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Industry Clusters and Irish Indigenous Manufacturing: Limits of the Porter View

EOIN O'MALLEY
The Economic and Social Research Institute
CHRIS VAN EGERAAT
Dublin City University Business School

Abstract: Studies by Porter (1990) and others find that competitive and successful industries usually occur in the form of clusters of industries which are linked together through vertical or horizontal relationships. This paper assesses whether the sectors of Irish indigenous industry which look most competitive and successful form such clusters. We also consider whether the recent growth performance of Irish indigenous industry has been linked to clustering and to the sectors identified as relatively strong. It is concluded that there is only limited or qualified evidence of Porter-type clusters in Irish indigenous industry, and that there is no clear association between the occurrence of such clusters, or established strong sectors, and the growth performance of indigenous manufacturing. We also comment on policy implications.

I INTRODUCTION

A good deal of discussion in the 1990s concerning Irish industrial policy has focused on the proposition that a competitive and successful industrial performance requires the development of competitive advantage in clusters of interlinked industries. This discussion reflects the insights of international researchers, particularly Porter (1990). Porter argues that the internationally competitive industries in a country are generally not a number of diverse and unconnected sectors or firms. Rather, competitive and successful industries usually occur in the form of specialised clusters of indigenous or "home-base" industries, which are linked together through vertical relationships (buyers/suppliers) or horizontal relationships (common customers, technology, skills, distribution channels, etc.). Porter states that this claim is empirically supported in the studies of the ten countries covered in his book, and he found that "the phenomenon of industry clustering is so pervasive that it appears to be a central feature of advanced national economies" (Porter, 1990, p.149). Since Porter's

(1990) study, quite a number of similar studies have been undertaken on other countries (e.g., Hernesniemi, Lammi and Yla-Anttila, 1996, on Finland; Beije and Nuys, 1995; and Jacobs, Boekholt and Zegveld, 1990, on the Netherlands).

In Ireland, Porter's findings influenced the Culliton review of industrial policy, which recommended that policy should aim to develop clusters of related industries, building on sources of national competitive advantage (Industrial Policy Review Group, 1992, pp. 73, 74). Subsequently, the National Economic and Social Council (NESC) commissioned a substantial study on industrial clusters in Ireland, examining in particular the relevance of clusters for the competitive advantage of three Irish sectors, dairy processing, the music industry and the Irish indigenous software industry. Reports on these three case studies have been published by NESC (O'Connell, Van Egeraat and Enright, 1997; Clancy and Twomey, 1997; O'Gorman, O'Malley and Mooney, 1997), and further discussion of their broader implications can be found in NESC (1998), particularly the papers by Clancy, O'Malley, O'Connell and Van Egeraat (1998) and by O'Donnell (1998). Clancy *et al*. (1998) concluded that their three case study sectors cannot be regarded as part of fully-developed industry clusters of the type and scale described by Porter, although they do gain appreciable benefits from the presence of some form of groupings of connected or related companies and industries, and from interactions between them.

In this article, we undertake a more broad-ranging analysis of the presence and role of industry clusters in Ireland and their relation to the growth performance of Irish indigenous industry. This analysis encompasses all manufacturing sectors, but without the level of detail on individual sectors found in the three case studies mentioned above. In Section II, we first outline very briefly Porter's view of why competitive industries generally occur in the form of clusters, and we also mention some alternative formulations of the cluster concept which have been proposed particularly for smaller economies. Our analysis of clusters in this paper essentially focuses on Porter's concept of clusters, but we refer again to these alternative formulations in assessing the implications of our findings and in drawing conclusions, since it is worth considering whether they indicate directions for further research.

In Section III, we follow the methodology employed by Porter (1990), and other subsequent studies on other countries, in order to identify those sectors in which Irish indigenous industry has achieved the greatest international competitive success. And, again following Porter's approach, we assess whether these relatively competitive sectors take the form of clusters of connected industries, as Porter's theory would expect.[1] It is concluded that there appears to be only

[1]This analysis in Section III is largely based on previously unpublished work carried out as background for the NESC project mentioned above, and we acknowledge financial support from NESC for this research.

limited evidence of Porter-type clusters in Irish indigenous industry.

However, there are some doubts about the effectiveness of Porter's methodology for identifying relatively competitive indigenous industries in the case of Ireland. To supplement that approach, we then identify, in Section IV, those sectors which account for relatively large proportions of Irish indigenous industry by comparison with the industrial structure of the EU, using Irish and EU sectoral employment data. Combining the results of the Porter-style identification of relatively competitive sectors and this additional identification of relatively large sectors, we produce a list of all sectors in which Irish indigenous industry might be regarded as relatively competitive or strong on one or both of these grounds. We then consider how many of these really are clear examples of strong and competitive indigenous sectors, and whether there are grounds for revising our initial conclusions (in Section III) concerning the occurrence of the sort of clusters of connected industries described by Porter. We also consider whether the growth performance of indigenous industry over the past decade has come mainly from the sectors identified as relatively strong, or whether there has actually been a good growth performance in other sectors which appeared to be relatively weak to begin with.

Finally, Section V assesses the implications of our findings and draws conclusions concerning the importance of clusters and strong sectors for the development of Irish indigenous industry.

As background to this, it should be noted that the general context is one of a relatively successful overall performance by Irish indigenous industry over the past decade. The rate of growth of the output of indigenous industry has been close to twice as high or higher than the industrial growth rate of the OECD or EU. Employment in indigenous industry has been on a rising trend since 1988, while manufacturing employment has been declining in the EU and most other major OECD economies. And the exports of indigenous industry have been growing faster than the manufacturing exports of the OECD or EU. A number of other features combine to confirm that this was a genuinely strong *competitive* performance, rather than simply a response to favourable demand conditions in the rapidly growing Irish economy (O'Malley, 1998).

II PORTER'S "DIAMOND MODEL" AND SOME ALTERNATIVE FORMULATIONS

To understand Porter's view of why competitive and successful industries generally occur in the form of clusters, we must refer to his "diamond model" of competitive advantage. According to Porter's theory, the competitive advantage of an industry derives from the national "diamond", i.e., the four different determinants of competitive advantage which are created within the home base

of a country. These four determinants are domestic *factor conditions*, the nature of *domestic demand conditions*, the presence of *related and supporting industries*, and firm *strategy, structure and rivalry* in the industry concerned. Porter also identifies two other influences — government and chance events — which can affect the competitive advantage of an industry through the influence they have on the four principal determinants of competitive advantage.

The conditions which bring about successful industry clusters are said to grow out of the operation of the determinants of competitive advantage, in various ways. For example, if one competitive industry is a sophisticated and demanding customer for the products of its suppliers, it creates domestic demand conditions which help to develop and sustain competitive advantage among the supplier industries. At the same time, if the suppliers are competitive, they help to sustain the competitive advantage of the customer industry through their role as supporting industries. As another example, two or more industries may be "related" industries in so far as they require the same type of factor conditions, such as specialised labour skills. If they are based in the same location, they can have the effect of developing and strengthening the common pool of labour skills through training and on the job experience, and hence each of the industries benefits from this general strengthening of factor conditions. By such means, the industries in a cluster are linked to each other in ways that mutually reinforce the competitive advantage of each industry concerned.

There is now a body of literature which is critical of Porter's model.[2] O'Donnell (1997) suggests that two types of critique could be of particular relevance for the study of small open peripheral economies, namely, those critiques concerning the role of multinational enterprises (MNEs), and those which propose that Porter's diamond model be reformulated as a "double diamond" or "multiple diamond" model.

As regards MNEs, Porter has been criticised for largely excluding foreign-owned MNEs as contributors to the competitive advantage of advanced host economies (unless they "become part of the host country diamond"). According to Porter, many MNE subsidiaries lack key managerial and R&D functions and, as a result, the information flow and technical interchange between such foreign-owned subsidiaries and their local business partners will be limited. Furthermore, the free and open flow of information might be impeded due to cultural differences between foreign firms and local business partners (Porter, 1990, pp. 89, 103, 106, 679). Although Porter (1990, p.679), in a passage referring to developing countries, acknowledges that foreign MNEs can occasionally serve to "seed" a cluster, the main thrust of his theory puts the major emphasis on

[2] Lancy *et al.* (1998) include an outline of critiques of Porter, while Pentinnen (1994) provides a more detailed survey of such critiques.

indigenous home-base industries as having the potential to be the important customers and related and supporting industries in a competitive cluster. Reflecting this orientation, for the most part he simply excludes predominantly foreign-owned industries when identifying the competitive industries and clusters in the countries covered in his study. Responding to this, Dunning (1992), for example, proposes to internationalise Porter's diamond. This involves (among other things) including the activity of foreign-owned MNEs, in such a way that they can affect each of the diamond model's determinants of competitive advantage, thus potentially contributing to the competitive advantage of industry clusters in the host country.

Some researchers have argued that Porter's single national diamond model needs to be reformulated as a "double diamond" or "multiple diamond" model, for the purpose of application to smaller peripheral economies. The idea of a double diamond model is that a smaller economy, such as Canada, may be so closely linked to a larger one, such as the USA, that it is necessary to consider the two together in one framework. Then the industry clusters which are relevant for Canada are seen as being mainly located in Canada but also partly in the USA, and they can include subsidiaries of US MNEs in Canada and subsidiaries of Canadian MNEs in the USA. The determinants of competitive advantage which influence such clusters in a double diamond model include the determinants of competitive advantage applying in Canada as well as those applying in the USA (Rugman and D'Cruz, 1993). The "multiple diamond" model allows for the inclusion of more than one other country as a potential source of influential determinants of competitive advantage for industries in a small economy (Cartwright, 1993).

As was noted above, our analysis of clusters in Ireland in this paper essentially focuses on Porter's concept of clusters. But when we come to assess the implications of our findings, we will refer again to the above-mentioned critiques and alternative formulations, since they could contribute to understanding the findings from a small economy such as Ireland and they may indicate directions for further research.

It is also worth noting at this point that, in examining the role of clusters in Ireland, we are examining one dimension of Porter's theory. This is a key dimension for considering the relevance of the theory to the Irish context. It is beyond the scope of this one paper to address all aspects of Porter's theory, including an examination of the functioning of the determinants of competitive advantage for individual industries. However, we can draw on some previously published research on these aspects when assessing our findings.

III RELATIVELY COMPETITIVE SECTORS AND CLUSTERS

In this section, we identify those sectors in which Irish industry shows signs of having achieved the greatest international competitive success, following the methodology employed by Porter (1990). Porter's starting point in identifying the relatively competitive industries in a country is to calculate the country's exports of each product as a percentage of all countries' exports (or "world exports") of that product. If a country's share of world exports of a particular product is greater than its share of world exports of all products, this is taken as an indication suggesting that the country is relatively competitive or has a comparative advantage in that product.

As in Porter (1990), the data we used to carry out such calculations of shares of world exports for Ireland were taken from the United Nations *International Trade Statistics Yearbook*. The export categories were taken at the lowest level of aggregation for which data are published, which was often the five-digit SITC level. If five-digit SITC categories were not available, four-digit categories were used, and if these were not available the three-digit categories were used. Total Irish exports amounted to 0.79 per cent of total world exports. Therefore, we identified all of the export categories in which Ireland had a share of world exports that was greater than 0.79 per cent.

Having identified the export products which were relatively competitive according to that criterion, we proceeded to draw up a "cluster chart" for Ireland along similar lines to the cluster charts which Porter (1990) presents for the countries examined in his study. These cluster charts include all the products which are found to be relatively competitive in a country, and they display these in a way that is intended to highlight the pattern of competitive industries and the connections between them.

Following Porter's procedure, the first criterion for products to be included in an Irish cluster chart was that Irish exports of the product must generally account for at least 0.79 per cent of world exports of that product, for the reason mentioned above. The next criterion for a product to be included was that Ireland must generally also have a positive balance of trade in that product, unless the product has a share of world exports which is at least twice as great as 0.79 per cent. A few exceptions to these criteria were then made so as to include products which are among Ireland's top fifty in terms of absolute export value, and which have a balance of trade that is positive to modestly negative, even if they do not qualify on grounds of their world export market share being above 0.79 per cent. (Porter also includes such exceptions to the basic criteria when drawing up cluster charts.)

The cluster chart derived for Ireland following the criteria described above is

presented as Figure 1 in Van Egeraat and O'Malley (1999).[3] However, Porter also applies a further criterion, which is to exclude from the cluster chart industries whose exports come mainly from foreign-owned firms. In Porter's interpretation, such industries are not regarded as reflecting the nation's own competitive advantage. For the countries which are covered in Porter's study, the removal of the predominantly foreign categories was reported to be a relatively minor adjustment (Porter, 1990, p. 740). In Ireland's case, however, this is a major step. Half of the 127 export products which were still included in the cluster chart before the removal of the mainly foreign-owned categories came from sectors which were predominantly foreign-owned.

For the purpose of identifying the mainly foreign-owned categories, there are not sufficiently detailed data available which would show *exports* as such by nationality of ownership of the exporting firms. Rather, the available data which we used for the purpose of distinguishing nationality of ownership of firms were data on employment in (NACE) production sectors, from the Fórfás employment survey. The procedure we followed was to (a) match the (SITC) export categories to the corresponding (NACE) production sectors; (b) identify which (NACE) production sectors have a majority of employment in foreign-owned firms; and (c) identify the (SITC) export categories coming from those production sectors as coming from industrial sectors which are predominantly foreign-owned.

Having identified and removed the large number of mainly foreign-owned export categories, we were left with a cluster chart which looked very sparse compared to Porter's cluster charts, and which showed little in the way of indigenous industry clusters. It seemed that this could be largely a result of applying an arguably inappropriate "cut-off" level, i.e., the share of world exports required for including categories in the cluster chart. In order to be included, categories generally had to account for at least 0.79 per cent of world exports of the product concerned, because total exports from Ireland accounted for 0.79 per cent of total world exports. This could be seen as inappropriate in Irish circumstances.

A substantial majority of total Irish exports comes from foreign-owned firms, so that the share of total Irish indigenous exports in total world exports amounts to less than half of 0.79 per cent. Consequently, an Irish indigenous industry which accounts for, say, 0.5 or 0.6 per cent of world exports of its products would actually have a relatively large share of world exports by the standards of Irish indigenous industry in general. The figure of 0.79 per cent results mainly from the exceptional influence of foreign-owned firms in Ireland, and consequently it sets a standard which is arguably too high for assessing whether specific *indigenous* industries have a relatively large share of world exports. This is an issue which was not encountered to anything like the same degree in Porter's

[3] Van Egeraat and O'Malley (1999) also present other analyses of data relating to Ireland's international trade performance.

studies of countries where foreign-owned companies are less influential. To take account of this point, we applied a lower "cut-off" of 0.4 per cent of world exports as a criterion for including the mainly indigenous industries in our cluster chart. This cluster chart is shown in Figure 1.

Figure 1 is based on 1993 data because that is the latest year for which the necessary UN international trade statistics are available at the detailed five-digit SITC level. UN international trade statistics are available for 1995 but, unlike 1993 and earlier years, they include commodity data only at the more

Figure 1: *Relatively Competitive Indigenous Industries, 1993 (Cut-Off = 0.4 per cent)*

	MATERIALS/METALS	
Primary Goods	28821	Copper waste and scrap (0.6)
	288r	Other non-ferrous metal waste and scrap, excluding of copper (0.4)
	67332	Iron or steel large U, I, or H sections etc (2.9)
	683r	Nickel and nickel alloys, worked (0.5)
	68421	Aluminium bars, wire, etc (0.8)
	685r	Lead and lead alloys, worked (6.6)
	6912	Structures and parts of aluminium (0.9)
Machinery		
Specialty Inputs		
Services		

	FOREST PRODUCTS	
Primary Goods	246r	Pulpwood, woodwaste, non-chips (0.4)
Machinery		
Specialty Inputs		
Services		

	PETROLEUM/CHEMICALS	
Primary Goods	323r	Briquettes and similar solid fuels from coal (0.6)
	3344	Fuel oils, nes (0.7)
	5137	Monoacids and derivatives (1.3)
	5139	Oxygen-function acids and their derivatives (2.8)
	5145	Amine-function compounds (1.2)
	5146	Oxygen-functioning amino-compounds (3.7)
	5147	Amide-function compound, excluding urea (7.2)
	514r	Other nitrogen-function compounds (6.2)
	5154	Organo-sulphur compounds (0.8)
	516r	Inorganic esters and organic chemicals nes (1.5)
	52251	Ammonia, anhydrous etc (1.5)
	56216	Urea (1.6)
	5621r	Chemical, nitrogenous fertilisers, excl urea (1.7)
	583r	Polymerization etc products, excl. 5835, 5837, 5838, 5839 (0.5)
	584	Cellulose derivatives etc (2.9)
	598r	Misc. chem. prod. nes, excl prepared add. for mineral oils (0.6)
	882r	Chemical products for use in photography (0.8)
Machinery		
Specialty Inputs		
Services		

Figure 1: *Relatively Competitive Indigenous Industries, 1993 (Cut-Off = 0.4 per cent) (Continued)*

SEMICONDUCTORS/COMPUTERS		
Primary Goods		
Machinery		
Specialty Inputs		
Services		

MULTIPLE BUSINESS		
Primary Goods	699r	Manufactures of base metal nes, excl safes etc and chains etc (0.9)
	893r	Articles nes, of plastic etc, excl caps[a] (0.7)
Machinery		
Specialty Inputs		
Services		

TRANSPORTATION		
Primary Goods	713r	Internal combustion piston engines for aircraft and parts (3.4)
	7148	Gas turbines nes (1.0)
	7938r	Vessels for towing and floating structures other than vessels (0.5)
Machinery		
Specialty Inputs	7929	Aircraft parts, nes (0.4)
Services		

POWER GENERATION AND DISTRIBUTION
Primary Goods
Machinery
Specialty Inputs
Services

OFFICE		
Primary Goods	89521	Fountain pens, etc (1.4)
	895r	Office and stationery supplies, excl fountain pens etc (0.5)
Machinery		
Specialty Inputs		
Services		

TELECOMMUNICATIONS
Primary Goods
Machinery
Specialty Inputs
Services

DEFENCE
Primary Goods
Machinery
Specialty Inputs
Services

Figure 1: *Relatively Competitive Indigenous Industries, 1993 (Cut-Off = 0.4 per cent) (Continued)*

FOOD AND BEVERAGES		
Primary Goods	00119	Live bovine species, other than for breeding (3.6)
	0011r	Live bovine species for breeding (0.9)
	0013	Live swine (0.5)
	001r	Live animals for food except bovine, swine (2.7)
	01111	Bovine meat with bone in (4.8)
	01112	Bovine meat boneless (8.8)
	0112	Mutton etc, fresh, chilled, frozen (10.7)
	0113	Pig meat fresh, chilled, frozen (2.0)
	0114	Poultry fresh, chilled, frozen (0.6)
	0116	Edible offal fresh, chilled, frozen (4.8)
	0121	Pig meat dried, salted, smoked (2.2)
	012r	Meat and edible offal nes, salted, in brine, dried or smoked (1.6)
	014	Meat prepared, preserved nes etc (2.7)
	02242	Milk dry, 1,5% fat or less (9.7)
	02243	Milk dry, over 1.5% fat (3.9)
	02249	Milk (except dry) preserved, sweet (1.2)
	0224r	Whey (5.0)
	022r	Milk and cream, fresh, not concentrated or sweetened (1.4)
	023	Butter (11.9)
	024	Cheese and curd (3.0)
	5922	Albuminoid substances, glues (including casein) (5.7)
	0341	Fish, fresh, chilled, excluding fillet (2.1)
	0342	Fish frozen, excluding fillets (0.6)
	0344	Fish fillets, frozen (0.7)
	03503	Fish (excluding cod) dried, salted (0.6)
	035r	Fish meal, smoked fish and dried cod (0.8)
	043	Barley unmilled (1.0)
	04842	Pastry, cakes etc (1.6)
	048r	Cereal etc preps excl malt and bakery products (5.0)
	0612	Refined sugar etc (0.8)
	0814r	Meat meal fodder (3.3)
	091	Margarine and shortening (1.8)
	111	Non-alcoholic beverages nes (0.9)
	29193	Gut, bladders, etc non fish (1.0)
	291r	Crude animal materials excluding gut, bladders, etc non-fish (0.6)
	292r	Crude veg materials nes, excluding bulbs and cut flowers (1.1)
	41132	Fats of bovine, sheep, etc (2.8)
	4113r	Animal oils and fats nes, excl. of bovine cattle, sheep or goats (1.8)
Machinery	695r	Hand tools (e.g. spades) of a kind used in agriculture etc (1.5)
	721r	Dairy mach. nes (incl milking machines); agricultural mach. nes (0.9)
	742r	Pumps for liquid etc, excluding reciprocating and centrifugal (0.5)
Specialty Inputs	6935	Metal fencing, gauze, etc (1.4)
	693r	Barbed etc iron or steel wire used for fencing (0.5)
Services		

Figure 1: *Relatively Competitive Indigenous Industries, 1993 (Cut-Off = 0.4 per cent) (Continued)*

HOUSING/HOUSEHOLD		
Primary Goods	664r	Glass, excluding cast, rolled, drawn or blown, unworked (0.6)
	6652	Glass, household, hotel etc (1.9)
	6623	Refractory building products (0.7)
	8121	Central heating equipment (1.2)
	8997	Basketwork, brooms etc (1.6)
Machinery		
Specialty Inputs		
Services		
TEXTILES/APPAREL		
Primary Goods	658r	Textile articles nes, excluding bed etc linen (0.5)
	659r	Floor cov. excl knotted carp. and carp. of wool etc, nes (1.9)
	847r	Clothing accessories of textile fabrics nes (0.4)
Machinery		
Specialty Inputs	2111	Bovine, equine hides, raw (1.9)
	211r	Hides and skins, raw, excluding bovine and equine (2.0)
	2681	Wool greasy or fleece-washed (0.5)
	2682	Wool degreased, uncombed (1.0)
	65421	Woven fabrics of carded wool or fine hair (0.8)
	654r	Text. fabr., woven n-cotton, n-man-made, excl silk, wool (0.6)
Services		
HEALTH CARE		
Primary Goods		
Machinery		
Specialty Inputs		
Services		
PERSONAL		
Primary Goods	554r	Soap and cleansing preps excl organic surface-active (1.2)
	8972	Imitation jewellery (1.9)
Machinery		
Specialty Inputs		
Services		
ENTERTAINMENT/LEISURE		
Primary Goods	79321	Yachts, sports vessels etc (0.5)
	892r	Picture postcards etc and printed matter nes (excl 89286) (1.0)
	89424	Indoor game equipment (1.0)
	894r	Baby carriages, toys etc , excl indoor games etc (0.6)
Machinery		
Specialty Inputs		
Services		

Source: Derived from UN, *International Trade Statistics Yearbook*, 1993.

Notes: The numbers preceding product names are SITC (revision 2) codes. The numbers in parentheses after product names show Ireland's percentage share of world exports. (SITC)r = calculated residue. a = Added because this product is among Ireland's top 50 in terms of export value.

highly aggregated three-digit SITC level. In order to check whether a more up-to-date cluster chart would look much different, we compared the 1995 data (available at the more highly aggregated *three-digit* level only) with three-digit data for 1993. We found that 39 of the 42 (three-digit) export categories which would qualify for inclusion in a 1995 cluster chart would also be included in a chart for 1993. Thus, while there were some changes, the indications are that our 1993 cluster chart in Figure 1, using more disaggregated export categories, would be very largely the same as a more up-to-date chart.[4]

In Figure 1, the numbers which precede the names of the product categories are the relevant SITC product codes. And the numbers in parentheses after the names of the products show Ireland's percentage share of world exports of the products concerned. The products are grouped in the cluster chart in essentially the same standard format of groupings as in Porter's charts (although, on account of space constraints, there are some differences in presentation which are of no practical importance here). The chart involves distinguishing 16 pre-determined broad end-use groups and, within each of these, sub-groups of "primary" goods, machinery used for their production, specialty inputs for the goods, and associated services. This arrangement is intended to highlight patterns of competitive advantage and the possibility of connections or relationships between industries in the various groupings or clusters. However, it would require a good deal of careful research to establish whether there really are significant connections or relationships existing between the industries in each group or cluster. We have simply used our judgement to allocate all of the qualifying Irish industries into what appear to be the most appropriate sub-groups in a standard cluster chart, without investigating the extent of connections between industries in each group or cluster. Our arrangement of the industries into clusters, therefore, should be seen in the spirit of a hypothesis or suggestion that there could potentially be relevant connections between the industries in each "cluster", rather than a claim that there definitely are such connections.

With this caveat in mind, it can be seen that among the indigenous industries in Figure 1, there is a major grouping or cluster in the area of food and beverages, which might possibly have the connections and relationships characteristic of Porter's industry clusters. In this grouping, there is a particular focus on meat

[4] Donnellan (1994, Table 1) has previously presented a type of cluster chart for Ireland based on 1987 data. This was a more simplified version than our Figure 1, making no attempt to exclude mainly foreign-owned industries and using only three-digit product categories, whereas our Figure 1 follows Porter's approach in aiming to exclude the predominantly foreign-owned industries and in using the full available detail of five-digit or four-digit product categories. The use of the more disaggregated product categories is a significant difference because a single, apparently isolated, three-digit category could include a group of five-digit categories which would appear as a cluster in a fully detailed cluster chart.

and dairy products. However, the machinery and specialty inputs and services industries related to this grouping are limited in scope.

There also appears to be a somewhat smaller cluster in chemicals (particularly fertilisers and related products), but there is really less to this than meets the eye, for two reasons. First, it is almost certain that a number of the chemicals products here actually come mainly from foreign-owned rather than indigenous firms.[5] And second, some of the other products would come largely from one large state enterprise rather than a cluster of firms or industries. Apart from this, there appears to be a grouping of products in the area of textiles/apparel, but about half of these are essentially products of agri-processing and it might be more meaningful to regard them as part of the group of food and agriculture-related industries. Otherwise, the relatively competitive indigenous industries are mostly rather diverse.

It is worth noting that in a preliminary version of the cluster chart for Ireland — before the removal of the predominantly foreign-owned industries — there were other major groupings or clusters in the areas of semiconductors, computers and other electronics, and in healthcare products and pharmaceuticals (see Van Egeraat and O'Malley, 1999, Figure 1). However, focusing on Irish indigenous industry alone, while there has been a relatively strong competitive performance by indigenous industry over the past decade, there is distinctly limited evidence of the presence of substantial "clusters" of competitive indigenous industries of the sort which Porter's theory would expect, apart from the food-related industries.

IV "STRONG" SECTORS AND GROWTH PERFORMANCE

It seems to be at least conceivable that the reason why we find only limited evidence of substantial indigenous clusters is not because they do not exist, but more because Porter's methodology for identifying the relatively competitive indigenous industries, and hence the clusters of such industries, works rather poorly in the case of Ireland. There are two main reasons why this could be the case.

First, the major presence of foreign-owned companies in Ireland is a distinctive characteristic of the country which distorts the application of Porter's methodology. Because foreign firms account for most of Ireland's industrial exports, they have the effect of raising Ireland's share of world exports well above what it would be in their absence, to the figure of 0.79 per cent. As discussed

[5] Our procedure for matching SITC trade categories to corresponding NACE production sectors is such that more than ten SITC export categories in chemicals products come from just one NACE production sector, "Basic industrial chemicals (including fertilisers)". This production sector is mainly Irish-owned, but only by a small majority. Since a large minority of this production sector is foreign-owned, it is almost certain that a number of the individual export categories coming from this sector actually come mainly from foreign-owned companies.

above, we aimed to make some allowance for this effect by lowering the required cut-off point for predominantly indigenous industries to 0.4 per cent of world exports, in compiling Figure 1. However, this still would not deal with a potential problem which could arise from the fact that many individual industries in Ireland are predominantly foreign-owned. It is possible that some of these majority foreign-owned sectors could have a minority indigenous component which is relatively competitive and successful in its own right. But as long as we follow Porter's procedure of discarding those industries which are predominantly foreign, indigenous industries of this type would not appear in a cluster chart.

The second main factor which might distort the application of Porter's methodology in the case of Ireland is the fact that a very large proportion of the exports of Irish indigenous industry consists of certain types of food products. Meat and dairy products alone accounted for close to 59 per cent of the value of exports of indigenous industry in 1995 (*Census of Industrial Production*), and this greatly limits the scope for other products to qualify for inclusion in a Porter-style cluster chart. It could be argued that there is something rather artificial about this situation, because meat and dairy products are unusual among manufacturing products in the sense that they have exceptionally low value-added to material inputs. These two sectors account for only 23 per cent of indigenous industry's net output and 18 per cent of its employment. But, as they engage mainly in relatively low value-added processing, their gross output is unusually high relative to their net output, and hence they account for as much as 44 per cent of the gross output of indigenous manufacturing. Then, since meat and dairy products are also somewhat more highly export-oriented than the remainder of indigenous industry, they account for about 59 per cent of the value of exports of indigenous industry.

It can be seen, therefore, that if exports were measured in terms of their manufacturing value-added or net output content, rather than in terms of final product values, meat and dairy products would make up a much smaller share of the value of indigenous industry's exports. But, as it is, these two sectors account for such a large share of the recorded value of indigenous exports that this leaves only limited scope for other types of products to qualify for inclusion in a cluster chart.

In view of these doubts about the effectiveness of the cluster chart approach in identifying adequately all the relatively competitive and successful indigenous industries, we adopt an additional procedure in this section. We identify those sectors which account for relatively large proportions of Irish indigenous industry by comparison with the composition of industry in the EU, using Irish and EU sectoral employment data. Such indigenous sectors, which are relatively large by comparison with the EU's industrial structure, could prove to be competitive

and successful even if they do not appear in a cluster chart, although it will need to be considered whether this is actually the case.

To identify indigenous sectors which are relatively large by comparison with the EU, we calculate Irish indigenous employment in each NACE three-digit manufacturing sector as a percentage of total Irish indigenous manufacturing employment. Similarly for the EU, we calculate employment in each NACE three-digit manufacturing sector as a percentage of total EU manufacturing employment. Dividing the percentage of Irish indigenous manufacturing employment that is in each sector by the percentage of manufacturing employment that is in the same sector in the EU provides an index of industrial specialisation or concentration in Irish indigenous industry relative to the EU. Values of this index which are greater than 1 indicate that Irish indigenous industry is relatively specialised or concentrated in the sector concerned compared with the EU, and conversely for values less than 1.

Note that an index greater than 1 does not *necessarily* mean that the Irish sector is stronger, more highly developed or more competitive than the corresponding EU sector. If Irish indigenous industry as a whole is still generally less well developed than EU industry, some of its sectors could have indices greater than 1 without being highly developed or competitive by international standards. This could be the case particularly with sectors which are naturally protected or "non-traded", such as some of those making products or components for the construction industry. However, these indices should serve to draw attention to sectors which are relatively prominent in Irish indigenous industry and which might possibly prove to be competitive and successful, after further examination, even if they do not appear in a cluster chart.

Table 1 shows these "relative specialisation indices" for all NACE three-digit manufacturing sectors which have an index value greater than 1. Index values smaller than 1 are not shown in Table 1. Note that the data cover a total of 107 NACE three-digit manufacturing sectors, and just 35 of these are shown in Table 1 to have a relative specialisation index greater than 1.

For the final column of Table 1, we identified all NACE three-digit manufacturing sectors which have corresponding SITC export categories that were already identified as relatively competitive in the indigenous cluster chart in Figure 1. All such NACE production sectors which had one or more corresponding relatively competitive export categories are included in Table 1, even if their "relative specialisation index" is less than 1. Thus Table 1 combines together the results of the Porter-style identification of relatively competitive sectors from Figure 1 and our additional identification of relatively large sectors, to produce a listing of all sectors in which Irish indigenous industry might have some claim to be relatively competitive or successful on one or both of these grounds.

Table 1: *Relatively Large and Relatively Competitive Irish Indigenous Industries*

NACE Code	*Sector*	*Relative Specialisation Index*	*Corresponding Exports in Figure 1?*
14	Oil refining	n.a.	Yes
239	Peat	n.a.	Yes
Non-Metallic Mineral Products			
241	Clay products for construction	1.69	
243	Concrete, cement, plaster products	2.35	
245	Working of stone	1.35	
247	Glass and glassware	3.14	Yes
248	Ceramic goods		Yes
Chemical Industry			
251-3	Basic industrial chemicals (incl. fertilisers)		Yes
259	Household, office chemicals		Yes
Metals & Engineering			
221	Iron and steel industry		Yes
223	Drawing, cold rolling, folding of steel		Yes
224	Non-ferrous metals		Yes
314	Structural metal products	1.62	Yes
316	Tools, finished metal goods		Yes
321	Agricultural machinery	1.73	Yes
361	Ship and boat building		Yes
362	Railway rolling stock	3.63	
364	Aerospace equipment (including repair)	1.24	Yes
Food			
412	Meat processing	3.6	Yes
413	Dairy products	4.69	Yes
414	Fruit and vegetable processing	1.36	
415	Seafood processing	4.82	Yes
416	Grain milling	5.18	Yes
419	Bread and flour confectionery	1.79	Yes
420	Sugar manufacturing and refining	2.79	Yes
422	Animal and poultry foods	8.77	Yes
423	Other food products	2.2	
Drink & Tobacco			
428	Soft drinks	2.64	Yes
429	Tobacco products	1.43	
Textiles			
431	Wool industry	1.34	Yes
436	Knitting industry	1.09	
438	Carpets and other floor coverings	2.22	Yes

Table 1: *Relatively Large and Relatively Competitive Irish Indigenous Industries (Continued)*

NACE Code	*Sector*	*Relative Specialisation Index*	*Corresponding Exports in Figure 1?*
Clothing, Footwear & Leather			
441	Tanning and dressing of leather	1.68	Yes
453	Ready-made clothing and accessories	1.99	Yes
455	Household textiles	1.74	Yes
456	Furs and fur goods	1.31	
Timber & Wooden Furniture			
461	Sawing and processing of wood	5.53	Yes
463	Carpentry and joinery components	1.8	
464	Wooden containers	1.1	
466	Articles of cork, straw; brushes, brooms		Yes
467	Wooden furniture	1.92	
Paper & Printing			
472	Processing of paper and board	1.01	
473-4	Printing and allied industries, publishing	2.27	Yes
Other Manufacturing			
483	Processing of plastics		Yes
491	Jewellery, gold and silver wares	3.7	Yes
493	Photographic, cinematographic laboratories	1.05	
495	Miscellaneous manufacturing industries	1.38	Yes

Sources: Eurostat, *Structure and Activity of Industry — Main Results 1989/1990*, for EU manufacturing employment data. Forfás employment survey, 1990, for Irish indigenous manufacturing employment data.

There is a total of 47 sectors in Table 1, but it should be borne in mind that there are another 60 sectors which do not qualify for inclusion there. The missing sectors include, most notably, 31 sectors in the broad area of Metals & Engineering, as well as 4 sectors in Chemicals; these missing sectors include all those which are conventionally described as "high technology" industries. Also missing from Table 1 are between one and three sectors from nearly all of the other major industry groups.

An initial point worth noting about Table 1 is that the sector basic industrial chemicals (including fertilisers), which had more than ten corresponding export categories included in the cluster chart in Figure 1, has a relative specialisation index which is less than 1. In fact, its index is only 0.41. This adds considerably to our doubts, already discussed above, about whether there really is a strong Irish indigenous cluster in this area.

More generally, there is a considerable overlap between the group of sectors

which have relative specialisation indices greater than 1 and those which have corresponding export categories in the cluster chart in Figure 1, which is not surprising. Of the 35 sectors with relative specialisation indices greater than 1, 21 are also represented in the cluster chart while the other 14 are not represented there. The question we must consider is whether these other 14 sectors can realistically be counted among the more internationally competitive indigenous industries, even though they do not qualify for inclusion in the cluster chart.

For the most part, the answer to this question is negative. By matching up Irish SITC trade data to the corresponding NACE production sectors concerned, we find that the balance of international trade is negative for 11 of the 14 sectors, by a large margin in most cases. The three exceptions which have a positive balance of trade are other food products (NACE 423), tobacco products (NACE 429) and furs and fur goods (NACE 456). Other food products and tobacco products are predominantly foreign-owned industries, which is the reason why they were excluded from the cluster chart in Figure 1. Clearly, the substantial presence of foreign firms in these sectors could be the main cause of their relatively strong trade performance, but it is also possible that the indigenous components of these sectors would be judged to be relatively competitive in their own right if the required data were available. The furs and fur goods sector is mainly Irish-owned, but this sector is so very small, with well under 100 employed, that it is of little consequence.

Overall, therefore, our analysis of the relative specialisation indices calls for rather little qualification to the outcome of our cluster chart analysis in Section III above. There may be a case for including other food products and tobacco products among the more internationally competitive indigenous industries represented in the cluster chart in Figure 1. But this does little to change our conclusions to Section III concerning the existence of industry clusters, apart from indicating a slight strengthening of the cluster of food-related industries. Our analysis of the relative specialisation indices also adds to our doubts about whether there really is a strong indigenous chemicals cluster.

The 47 sectors listed in Table 1 should include virtually all of the best available examples of strong and competitive Irish indigenous industries. On closer examination, however, it is striking that few of them really stand up as clear and convincing examples of strong and competitive sectors, for various reasons. For example, many of these industries had a negative balance of trade, as discussed above. These cases include clay products for construction (NACE 241); concrete, cement and plaster products (243); working of stone (245); railway rolling stock (362); fruit and vegetable processing (414); knitting industry (436); carpentry and joinery components (463); wooden containers (464); wooden furniture (467); processing of paper and board (472); and photographic and cinematographic laboratories (493).

Two of the most important sectors, meat processing (NACE 412) and dairy products (413), perform well according to our indicators, but they operate to a great extent in a regulated and supported environment which is not subject to the full normal forces of competition. Hence it is questionable if they represent real *competitive* success (O'Connell, Van Egeraat and Enright, 1997).

In some other sectors, the indicators of a competitive performance and of relatively large size by comparison with the EU depend greatly on just one large company. This is not to say that there is nothing more to these industries than just the one large company, but it does mean that they would probably not be included in Table 1 in the absence of the one company concerned. It would be difficult, therefore, to maintain that these are convincing examples of strong and competitive indigenous *industries* or *sectors*, as opposed to companies. Sectors of this type include oil refining (NACE 14); peat (239); glass and glassware (247); basic industrial chemicals (251-3); iron and steel industry (221); aerospace equipment (364); sugar manufacturing and refining (420); other food products (423); and tobacco products (429).

A number of the remaining sectors had exports which accounted for a sufficiently large share of world exports in 1993 to be included in the cluster chart, but their share of world exports had declined over the seven year period leading up to 1993. This must give rise to reservations about describing them as strong and competitive. These cases include ceramic goods (NACE 248); drawing, cold rolling and folding of steel (223); structural metal products (314); tools and finished metal goods (316); soft drinks (428); articles of cork or straw, brushes and brooms (466); printing and allied industries, and publishing (473-4); jewellery, and gold and silver wares (491); and miscellaneous manufacturing industries (495).

Some of the other industries were experiencing particularly steep declines in indigenous employment, generally by 15 per cent or more in 1988-94, which was in marked contrast to the rising trend in total Irish indigenous manufacturing employment. These include ship and boat building (NACE 361); grain milling (416); bread and flour confectionery (419); carpets and other floor coverings (438); tanning and dressing of leather (441); ready-made clothing and accessories (453); household textiles (455); and furs and fur goods (456). In addition, one of the remaining industries, non-ferrous metals (224), was so small as to be of little significance, with less than 200 people employed.[6]

Of the 47 sectors in Table 1, only 7 had none of the characteristics mentioned above. These are household and office chemicals (NACE 259); agricultural machinery (321); seafood processing (415); animal and poultry foods (422); wool industry (431); sawing and processing of wood (461); and processing of plastics

[6] Note that some sectors actually have more than one of the characteristics discussed here.

(483). These sectors combined account for just 12 per cent of total indigenous manufacturing employment.

We have already concluded that, apart from the food-related industries, there is very limited evidence of the presence of substantial "clusters" of competitive indigenous industries of the sort which Porter's theory suggests are generally required for international competitive advantage. We can now add the observation that indigenous industry does not even have many clear and obvious examples of strong and competitive sectors, as judged by the simple criteria discussed above. Despite this, however, there has been a relatively strong competitive performance by Irish indigenous industry over the past decade.

This leads one to ask what type of sectors have been contributing to the relatively strong growth performance of indigenous industry. In fact, a wide range of sectors have contributed to this growth, with positive indigenous employment growth occurring in about three-quarters of all sectors since 1988 (O'Malley, 1998, Tables 3 and 4), at a time when industrial employment was declining in the EU and OECD. In this context, most of the sectors which were identified as relatively competitive or relatively large in Table 1 have made a positive contribution to growth in the 1990s, but generally not an exceptional contribution. In the case of the group of food industries, which seemed to be the best candidate for a Porter-style cluster, half of them had above average employment growth while the other half were well below average, with no growth or decline.

On the other hand, the highest rates of employment growth in indigenous industry in the 1990s have occurred mainly in the high technology sectors and in two others which are conventionally classed as "medium-high technology" sectors. Thus indigenous employment has been growing at rates of at least 6 per cent per year in reproduction of recorded media (which is mainly software); medical, precision and optical instruments; office machinery and computers; radio, TV and telecommunications equipment; electrical machinery and apparatus; pharmaceuticals; and machinery and equipment. All of these sectors are predominantly foreign-owned, and Irish indigenous industry has for long been under-represented in these sectors compared to the industrial structure of the EU. Thus, none of them are represented in Table 1 which aimed to include the best available examples of strong and competitive Irish indigenous industries identified on the basis of static indicators. In these cases, therefore, there has been an exceptionally strong growth performance by sectors of indigenous industry which appeared to be relatively weak to begin with from an examination of the static indicators.

It is noticeable that the fast-growing sectors mentioned above are well represented in a preliminary version of the cluster chart for Ireland — before the removal of the predominantly foreign-owned industries. As was mentioned

at the end of Section III above, this preliminary cluster chart included major groupings or clusters in the areas of semiconductors, computers and other electronics, and in healthcare products and pharmaceuticals (see Van Egeraat and O'Malley, 1999, Figure 1). The products concerned were coming mainly from foreign-owned firms in Ireland. Thus, if we take the foreign-owned MNEs into consideration, it is possible to regard the fast-growing indigenous sectors as part of clusters of competitive industries. It may well be the case that the relative success of indigenous firms in these sectors owes something to participation in such clusters which mainly involve foreign MNEs. Clancy *et al.* (1998) and O'Gorman, O'Malley and Mooney (1997) find that this is true in the case of the indigenous software industry. As regards Porter's (1990) views on this issue, the main thrust of his theory puts the emphasis on indigenous home-base industries as having the potential to be the important participants in a cluster, as was outlined in Section II above. However, Porter (1990, p.679) does allow that foreign multinationals can occasionally serve to "seed" a cluster, acting as sophisticated customers or related industries.

V ASSESSMENT AND CONCLUSIONS

Despite the scarcity of substantial Porter-style indigenous clusters and the scarcity of convincing examples of strong indigenous sectors, Irish indigenous industry as a whole has performed well over the past decade. This reflects the fact that a relatively good competitive performance and quite strong growth have been possible for many sectors which are not part of discernible indigenous Porter-style clusters. Such a performance has been possible for many sectors which looked rather weak when assessed in terms of static indicators such as export market share, balance of trade or relative size, or which looked rather insubstantial in so far as they were based mainly on one large firm. No doubt this good overall performance was assisted by improvements in the general competitiveness of the economy, with respect to infrastructure, labour costs, other input costs, etc. as detailed in Barry (1999).

Porter's theory would not rule out the possibility of good growth in an industry that does not have a strong established position and does not qualify for inclusion in a cluster chart at a particular time. But it does not seem consistent with the general expectations of his theory to find that the Irish cluster chart of indigenous industry could miss out on the industries which proved to have the most rapid development potential, as well as a considerable number of others which have had a good competitive performance and relatively strong growth compared with most industrial countries. It may be that Porter's theory still has considerable validity, in the sense that it may apply to most successful industries in most advanced industrial countries. However, it does not seem to provide an

adequate insight into the performance of Irish indigenous industry. This raises the question whether the critiques of Porter's model and the alternative formulations which were outlined in Section II might serve to illuminate the Irish situation.

First, the suggestion that foreign-owned MNEs should be included as potential contributors to the competitive advantage of host-country industry clusters seems likely to have merit in the Irish case. As noted above, the relative success of indigenous firms in the high technology sectors may well owe something to interaction between them and foreign-owned MNEs. Thus, Porter's acknowledgement that foreign multinationals can sometimes help to develop host-country indigenous industries, in certain (apparently exceptional) cases, may refer to a process that actually has quite broad implications in Irish circumstances.

Second, as regards the proposed "double diamond" model outlined in Section II, it is not so clear that this would fit the case of Ireland well. It is difficult to identify one particular large country, or bloc of countries, whose "diamond" is structurally and systemically integrated with the diamond of Ireland to the extent proposed in the double diamond model. The USA is the principal source of investment by foreign MNEs in Ireland and, to some extent at least, these can have favourable influences on conditions for Irish industry such as demand conditions or factor conditions. However, the level of integration in the case of Ireland and the USA is far removed from the level of integration of the North American double diamond — "creating a single home base" for multinationals from both nations (Rugman and D'Cruz, 1993). Furthermore, other elements of a possible cross-border diamond involving Ireland, such as influential demand conditions or supplier industries, would scarcely be located primarily in the USA, but more likely in the UK, or the EU, which are Ireland's principal trading partners.

Some variant of the related concept of a "multiple linked diamond" model might, potentially at least, have greater applicability to the Irish case, since it allows for the inclusion of more than one other country as potential sources of influential determinants of competitive advantage. Clancy *et al.* (1998) report evidence that, in their case studies of three Irish industries, foreign countries can in fact be the source of influential demand conditions, suppliers and competition, as well as MNE subsidiaries in Ireland which can play key roles as related, supporting and customer industries for Irish industries. The range of foreign countries which are involved in this can apparently vary depending on the industry, so any future research on this line would probably need to be guided by an industry or cluster focused design, rather than expecting to identify a single "multiple linked diamond" that applies to all industries.

However, it is not clear that the multiple diamond framework would actually prove to be applicable to the Irish case. A distinctive feature of the concept is

that it proposes a high degree of interaction between the industries of the countries involved. This includes an influential role for investment by MNEs, as well as "managerial commitment to being close to customers, knowing the competitive environment, linking with related industries and utilising research and development resources in foreign markets" (Cartwright, 1993, p.67). It may be that many Irish industries are not really so closely inter-linked with foreign economies as to fit this profile, and hence it is not clear whether the multiple linked diamond framework applies in the Irish case. Nevertheless, from the case studies reported by Clancy *et al*. (1998), it does at least seem clear that, for the small and very open economy of Ireland, various types of international influences can have quite a significant bearing on the determinants of competitive advantage.

As regards policy implications, we conclude that it is not necessary for Irish industrial policy to focus heavily on the development of predominantly indigenous industry clusters of the type and scale described by Porter as the general case. However, an important qualification or clarification to this conclusion arises from findings discussed by Clancy *et al*. (1998). They find that, even in the absence of fully developed Porterian clusters, there generally are appreciable benefits for the competitive advantage of Irish industries arising from the presence in Ireland of some form of groupings of connected or related companies or industries, and from interactions between them. Such beneficial relationships in groupings of companies or industries can include, for example, customer/supplier relations, rivalry between competitors, the effects that groups of firms using similar skills have on the development of pools of specialised skills, the process of entrepreneurial spin-offs from existing groups of firms, information flows and knowledge transfers.

Companies' competitive advantage can benefit from such relationships even if the groupings concerned lack significant features of Porter's general concept of "clusters". For example, industries in the grouping may not necessarily be sufficiently large and successful to have a relatively large share of world exports. Or major parts of such groupings may commonly consist of foreign-owned companies in Ireland, whereas Porter's clusters are predominantly indigenous, as the usual rule. Also, such groupings may not necessarily include in Ireland some important components of a full-scale cluster, such as suppliers, customers or related industries.

Based on these findings of Clancy *et al*. (1998), we would conclude that, while it is not necessary for Irish industrial policy to focus on developing clusters of the same type and scale described by Porter as the general case, it would commonly be advantageous for policy to include a conscious element of building on different types of relatively successful groups of connected companies or industries. The groups concerned may be lacking in major features of Porter's

clusters, and foreign-owned firms may be important components of them.

Finally, our findings also suggest that it would not be a good idea to write off the development prospects of indigenous industries based on static indicators such as their share of world exports, their balance of trade or the relative size of sectors. Some relatively small or undeveloped sectors, or indeed individual companies, can prove to have good growth potential, particularly where companies concerned have some past record of growth. Thus the present policy of aiming to support in particular the further development of companies with a good track-record is not unreasonable, even if they do not appear to be part of strong industries or clusters from an inspection of static indicators.

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