



Tight Clusters or Loose Networks? The Critical Role of Inward FDI in Cluster Creation

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Tight Clusters or Loose Networks?

The Critical Role of Inward FDI in Cluster Creation

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ABSTRACT

The purpose of this paper is to investigate the role of inward foreign direct investment (FDI) in instigating a clustering process. In particular, the study examines the situation in which FDI is initially attracted to a region as a result of public policy initiatives rather than the existence of sophisticated local capabilities. Under these circumstances, the presence of large foreign-owned multinational corporations (MNCs) is shown to result in local knowledge transfers and regional reputation effects. These effects give rise to a clustering process, which contrary to other perspectives (PHELPS 2008), shows that external economies can be captured locally from FDI.

Industry clusters, Foreign direct investment, Multinational Corporations, Regions, Spillovers, External economies

JEL Classifications: F2, F23, R1, R11

INTRODUCTION

Within the theoretical sphere of industrial clusters, districts and innovation systems, an abundance of research has been produced on regional cases of industrial agglomeration. In much of this case-based research, the development of industrial activity is shown to be embedded within an institutional structure that has a long history and tradition in the region. Such regions are characterised primarily for their collective learning capacity, inter-organisational co-operation, high innovative capacity and culture of entrepreneurship. As YEUNG et al., (2006) point out many of the renowned industrial clusters are characterised by “an endogenous and self-organized form of cluster development” (p.522). For example, the scientific and research history of the University of Cambridge placed it at the centre of innovation and growth of high technology firms in the Cambridge region (ROSENBERG, 2002). Silicon Valley is embedded in a history of entrepreneurial activity and spin-off firms that dates back to the early 1900s with the formation of a number of innovative enterprises (e.g. Hewlett Packard and Shockley Semiconductor). Likewise, the research on Third Italy within the genre of industrial districts shows the development of regional specialisations in sectors such as ceramics, racing cars, textiles and clothing. Such districts are characterised by co-operation between firms through established long-term links that are embedded within the locality’s social norms and cultural fabric. In this way, such regional industry agglomerations have developed organically from the ‘bottom-up’.

As regions become specialised in particular sectors foreign investors are attracted to these locations to tap into local capabilities and knowledge as well as participate in collective learning and collaborative activities (PORTER 1990, p. 606-613). Particularly when MNCs engage in asset-augmenting investments, whereby the MNC wishes to “enhance its future wealth-creating capabilities in a cost-learning effective way” (DUNNING, 2000a, p.19), they locate to regions in order to access local knowledge spillovers (NARULA and ZANFEI,

2005). ENRIGHT (1998) purports that MNCs can benefit from having a presence in clusters because the affiliate acts as ‘listening posts’, gathering industry and competitive knowledge and disseminating it within the corporation. According to DUNNING (2000b), “although globalization is widening the options open to MNEs to locate in different countries, *within* countries there is a suggestion that at least some kinds of value-added activities – and particularly asset-augmenting activities – are becoming more concentrated, and are favouring sites which have a cluster of related firms” [emphasis in original] (p.34).

Consequently, the presence of FDI in industry agglomerations has led to empirical work on the effect that such investments can have on clusters. For example, it has been empirically evidenced that the presence of FDI in clusters can contribute to the advancement and dynamics of clusters (e.g. ENRIGHT, 2000; BIRKINSHAW and HOOD, 2000). BIRKINSHAW and HOOD (2000) found that subsidiaries in leading-edge clusters tend to be relatively autonomous and more embedded in the locality, thus the authors conclude that this adds to the dynamism of a cluster. Moreover, within the industrial district literature the presence of foreign-owned MNCs is shown to impact the structure of a district (MARIOTTI et al., 2008), which is traditionally defined by a group of inter-linked small and medium-sized enterprises. The presence of foreign-owned MNCs, however, is found to enhance the degree of internationalisation of domestic firms in terms of engaging in outward foreign investment (MARIOTTI et al., 2008).

Much of this research on the presence of FDI in and its contribution to clusters is based on existing industrial agglomerations (PHELPS, 2008), that is, the attraction of FDI to leading clusters as well as the effect of FDI on clusters that are already in existence. Indeed, the presence of foreign investors in leading-edge and endogenously developed clusters, such as those described above, can be expected and the contribution or effect that such investment can

have on these clusters has been a source of academic interest. However, in circumstances where public policy has exogenously attempted to create industrial agglomerations through attracting FDI to a region, the contribution of such investment to the development of a clustering process is ambiguous. Although it may be the expectation of policymakers that such investment will lead to local economies and a clustering effect, there is limited research to either support or refute this. As PHELPS (2008) states “[t]he literature that has dealt with FDI as an instigator of potential clustering processes, perhaps understandably, has remained obscure – focusing on the likes of failed attempts to produce growth poles or industrial complexes from scratch through FDI” (p. 461).

This paper aims to address this gap in the literature and poses the following research question: in agglomerations generated by FDI through a ‘top-down’ policy-approach, how, if at all, can such investment instigate a clustering process? A case study of an agglomeration of firms around cardiovascular medical devices on the west coast of Ireland is used to investigate this research problem. The genesis of the agglomeration is rooted in public policy that attracted large foreign investors in the sector to the region. Following this introduction, the second section of the paper reviews the literature on industrial clusters and the presence of FDI. The research methodology employed and the resulting empirical findings are detailed in the third and fourth sections consecutively. Finally, the fifth section discusses the findings within the context of the literature and subsequently, conclusions are drawn.

INDUSTRY CLUSTERS AND INWARD FOREIGN INVESTMENT

The presence and significance of foreign-owned MNCs in industry clusters has generated much interest by scholars over the past two decades (e.g. DUNNING, 1993, 1998, 2000a, 2000b; YOUNG et al., 1994; ENRIGHT, 2000; BIRKINSHAW, 2000; DE PROPRIS and DRIFFIELD, 2006; PHELPS, 2008). Michael Porter’s work on the competitiveness and

innovativeness of industries (PORTER, 1990) has been criticised for focusing solely on the home-base of a nation in determining competitive advantage and ascribing a limited and an ambiguous role to inward FDI. According to PORTER (1990) inward FDI is 'not entirely healthy' (p.671) and while in a later publication (PORTER, 1998) it is acknowledged that FDI can contribute to the development of a cluster, it is suggested that this will occur only if foreign-owned firms 'make a permanent investment in achieving a significant local presence' (p.220). In MARKUSEN's (1996) typology of industrial districts, FDI features strongly within the satellite industrial platform district that is characterised by the dominance of foreign-owned branch facilities. According to MARKUSEN (1996) there are negligible local linkages in this type of cluster as the foreign-owned branches are assumed to interact internationally and have little commitment to the local region. While it is acknowledged that the presence of foreign investors may influence the development of the local cluster over time MARKUSEN (1996) perceives the instance of this to be low.

In recent years scholars have begun to attach more importance to FDI in industry clusters and have rejected this limited and rather stark view of the impact of FDI (e.g. ENRIGHT, 2000; DUNNING, 2000a). In doing so, inward FDI has been predominantly studied from two different approaches, that is, the attraction of FDI to clusters and, conversely, the contribution that foreign investors can make to clusters as well as their effect on the structure and dynamics of clusters.

Authors have concluded that the significant presence of similar industrial activity in a region will attract FDI (PELEGRÍN and BOLANCÉ, 2008; BRONZINI, 2007). The emergence and sustainability of clusters is based on the development of external economies, such as the creation of a skilled labour pool, the growth of specialised suppliers and knowledge spillovers (PORTER, 1990; KRUGMAN, 1990; 1991a; 1991b). In particular, much of the literature has

focused on non-economic relations and processes that underlie the exchange of knowledge. A region's 'untraded interdependencies' (STORPER, 1997; SCOTT AND STORPER, 2003), 'institutional thickness' (AMIN AND THRIFT, 1994) and 'collective learning processes' (LAWSON AND LORENZ, 1999) refer to the social processes that impact the generation, absorption and dissemination of knowledge. Communities of firms that share a common language, norms, and routines are postulated to facilitate the dissemination of knowledge (MASKELL, 2001; HENRY AND PINCH, 2000). More specifically, knowledge is shown to flow through links with suppliers, the cessation and formation of firms, informal collaboration as well as the movement of labour as personnel carry tacit knowledge between firms (HENRY AND PINCH, 2000; PINCH AND HENRY, 1999).

Therefore, by maintaining a presence in such clusters, it is put forward that foreign-owned MNCs will gain access to these knowledge spillovers, resources and technological capabilities (DUNNING, 2000a). Empirically, IVARSSON (1999) analysed the importance of internationally competitive clusters in Sweden as an attraction for FDI and found that over one half of foreign-owned firms in the country are located in clusters. Foreign affiliates within clusters were found to be more likely to engage in formal technological co-operations with firms in the host country than those affiliates not located in clusters. In corroborating with DUNNING's (2000a) view this suggests that MNCs are drawn to clusters to tap into local technological capabilities. Similarly, CANTWELL and PISCITELLO (2005) undertook quantitative analysis of the location of research activities by foreign-owned MNCs across regions in Germany, UK, Italy and France to examine the role of spillovers and externalities in attracting these activities. The authors found that innovation tends to be geographically concentrated and that MNCs are responsive to agglomeration potential. The presence of both intra- and inter-industry spillovers, representing both specialisation and diversity externalities, were found to be important factors in attracting technological activities of MNCs.

In terms of the contribution that FDI can make to clusters, research has shown that the presence of FDI can enhance the degree of internationalisation of local firms (MARIOTTI et al., 2008) and can connect clusters in different locations (HERVÁS-OLIVER et al., 2008). In addition, empirical work has evidenced how FDI can impact cluster advancement (PETERS, 2000; BEST, 2001; BIRKINSHAW, 2000) as well as cluster dynamics (ENRIGHT, 2000), particularly through the transfer of technology (ENRIGHT, 2000; THOMPSON, 2002; PADILLA-PEREZ, 2008) or enhancing the perception and reputation of a cluster (BIRKINSHAW, 2000). However, the degree of contribution often has conditions attached, which relate to the characteristics of the industry cluster. From an econometric analysis of productivity spillovers from inward foreign investment in the UK, DE PROPRIIS and DRIFFIELD (2006) report that such gains for domestic firms are found to occur when a cluster already exists. Similarly, PADILLA-PEREZ (2008) concludes that technology transfer from FDI can impact a region but rather than being an ‘automatic’ occurrence, certain regional characteristics should be present, such as high local capabilities, universities engaging in industry-related research and specialised labour. Further indication of the need for an existing local specialisation to be in place in order for FDI to contribute is found in the research by MARIOTTI et al., (2008) which shows that the presence of foreign-owned MNCs will enhance the internationalisation of local firms when these domestic firms in a district have already initiated an internationalisation process (MARIOTTI et al., 2008).

Alternatively, other scholars have argued that the characteristics of the foreign investors themselves are also important in determining their contribution to a local cluster (YOUNG et al., 1994; MALMBERG and SØLVELL, 2002). The proposed characteristics include; the export-orientation of the firm, the employment of skilled workers, the development of an R&D facility, the responsibility for leading products and marketing and sales functions (YOUNG et al., 1994) as well as the ownership of valuable competencies and the assignment

of strong mandates by the parent company (MALMBERG and SØLVELL, 2002). In general, when the inward investment is characterised by higher value-added activities, the argument is put forth that such investment is more likely to make a stronger positive contribution to the development and dynamics of a cluster.

In addition to the positive contribution that FDI can make to clusters, some negative effects have also been discussed in the literature (e.g. MARIOTTI et al., 2008; DE PROPRIS and DRIFFIELD, 2006; AITKEN and HARRISON, 1999). These adverse effects are not unique to industrial clusters but more accurately relate to MNCs entering a host economy in general. In particular, foreign investors can create a ‘crowding-out’, ‘competition’ or ‘market-stealing’ effect whereby market share is captured from local firms (MARIOTTI et al., 2008 p.722; DE PROPRIS and DRIFFIELD, 2006 p. 279; AITKEN and HARRISON, 1999). In the context of an industrial cluster, this may result in its demise (MARIOTTI et al., 2008) or conversely the increased competition may enhance the efficiency of the cluster in the long term (DE PROPRIS and DRIFFIELD, 2006). DE PROPRIS and DRIFFIELD (2006) empirically show that within clusters, the competition effect of new foreign investment can result in a loss of productivity for domestic firms but that this is offset by the spillover gains that occur from foreign to local firms. However, in non-cluster cases there are no spillover gains and the ‘crowding-out’ effect dominates (DE PROPRIS and DRIFFIELD, 2006). Therefore, the research suggests that even though there can be adverse effects to inward FDI entering clusters, this is compensated by the positive contribution that is captured.

However, much of this empirical-based research on the positive contribution of FDI relates to *existing* clusters (PHELPS, 2008). Therefore, the predominant arguments calling for a more critical reflection centre on the type and stability of clusters formed on the back of FDI and the degree to which foreign investors in FDI-dominated clusters will contribute to the local

milieu (DE PROPRIS and DRIFFIELD, 2006; PHELPS, 2008). Even though there are studies of FDI resulting in the formation of clusters (e.g. O’GORMAN and KAUTONEN, 2004; JACOBSON and MOTTIAR, 1999; Ó’RIAIN, 1997), the issue of the stability of such clusters and whether they are indeed clusters in a real sense is contested. DE PROPRIS and DRIFFIELD (2006) argue that “FDI-generated clusters can be fragile and have often proved unable to provide a sustainable development for localities” (p. 287). This is due, it is argued, to a lack of embeddedness by the foreign investor with often limited local spillovers and when linkages do occur in the form of subcontracting relationships with local suppliers the result is often a ‘monopsonistic cluster’, where “survival depends on the MNE” (DE PROPRIS and DRIFFIELD, 2006 p.281). PHELPS (2008) supports this view and contends that there are few examples in Europe of robust clusters being developed around MNCs. In addition, the case is made that the external economies produced in FDI-dominated clusters, such as a specialised labour market and knowledge flows, are claimed to be shared predominantly among the foreign investors themselves as such clusters inherently lack a strong indigenous base (PHELPS, 2008). Furthermore, BIRKINSHAW and HOOD (2000) empirically showed that clusters with high levels of foreign ownership tend to contain affiliates with less autonomy and weaker capabilities and as a result the cluster itself is less dynamic. However, clusters that develop from a strong indigenous base of local capabilities can attract foreign investment to tap into local knowledge (DE PROPRIS and DRIFFIELD, 2006; DUNNING, 2000a; ENRIGHT, 1998). In turn, domestic firms are found to gain from such foreign investment in the cluster (DE PROPRIS and DRIFFIELD, 2006). Therefore, it is concluded that to capture external economies from FDI, such investment must enter existing clusters driven by indigenous firms (PHELPS, 2008; DE PROPRIS and DRIFFIELD, 2006) and cluster policy should not be focused on generating clusters through the FDI mechanism.

Drawing such conclusions may be premature however, given that, as PHELPS (2008) professes, the research on FDI as an initiator of regional clustering remains 'obscure' (p.461). To address this issue therefore, this paper examines how, if at all, inward foreign investment can instigate a clustering process when it is attracted to a region primarily as a result of targeted public policy. Within the national environment a combination of targeted industrial policy (e.g. corporate tax incentives) and certain national conditions (e.g. the cost and availability of labour and political stability) can attract foreign investment in particular sectors. In an attempt to build and reap the gains from a 'knowledge-based' economy, the development of high-technology sectors has been the predominant intention of policymakers across developed and developing countries globally. The grey area in the literature pertains to how foreign investment under such circumstances can lead to a regional clustering process.

Previous studies that have investigated the development of clusters from FDI have primarily shown the growth of an indigenous group of suppliers around the foreign investors (e.g. JACOBSON and MOTTIAR, 1999), which it has been suggested leads to a 'monopsonistic cluster' with limited local spillovers and where external economies occur they mainly benefit the foreign investors themselves (DE PROPRIS and DRIFFIELD, 2006; PHELPS, 2008). This viewpoint is tested here by examining if, and how, a transfer mechanism can occur from FDI that results in the creation of a clustering process which goes beyond that of a supply-based system. Finally, given that the foreign investors are initially attracted to the host economy primarily due to public policy initiatives and the availability of labour rather than tapping into a local market it can be expected that with such investment organisations will engage in global linkages. Indeed the extended spatial scale of industrial agglomerations in a globalised environment has been acknowledged in the literature (e.g. KEEBLE et al., 1998; PHELPS and OZAWA, 2003) and its effect on a cluster is a source of debate (e.g. BATHELT, et al. 2004; LORENTZEN, 2007). The extent to which such international

linkages impinge on the development of a clustering process locally is questionable. These conceptual issues were applied to an empirical case study of a particular medical device agglomeration in Galway, in the west of Ireland. The following section details the research methodology employed.

RESEARCH APPROACH

As the aim of this study is to explore the phenomenon of FDI and industrial clusters, the research agenda lends itself most appropriately to a case study approach “which focuses on understanding the dynamics present within single settings” (EISENHARDT, 1989 p.534). The approach is used to investigate certain contemporary phenomena within its real-life context (YIN, 1984 p.23), rather than to seek generalisability through statistical representativeness. There were two primary stages to the research methodology employed (see table 1).

The purpose of the first stage was to investigate the evolution of the medical technology sector in Galway and to identify the existence of a cluster of activity. A database of medical technology firms, both past and present in Galway was compiled. The database is organised per year and shows the investments and divestments by medical technology companies in Galway city and county in each given year to 2009. Initially, databases from industrial development agencies as well as internet and newspaper archive searches were used to compile a list of past and present medical technology companies in the region.

Table 1: Research Approach

| Research stage | Research method | Data sources |
|---|---|---|
| Stage 1 Evolution of the medical technology sector in Galway and identification of an agglomeration | Company Database: compilation of data on past and present firms | Sources of data: Industrial development agency databases, Company Registration Office, internet and newspaper archive searches Data compiled: Origin of firm, nature of activity, year of incorporation, exit year |
| | Nine personal interviews with relevant interest groups | Industry associations: 1. IMDA (Irish Medical Device Association) 2. ATC Group (Atlantic Technology Corridor Group) Regional agencies: 3. WDC (Western Development Commission) 4. BMW Assembly (Border, Midlands and Western Assembly) Policy and industrial development agencies: 5. Forfás (National Policy Advisory Board) 6. Enterprise Ireland 7. IDA Ireland (Industrial Development Authority Ireland) Academic organisations: 8. NCBES (National Centre for Biomedical Engineering Science), National University of Ireland, Galway 9. Technology Transfer Office, National University of Ireland, Galway |
| Stage 2 Dynamics of the cardiovascular medical device cluster in Galway | Six personal interviews with member companies | Foreign-owned MNCs: 1. MNC A (large-sized): Director of Product & Technology Development 2. MNC B (large-sized): R&D Manager 3. MNC C (medium-sized): Senior Engineering Manager Indigenous companies: 4. Indigenous A (Small-sized firm): R&D Manager 5. Indigenous B (Medium-sized firm): Finance Manager 6. Indigenous C (Medium-sized firm): R&D Manager |

Subsequently, the year of registration with the Companies Registration Office Ireland was used as a proxy of when the firm established in the region. Company websites, newspaper archives and general internet searches were used to identify the firms' broad technology classification of activity in the region and whether they are indigenous or foreign-owned. For each year the database shows the companies that invested, those that divested, the nature of activity of these firms and their origin. From the searches undertaken there were seven companies identified that had a company registration number but no information could be found on these companies from internet or newspaper searches. These companies were excluded from the analysis as their activity and status could not be confirmed in the region. In total, forty-two medical technology companies were identified in Galway in 2009.

The analysis of this database combined with nine interviews carried out with organisations representing industrial associations, regional development agencies, public policy agencies and academic institutes in the region provides an understanding of the development of the industry and indicates the influence of FDI. Significantly, this first stage also identified the development of a particular area of expertise in the field of cardiovascular medical devices in Galway, which is driven by the presence of two foreign-owned MNCs, Boston Scientific and Medtronic, as the largest employers in the region, employing approximately 4500 people between them.

Having identified this particular technological agglomeration in Galway the purpose of the second stage of the research approach was to investigate how, if at all, FDI has stimulated a clustering effect. With some exceptions (e.g. PADILLA-PEREZ, 2008; YEUNG et al., 2006; HERVÁS-OLIVER et al., 2008), much of the empirical research undertaken on the contribution of foreign-owned affiliates to industry clusters has been either primarily quantitative in its methodological approach (e.g. BIRKINSHAW and HOOD, 2000;

BIRKINSHAW, 2000; THOMPSON, 2002; DE PROPRIIS and DRIFFIELD, 2006; SHAVER and FLYER, 2000; MARIOTTI et al., 2008) or has involved an analysis of particular MNC affiliates rather than including an examination of both indigenous and foreign-owned firms in the industry cluster (e.g. ENRIGHT, 2000; PETERS, 2000; BIRKINSHAW and HOOD, 2000; THOMPSON, 2002). As a result, this provides a more limited insight into the extent and precise operation of spillover mechanisms (THOMPSON, 2002) and the resulting effect on the locality. For this study, both foreign-owned and indigenous firms were examined to understand the dynamics of the agglomeration. Data was collected from in-depth semi-structured interviews with high-level managers in six of the fourteen companies identified as being involved in the cardiovascular medical device agglomeration at the time. Senior managers from three indigenous firms and three foreign-owned firms (including Boston Scientific and Medtronic) were interviewed. The interviews were semi-structured in nature and covered topics such as, company background, inter-organisational linkages and their geographical scope, accessing industrial and technical knowledge, and local linkages and processes. To investigate the contributing role of FDI more specifically, questions relating to ties between the foreign-owned firms and indigenous firms locally were included.

Based on this two-stage approach, the following section presents the research findings focusing on how the medical technology sector has evolved in Galway, the identification of an agglomeration around cardiovascular devices and the influence of FDI within this particular agglomeration.

FOREIGN-OWNED MNCs AND THE CLUSTERING PROCESS: THE CASE OF A MEDICAL DEVICE AGGLOMERATION IN GALWAY

Similar to that of other knowledge-based sectors in Ireland, the Irish medical technology industry is dominated by the presence of world-leading MNCs, such as Boston Scientific, Johnson & Johnson, Stryker, Vistakon, Medtronic and Tyco Healthcare. Fifteen of the world's top twenty-five medical technology companies have operations in Ireland (IDA IRELAND, 2008) and these, together with a smaller base of indigenous companies, employ an estimated 24,000 people in approximately 140 companies (IBEC/IMDA, 2008).

A strong concentration of medical technology activity has developed in the West¹ of Ireland in particular, where Galway city is a key economic centre. Almost 40% of total employment in the medical device sector in the country is in the West region (FORFÁS, 2008 p.23). In 2004, the National Policy Advisory Board, Forfás, reported a significant specialisation of medical device activity in the West, with the region showing an employment share of over three times the national average for this sector (i.e. a location quotient of 3.92) (see Table 2).

Table 2: Location quotient by region in the Medical Devices Industry in Ireland, 2004

| Area | Location quotient |
|---|--------------------------|
| <i>State</i> | <i>1.00</i> |
| Border | 1.06 |
| Midlands | 1.55 |
| West (counties Galway, Mayo, Roscommon) | 3.92 |
| Dublin | 0.19 |
| Mid East | 0.54 |
| Mid West | 1.24 |
| South East | 1.04 |
| South West | 0.92 |

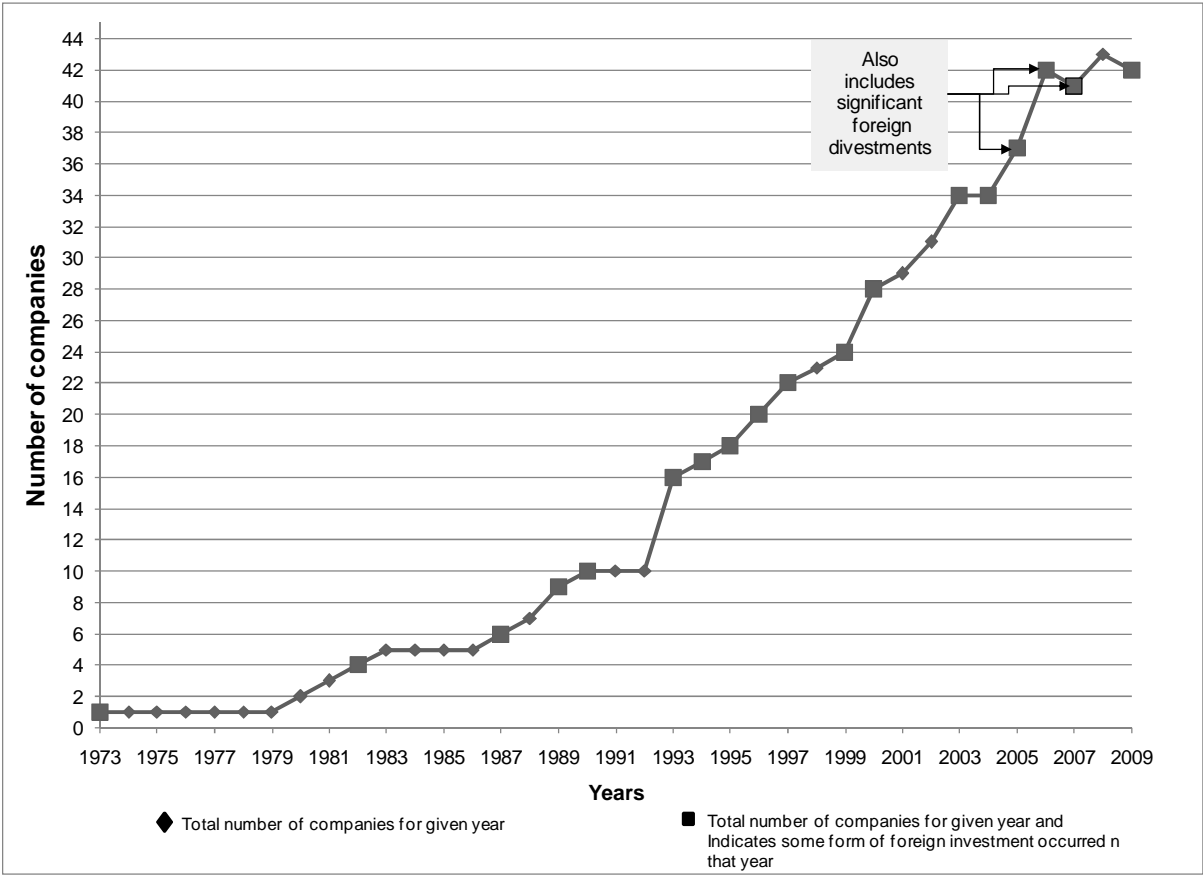
Source: FORFÁS (2006), p.8.

Galway city and county has been the recipient of significant investments by foreign-owned corporations, including Boston Scientific, Medtronic, Tyco Healthcare, Abbott and Merit Medical. The American corporation, CR Bard brought one of the first major investments in

medical technology to the region in 1982, while in 1994 the leading medical technology firm in its field, Boston Scientific, established a manufacturing facility. In 1999, another leading American MNC, Medtronic, took over the CR Bard subsidiary in Galway and presently both Medtronic and Boston Scientific create most of the employment by far in the region in medical technology (employing approximately 4500 between them).

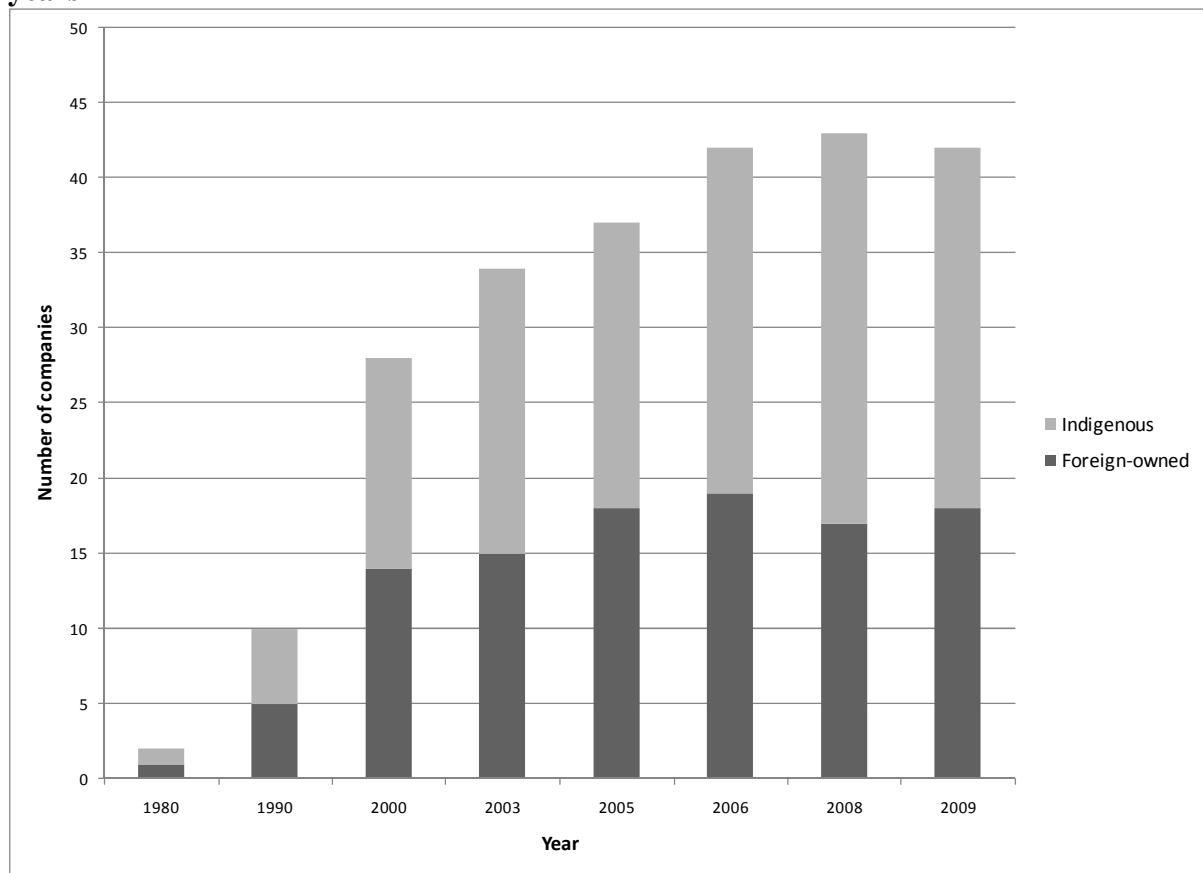
The analysis of the database compiled reveals that the presence and growth of foreign investors has had a significant impact on the growth of the sector in the locality (see Figure 1). While the sector has experienced some divestments in recent years the number of firms has grown considerably since the mid-1990s (see Figure 1) and presently comprises of approximately 42 firms which are involved in the development and manufacture of diagnostics, medical devices and their components or accessories, suppliers and subcontractors.

Figure 1: Medical technology-related companies in Galway for each year, 1973-2009



Whilst initially attracted to Galway due to alluring tax structures and financial packages as well as the availability of labour, foreign investors have always driven the sector in Galway. However, a growing indigenous base of companies has also developed along with the foreign investors (see Figure 2). These indigenous firms tend to be much smaller in size compared to their foreign counterparts and are comprised of firms involved in the production of medical devices and their components as well as more basic suppliers.

Figure 2: Nature of investment by medical technology companies in Galway for given years



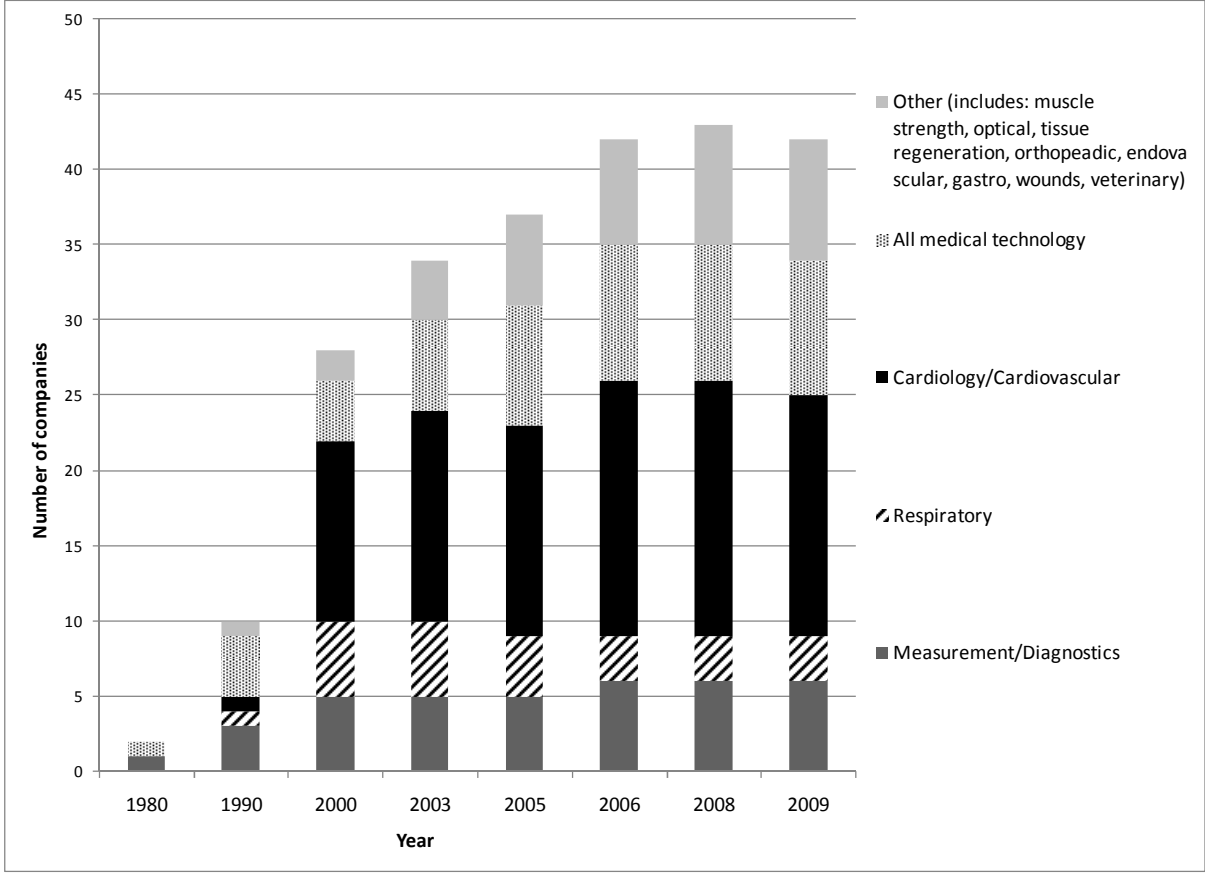
Beyond attracting FDI, public policy has also played a role in the development and dynamics of the sector locally. Since 2000 there has been a substantial drive within the Irish policy system to promote science, technology and innovation, including the commercialisation of research at third-level institutes and the creation of stronger links between industry and the third-level sector. The upshot of this has been the establishment of industry-academic research centres such as the Regenerative Medicine Institute (REMEDI) based at the local university in Galway. REMEDI is involved in stem cell biology and manufacturing, gene therapy, orthobiologics, immunology, cardiovascular, socio-economic and bioethical research (REMEDI 2009). One of its main industrial partners is Medtronic in Galway, which builds a reputation for REMEDI, opens opportunities for students and further funding and provides the possibility for the development of a patentable product from the research (Brady 2006). REMEDI is also embedded within the activities of the National Centre for Biomedical

Engineering Science (NCBES), which was established in 1999 and is also based at the local university. Since its establishment the NCBES has engaged in numerous formal research contracts with the medical technology sector and participates in Enterprise Ireland Innovation Partnership projects that provide funding for research projects involving third level institutes and Irish-based companies.

In addition to such research-based collaborative activities, the University has influenced the development of the local labour market by introducing a new degree programme in Biomedical Engineering in 1998, the first students of which graduated in 2002. The degree programme was established under the Department of Mechanical Engineering, which changed its name in 2002 to the Department of Mechanical and Biomedical Engineering, reflecting the Department's focus on biomedical research and education activities. The course assists in meeting the specific labour requirements of the local medical technology firms.

Over time the production of cardiovascular-related devices and their components has become a particular area of expertise in Galway (see Figure 3). Both Boston Scientific and Medtronic are involved in the production of coronary drug-eluting stents² in the region and many of the other companies produce related cardiology products, such as guidewires, balloon catheters, hypotubes and filters, which are used in balloon angioplasty and/or stenting procedures. Other areas of activity are also illustrated in Figure 3, including diagnostics and respiratory, while the category 'all medical technology' primarily incorporates suppliers or subcontractors that serve medical technology companies without any specialisation in any particular technological field.

Figure 3: Broad technology classification of medical technology companies in Galway for given years



Given that a particular area of expertise has developed around cardiovascular devices that is driven by Boston Scientific and Medtronic as large foreign-owned employers in the region, the next subsection focuses on understanding the dynamics within this agglomeration.

The Cardiovascular Agglomeration in Galway

This is an export-oriented cluster with all of the firms examined selling output internationally, particularly to North America and Europe. It was evident from the interviews that the companies engage with distributors, strategic partners and/or other company offices globally in order for their products to reach the marketplace. All companies designing and producing complete medical devices reported access to end-users of the device, that is, physicians, as vital for feedback on the devices as well as information on the instrumentation required for

the latest procedures. Accessing end-users in the leading international markets is an important means of obtaining such information, while local end-users are used to a lesser degree.

The inputs for most of the companies are sourced from a mixture of the region, the rest of Ireland, Europe and North America. Often the highly specialised materials and components are sourced from abroad and more lower-value added activities are accessed locally. While the MNCs are part of global operations and therefore may have access to the corporation's chain of suppliers, the indigenous companies interviewed reported the use of the internet and attendance at tradeshows as the main methods of accessing suppliers abroad that are generally quite specialised. As these suppliers are based across Europe, America and/or Asia the distribution of the goods to and from these destinations can be cumbersome and slow in which case local suppliers would be preferable but generally not possible due the specialisation of the activity. However, none of the companies reported any major issues in dealing with their suppliers abroad in terms of cultural or linguistic barriers. The companies tend to build long-term partnerships with the firms with a high degree of interaction to improve costs, efficiency and quality. Switching suppliers is not easy within the medical technology sector because of the regulatory standards that have to be maintained. It can take a number of years to get regulatory approval for a supplier and as a result both indigenous companies and MNCs prefer to build long-term relationships with their suppliers. This means that firms will not immediately switch to a supplier that is located nearby for purely proximity reasons nor will they switch to suppliers based in lower cost economies simply for cost advantages. As trust builds between the companies and the regulatory standards are met, the relationship tends to be long-lasting.

Most of the companies examined have a high degree of direct business or personal contacts with universities or research centres. All of the companies reported to have both formal and informal linkages with the local university, NUI Galway, through various science and

engineering departments and particularly the NCBES research centre. While the local university is clearly an important resource in the region, collaboratively aligning with international universities and research centres is also critical for at least three of the companies interviewed - two large MNCs and one indigenous firm. These universities are based in the US, Europe and Japan. The criticality of working with such international institutes is evidenced by the indigenous company having a researcher placed full time in an American university, while a senior manager from an MNC stated that “there are so many centres of excellence in Europe and the US that we would be exceptionally naïve not to be working with them” (R&D Manager, MNC B). The three companies report the importance of accessing these colleges because they have renowned research centres of expertise from which the firms can develop their R&D activities and they have leading clinicians and cardiologists associated with them that provide access to the end-user for the firm.

Conferences, tradeshows and/or clinical congresses were cited by all the managers of companies interviewed as the primary mechanisms for keeping abreast of technological and industrial developments in the sector. These conventions and shows are typically renowned events hosted primarily in the US and Europe attracting leading medical technology companies and clinicians from around the world. Both MNCs and indigenous companies emphasise the importance of attending these events for accessing the end-user. However, the indigenous companies in particular, also point to the opportunities for networking, displaying their products, attracting attention to the company, marketing and promoting the company, observing competitors, finding suppliers and potential partners.

While tradeshows focus on technologies and are aimed at medical device companies allowing them to showcase their products and materials, conferences are more oriented around the end-user. Often live clinical procedures takes place at these conferences, whereby leading

physicians demonstrate the latest devices. Therefore, medical technology companies can gather information on market developments as well as observe the needs of the physician so that the company can tailor their products to meet those requirements. Such conferences facilitate vital end-user access for the company. As a senior R&D manager from one MNC explained;

“We attend two or three of the principal medical conferences, which are dedicated to cardiology, interventional cardiology, so we’ll certainly do that and we’ll send quite a lot of people to them as well... where there is a lot of customer interaction – they see what’s happening in the market, they see what the cardiologists want or what the problems are” (Director of Product & Technology Development, MNC A)

Overall, as anticipated, the findings emphasise the extent to which the firms in the agglomeration participate in geographically extended events and linkages with suppliers, partners, distributors, end-users and research centres. Therefore, given the pervasiveness of such global linkages, the extent to which a clustering process has emerged from the presence of the foreign investors in the region can be questioned.

While much of the cluster literature emphasises joint collaborative actions as well as informal linkages facilitating knowledge exchange, this agglomeration is highly competitive and is characterised by limited inter-firm collaborative linkages. The MNCs produce similar products from the facilities in Galway and directly compete with each other in the global marketplace. As a result intellectual property is highly valuable and collaboration between the companies is controlled and limited to general business environment issues, such as the supply of local graduates, infrastructure and government funding. Cooperation and inter-firm trust at this level occurs primarily through the nationally-based industry association, IMDA (Irish Medical Device Association). The interviewees reported that they never engage in

informal contacts with competing firms in the region with regards to product, process, technological or market knowledge. As a manager from a MNC commented;

“We would never, ever discuss the products and technologies or anything competitive , however if it comes to the supply of graduates to the industry..., if it comes to government support for R&D...all these things are good for everybody...and there’s a good bit of interaction” (Director of Product & Technology Development, MNC A)

However, while there may be limited joint collaboration, the significant presence of direct competitors enhances the dynamism and vibrancy of the agglomeration. In particular, the findings reveal that the presence of the large MNCs has played an important role in creating a focal point in the region for medical technology activity. This role is shown to occur through two primary mechanisms, that is, *local knowledge transfers* and *regional reputation effects*.

As demonstrated in Figures 1 and 2 there is evidence of start-up companies emerging in the region along with foreign investment. Of the three indigenous companies interviewed, two were established by people who had previously worked as managers in the large MNCs in the region. The other company established as a component supplier to medical device firms following the transfer of know-how from a large MNC. These connections with the MNCs can create important network opportunities for the small start-ups. For example, one company reported that when the managing director worked in a previous MNC he had created links with a medical specialist in the UK, who in turn had linkages with opinion leaders in the healthcare market. This contact has allowed the managing director of the start-up to access feedback from international experts.

Furthermore, the use of local suppliers by MNCs acts as a positive externality for the other indigenous companies in the agglomeration that use the same suppliers. The MNCs are important customers for the local suppliers and they impose high international standards on

the materials and services supplied to meet FDA (US Food and Drug Administration) requirements in particular. Therefore, without the need for much further investment the indigenous companies benefit from the availability of high quality suppliers in the region. As a senior manager from one indigenous company stated;

“...some of the bigger companies, you know, Boston Scientific, Medtronic, they force the supplier companies to comply with the standards and because they are ultimately the biggest customer then they can drive the standards that these suppliers need and a quality system within Medtronic isn't going to allow a supplier to slip and we would benefit from that...So they [the suppliers] can come in here and in a very short period of time be quite productive” (R&D Manager, Indigenous A)

While this may not be creating a clustering effect directly as firms outside the cluster can also obtain the same benefits by using the same suppliers as the large foreign-owned MNCs, it is enhancing the knowledge base of the region in the medical device field, which will ultimately attract more firms. In addition, interaction with the MNCs influenced one indigenous component supplier to move from the electronics and metal-work industry solely into the medical technology field. The local MNCs have provided a pathway for this firm to international markets as the company sells to global sites belonging to the MNC as well as the local sites.

The presence of the large MNCs is also important for developing a pool of skilled labour and attracting workers to the region, as noted by the managers interviewed. Having access to a pool of skilled labour is an important resource for companies in the sector and is facilitated by the concentration of firms in the region. As one manager from an indigenous company commented;

“It's [the concentration of medical device companies in Galway] useful in that what you need to be able to do...what's really, really important, especially in the R&D side but also across the board is to be able to hire people, good people...So it's very important to be somewhere where it's desirable to live and

then to be near a place where there's a few different opportunities for people" (R&D Manager, Indigenous C)

As the presence of the large MNCs provides people with the opportunity to move between companies, labour is attracted to the region. Two of the companies that have lost staff to other firms in the region observe that labour mobility is often positive because knowledge is transferred and new contacts as well as opportunities arise. As a senior engineering manager from one of these companies commented;

"I know we've lost two or three [people] to Boston Scientific...But I mean I don't see it as a bad thing, Boston Scientific guys come down here and they bring ideas about what they do and vice versa up there". (Senior Engineering Manager, MNC C)

The final mechanism by which knowledge transfers to the region from MNCs is through their collaborative involvement with the local university and its research centres. As previously noted Medtronic in the region is an official industry partner to REMEDI based at the local university. Indeed, all of the companies interviewed had formal or informal collaborations with the university that took various forms, such as the sponsorship of PhD and Masters students by firms, the analysis and testing of materials or the use of equipment and labs. Such contact between the university and the local firms enhances knowledge flow in the region.

In addition to local knowledge transfers manifested in the form of start-up firms, high-quality suppliers, skilled labour and university-industry collaborations, the presence of the foreign-owned MNCs was also found to create intangible effects. When asked about the region as a business location for medical technology firms, the interviewed managers from the smaller companies referred to the benefits of being part of a centre of activity that is driven by international players and therefore is internationally recognised. The senior R&D manager from one indigenous company commented;

“It’s [Galway] one of the centres in the world really for the medical device industry. You’ve got three of four of them, you’ve got the Galway-based, you have Minneapolis in the States, California.....I think, well....we’re [referring to the company itself] very much a relatively small player..., it’s such an international discipline really within the medical device industry that I think as long as you are based in some of these hubs you are not left out of the loop because you’ll always have contacts with Medtronic and some other of the larger companies”. (R&D Manager, Indigenous A)

One of the main advantages of being part of such a centre of activity is that international actors are drawn to the region and this facilitates local firms in establishing global linkages. A senior manager from one indigenous firm reported;

“I don’t think working with people abroad is a problem. Because Galway is kind of a centre for the medical device industry they [the suppliers] are actually over here a lot so they do visit every year or every second year, so you have the personal contact there as well” (R&D Manager, Indigenous A).

In addition, due to the high concentration of medical technology activity in the region, created particularly by the presence of world-leading MNCs in the field, a leading international tradeshow conference, MEDTEC (Medical Equipment Design & Technology Exhibitions & Conferences), has taken place as a regional event in Galway over the past number of years. The tradeshow and conference, which is also held in at least five other countries provides medical technology companies the opportunity to showcase their products and build new relationships. Many of the managers pointed to its value in “actually attracting companies to come in here”. (R&D Manager, MNC B). As a director from one indigenous company explained; “we use events like the local trade conference”. “...[it] helps us keep in touch with our customers...” (Finance Manager, Indigenous B).

Therefore, the presence of the world-leading MNCs in the region attracts international attention and builds a regional reputation that produces positive effects for the neighbouring

firms. The perception of the region as being a centre of activity for medical technology draws international actors to the region and facilitates firms in establishing global networks.

DISCUSSION AND CONCLUSIONS

It has been suggested in the literature that in order to capture external economies from FDI, such investment must enter existing clusters driven by indigenous firms (PHELPS, 2008; DE PROPRIIS and DRIFFIELD, 2006) and cluster policy should not be focused on generating new clusters through the FDI mechanism. However, the empirical research to support or refute this is limited. The purpose of this paper is to investigate how, if at all, inward foreign investment can instigate a clustering process when it is initially attracted to a region as a result of targeted public policy rather than the existence of local sectoral capabilities or a local market. The case study of the agglomeration in cardiovascular medical devices on the west coast of Ireland reveals that the establishment of foreign-owned MNCs in the region, particularly that of two internationally leading organisations which have created significant employment in the region, have resulted in the emergence of a medical technology cluster.

The presence of the foreign-owned MNCs has resulted in local knowledge transfers and regional reputation effects. Knowledge has transferred to the local economy from the foreign investors and is apparent in the emergence of start-up firms, the growth of a pool of skilled labour, labour mobility, the development of high quality suppliers and the development of industry-university research collaborations. In addition, the presence of significant product development and manufacturing facilities by two world-leading MNCs, Boston Scientific and Medtronic, both in the field of cardiology devices has resulted in reputational effects for the region. International attention is drawn to the region and global actors visit the cluster due to

the presence of the MNCs. Consequently, their presence facilitates local neighbouring firms in establishing their own linkages abroad and participating in global networks.

Overall, the research shows that FDI can instigate a clustering process. It contests the view that there are generally limited local spillovers in FDI-generated clusters (MARKUSEN 1996, DE PROPRIS and DRIFFIELD, 2006) and, contrary to other perspectives (PHELPS, 2008), it shows that external economies can be captured locally from FDI in such clusters. It also reveals that FDI can generate a clustering process that goes beyond vertical sub-contracting relationships as described by DE PROPRIS and DRIFFIELD (2006). Indeed, the case reveals that even without extensive trading linkages locally, a significant clustering effect can occur as indigenous firms in the same or related field of activity benefit from locating in the same region as the large foreign investors as it facilitates them in accessing and establishing global networks.

Given that it is foreign investors that are creating a clustering effect, it can be argued that the survival of the cluster depends on the continued presence of these investors in the region. At the same time, studies have shown that the cessation of a firm is also a source of knowledge dissemination in a region (PINCH AND HENRY, 1999; HENRY AND PINCH 2000). As a firm closes the knowledge is reconfigured by individuals moving to other companies or establishing new firms in the locality. There have been closures by MNCs in Galway, most notably Abbott in 2007, but as Figure 1 illustrates the number of medical technology companies in the region continued to rise.

In conclusion, in contesting PHELP's (2008) view the study shows that a cluster process can be generated by foreign investors and as external economies can be reaped locally it is worthwhile for policymakers to pursue the FDI mechanism for generating industrial clusters. The study reveals that this is particularly apparent in the case of a small, open economy such

as Ireland whereby the economy may be too limited to indigenously build a sector in which the country does not already have a comparative advantage. Under these circumstances the next phase of development for policymakers to focus attention on should be promoting the capacity and capabilities of the emerging indigenous base and to continue to attract additional FDI based on the need to tap into such local capabilities.

¹ The West of Ireland is defined here as a Regional Authority NUTS III area and covers three counties, namely, Galway, Mayo and Roscommon.

² A stent is defined as a device that is placed inside a blood vessel, which has been obstructed by a blockage, to keep the vessel open. Stenting is a minimally invasive surgical procedure. A drug-eluting stent is a medicated stent that slowly releases a drug to prevent the re-blocking of the artery.

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