irish Republic, the UN Trade Statistics for 1987 are used to identify those sectors (at the SITC 3 digit level) whose share of world exports is more than the Irish average share of 0.6 per cent of world manufacturing exports.

The resultant cluster chart for Ireland contains 52 subsectors whose share of world exports exceeds Ireland's overall 0.6 per cent share of manufacturing exports (Table 1). There are 5 groups or "clusters" of these subsectors:

— the 13 food and drink subsectors;
— the 4 electronics subsectors;
— the 7 chemicals subsectors;
— the 8 mechanical engineering subsectors; and
— the 5 clothing and textiles subsectors.

Some of these subsectors can be seen as organically linked, in that they buy from and sell to one another. Milk and cream, butter, and cheese all are products of milk processing; chocolate products also use milk. Live animals and meat products are just different forms of the same product. Yet other subsectors are not organically linked, such as fish and tobacco, pharmaceuti-

Table 1: *An Irish Trade Share Cluster Chart (i.e. those sectors whose 1987 share of world exports equal or exceed the overall Irish share of 0.6 per cent)*

Minerals / Metals	*Forest Products*	*Pharm / Chemicals*	*Computers etc.*
(211) Hides, Skins etc.	(642) Paper etc. Products	(513) Carbon Acids etc.	(752) ADP Equip.
(266) Synthetic Fibres to Spin	(892) Printed Matter	(514) Nitrog. etc. Compounds	(874) Measuring Controlling Instruments
(277) Natural Abrasives, N.E.S.	(893) Articles of Plastic, N.E.S.	(515) Organo/Inor. Compounds	
(287) Base Metal Ores, N.E.S.		(541) Med. Pharm. Products	
(292) Crude Vegetable Mat., N.E.S.		(551) Essential Oils etc.	
(695) Tools		(553) Perfumery etc.	
(699) Base Metal MFRS, N.E.S.		(592) Starch, Gluten etc.	

Multiple Business	*Transport*	*Power Generation*	*Office*	*Tele-Communications*	*Defence*
	(621) Materials of Rubber	(741) Heating etc.	(759) Office, ADP Parts, Acess.	(764) Telecom. equip., Parts, Acess., N.E.S.	
	(884) Optical Goods	(742) Pumps for liquids etc.			
		(772) Switch Gear etc.			
		(773) Elect., Distributing equip.			

Food	*Textiles / Apparel*	*Housing & Household*	*Health Care*	*Personal*	*Education / Leisure*
(001) Live animals for food	(651) Textile Yarn	(664) Glass	(872) Medical Instruments N.E.S.		(894) Toys, sport goods, etc.
(011) Meat fresh, chilled, frozen	(652) Cotton Fabrics	(665) Glassware			(898) Musical ins. parts
(022) Milk & Cream	(842) Men's outerwear	(775) Household type Equip. N.E.S.			
(023) Butter	(843) Women's outerwear	(812) Plumbing, Heating Lighting Equip.			
(024) Cheese & Curd	(845) Outerwear Knitwear				
(034) Fish fresh, chilled, frozen					
(043) Barley unmilled					
(048) Cereal etc.					
(062) Sugar candy non-choc.					
(073) Chocolate & Products					
(098) Edible products preparations, N.E.S.					
(112) Alcholic Beverages					
(122) Tobacco Manufacture					

Source: United Nations (1989), *International Trade Statistics Yearbook*, Volumes I and II UN, New York.

cals and starch, gluten, etc. What is most interesting about the trade cluster chart, though, is the absence of many spin-off or related industries. For example, there is no spin-off of a major dairy machinery industry, or a strong farm chemicals subsector.

The view that there are few linkages between most manufacturing sectors in Ireland is also supported by the evidence from the Input/Output data for 1985 (CSO 1992). In only 7 sectors of the 18 manufacturing sectors did purchases within Ireland exceed those from abroad. In only 10 sectors did purchases from within their own sectors exceed 10 per cent of their total purchases within Ireland. In only 6 sectors did purchases from another manufacturing sector exceed 10 per cent of a sector's total purchases within Ireland.

2.2 Regional Spatial Proximity

The spatial clusters of Irish manufacturers are relatively concentrated. Data for the spread of firms by county and by 31 subsectors indicate that there are 43 county concentrations of 15 per cent or more of the total number of firms in a subsector (Table 2). Twenty-six of these concentrations are in Co. Dublin, and 12 are in Co. Cork. While these two counties contain 39 per cent of all manufacturing firms and 37 per cent of manufacturing employment, they contain 88 per cent of the total number of clusters. Clusters also appear in Counties Louth and Monaghan (footwear); Co. Donegal (woollens and knitting); and Co. Wicklow (leather). Overall, 14 of the 31 subsectors have a Theil clustering index of 30 per cent or higher.

There is also a high association between the spatial distribution of most sectors across regions. Of nine broad sectors whose regional spread is correlated against each other's, all but one sector's correlations are significant at the 5 per cent level of significance. This is what would be expected, given that there is such a high concentration in Counties Dublin and Cork. More detailed analysis of correlations between the spread of subsectors reveals more variation. There are high correlations between the regional spreads of leather and meats, timber and plastics, timber and other manufacturing, and timber and metals; and between 2 subsectors dominated by overseas firms, office and data processing and chemicals. Interestingly, low correlations were recorded between dairy and a number of subsectors such as meat, confectionery, and chemicals; between wool and knitting, and between leather and footwear.

Whether the generally strong spatial association between sectors indicates active sectoral clustering is open to question. Five of the 7 pairs of sectors which are most highly spatially associated at regional level have low levels of vertical linkages according to the 1985 National Input-Output data. A more

Table 2: *The Number of Establishments: County Shares and Clustering Indices by Subsector 1987*

Nace Code	*Subsector*	*Clusters (> 15 per cent in County)*	*Clustering Index (% of max.)*
251	Basic Industrial Chem.	Dublin (16%), Cork (28%)	30.9
257	Pharmaceuticals	Dublin (22%), Cork (25%)	25.0
255-256, 258-260	Chemicals, rem.	Dublin (48%), Cork (15%)	37.8
22	Metals production	Dublin (42%)	40.1
31	Man. of metal arts	Dublin (29%)	15.5
32	Mechanical engineering	Dublin (28%)	17.3
33	Office and data process.	Dublin (47%), Cork (26%)	49.7
34	Electrical engineering	Dublin (36%)	25.4
35	Man. of motor vehicles	Dublin (25%)	14.2
36	Man. of other transport	Dublin (18%), Cork (21%)	31.9
37	Instrument engineering	Dublin (26%)	22.8
412	Meat processing	Dublin (20%)	11.4
413	Dairy products	Cork (26%)	17.9
416, 422	Feedstuffs	Cork (21%)	9.4
419	Bread etc.	Dublin (19%)	12.6
420-421	Confectionery	Dublin (49%), Cork (15%)	43.7
417-418, 423	Other Food	Dublin (31%)	30.0
424-429	Drink and Tobacco	Dublin (21%), Cork (17%)	18.9
431	Wool	Donegal(24%)	21.6
436	Knitting	Dublin (27%), Donegal (20%)	32.6
432-434, 437-439	Other Textiles	Dublin (24%)	19.6
44	Leather etc.	Dublin (16%), Wicklow (16%)	23.1
451	Footwear	Louth (25%), Monaghan (21%)	34.0
453-456	Clothing	Dublin (51%)	35.9
46	Timber etc.	Dublin (19%)	10.1
471-472	Paper products etc.	Dublin (56%)	45.3
473-474	Printing and publishing	Dublin (50%)	32.8
14	Mineral oil refining	Dublin (40%), Cork (20%)	51.2
481-482	Rubber products	Cork (23%)	21.2
483	Plastics	Dublin (27%), Cork (15%)	20.5
49	Other manufacturing	Dublin (50%)	41.8

Source: CSO (1990), *Census of Industrial Production 1987*, Dublin: Stationery Office.

Note: *Theil's Formula for Spatial Clustering:*

Theil's formula for an index of spatial clustering is as follows:

$$I = \frac{Y.\log Y}{1/N}$$

where I = the index of spatial inequality or clustering;
Y = the county's or region's share of a sector's activity;
N = the number of counties or regions involved.

The index (I) can be expressed as a percentage of a maximum clustering index possible (i.e., the log of the number of areas involved).

likely explanation is the general preference for the greater urban conurbations of Dublin and Cork.

2.3 Systematic Clustering

Examination of those sectors or subsectors seen as highly clustered as defined by various and different indicators suggests that two groups of sectors may be examples of systematic and mutually-reinforcing clustering (Table 3). First, the food sectors are prominent amongst those sectors with above-average shares of world trade, high backward linkages, high degrees of spatial clustering and above-average shares of UK/Irish employment. Second, the wood products and printing and paper sectors are linked together, both in terms of vertical linkages at national level, and of spatial association between the sectors; and one or both of these sectors or their subsectors are present in six other lists of highly clustered sectors or subsectors.

III PERFORMANCE

3.1 Clustering and Exports

The relationship between whatever clustering there does exist (at sectoral or regional levels) and above-average shares of world exports cannot be considered to be a strong one. The strong export performance of the electronics and chemicals sectors could not be ascribed to whatever clustering is present in those sectors: it has much more to do with the strength of the multinationals who have been attracted to Ireland. In the food sectors, the presence of strong linkages to the primary sector can be seen as a major factor in the ability to be a competitive producer, yet the prevalence of selling into EC intervention suggests that such linkages have only a limited impact on general competitiveness.

3.2 Spatial Clustering and Productivity

One indicator of performance is that of productivity, defined here as net output per employee. Spatial concentration could be associated with either a higher level of productivity for all firms involved, or with a higher level of productivity for the smaller firms who might be expected to have more to gain from a spatial cluster.

The results for both Ireland and the UK suggest, however, that such associations were relatively weak and statistically insignificant (Table 4). While all five of the relationships examined were positive, none was significant at 5 per cent levels of significance (this is so for both linear and non-linear relationships). The strongest association is that between UK indices of spatial clustering and the relative productivity of small firms, which becomes significant at around the 6 per cent level of significance.

Table 3: *A Comparison of the Most Clustered Sectors (Ranked by the Various Clustering Indicators)*

Trade Share Chart 1987	*Concentration of Purchases Within Own Sector 1985*	*Domestic share of Purchases 1985*	*Domestic Share of Sales 1985*
Live Animals (001)	Milk & Dairy (33)	Meat/Meat Products (31)	Non Metalic Mineral Products (15)
Meat (011)	Other Food (35)	Milk & Dairy Products (33)	Other Transport Equip. (29)
Milk & Cream (022)	Motor Vehicles (27)	Leather/Footwear (43)	Paper and Printing (47)
Butter (023)	Wooden Products (45)	Tobacco Products (39)	Motor Vehicles (27)
Cheese & Curd (024)	Paper & Printing (47)	Beverages (37)	Wooden Products (45)
Barley (043)			
Sugar Candy (062)			
Chocolate Products (073)			
Edible PDS, N.E.S. (098)			
Natural Abrasives (277)			
Compounds (515)			
Oils (551)			
Starch (592)			
Auto DP Equip. (752)			
Office, ADP Parts (759)			
Medical IMST (872)			
Toys, Sport Goods etc. (894)			
Musical Instruments (898)			

Concentration of Firms Within Counties 1987	*Concentration of Employment Within Counties 1986*	*Association of Sectors Within Regions 1987*	*Share of UK/Irish Industrial Employment 1989*
Mineral Oil Refining (14)	Paper etc. Products	Clothing etc./Paper Products	Wood Products
Office and DP Equip. (33)	Drink and Tobacco	Clothing etc./Timber etc.	Food, Drink & Tobacco
Paper Products (471-472)	Other Manufacturing	Timber etc./Paper Products	Glass
Confectionery (420-421)	Chemicals	Paper Products/Miscellaneous	Textiles, Clothing, Leather and Footwear
Other Manufacturing (49)		Clothing etc./Miscellaneous	
Metals Production (22)		Chemicals/Metals & Engineering	
Chemicals Remainder (255-256, 258-260)		Metals & Engineering/ Paper Products	
Clothing (453-456)			
Footwear (451)			
Printing and publishing (473-474)			

Note: *Sources of the Various Clustering Indicators*

(a) *Trade Share Chart 1987:* These are the subsectors at 3 digit level who have a share of their sector's world exports at four times the Irish National average shares. The data are from the United Nations (1989), "International Trade Statistics Yearbook", Vols I and II, UN New York.

(b) (i) *Concentration of Purchases Within Own Sector 1985:*
(ii) *Domestic Share of Purchases 1985:*
(iii) *Domestic Share of Sales 1985:*
All three indicators are from CSO (1992), *Input-Output Tables for 1985*, Dublin: Stationery Office.

(c) *Concentration of Firms within Counties 1987:* Based on the clustering indices derived from data in the CSO (1990), *Census of Industrial Production 1987*, Dublin: Stationery Office. (As presented in Table 2.)

(d) *Concentration of Employment Within Counties 1986:* Clustering indices were derived for employment using 1986 data for the spread of employment in 9 sectors across counties; the source of the data was the CSO (forthcoming) *Census of Population 1986: Local Population Reports*, 2nd Series, Table 10, Dublin: Stationery Office.

(e) *Association of Sectors Within Regions 1987:* Correlations of the spatial company distribution across planning regions of 9 broad sectors, using data from the CSO (1990), *Census of Industrial Production 1987*, Dublin: Stationery Office.

Table 4: *Association of Clustering and Performance Indices*

Sectors	*Variable Y*	*Cluster Index*	*Correlation Values*
Ireland 31 Subsectors	Net Output Per Employee	County Share of Number of Firms	0.2691 (0.1930)
Ireland 31 Subsectors	Relative Output of 1-50 Firms	County Share of Number of Firms	0.0452 (0.0496)
Ireland 31 Subsectors	Relative Output of 1-100 Firms	County Share of Number of Firms	0.0514 (0.0475)
UK 20 Sectors	Net Output Per Employee	Region Share of Employment	0.3090 (0.1892)
UK 20 Sectors	Relative Output of 1-200 Firms	Region Share of Employment	0.4338 (0.3315)

Notes: (1) Theil's (1967) formula for spatial clustering indices is applied to the Irish and UK data; the Irish clustering indices for the county spread of firms are given in Table 2.
(2) Correlation Values are given for both the linear associations and (in brackets) the non-linear associations.
(3) All associations, while positive, turn out to be statistically insignificant at 5 per cent levels of significance.

Source: Irish data: CSO (1990), *Census of Industrial Production 1987*, Dublin: Stationery Office.
UK data: UK CSO (1991), *Report on the Census of Production 1989 Summary Volume*, London: HMSO.

3.3 Spatial Clustering and Innovation

If clustering dynamically adds to the spread of innovations within a group of firms, then a cluster of companies in a particular locality should have an above-average share of innovations. Yet a comparison of the spread of firms in the Irish Republic (by county and sector) with the spread of R&D and Feasibility Grants (by county and sector) shows that there is a considerable correspondence between the two (Table 5). This is most notable for the counties with the largest concentrations of establishments — Counties Dublin and Cork. There are examples of shares of innovation grants exceeding shares of firms, but overall in most sectors and counties there is a close correspondence between a county's share of innovation grants and its share of establishments.

Table 5: *Counties Dublin and Cork Shares of Innovation Grants and of Establishments*

Sector (Nace Code)	*No. of R&D and Feas. Grants Paid in 1988 Nationally*	*Co. Dublin*		*Co. Cork*	
		% of Grants	*% No. of Firms*	*% of Grants*	*% No. of Firms*
Chemicals (25-26)	59	32	34	14	20
Metals etc. (22, 31-37)	262	34	30	14	11
Food (411-423)	89	20	19	16	15
Drink and Tobacco (424-429)	7	29	21	29	17
Textiles (43)	25	16	23	4	12
Clothing etc. (44-45)	64	42	45	11	7
Timber etc. (46)	23	35	19	9	9
Paper and Printing (47)	28	50	51	18	7
Miscellaneous (14, 48-49)	76	29	33	9	16

Sources: (a) Grants: IDA (1989), *Annual Report 1988: Details of Capital Expenditure*, IDA, Dublin, and Shannon Development unpublished data.
(b) Companies: CSO (1990), *Census of Industrial Production 1987*, Dublin: Stationery Office.

IV CONCLUSIONS AND IMPLICATIONS

4.1 Conclusions

For Ireland, a small, open and peripheral economy, linkages between manufacturing sectors are generally not substantial, as examination of a Porter-type trade share cluster chart and of national input-output data shows. Spatial clustering is highly concentrated, with 88 per cent of firm clusters locating in the two major urban centres in the Republic. Yet in a sense this result — that groups of companies gather where conurbations of people gather — is almost tautological. Two groups of sectors — the food

sectors, and wood and printing sectors — could be described as systematically clustered, as they appear as highly clustered according to a number of indicators.

Little association between what clustering there is in Ireland and various aspects of industrial performance has been found. The influence of sectoral linkages and spatial concentration on achieving above-average trade shares is problematic. The correlations between spatial clustering and productivity, both for all firms and for small firms relative to the sector, is extremely weak. The spread of innovation grants is similar to the spread of companies by sector and county, suggesting that spatial clustering did not spur on the forces of innovation.

The question remains whether the lack of association between whatever clustering there is in Ireland and aspects of industrial performance is due to the low level of sectoral clustering that generally exists in Ireland. If sectoral clustering is not present to any great extent, it cannot be expected to have considerable consequences. The relatively stronger correlation between spatial clustering in the UK and the productivity of small firms suggests that smaller firms do benefit from being part of a spatial cluster, but at a size of cluster that is considerably bigger than what is generally possible in the Irish Republic.

4.2 Implications

What can policy-makers make of these conclusions, given that the Culliton Report (1992) suggests that building industrial clusters should be an important element guiding direct intervention by development agencies? First, there may well be more subtle and localised clustering happening in some sectors that does make a difference to performance and that should be reinforced by government support for local specialised infrastructure. Possible examples are the dairy industry in Munster, computers and chemicals in Cork, clothing in Donegal, aerospace in Shannon/Limrick, furniture in Navan, and some sectoral pockets of firms in Dublin.

Second, it seems likely, however, that in many sectors there is limited potential for localised regional clustering in Ireland. Telesis (1982) considers that Ireland is too small to enjoy more than a few regional clusters of industry. As Ira Magaziner (1990) points out, Porter skirts over the issue of how a country creates industry clusters where none exist.

Third, the rationale for encouraging sectoral clustering and linkages at national level remains valid. The progress made since the mid-1980s in increasing the domestic linkages of foreign-owned firms indicates the potential of such encouragement. Kennedy (1991) points out, however, that Ireland should be seen as a region in a bigger EC economy, and that EC

linkages and purchasing chains are more important than purely domestic linkages. As a related aspect, there should be scope, in the promotion of industrial incentives to both overseas and indigenous companies, to pro-actively seek out and stimulate those projects with the potential for commercially linking up and "clustering" with companies already in Ireland.

Fourth, and most important, Porter's clustering is essentially a mechanism for transmitting market and related information and stimuli faster than otherwise would be the case. In Ireland's case, one major implication of clustering is that "bridges" to the major international clusters need to be strenghtened, over which specific information on market needs, technologies, etc. is rapidly passed onto, and absorbed by, Irish-based firms.

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APPENDIX

Table A1: *The UK/Irish Economic Space: Clustering of Industrial Employment 1989*

Sector	*12 Region Cluster Employment Index (% of Maximum)*	*Republic of Ireland Share of Total*
	%	%
Food, Drink and Tobacco	4.0	7.0
Textiles, Clothing, Leather and Footwear	8.7	4.9
Wood Products	6.7	7.3
Paper Products	17.4	3.7
Chemicals, Plastics and Rubber	6.4	3.7
Glass	8.3	5.0
Metal Engineering etc.	10.0	3.6
Other (including Transport)	11.9	1.6
Total Manufacturing	7.3	4.2

Sources: The data in Table A.1 are derived from the *Irish Labour Force Survey 1989* and the *UK Census of Industrial Production 1989*. The sectoral categories used are those of the *Irish Labour Force Survey 1989*, Table 13. The UK 21 sectors translate into the Irish categories as follows:

Irish	*UK*
Food and Beverages	Sectors 41, 42
Textiles etc.	Sectors 43, 44, 45
Wood etc.	Sector 46
Paper etc.	Sector 47
Chemicals etc.	Sectors 25, 26, 48
Glass etc.	Sector 24
Metals etc.	Sectors 22, 31, 32, 33, 34, 37
Other Manufacturing (Including Transport Equipment)	Sectors 35, 36, 49