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IRISH ICT CLUSTER

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***Summary:** Ireland has one of the highest concentrations of information and communications technology (ICT) activity and employment in the OECD. This activity comprises both electronics hardware manufacturing, such as PCs, and software products and services, especially business application products and 'localisation'. It has largely been driven by foreign direct investment (FDI), though recent evidence suggests that the indigenous software industry is now growing at a much faster rate than the multinational sector. It is also a major factor in high skill, high wage job creation since the early 1990s and comprises a key element of Ireland's 'national innovation system'. This paper identifies some potential areas for research on cluster development and innovation.*

Growth & trade performance

Over the last decade, Ireland has experienced the fastest growth rate of output and employment of any country in the OECD, with the number of jobs across the economy increasing by 42 per cent between 1990-99 (see Figure 1). While the services sector was the main source of this increase, manufacturing employment also grew rapidly, for the most part in high value adding, knowledge based activities (see Figure 2). The scale and composition of this growth have given rise to the term 'Celtic tiger', and initial doubts about its sustainability have been met with evidence of far-reaching cumulative structural change and adaptation.

Irish growth is essentially export led, with over 90 per cent of GDP sold abroad and an average increase in export volumes of more than 12 per cent a year during the 1990s. Ireland has consistently recorded a trade surplus over this period in excess of 10 per cent of GNP, primarily due to the impetus provided by a large, globalised and increasingly sophisticated ICT sector. Recent OECD data indicates that Ireland has the highest proportion of high technology industries represented in its manufacturing exports of all OECD countries (OECD 1999).

Electronics accounts for more than a third of Irish exports, with a third of the PCs sold in Europe manufactured in Ireland. In addition, Ireland is now the biggest exporter of software products in the world, having just overtaken the US. Over 40 per cent of packaged software and 60 per cent of business application software sold in Europe is produced in Ireland. International demand is the main factor in continuing export growth not only for multinational companies in Ireland but also for the indigenous software industry which exports almost 60 per cent of its output (Travers 1999).

Foreign direct investment

However, the key driver of Ireland's trade performance has been FDI, which accounts for two thirds of manufacturing output and over 80 per cent of manufacturing exports. In 1998, Ireland attracted FDI inflows of \$6.8 billion, which makes it one of only four countries in the OECD – along with Finland, Sweden and the Netherlands – where FDI amounts to more than 8 per cent of GDP. Moreover, with only 1 per cent of the EU population, Ireland gained 23 per cent of all FDI projects in Europe in 1997, covering manufacturing, software, teleservices and shared services projects.

In computer software, Ireland has the largest market share of FDI in Europe with 55 per cent of the total, more than twice the market share of the next most successful country (France at 21 per cent). Similarly, Ireland's market share of FDI in teleservices (over 28 per cent in 1994-97) and in shared services such as back office activities (37 per cent over 1996-97) is also the highest in Europe. In electronics, Ireland's market share is second only to the UK at around 22 per cent, and the gap is closing (see Figure 3). In the manufacturing sector too, Ireland's market share of FDI increased to 13 per cent of the total by 1997, behind the UK and France. 19 of the top 25 computer firms in the world have manufacturing operations in Ireland.

Cluster characteristics

Ireland's ICT activities were mainly characterised at the initial stages of development by manufacture and assembly of electronics hardware, but this is rapidly being overtaken by more complex integrated manufacturing and software operations, including those of the indigenous software industry as assembly operations relocate to low labour cost countries. During the 1990s, indigenous firms achieved growth rates of 11 per cent a year for employment, 25 per cent a year for the value of sales and almost 40 per cent a year for the value of exports. While the electronics sector continues to be dominated by large multinational companies, employment in software products and services is more evenly divided between overseas and indigenous companies, mainly SMEs.

Most of the software multinationals in Ireland are packaged software or product companies selling to mass markets, though the growing emphasis on localisation requires a higher level of software engineering skills and is more reliant on outsourcing and indigenous supply chains, including translation, fulfilment, packaging, manual printing, transport and technical support (see Figure 4). Irish public policy has recognised that 'the full benefit of the presence of foreign production firms depends on the extent to which they can be integrated into their environment. Such relationships are not only beneficial for local suppliers that benefit from technology transfer... Foreign firms will be anchored to the regional economy,

merging local and global interests, and making sudden divestiture less likely than before' (OECD 1998a).

As a result, indigenous software producers tend to be more specialised in terms of both types of products and types of customers. According to a recent survey, half or more of the sales of about a third of these firms go to the Irish subsidiaries of multinationals (O' Gorman 1997). However, a further third have little or no linkage with the multinational sector and have targeted niche markets both locally and globally. Indigenous firms also provide software services such as programme development, consultancy and technical training, which tends in many case to lead to the development of new software products. Irish software start-ups, particularly Iona Technology, Smartforce, Baltimore Technology and Riverdeep, have contributed to the 'critical mass' achieved by the industry, but they have now been joined by an array of dynamic new operators such as Datalex, Flexicom, Piercom, Managed Solutions Corporation and Peregrine Systems.

Geographical concentration

While manufacturing employment in general is widely dispersed in Ireland, the software industry is concentrated largely in the Dublin area, with smaller regional clusters in Cork, Limerick/Shannon and Galway (see Figure 5). The cluster dynamic is supplied in each case by a mix of inter-firm collaboration, interaction and rivalry, by the development and constant replenishment of common pools of skilled labour, by the localised support of research and educational institutions and by the strategies of national and regional development agencies.

This dynamic broadly follows the pattern identified by previous OECD research which found that 'industrial clusters with links to local and regional innovation networks have been associated with accelerated diffusion of technology and know-how. The pace at which technologies are diffused within national innovation systems depends on the country's industrial structure and technological specialisation, institutional set-up, corporate governance regimes, degree of economic openness and the flexibility of firms' organisational and managerial structures' (OECD 1997). In order to test this observation further, the research proposed here will include a detailed case study of the Galway ICT cluster.

Research & development

Despite Ireland's strong ICT export performance, its dependence on FDI has also been associated with the use of imported rather than locally generated technologies. This is reflected in the very large deficit in Ireland's 'technology balance of payments', which measures flows in knowledge and 'disembodied' technologies between countries (see Figure 6). It is compounded by Ireland's comparatively low R & D intensity, as indicated by its low level of business expenditure on R & D as a proportion of GDP (at 1.5 per cent). It has only been with the growth of the indigenous software industry that this problem is being addressed. R & D business expenditure as a proportion of GDP has more than doubled over the past decade with indigenous software companies allocating more than 10 per cent of the value of sales in 1995 (National Software Directorate 1996), and almost 20 per cent among those companies that actually performed R & D.

The increased emphasis on R & D is supported by a substantial influx of third level graduates into the ICT sector, most with qualifications in computer science and engineering, and a huge expansion of Government research funding as part of the National Development Plan 2000-2006. The Government's Research, Technological Development and Innovation (RTDI) strategy is based on the recognition that 'there is a strong link between investment in the research and innovation base of the economy and sustained economic growth... [T]he accumulation of "knowledge capital"... will facilitate the evolution of the "knowledge-based" economy' (para 6.35). Its objectives are to:

- develop intellectual infrastructure to 'root' overseas companies here through more extensive use of research based in Ireland,
- persuade and encourage companies to develop their own research activities,
- develop a world class research environment in our higher education institutions and State research institutions, and
- ensure a vibrant and dynamic pool of high quality, technically literate graduates from the graduate to postdoctoral levels to service the needs of these companies and to start their own companies (para 6.35).

Policy structures

The evolution of Ireland's ICT sector has been driven not only by market conditions but by the conscious design and delivery of public policy over a number of decades in the context of EU membership and, more recently, social partnership (O' Donnell 2000). This has comprised measures to attract knowledge intensive FDI through IDA Ireland, support for indigenous companies and networks through Enterprise Ireland, promotion of education and training at all levels, especially universities and technical colleges, development of a sophisticated telecommunications infrastructure, increased funding support for research in third level institutions and strengthened linkages between companies and the education sector.

Ireland's human resource base has been a key factor in the creation of competitive advantage for its ICT industries. In the most recent IMD World Competitiveness Report (1998), Ireland was ranked first in the world for the 'fit' between its educational system and the needs of a competitive economy (see Figure 7). Certainly, Ireland's economic transformation is evidence that 'past national strategies for investing in education and training have paid off in terms of faster productivity growth and higher levels of productivity at the aggregate level, and higher earnings and employability at the individual level' (OECD 1998b).

However, the experience of the Irish ICT cluster seems to demonstrate that skills and training are a necessary but not sufficient condition for success in global markets. There is also a role for targeted, flexible industry policies in the context of an active partnership with unions, business and the community. The role for the Government in this context has been characterised as the 'Flexible Developmental State', which is 'defined by its ability to nurture Post-Fordist networks of production and innovation, attract international investment and link these local and global technology and business networks together in ways which promote development (O' Riain 1999).

Further research will clarify those aspects of policy which are unique to Ireland and those that may have more universal application.

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