



No.89/October 2005

Promoting Industrial Clusters: Evidence from Ireland

Anne Marie Gleeson

Department of Economics and IIIIS
Trinity College Dublin

Frances Ruane

Department of Economics and IIIIS
Trinity College Dublin

Julie Sutherland

School of Economics, University of Wollongong
IIIIS, Trinity College Dublin



IIS Discussion Paper No. 89

Promoting Industrial Clusters: Evidence from Ireland

Anne Marie Gleeson

Frances Ruane

Julie Sutherland

Disclaimer

Any opinions expressed here are those of the author(s) and not those of the IIS.
All works posted here are owned and copyrighted by the author(s).
Papers may only be downloaded for personal use only.

Promoting Industrial Clusters: Evidence from Ireland*

Anne Marie Gleeson*, Frances Ruane* and Julie Sutherland**

***Department of Economics and IIS, Trinity College, Dublin**

**** School of Economics, University of Wollongong
and IIS, Trinity College Dublin**

Abstract

This paper analyses the spatial concentration and sectoral specialisation of local enterprises (LEs) and multinational enterprises (MNEs) in Ireland. Entropy indices are used as indicators of spatial and sectoral clustering in Irish manufacturing. Correlation coefficients are calculated to estimate the co-location patterns of LEs and MNEs, allowing an investigation of the overall impact of stated industrial and regional policy goals on the Irish manufacturing sector. The pattern of spatial changes found suggests that market forces were already driving enterprises out of more concentrated locations prior to the introduction of policies to promote greater spatial dispersion in the late 1990s. MNEs have become more sectorally specialised over the period, which is not surprising as policy is deliberately selective in attracting MNEs to key high tech manufacturing sectors. The less concentrated sectoral pattern amongst LEs enterprises is consistent with general restructuring in Irish manufacturing from lower- to higher-tech sectors, and the high sectoral correlation for high-tech MNEs and LEs suggests that LEs are following MNEs into the same sectors.

JEL classifications: L60, R12, R58

Keywords: geographic concentration, sectoral specialisation, entropy indices, MNEs, LEs, public policy

* The authors acknowledge the assistance of the Central Statistics Office (CSO), Ireland in allowing access to the micro-data used in this paper. To facilitate the research conducted the CSO gave the authors controlled access that was at all times within the CSO's premises under stringent conditions. We are grateful for financial support from the Irish Research Council for the Humanities and Social Sciences and DEPFA BANK in undertaking this research. Helpful comments were received from Austin Gleeson, Tom Pius Moloney, Ana Teresa Tavares, Aurora Teixeira and participants at the workshop in Porto in April 2005, as well as conference attendees at the *Irish Economics Association Annual Conference* in May 2005.

I Introduction

New economic geography focuses on the importance of the location of industries within economies and emphasises the role of centripetal and centrifugal forces that affect the spatial concentration and sectoral specialisation of industry. The tendency for enterprises conducting innovative economic activity to cluster has been found to be higher in industries where external economies of scale and new economic knowledge play an important role. When this knowledge is tacit, geographical boundaries will exist (Audretsch and Feldman, 1996). Enterprises will locate within close geographic proximity to each other in order to benefit from potential knowledge externalities and to gain access to skilled workers endowed with a high level of industry-specific human capital. The spatial concentration and sectoral specialisation of enterprises thus have significance for regional and industrial policy as the establishment of high technology clusters has the potential to increase economic activity and enhance regional development.

Ireland's success in attracting foreign direct investment (FDI), evidenced by the strong presence of multinational enterprises (MNEs) in its manufacturing sector, has been well documented (Barry, Bradley and O'Malley, 1999 and Ruane and Uğur, 2005). Consistent public policy instruments promoting Ireland as an export platform for manufacturing FDI over the past four decades have integrated regional and industrial policy objectives through proactive and selective support for MNE projects. Specifically, the focus of industrial policy has been to attract MNEs in the electronics (NACE 30-33) and chemical and pharmaceutical sectors (NACE 24). In the former case, the policy has sought to encourage MNEs across the range of upstream-downstream industrial activities so that an effective industrial clustering of MNEs would result (Görg and Ruane, 2001). For example, the Industrial Development Authority (IDA), which is charged with promoting Ireland as an industrial location for FDI,

has enticed leading enterprises in these high-tech sectors (Intel, Dell, IBM, Hewlett Packard) in the hope of generating a ‘contagion’ effect that encourages other MNEs in electronics to locate in Ireland with upstream and downstream links to these sector leaders (Krugman, 1997). In the case of chemicals and pharmaceuticals, policy has focussed on creating a geographic clustering of upstream activities, centred primarily on the creation of a serviced site in Cork, as well as encouraging the location of pharmaceutical plants in downstream activities more widely distributed throughout Ireland.

The success, or otherwise, of policies encouraging spatial and sectoral industrial clustering of MNEs in Irish manufacturing is relatively little analysed or understood. Moreover, the correlations between spatial and sectoral MNE clustering and the concentration of local (Irish-owned) enterprises (LEs) have not been measured. This paper compares the spatial and sectoral concentration of manufacturing enterprises in the Irish economy in 1985 and 2001 in order to establish the impact of industrial and regional policy objectives on the clustering of enterprises during this time. Entropy indices are estimated as indicators of clustering patterns for MNEs and LEs separately. To examine the clustering relationships, if any, between enterprises in Irish manufacturing, correlation coefficients are estimated to measure the co-location patterns of LEs and MNEs in 1985 and 2001. The combination of entropy indices and correlation coefficients permits analysis of the impact of stated industrial and regional policy goals on the overall sectoral and spatial clustering of manufacturing within Ireland.

The remainder of this paper is organised as follows. Section II describes previous literature on the use of entropy measures as a means of measuring industrial clustering. Section III reviews Irish industrial and regional strategy over the past forty years with an emphasis on the increasingly high tech focus of policy since the late 1980s. In Section IV the data set used is described and entropy indices and correlation coefficients of manufacturing at Irish county

and sectoral level for 1985 and 2001 are reported. Section V focuses on the implications of the results obtained for clustering policy in Ireland.

II Context

The analysis of enterprise clustering presented in this paper is an application and extension of the *new economic geography* literature that explains the spatial concentration and dispersion of economic activity within countries or regions (Krugman 1979, 1980, and 1991) in the context of the new theories of international trade and endogenous growth (see Fujita and Thisse, 1996 and Ottaviano and Puga, 1997 for comprehensive literature surveys). The basic model of new economic geography has its origins in the new international trade theory literature developed by Krugman (1979 and 1980), which, in turn, has its foundations in the Dixit-Stiglitz (1977) model of monopolistic competition. Increasing returns to scale (IRS) and product differentiation play a crucial role in explaining the spatial distribution of production by acting as centripetal forces that depend on transportation costs, with the best locations being those that are close to the consumer market and to suppliers. Hirschman's (1958) forward and backward linkages come into play, leading to a spatial concentration of people and production reinforced by higher wages in large market locations that attract industrial labour, enlarging the market further through linkage effects. The model thus explains how a core-periphery industrial pattern can emerge as a function of transport costs, economies of scale and industrial labour relocation.

Krugman (1993) suggests further grounds for concentration that can result in a spatial 'lock-in' effect, which creates a locational path-dependence favouring the growth of clusters built on one or two large enterprises that act as leaders or anchor enterprises and feed the growth of numerous smaller enterprises (Davies and Lyons, 1996). This can occur by accident or as a result of 'first nature' location conditions, such as the location of specific raw materials or

other geographical advantages. Industry locates in a particular area in order to utilise such specific local resources and in so doing attracts further inflows of capital and labour. A pattern of spatial concentration and agglomeration emerges which persists even after the original factors have been exhausted or the initial industries have declined or exited.

Krugman and Venables (1995) and Helpman (1998) extend the Krugman (1991) model by examining the impact of costs associated with increasing agglomeration, such as increased housing and other congestion costs, which limit the degree of centripetal pull in the face of falling transportation costs. This ultimately leads to a dispersal of production to the periphery where wages and expenses are lower, suggesting the existence of a U-shaped relationship between production costs and spatial concentration. Costs of concentration initially fall due to the benefits of internal and external economies of scale resulting from expansion of the market. Over time, the increase in congestion and other related costs outweigh the original benefits of spatial concentration and as a consequence, with the assistance of decreased transport costs, economic activity begins to disperse.

Focussing on specialisation, Krugman and Venables (1996) show how regional specialisation may be more intense where enterprises have strong forward and backward linkages with certain types of suppliers and buyers where pecuniary externalities arise through market transactions. In this two-sector model both sectors are imperfectly competitive and enterprises are horizontally linked so that there is a greater proportion of exchange between enterprises in the same sector than with enterprises in other sectors. The result is that if one more firm locates in the region it will benefit same sector enterprises through linkage effects, but the resulting increased demand for labour and other inputs, and consequent rising factor prices, may harm all enterprises. Increasing factor demand and prices in the region may result in the non-linked enterprise dispersing to areas where costs are lower.

Thus decisions regarding enterprise production and location depend on many factors, including the location of specific resources, economies of scale and linkage effects. Once located, there is an interconnectedness between space and sector which manifests itself in spatial and sectoral clusters that reflect different degrees of spatial concentration and sectoral specialisation. Different indicators are used to measure the degree of specialisation and concentration and many of the indices are a variant of, or related to the Hirschman-Herfindahl index. In this paper we use entropy indices based on Aiginger and Davies (2004) to measure spatial concentration (at county level) and sectoral specialisation (at NACE 4-digit level).

Following Aiginger and Davies (2004), and focusing on the number of enterprises (E), the entropy index of sectoral specialisation ($SPEC$) is a measure of the extent to which a given geographical area (Irish county, $r = 1, \dots, K$) specialises in a number of industrial (NACE) sectors ($i = 1, \dots, N$).

$$SPEC_r = -\sum_{i=1}^N \left(\frac{E_{ir}}{E_r} \right) \ln \left(\frac{E_{ir}}{E_r} \right) \quad (1)$$

$SPEC_r$ is an inverse measure of sectoral specialisation. If manufacturing sectors are of equal size in a county, then $\left(\frac{E_{ir}}{E_r} \right) = \frac{1}{n}$ for all sectors, and $SPEC = \ln(n)$. If a county is completely specialised in one sector only, then $SPEC = \ln 1 = 0$. The value of $SPEC$ increases the more evenly enterprises in a county are spread across sectors. Similarly, spatial concentration ($CONC$) in Irish manufacturing is measured as:

$$CONC_i = -\sum_{r=1}^K \left(\frac{E_{ir}}{E_i} \right) \ln \left(\frac{E_{ir}}{E_i} \right) \quad (2)$$

which defines the extent to which manufacturing activity in a given sector is concentrated in a particular Irish county. If there is equal spatial dispersion of industry then $CONC = \ln(r)$, and if there is total concentration, $CONC = \ln 1 = 0$. Weighted averages or typical levels of

sectoral specialisation and spatial concentration are calculated with county and sectoral shares of total Irish manufacturing, respectively, as weights. Thus average sectoral specialisation (*AVSPEC*), using county shares of Irish manufacturing as weights, is defined as:

$$AVSPEC = \sum w_r \cdot SPEC_r, \text{ where } w_r = \frac{E_r}{E} \quad (3)$$

Similarly, average spatial concentration (*AVCONC*), using industry shares of Irish manufacturing as weights, is defined as:

$$AVCONC = \sum v_i \cdot CONC_i, \text{ where } v_i = \frac{E_i}{E} \quad (4)$$

The two indices can be re-expressed as

$$AVSPEC = -\left\{ \sum \sum \left(\frac{E_{ir}}{E} \right) \cdot \ln \left(\frac{E_{ir}}{E} \right) \right\} - \left\{ -\sum \left(\frac{E_r}{E} \right) \cdot \ln \left(\frac{E_r}{E} \right) \right\} \quad (5)$$

$$AVCONC = -\left\{ \sum \sum \left(\frac{E_{ir}}{E} \right) \cdot \ln \left(\frac{E_{ir}}{E} \right) \right\} - \left\{ -\sum \left(\frac{E_i}{E} \right) \cdot \ln \left(\frac{E_i}{E} \right) \right\} \quad (6)$$

where the second terms in both equations are also entropy indices. The second term in equation (5) is the spatial entropy index at national level, Irish Concentration (*IRCONC*).

Similarly, the second entropy term in equation (6) is the sectoral entropy index at national level, Irish Specialisation (*IRSPEC*).

In Section IV we present estimates of equations 5 and 6 (*AVSPEC and AVCONC*) for all manufacturing in Ireland and for MNEs and LEs separately between 1985 and 2001, a period of significant change in Ireland's industrial policy and performance landscape.

III Ireland's Industrial and Regional Policies

Ireland's policy of promoting FDI dates back to the late 1950s, when it started to promote itself as an export-platform manufacturing base for the European market. Beginning in the

early 1970s, and in anticipation of joining the EU, policy towards FDI became increasingly selective, seeking to attract MNE investment specifically into modern high technology (high tech) sectors. It was widely accepted that Irish entrepreneurs were not well placed to move into the production of high-tech products and the strategy was designed to fill this entrepreneurial gap through MNE investments, specifically in electronics and pharmaceuticals. Such high tech products were identified as being readily suited to an export-platform island economy because of their low per-unit-value transportation costs.

The strategy of establishing high tech MNE based sectors had two dimensions, sectoral and spatial. The aim of the sectoral dimension was to entice key international manufacturing enterprises by emphasizing Ireland as an ideal platform for exporting into the EU. This required a project centred approach to attracting MNE investment that worked through an identification process comprising four steps. The first step identified niche markets with global growth potential, especially European growth potential. The second step generated information on enterprises in these sectors, typically in the USA, which were already exporting large volumes into Europe and which looked, in terms of a Vernon-type product cycle, likely to be considering a European production base. The third step was to persuade these enterprises to consider Ireland as an investment base; such persuasion was only credible for high value-to-volume products, as low value/volume products would not find an island such as Ireland a competitive long-term location choice. The final step involved agreeing an incentives package that would secure the investment and at the same time ensure significant employment benefits to Ireland as a host country. Irish policy makers recognised the heterogeneity of potential MNEs and their different host-country potentialities at a very early stage.

The project-based approach established the framework for developing the spatial dimension of the strategy, namely the high tech cluster concept that developed in the 1980s, which had

two intended outcomes. Firstly, high tech MNE clusters would generate Marshallian external economies and optimise the positive cumulative effects of attracting FDI enterprises. These effects would be reflected in (i) the development of potential Hirschman-type production linkages between foreign enterprises; (ii) the growth of a skilled labour pool to which all entrants and incumbents would have access; and (iii) the possibility of higher levels of linkages and technology transfer from MNEs to LEs as LEs clustered next to MNEs. Secondly, the creation of clusters raised the possibility of regional markets emerging with critical mass in terms of labour and service supply; it was argued such regional markets would allow greater numbers of enterprises to locate successfully outside Dublin and Cork, the largest Irish cities. This approach replaced the earlier policy, operating in the 1960s and 1970s, of distributing individual manufacturing plants in a highly dispersed way across small-town clusters in Ireland.

The successful implementation of this sectoral and spatial approach to cluster creation required the identification of key sectors and associated locations, and their promotion to potential inward FDI enterprises. In the case of electronics it also built on an active programme (in the 1980s and 1990s) that fostered production links between enterprises, thereby building a vertically integrated electronics sector to service the European market. With the location of Intel, Microsoft, Dell and Hewlett Packard as the hub, the spokes were quickly populated by dozens of smaller electronics and software enterprises, all of which wanted to interconnect with these key industrial leaders. As Krugman (1997) explained, the Irish economy was a significant beneficiary from the process of clustering and also of some good luck. Part of this luck was ‘made’ in the consistent enterprise-centred approach developed over the previous 25 years, and in the management by policy makers of the process of rapid cluster building. For example, policy has been highly active in addressing skill needs

(including specialised skills) and in managing a good industrial relations environment for incoming investors.

It is now widely recognised that consistency in public policy, through proactive and selective support for MNE projects in a manner that has integrated regional and industrial policy objectives, has been crucial to the success of building an MNE export platform base in Ireland. However, the consequences of this policy success for the concentration and specialisation of MNEs and LEs is not clear.

Most FDI during this period has been in high-tech industries and in the form of greenfield export-platform investment, reflecting the fact that the small Irish domestic market is not the primary attraction for most FDI investment; US MNEs locating in Ireland export 94% of their output, 76% of which is bound for EU destinations (IDA, 2002). Consequently, the spatial distribution of Irish consumers is not relevant to the location choices of MNEs which are driven by production rather than market considerations. The absence of a significant local market means that in principle MNEs are more likely to be able to respond positively to incentives created by regional policy in terms of their location choices. As such, there is a natural contrast between the situation of export-focused MNEs and the primarily domestic-focussed LEs. Also, the question of whether the location pattern of LEs mirrors that of MNEs is of particular interest where evidence of LE/MNE dualism is apparent.

This paper explores how the spatial and sectoral clustering of Irish manufacturing has changed since the mid 1980s in response to the proactive industrial and regional clustering policies described. In the improved economic climate of the late 1990s, and with the effects of globalisation becoming ever more evident, the policy emphasis on spatial dispersion outside large centres, sectoral specialization, and cluster creation has grown significantly, raising two important questions in the context of Irish manufacturing industry: Are MNEs becoming more

or less sectorally specialised and spatially concentrated? To what extent is there evidence that LEs are mirroring the clustering patterns of MNEs?

IV Evidence of Clustering for Irish Manufacturing

Our empirical study is based on sectoral data derived from a census of manufacturing plants in Ireland with three or more employees. The data on enterprise numbers are collected as part of the Census of Industrial Production conducted annually by the Central Statistics Office of Ireland. Data between 1985 and 2001 are used to measure changes in spatial and sectoral clustering at the Irish county and 4-digit NACE sector level respectively for MNEs and LEs using the entropy indices described in Section II. In order to take account of the restructuring of the Irish economy towards high tech industry, we disaggregate manufacturing into two sectoral groups, namely high tech (chemicals and pharmaceuticals, NACE 2411-2470 and electronics, NACE 3001-3350) and low tech (enterprises in the remaining NACE categories). Table 6.1 reports entropy indices for all Irish manufacturing enterprises, Columns 1-3 show estimates for AVCONC and Columns 4-6 show estimates for AVSPEC. The entropy index for total enterprises (column1) is on a downward trend over the period 1985 to 1992/3, where after it rises. Since the entropy index is an inverse measure of concentration, this implies an inverted U-shaped pattern of spatial concentration over the period, with average spatial concentration across counties showing an increasing trend until 1992-93 before declining; by 2001 enterprises were less spatially concentrated than they were in 1985. This pattern is also evident in the average spatial concentration indices for both MNEs and LEs (columns 2 and 3), but notably the turning point for MNEs is rather later than for LEs (1995 compared with 1992). While the patterns over time are quite similar, there is a striking level difference between MNEs and LEs – the former are significantly more spatially concentrated than the latter, with entropy indices for MNEs around two thirds the level of those for LEs. Thus while

the spatial patterns over the period are similar, there has been no reduction in the gap between MNEs and LEs in terms of the degree of spatial concentration.

Table 6.1 Entropy Indices for Manufacturing Enterprises 1985-2001

Year	AVCONC			AVSPEC		
	(1) TOTAL	(2) MNE	(3) LE	(4) TOTAL	(5) MNE	(6) LE
1985	2.236	1.488	2.209	4.036	3.334	3.869
1986	2.217	1.474	2.188	4.052	3.342	3.881
1987	2.217	1.483	2.190	4.072	3.360	3.890
1988	2.195	1.454	2.167	4.084	3.345	3.899
1989	2.194	1.455	2.165	4.091	3.330	3.912
1990	2.188	1.450	2.155	4.092	3.301	3.914
1991	2.181	1.435	2.148	4.106	3.269	3.931
1992	2.179	1.432	2.145	4.081	3.209	3.910
1993	2.190	1.428	2.155	4.084	3.144	3.928
1994	2.201	1.423	2.176	4.096	3.195	3.935
1995	2.193	1.411	2.172	4.107	3.195	3.943
1996	2.200	1.421	2.173	4.123	3.181	3.963
1997	2.216	1.452	2.187	4.140	3.196	3.984
1998	2.203	1.470	2.171	4.131	3.172	3.972
1999	2.224	1.466	2.196	4.128	3.125	3.979
2000	2.244	1.462	2.219	4.126	3.108	3.991
2001	2.249	1.488	2.220	4.116	3.163	3.959

Source: Own estimates derived from CSO data.

Focusing next on changes in sectoral specialisation between 1985 and 2001, the index for all enterprises in Irish manufacturing on average across counties (AVSPEC) is trended upwards (column 4) over the period. This implies that sectoral clustering has declined continuously over the period. However, this average result for all enterprises masks differences in sectoral specialisation between MNEs and LEs. The decline in AVSPEC for MNEs (column 5) indicates that they have become more sectorally clustered over the period. This MNE trend toward sectoral specialisation contrasts with that for LEs – the upward trend in column 6 highlights the constant decline in sectoral specialisation for LEs over the period. While the gap between the indices for MNEs and LEs widens significantly over the period, it is noteworthy that the difference in sectoral specialisation between the two groups (measured by AVSPEC) is much less than the difference in spatial concentration (measured by AVCONC).

As a result of the emphasis in Irish policy shifting the economy from low tech to high tech, we present entropy indices for both sectoral groups in Table 4.2.

Table 6.2 Entropy Indices for Total Manufacturing by Sectoral Groups, 1985-2001

Year	AVCONC		AVSPEC	
	(1) High Tech	(2) Low Tech	(3) High Tech	(4) Low Tech
1985	1.835	2.292	2.655	3.816
1986	1.840	2.273	2.670	3.827
1987	1.870	2.269	2.668	3.848
1988	1.858	2.248	2.689	3.856
1989	1.856	2.248	2.671	3.865
1990	1.895	2.236	2.663	3.865
1991	1.881	2.233	2.705	3.870
1992	1.905	2.226	2.679	3.848
1993	1.925	2.234	2.656	3.856
1994	1.932	2.245	2.670	3.869
1995	1.910	2.242	2.686	3.877
1996	1.909	2.251	2.702	3.893
1997	1.945	2.263	2.716	3.909
1998	1.949	2.248	2.681	3.904
1999	1.969	2.269	2.635	3.907
2000	1.972	2.290	2.642	3.908
2001	2.025	2.287	2.632	3.895

Source: Own estimates derived from CSO data.

Table 6.2 indicates that the spatial distribution of the high-tech sectors is significantly more concentrated than that of the low-tech sectors throughout the period, reflecting perhaps their general need to access more location-specific factors, and hence their lower ability to be spatially footloose. However, this difference became much less marked over the period as enterprises in the high-tech sector become increasingly spatially dispersed and the low-tech sectors became more spatially concentrated over the early part of the period. In terms of sectoral specialisation, the high-tech sectors became less specialised over the period, reflecting the growth in activities in entirely new high-tech sectors in the early period; the downward trend in recent years is perhaps some evidence of sectoral consolidation and clustering among the high-tech enterprises. The upward trend in the AVSPEC index for the low-tech sectors, reflecting greater sectoral dispersal, is consistent with structural adjustment

in low-tech sectors in response to increased competition on the domestic market and new opportunities on export markets as the EU single market opened up.

The combination of results in Tables 6.1 and 6.2 suggest that we look beyond the degree of specialisation/concentration measured by the entropy indices to focus on how the actual patterns of location by sector (NACE 4-digit) and space (county) have changed between 1985 and 1991. We use correlation coefficients to examine the co-clustering of MNEs and LEs both spatially and sectorally, and to establish whether the clustering policy in operation has led to LEs mirroring the clustering patterns of MNEs. Spatial correlation coefficients are

calculated using $MNE\ Share = \frac{MNE_{k,r}}{MNE_{k,Total}}$ and $LE\ Share = \frac{LE_{k,r}}{LE_{k,Total}}$, where $r =$ county and

$k =$ high or low tech sectors. Sectoral correlation coefficients for high tech and low tech

sectors are calculated in a similar manner as $MNE\ Share = \frac{MNE_{k,i}}{MNE_{k,Total}}$ and

$LE\ Share = \frac{LE_{k,i}}{LE_{k,Total}}$, where $i =$ sector and calculated for high tech and low tech sectors, as

reported for 1985 and 2001 in Table 6.3.

Table 6.3 MNE and LE Correlation Coefficients

	<i>Spatial</i>		<i>Sectoral</i>	
	<i>1985</i>	<i>2001</i>	<i>1985</i>	<i>2001</i>
Total	0.954	0.959	0.301	0.122
High Tech	0.955	0.964	0.578	0.594
Low Tech	0.941	0.947	0.487	0.229

Source: Own estimates derived from CSO data.

We find very high correlation coefficients for the spatial concentration of all enterprises over the period, with virtually no change in the coefficient values between 1985 and 2001. This aggregate result also reflects what has occurred spatially in both the high- and low-tech

sectors, implying a strong positive relationship between the spatial co-location MNEs and LEs in all sectors at county level. In other words, the spatial centres of high tech clustering of MNEs are very similar to those of LEs.

By contrast, sectoral correlation across all enterprises is much lower and has fallen significantly over the period. This indicates that at the 4-digit level, there is low and declining sectoral clustering of MNEs and LEs over the period – at this level of disaggregation, MNEs and LEs are not operating in the same sectors. To take account of sectoral restructuring and the focus of shifting activities increasingly into the high-tech sectors we decompose the total of manufacturing into high-tech and low-tech groups and look at sectoral correlations within those groups. Not unexpectedly, the correlation coefficients for both groups are higher than for manufacturing as a whole. However, what is striking is the marked difference in the patterns for high-tech and low-tech sector groups. The correlation for high tech is stable at close to 0.6, showing that the MNEs and LEs are to a considerable degree operating in the same high-tech sectors. By contrast, the coefficient values are very small for the low-tech sector, and reduced by over 50 per cent between 1985 and 2001, indicating a diminishing relationship between MNEs and LEs. Thus there is little evidence of MNE-LE sectoral clustering when looking at total manufacturing and the low-tech sectors but there does appear to be some tendency toward clustering between MNEs and LEs in the high tech sectors.

The dominance of the low-tech sectors, in terms of enterprise numbers, should be noted in order to aid the interpretation of the above results. The LE share of the low-tech sectors rose from 88 per cent in 1985 to over 90 per cent in 2001, at a time when the low-tech share of total manufacturing enterprises in Ireland fell from 88 to 86 per cent. Over the same period, the LE share of manufacturing enterprises in the high-tech sectors increased from 50 to 55 per cent, while the high-tech share of total manufacturing has increased from 12 to 14 per cent. These results are in line with the industrial policy for restructuring of the Irish economy

where the focus has been on attracting high tech MNEs to foster growth in the indigenous high-tech sector.

V Conclusions for Policy

This paper has analysed the spatial concentration and sectoral specialisation of both host-country and foreign enterprises in an economy that has experienced extraordinary growth in export-platform FDI over the past two decades. The use of entropy indices as indicators of spatial and sectoral clustering in Irish manufacturing for both MNEs and LEs separately, as well as for high-tech and low-tech sectors, combined with correlation coefficients to estimate the co-location patterns of LEs and MNEs, allow investigation of the overall impact of industrial and regional policies on Irish manufacturing.

LEs and MNEs exhibit a similar trend in spatial concentration, growing more clustered from 1985 until the early 1990s before trending toward greater spatial dispersion up to 2001. Throughout the period, the level of spatial concentration among MNEs remained far greater than that of LEs across counties. This trend from more to less spatial concentration since the late 1990s in part reflects the spatial policy direction implemented at the time, which focused on developing the regional areas of Ireland whilst at the same time reducing congestion in the main cities of Dublin and Cork. However, the effect can only partly be due to policy as the real emphasis on spatial dispersal came late in the 1990s when the economy reached full employment, while it is evident that the process of spatial dispersal had begun in the early 1990s. This suggests that there were market forces already driving enterprises out of the more concentrated locations so that while policy reinforced those pressures, it cannot be said to have led them.

The pattern of sectoral specialisation for MNEs and LEs provides more of a contrast, as MNEs have become more sectorally concentrated over the period while LEs have become less concentrated. Since policy in attracting MNEs is deliberately selective, with the IDA focussed on key sectors in manufacturing, such a pattern for MNEs is to be expected. The less concentrated sectoral pattern amongst LEs enterprises is consistent with general restructuring, and given the high sectoral correlations coefficients for high-tech MNEs and LEs, may well be evidence that LEs are following MNEs into the same sectors. Further sectoral level analysis is required to address this issue.

The analysis in this paper highlights the overall impact of industrial and regional policy on the sectoral and spatial development of the Irish economy. Our evidence on the timing of spatial dispersion suggests that recent policies have intensified rather than initiated the spatial changes that were already underway in Irish manufacturing from the early 1990s, and these effects are likely to be further intensified as EU membership increasingly constrains the use of grant aid for manufacturing in the greater Dublin area. The much higher sectoral correlation for MNEs and LEs in high-tech sectors suggests that the promotion of sectoral clustering in these sectors is successful. The downward trend in sectoral specialisation for LEs and for the low-tech sector generally suggests that sectoral restructuring is still occurring on a significant scale in Ireland. In Section III, we asked two questions: Are MNEs becoming more or less sectorally specialised and spatially concentrated? To what extent is there evidence that LEs are mirroring the clustering patterns of MNEs? The answers are clear: MNEs are becoming more sectorally specialised less spatially concentrated, and LEs are mirroring the clustering patterns of MNEs in spatial terms but not the sectoral patterns. Further analysis at regional level is required to investigate the spatial consequences of such restructuring and the patterns of clustering that are emerging between foreign and local enterprises in Ireland.

References

- Aiginger, K. and S. Davies, 'Industrial Specialisation and Geographic Concentration: Two Sides of the Same Coin? Not for the European Union', *Journal of Applied Economics*, VII, 2, (2004) 231-248.
- Audretsch, D. and M. Feldman, 'R&D Spillovers and the Geography of Innovation and Production', *American Economic Review*, June, 86, 3 (1996) 630-40.
- Barry, F., Bradley, J. and E. O'Malley, 'Indigenous and Foreign Industry', in F Barry (ed.), *Understanding Ireland's Economic Growth*. (London: Macmillan Press Ltd, 1999) 45-74.
- Davies S and B Lyons (eds.), *Industrial Organisation in the European Union: Structure, Strategy and the Competitive Mechanism* (Oxford: Oxford University Press, 1996).
- Dixit, A. and J. Stiglitz, 'Monopolistic Competition and Optimum Product Diversity', *American Economic Review*, 67, 3 (1977) 297-308.
- Fujita, M. and J.F. Thisse, 'Economics of Agglomeration', *Journal of the Japanese and International Economies*, 10 (1996) 339-378.
- Görg, H. and F. Ruane, 'Multinational Companies and Linkages: Panel-data Evidence for the Irish electronics sector', *International Journal of the Economics of Business*, 8 (2001) 1-18.
- Helpman, E. 'The size of Regions' in Pines, D., Sadka, E and Zilcha, I. (eds) *Topics in Public Economics*, (Cambridge University Press, 1998).
- Hirschman, A. *The Strategy of Economic Development* (New Haven, Conn.: Yale University Press, 1958).
- IDA Ireland, *Annual Business Survey* (Dublin: Government Publications, 2002).
- Krugman, P., 'A Model of Innovation, Technology Transfer, and the World Distribution of Income', *Journal of Political Economy*, April, 87 (1979) 253-266.
- _____, 'Scale Economies, Product Differentiation, and the Pattern of Trade', *American Economic Review*, 70 (1980) 950-959.

_____, *Geography and Trade* (Cambridge: MIT Press, 1991).

_____, 'First Nature, Second Nature and Metropolitan Location', *Journal of Regional Science*, 33 (1993) 129-144.

_____, 'Good News from Ireland: A Geographical Perspective' in A Gray (ed), *International Perspectives on the Irish Economy* (Dublin: Indecon Economic Consultants Public Policy Series, 1997).

Krugman, P. and J. Venables, 'Globalisation and Inequality of Nations', *Quarterly Journal of Economics*, 110 (1995) 857-80.

_____, 'Integration, Specialisation and Adjustment', *European Economic Review*, 40 (1996) 959-967.

Ottaviano, G. and D. Puga, 'Agglomeration in a Global Economy: A Survey', *CESPRI Working Paper No. 97* (1997).

Ruane, F. and A. Ugür, 'Trade and Foreign Direct Investment in Manufacturing and Services', in Newman C and J O'Hagan, *The Economy of Ireland: National and Sectoral Policy* (Dublin: 2005), pp 162-187.



Institute for International Integration Studies

The Sutherland Centre, Trinity College Dublin, Dublin 2, Ireland

