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The knowledge spillover theory of entrepreneurship and foreign direct investment

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THE KNOWLEDGE SPILLOVER THEORY OF ENTREPRENEURSHIP AND FOREIGN DIRECT INVESTMENT

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Abstract

We explore if the Knowledge Spillover Theory of Entrepreneurship, applied to FDI, provides at least a partial explanation for the greater emergence of recent knowledge-based entrepreneurship in Ireland compared with Wales. In order to examine how FDI and entrepreneurship policy in these two regions might have influenced the levels of knowledge-based entrepreneurship, we outline FDI and entrepreneurship policies for Wales and Ireland and key measures of knowledge creation, and evaluate the extent and nature of FDI activity and its relationship with entrepreneurship in general and knowledge-based entrepreneurship in particular. Implications include possible policy directions for countries that are characterized by weak knowledge-creating institutions yet wish to encourage knowledge-based entrepreneurship.

JEL-classification: J24, L26, M13, 03

Keywords: Economic Development, Entrepreneurship, Foreign Direct Investment, Ireland, Knowledge Spillovers, Wales

Note: The paper's authors are listed in alphabetical order

INTRODUCTION

According to the knowledge spillover theory of entrepreneurship, low levels of knowledge-based entrepreneurship might result from two factors: (1) failure of private firms and public institutions to generate new knowledge; and (2) failure of individuals to exploit that new knowledge. First, the absence of an indigenous industry base and/or the absence of domestic knowledge-creating institutions, such as public research institutes, might militate against the emergence of knowledge-based entrepreneurship. Second, according to the knowledge spillover theory of entrepreneurship, individuals may fail to commercialise new knowledge via entrepreneurship. Individuals with new knowledge might under invest in commercialization activity as they do not see the benefits, or fail in their attempts to commercialize, due to a lack of market knowledge. Those individuals or organizations with market knowledge or other resources may not be aware of the new knowledge, and therefore fail to invest, or under-invest, in the knowledge or in new firms (ACS *et al*., 2006).

There are a variety of possible policy responses to these two problems. In terms of the absence of domestic knowledge-creating capacity, policy makers might seek to attract inward foreign direct investment (FDI). FDI enables the transfer of intangibles to another country and also makes knowledge spillovers possible and therefore may play a role in industrial development and entrepreneurship. In today's global knowledge economy, firms are interested in operating in countries in which they can take advantage of strategic assets, especially intangibles such as information and human capital. Internalization theory describes how local firms' knowledge of laws and relationships with local players provide 'home court advantages'. Foreign firms must therefore leverage special advantages, often information-based intangibles, in order to compete in these markets (MORCK and YEUNG, 1992). During the course of these FDI activities, there is a transfer of technology and intangibles to the host country that involves people and machinery, and some of this knowledge spills over.

As different types of FDI enable different levels of knowledge spillovers, we expect that entrepreneurial activity will be more pervasive in sectors where entrepreneurs are exploiting opportunities relating to MNE economic activity (ACS and VARGA, 2005). We argue that the emergence of knowledge-based entrepreneurship can, at least in part, be understood in terms of how regional public policy supports the creation and exploitation of knowledge through a combination of FDI and entrepreneurship policy. Given COOKE *et al*.'s (2003) finding that more successful core regions tend to have 'entrepreneurial' innovation systems, whilst less successful peripheral regions have 'institutional' ones (COOKE *et al*., 2003), this may highlight, for example, that the nature of entrepreneurship policy and the extent of its integration with FDI policy influences the emergence of knowledge-based entrepreneurship.

In a previous paper, ACS *et al.* (2007) examined the relationship between entrepreneurship and foreign direct investment in developed and developing countries. The purpose of this paper is to extend this research to examine if The Knowledge Spillover Theory of Entrepreneurship applied to FDI can provide an explanation (or at least part of it) for differences in the levels and nature of knowledge-based entrepreneurship in Ireland compared with Wales. As the emergence of knowledge-based entrepreneurship is influenced by many factors and as there may be a significant time lag between policy choices and the influence on entrepreneurship, we choose the case method as the most appropriate method for our study. We present Ireland and Wales as case studies, which we then compare.

Ireland and Wales offer a 'natural experiment' for exploring the impact of policy on the emergence of knowledge-based entrepreneurship. Both are similar in that they have traditionally been seen as relatively small, peripheral economies. Ireland has a population of approximately four million in Ireland and three million live in Wales. Both economies share a long history of FDI attraction and an absence of a strong indigenous industry and general R&D base. Both Ireland and Wales spend only around 1.1% of their GDP on R&D, compared with an OECD average of 2.25% (OECD, 2006a), as illustrated in Table 1.

However, the two countries today differ significantly in terms of economic performance, with Ireland often described as the "Celtic Tiger" [1], whilst Wales' relative GDP per head has dropped steadily over the last 20 years.

* Insert Table 1 about here *

The cases are structured around the basic hypothesis that the knowledge spillover theory of entrepreneurship as it relates to FDI might explain levels of knowledge-based entrepreneurship. In collecting case material we focused on the following issues: What has been the evolution of Irish and Welsh FDI and entrepreneurship polices in general, and those related to the knowledge-spillover theory in particular? How do they then differ in terms of the nature and extent of FDI and entrepreneurial activities? To what extent might the knowledge-spillover theory provide at least a partial explanation for this? We use secondary data sources to describe the nature of FDI activity, and the policies pursued around FDI and knowledge-based entrepreneurship. We use secondary and Global Entrepreneurship Monitor (GEM) data to identify broad relationships between FDI and entrepreneurship both generally and specifically as related to knowledge-based outcomes. GEM data is then used specifically to undertake more in-depth analysis of the levels of knowledge-based entrepreneurship in Ireland and Wales and make a comparison by sector, age, sex, education level, export and growth focus. GEM survey data is drawn from population samples for 2003-2006 in Wales and Ireland estimating the prevalence rates of nascent and new businesses. A standardized telephone survey was conducted of a representative sample of adults, including 6,779 in Ireland and 20,121 in Wales. The survey provides a broad array of information related to individuals' demographics, perceptions of the country environment for entrepreneurship, attitudes and awareness of entrepreneurship and the self-reporting of involvement in entrepreneurial activities. (See Reynolds et al., 2005 for a review of GEM methodology and approach.). To estimate levels of knowledge-intensive entrepreneurship, we utilize two measures drawn from the EUROPEAN COMMISSION (2006).

The rest of the paper is organized as follows. First, we articulate why the knowledge spillover theory of entrepreneurship might explain variations in the levels of knowledge-based entrepreneurship both generally, and more specifically as this relates to FDI. This is followed by a brief review of FDI and entrepreneurship development policies in Ireland and Wales. We then discuss Ireland and Wales in terms of (i) inward FDI, and (ii) entrepreneurship outcomes seeking to explore variations in the nature and extent of FDI and knowledge-based entrepreneurship, comparing entrepreneurs in general and exploring the profile of knowledge-based entrepreneurs in particular. For each country, we examine factors such as age, sex, education levels, and export and growth focus. We then discuss the different links between policy and effect in Wales and Ireland. We conclude with possible policy directions for countries that are characterized by weak knowledge-creating institutions but wish to encourage knowledge-based entrepreneurship.

KNOWLEDGE SPILLOVER THEORY OF ENTREPRENEURSHIP AND ITS RELATIONSHIP WITH FDI

The Knowledge Spillover Theory of Entrepreneurship relaxes two central (and unrealistic) assumptions of ROMER's (1990) endogenous growth model. The first is that knowledge is automatically equated with economic knowledge. In fact as ARROW (1962) emphasized, knowledge is inherently different from the traditional factors of production, resulting in a gap between knowledge (K) and what he termed economic knowledge (K^c). The second involves the assumed spillover of knowledge. The existence of the factor of knowledge is equated with its automatic spillover, yielding endogenous growth. In the Knowledge Spillover Theory of Entrepreneurship, *institutions* impose a gap between new knowledge and economic knowledge ($0< K^c /K<1$) and results in a lower level of knowledge spillovers (ACEMOGLU *et al.*, 2004).

The degree to which economic agents recognize entrepreneurial opportunities emanating from knowledge spillovers and the decision to commercialize them through the startup of a new firm is captured by the equation reflecting entrepreneurial choice,

(1) $E = \gamma(\pi^* - w)$

where E reflects the decision to become an entrepreneur (generally stated in terms of probabilities), π^* is the profits expected to be earned from entering into entrepreneurship, w is the wage that would be earned from employment in an incumbent enterprise and γ represents all other variables that influence entrepreneurship (EVANS and JOVANOVIC, 1989).

Since the expected profit opportunities accruing from entrepreneurship are the result of knowledge not commercialized by the incumbent firms, entrepreneurial opportunities will be shaped by the magnitude of new knowledge but constrained by the commercialization capabilities of incumbent firms. Knowledge opportunities can be expressed as K^θ, where K is the aggregate stock of knowledge and θ $(0 < \theta < 1)$ refers to the share of knowledge not exploited by incumbents,

(2) $E = \gamma(\pi^*(K^\theta) - w)$.

The opportunity space for potential entrepreneurs is thus dependent on the efficiency of incumbents in exploiting new knowledge who are assumed incapable of fully exhausting the opportunities provided by new knowledge.

Equation (2) implicitly assumes away any institutional or individual barriers to entrepreneurship. Yet, as a rich literature suggests (PARKER, 2004), there is a compelling array of financial, institutional, and individual barriers to entrepreneurship, which result in a modification of the entrepreneurial choice equation,

(3) $E = \gamma \ (\pi^*(K^\theta) - w)/\beta$

where β represents those institutional and individual barriers to entrepreneurship, spanning factors such as financing constraints, risk aversion, legal restrictions, bureaucratic and red tape constraints, labor market rigidities, lack of social acceptance, etc. While we do not explicitly specify these specific entrepreneurial barriers, we note that they span a broad spectrum of institutional and individual characteristics which, when taken together, constitute barriers to entrepreneurship. The existence of such barriers, i.e., a high value of β, explains why economic agents would choose not to enter into entrepreneurship, even when confronted with knowledge that would otherwise generate a potentially profitable opportunity. Based on this simple model originating in standard assumptions applied in microeconomics, we present the following two propositions:

Proposition 1: An increase in the stock of knowledge has a positive effect on the degree of entrepreneurship. The extent of the impact is however determined by the efficiency of incumbents to exploit knowledge: the more efficient incumbents are, the smaller is θ and the smaller the effect of new knowledge on entrepreneurship.

Proposition 2: Entrepreneurial activities are decreasing in higher regulations, administrative barriers and governmental market intervention.

How can this model be applied to FDI? First, FDI directed at export will embody the latest technology and be the most valuable. Domestic R&D might lag in its commercial ability. There are several differences with knowledge coming through FDI. The first difference is that if knowledge comes from FDI the difference between ($0< K^c/K<1$) for domestic knowledge investment, then for FDI that is already focused on production K^c/K should be equal to unity since all of the knowledge will be exploited by the new investment. If all knowledge is exploited, no knowledge will be left over to be exploited by entrepreneurs. FDI to generate knowledge spillovers needs to create a gap between K^c/K or θ needs to be greater than zero. One way to create a gap between K^c/K is to have FDI invest in R&D facilities that produces knowledge that might not be commercialized. A second approach is to increase domestic R&D

(K) in such a way as to produce a wedge between K^c/K. The gap between K^c/K creates the opportunities for generating knowledge spillovers that might lead to entrepreneurial startups. The next section examines how Ireland and Wales pursued such a strategy.

EVOLUTION OF FDI AND ENTREPRENEURSHIP POLICIES

Ireland: FDI and Entrepreneurship Development Policy

Ireland's recent economic success, earning it the label 'Celtic Tiger' was partially the result of four decades of pursuing an export-led industrial policy that relied on attracting inward FDI**.** Ireland is a world leader in "high-tech" business activity, with 46.5 percent of value-added in manufacturing from high technology companies (OECD, 1998), compared with 10% for the European Union and 16.4% for the United States. Ireland first started attracting export-oriented FDI inflows with the introduction, in the mid-1950s, of a fifteen year 'tax holiday' on profits from export sales[2]. At the time the Irish government funded the state development agency's programs that built 'advanced factories' (purpose built factory accommodation for overseas firms) and provided generous capital grants to foreign firms. Such initiatives, aided by Ireland's entry into the European Economic Community in 1973, led to significant success in attracting inward FDI during the period from 1973 to 1980 (RUANE and GÖRG, 1996). However the oil shocks of the 1970s and ensuing global recession forced many foreign firms to close their operations in Ireland. In particular, labour-intensive firms involved in sectors such as man-made fibres, textiles, clothing and footwear determined that Ireland was no longer an attractive location (ACS *et al*., 2007).

In response, Ireland's Industrial Development Authority (IDA) developed new policies that targeted 'flagship' emerging high technology sectors such as electronics, computer software, biotechnology and

healthcare. Often, the IDA focused on relatively young firms in these new key sectors. The Irish government subsequently extended incentives to cover firms engaged in internationally traded services (e.g. financial services, call centres). Reflecting the nature of such activities and the policy objective of generating employment, firms received employment grants as well as capital grants (that is, payments per job created). In addition, a broad range of policy tools such as training grants, subsidized rents, technology transfer grants and low interest loans were used by the IDA to tailor packages that would be attractive to specific firm needs (MURPHY and RUANE, 2004). The Irish government also sought to increase the flow of trained graduates to industry by creating new National Institutes of Higher Education (tertiary colleges with a focus on vocational skills). From the 1990s, the number of firms investing in Ireland increased significantly. In particular, there was a tremendous growth in the scale of FDI inflows from the US, and a growing proportion of FDI was directed to ICT sectors.

Ireland's success at attracting FDI also broadly reflects government commitment to the policy objective, government policy initiatives and instruments, and the IDA's extensive efforts. These policies evolved over time, as has the rationale for why firms elected to establish operations in Ireland (BEGLEY *et al.*, 2005). The key reasons why firms have chosen to locate in Ireland more recently include the following: low corporate tax regime, access to capital and employment grants, IDA lobbying, a pro-business regulatory environment and government, 'demonstration effects' and the availability, at a low cost, of a young, English-speaking, educated and trained workforce. Reviewing the effectiveness of policies aimed at attracting FDI, MURPHY and RUANE (2004:135) argue that three factors partly explain Ireland's success: (a) the emergence of self-sustaining clusters in area such as software, electronics, pharmaceuticals and financial services that resulted from the targeted approach of the IDA and efforts to build vertical linkages; (b) the extension of incentives to include internationally traded services; and (c) the emergence of a pro-FDI reputation, that reflects the consistency and pro-active nature of Irish government policies towards FDI.

In addition to attracting inward FDI, however, Irish industrial policy has also sought to support export-oriented indigenous firms, including new enterprises, highlighting a consistent focus for FDI and entrepreneurship policies conducted simultaneously. While the differences between foreign and indigenous firms have persisted, there is evidence that the performance of indigenous manufacturing firms has improved. Today's indigenous manufacturing firms, for example, are more export-oriented and profitable than those operating before 1987 (O'MALLEY, 2004). Industrial policy focused assistance on established and new manufacturing firms, which had potential to either export or to substitute for an imported product. As such Irish entrepreneurship policy focused on a narrow range of 'high potential start-up' ventures, mainly manufacturing firms with export potential and 'internationally traded services' businesses. The range of measures used to assist established and new manufacturing firms includes preferential corporate tax[3] and capital and employment grants. For example, as long ago as 1978, the IDA initiated the Enterprise Development Programme (EDP) that targeted managers, professionals (engineers and accountants) and academics to start businesses with high growth potential. Often the new EDP ventures supplied to foreign-owned firms or import substitution businesses. EDP entrepreneurs received extensive state assistance in terms of loan guarantees and 'soft supports'. Over the twenty years the EDP operated, about 350 businesses received state assistance, across sectors such as machinery/tool making/computers, electrical and electronics, food, instruments and medical devices and internationally traded services. The IDA also operated a 'Linkages Programme', under which it actively sought to encourage established and new firms to exploit sub-supply opportunities with foreign firms. This programme enjoyed moderate success in some sectors, such as electronics, although the nature of foreign firm activity required that a significant proportion of exports consist of components sourced from outside Ireland.

Current supports for entrepreneurial activity are also focused on a small number of new start-ups engaged in manufacturing or internationally traded services (for example software firms) and are delivered by Enterprise Ireland, the sister organization of IDA[4]. Enterprise Ireland provided assistance to

54 high potential start-ups (HPSUs) in 2002 and 65 HPSUs in 2004. Policy interventions by Enterprise Ireland have evolved to include initiatives aimed at stimulating venture capital investments (by part investing in venture capital funds) and funding university and institute incubators. In addition, regional County Enterprise Boards were introduced to support and promote entrepreneurial activity in a broader range of sectors, although they also act as the 'seed' development stage for future Enterprise Ireland clients.

Wales: FDI and Entrepreneurship Development Policy

Historically the Welsh economy has been biased towards the heavy industries of coal and steel. The decline of these industries in the 1970s and 1980s led to high unemployment levels in Wales in the 1980s (NATIONAL AUDIT OFFICE, 1990). The Welsh Office and Welsh Development Agency (WDA) therefore placed great importance on tackling unemployment and creating and safeguarding jobs in Wales. One way of achieving this was attracting inward FDI. During the 1980s the WDA was successful at attracting inward FDI, with Wales securing a disproportionate percentage of inward FDI into the UK. The WDA was particularly successful at attracting FDI in the electronics, automotive equipment and transport equipment sectors.

In pursuing this policy, Wales accessed UK government schemes such as the Regional Development Grant (RDG) and Regional Selective Assistance (RSA) programmes, and more recently to significant EU funds, between 1990 and 1997 receiving £890m in Regional Preferential Assistance (RPA) to industry, a third of the UK total and a quarter of UK RSA spending (BROOKSBANK *et al.*, 2001). Unsurprisingly, research focused on the association among these relatively high levels of RPA to industry in Wales, infrastructure development and the disproportionately high share of inward investment that the region has received (HILL and MUNDAY, 1992; JONES 1996). More specifically the reasons for the WDA's success at attracting inward FDI include the presence of the following: grant-assisted areas close to the

rich markets of the South East of England, a plentiful, and cheap, source of semi-skilled labour, and good road infrastructure (MUNDAY and ROBERTS, 2001). In 1998 there was a change in focus with the Department of Trade and Industry (DTI, 1998) stating that the RSAs would now focus support on high quality, knowledge-based projects that provided skilled jobs. However there is evidence to suggest that, following these changes, the key reasons for foreign re-investment were still predominantly linked to labour skills and costs and government assistance, with only a minor role for local suppliers, partnerships and training, and virtually no impact from local technology transfer activities or links with local research institutions (PHELPS *et al.*, 2003).

Since 1998, the Welsh policy focus has shifted from attracting FDI and towards indigenous firm growth. This coincided with a fall in FDI flows, political devolution, European Union Objective One funding for two-thirds of Wales and a New Economic Development Strategy (NEDS) for Wales including for the first time, an Entrepreneurship Action Plan. The enterprise policy focussed on the growth of small Welsh businesses and raising entrepreneurship in general, rather than on a more specific policy related to knowledge-based entrepreneurship (ENTREPRENEURSHIP ACTION PLAN, 2000). Explicit aims were to (1) create an entrepreneurial culture where more people recognise business opportunities and are motivated and skilled to convert these ideas into action; (2) improve the quality, accessibility and relevance of advice and training infrastructure; (3) commit to entrepreneurship by the public sector by supporting small businesses and creating opportunities for local businesses; and (4) develop an effective implementation plan that cuts across traditional functional boundaries and involves a wide range of organisations.

Wales' focus on knowledge-related sectors has been largely indirect, or relatively modest, with much greater attention given to general entrepreneurship and promotion activities, as well as specific policies aimed at increasing entrepreneurship amongst under-represented groups, such as females. Recent policies on entrepreneurship in high growth businesses offered £15M to support 200 firms through the

Entrepreneurship Action plan. The Knowledge Bank for Wales provided an additional £14M to support high growth potential firms (WELSH ASSEMBLY GOVERNMENT, 2005), though many of those assisted initially were larger established firms. Where specific knowledge-related activities have been promoted, these tend to focus more on higher education than on FDI. Technium incubators provide an arena for indigenous SMEs, multinationals and higher education to collaborate and network, though their effectiveness has been questioned by some (e.g. COOKE, 2003), due to the shortage of academic entrepreneurs relative to the number of new businesses.

FDI, AND ENTREPRENEURSHIP OUTCOMES

Both countries have also been relatively successful in attracting inward FDI over the past several decades. FDI inflows in Ireland and Wales for the period 1993-2002, for example, were US$97.2 billion and US$38.8 billion respectively. The Welsh figure represents approximately 8% of inflows into the UK. Relative to OECD countries, this places Ireland 12th of 30 countries. While the UK ranks third, inflows into Wales would rank Wales as 20th. However, as highlighted earlier, there are important differences between Ireland and Wales in terms of recent general economic performance. After 1997, for example, FDI inflows to Ireland increased significantly while in Wales, FDI inflows declined (see JONES and WREN, 2002; COOKE, 2003).

Since the 1970s there has been a significant change in the sectors representation of firms locating in Ireland (Figure 1). Within manufacturing activities there has been a shift away from low-tech sectors to high-tech sectors. This shift has been continual since the early 1970s. In 1974, 65% of employment in foreign firms was in low-tech sectors, 23% in medium-tech sectors and 12% in high-tech sectors. By 1999, low-tech had declined to 24%, medium-tech had declined to 20% and high-tech had increased from 12% to 56%. So by the end of the 1990s, over half of all foreign industry was in high-tech sectors (office

and computing machinery; professional instruments; pharmaceuticals; communications equipment; electrical apparatus; and aircraft), with about a quarter in each of medium-tech and low-tech sectors.

* Insert Figure 1 about here *

In addition to a shift from low technology to high-tech manufacturing activities there was an increase in the importance of the internationally traded service sectors during the 1990s. Employment in internationally traded services sectors (by Irish and foreign owned) increased from just under 16,000 in 1993 to just over 68,000 in 2000, and increase of 23.3% p.a. (in the same period manufacturing employment grew from 219,000 to 281,000, or 3.6% p.a.) (NATIONAL ECONOMIC AND SOCIAL COUNCIL, 2003). The direct contribution of foreign-owned multinationals in the internationally trading sectors accounted for approximately 16 per cent of total employment growth for this period.

In Ireland in 2004, there were slightly over one thousand international corporations employing 129,000 staff. Annual output for 2002 from foreign-owned companies amounted to €69B, of which €65B (or nearly 95%) was exported. Of the one thousand foreign firms with some operations in Ireland, 46% are headquartered in the US and account for 75% of all exports from foreign-owned Irish subsidiaries and 69% of employment in foreign-owned Irish subsidiaries[5]. Wales, with just 5% of the UK population, attracted a disproportionate percentage of UK-bound FDI. JONES and WREN's (2002) data suggests that this rate fell over the 1990s from nearly 13% in 1989 to 6.1% in 1999. Approximately 40% of the foreign investors supported by grant aid in the 1990s were from the US, followed by significant inward investment from the rest of Europe and Japan (BROOKSBANK and PICKERNELL, 2001; PHELPS *et al.*, 2003). In terms of direct employment, the WELSH OFFICE (1997) indicated that foreign firms employed around 75,000 in manufacturing, over a third of the total manufacturing workforce.

* Insert Table 2 about here *

The two countries also differ in terms of the nature of FDI. Table 2 classifies FDI by sector of activity. Sectors with higher levels of FDI in Ireland compared to Wales include chemicals, machinery and equipment, and services generally, with a clear concentration in Ireland on transport, communications and financial services. Sectors where inward FDI is more important in Wales than Ireland include timber-based industries, electronics and motor vehicles. In Wales, there is a concentration of FDI in electronics (39.6%), as well as automotive and transport equipment (15.7%). There are also relatively large amounts of Welsh grant aid focused on the automotive component and electronics sectors (these sectors account for 43% of all employment in foreign firms). However, it could be argued that, very broadly, both countries have enjoyed significant FDI in "knowledge-based" sectors, such as chemicals, machinery, electronics, transport equipment and business services (67.8% in Ireland versus 70.8% in Wales).

In Wales, however, there is a relative paucity of higher-level functions in industries populated by foreign firms. ROBERTS (1996) found in Wales almost 77% of employees in foreign firms were operatives or assembly workers, compared to the UK FDI average of 60% (CSO, 1992). Given that 48% of the Welsh workforce were in manual occupations at the time when FDI was at its height (Regional Trends, 1996), it is clear that FDI in Wales was not relatively concentrated in the higher paid non-manual occupations as a result of FDI. MORGAN (1991) also concluded that Wales was particularly afflicted by the "branch plant" economy model in electronics due to the lack of R&D carried out by inward investors in Wales. Multinationals based in Wales were able to spatially separate assembly from higher level functions such as R&D.

Furthermore, there are relatively low levels of R&D activity among foreign firms in Wales. For example, in terms of the automotive component sector, CLIFTON *et al.*'s (2000) survey of Welsh first tier automotive suppliers reported that 23% of UK firms, and 40% of non-UK firms do not locate R&D activities in Wales. Another study reports that fifty-two percent of firms conduct some research, design and development activity on site, though the predominant focus is routine activities such as product

testing and adaptation (PHELPS *et al.*, 2003). Higher level R&D tended to emerge from the parent company or other international sources, with only 2-4% developed with local linkages (e.g. universities, research institutions, innovative SMEs) (PHELPS *et al*., 2003).

While there are on-going concerns in both Ireland and Wales about the embeddedness of foreign firms, presence of strategic functions, and closure and relocation of firms to lower cost locations, it is evident that the two regions attracted different FDI profiles. It is perhaps unsurprising, therefore, that comparing the nature of early stage entrepreneurial activity (ESE) to the nature of FDI for Ireland and Wales suggests that there may be links between FDI and subsequent entrepreneurial activity (Table 3) which differ between the two countries This seems particularly the case for the industries classed as knowledge-intensive (Eurostat definition) which are found predominantly in manufacture of equipment, electrical goods, vehicles, other manufacturing, transport and storage and business services. In these areas Ireland and Wales both have concentrations of FDI activity (59.5% and 60.5% respectively). In Wales, however, FDI is concentrated in manufacturing, whereas the early stage entrepreneurship has been in services. In Ireland there has been a closer relationship between the location of knowledge-intensive-related FDI and early-stage entrepreneurial activity. This is particularly true for high technology, knowledge-based entrepreneurship (both manufacturing and services), as is also shown in table 3.

There are also important differences in perceptions of entrepreneurial activity in Ireland and Wales, as illustrated in Table 3. Differences in policy towards FDI as it relates to the knowledge-based spillover theory of entrepreneurship may be at least partly related to this, because of the higher status attached to the extent, nature and outcomes of entrepreneurial activities that result from knowledge-based as opposed to non-knowledge-based activities.

* Insert Table 3 about here *

GEM data from 2003-2006 also indicates clear differences in terms of both the levels and natures of entrepreneurial activity generally and specifically those related to knowledge-based activities. Total Early Stage Entrepreneurial Activity, for example, is 8.2% for Ireland and 5.7% for Wales (Table 4).

We also find differences in the level of knowledge-based entrepreneurship in Ireland and Wales. The rate of High-Technology Knowledge-intensive Early Stage Entrepreneurship averages 0.9% in Ireland, compared to 0.3% in Wales. That is, in Ireland the rate is three times higher than the rate reported for Wales. The difference is smaller when we use the broader classification of Knowledge-Intensive Early Stage Entrepreneurship, with Ireland reporting a rate of 3.2%, compared to 2.6% in Wales. In terms of new firm activity, there is a larger difference between Ireland and Wales for the High and Medium Technology Manufacturing: 3.1% in Ireland compared to 0.6% in Wales.

* Insert Table 4 about here *

Exploring the characteristics of entrepreneurs in Ireland and Wales, we identify a number of important differences. These differences also apply to entrepreneurs in Ireland and Wales in general and also specifically to knowledge-based entrepreneurs. Irish knowledge-based entrepreneurs are younger; more likely to be male, which might reflect the policy focus on raising female entrepreneurship in Wales; more educated than those in Wales (combining post secondary and post graduate categories), more growth-oriented ; and more export-oriented.

* Insert Table 5 about here *

DISCUSSION

The results above suggest that the different policy foci in Ireland and Wales can provide at least a partial explanation for the differences in knowledge-intensive entrepreneurship, in terms of both its size and scope. The different entrepreneurial populations we identified may, for example, relate to policy foci in the two countries. The differences in profile (age, education, gender, growth, and exports) may reflect the much earlier and coordinated focus in Ireland on education, growth and export-based entrepreneurship, and linking to FDI and other knowledge-creating mechanisms. In Ireland there has been a concerted, consistent and simultaneous focus in both FDI and entrepreneurship development in complementary areas over the last two decades, related to export-led and knowledge-intensive sectors. Irish entrepreneurship policy focuses more narrowly on 'high potential start-ups'. Irish entrepreneurs who received support tended to be well-educated and starting businesses in knowledge-based sectors such as software. Ireland's science and technology development policy specifically includes an integration of high-technology foreign firms into the economy, with development of high-technology indigenous firms, through attraction of high-level foreign firms functions, but also developing the innovation capability of indigenous firms to access, assimilate, absorb and adapt new technologies (JONES-EVANS, 2002).

In contrast, JONES-EVANS (2002) criticizes the lack of such a coherent science and technology policy for Wales. Instead, Wales targeted raising entrepreneurship levels more generally following the FDI-attraction focus of the 1980s and 1990s. Wales, unlike Ireland, did not pursue a linked and simultaneous strategy of FDI and entrepreneurship. Rather, until the late 1990s, Wales focused on FDI which assisted in the development of a regional innovation system (COOKE, 2003). Wales' attention to entrepreneurship emerged more recently and there have been comparatively few attempts to link the two until relatively recently. There were many issues over resources. In Wales, the resources obtained by FDI on an ongoing basis raised an opportunity cost issue for entrepreneurship policy resources (BROOKSBANK and PICKERNELL, 2001). COOKE (2003) also concludes that the Welsh Assembly

Government's attempts to grapple with re-tracking the Welsh regional innovation system without large scale FDI attraction failed to foster entrepreneurship and innovation because of risk aversion, tight central control of budgets, and enterprise and innovation support instruments designed for public rather than private benefit. Welsh entrepreneurship priorities were also broader, with a focus on overall entrepreneurial activity and ultimately less policy resource on high-growth early stage entrepreneurship than originally planned.

While the effects of knowledge spillovers from MNEs into the local economy can be difficult to analyse specifically, GRÖG and STROBL (2002) demonstrate that the presence of MNEs has a positive effect on the entry of indigenous manufacturing firms in Ireland. They conclude that this effect reflects both the presence of MNEs in the same industry and the presence of MNEs in downstream industries. There is a positive indirect employment effect of MNEs on locally-based suppliers, including both indigenous and foreign-owned suppliers, in the Irish electronics sector (GRÖG and RUANE, 2001). Furthermore, of the 270 new high potential start-ups that received assistance from Enterprise Ireland between 1999 and 2003, eighty-eight (33%) were started by entrepreneurs whose immediate prior place of employment was a foreign multinational firm in Ireland; while twenty-seven (10%) were started by entrepreneurs leaving universities and institutes. In particular, the presence of MNEs seems to have stimulated indigenous investment and new companies in the same industries, but in different product categories. Foreign firms significantly and positively influence the emergence of strong competitive advantage in indigenous firms (O'MALLEY and O'GORMAN, 2001). These benefits include the development of a skilled workforce, access to market opportunities and, in particular, export markets. Indigenous firms also benefit from investments in the tertiary education system that sought to produce graduates with skills suitable to attracting FDI (ACS *et al.*, 2007). In addition, 'on the job' learning in MNEs in a broad range of sectors is important in developing the skills of the indigenous firms' workforce. Also in some sectors populated by foreign-owned firms, there is also a direct increase in

indigenous entrepreneurial activity. The most striking example can be found in the software sector in which both indigenous companies and Irish subsidiaries of MNEs achieved worldwide success.

In Wales, in contrast, the relative lack of higher level functions in foreign firms may have had deleterious effects on SME development, and knowledge-based entrepreneurship in particular. The shortage of such jobs forces potential employees to leave a region, reducing the pool of potential entrepreneurs and innovators (FIRN, 1975). PHELPS *et al.* (2003) suggest only minimal local links in higher functional areas related to innovation in the pre-2003 period, though they also highlight that more focused recent initiatives targeted at a small number of inward investors may improve this situation. The Source Wales initiative to improve local supply linkages did not have time to dramatically impact the situation, with a quarter of the plants having had links with this initiative (PHELPS *et al.*, 2003). Overall, as institutional initiatives develop, there is a better balance between inward investment and indigenous development, further emphasizing the relatively recent nature of initiatives to link the two (PHELPS *et al.*, 2003).

Prior to the end of the FDI boom, Wales began to generate a regional innovation system through supply chain integration and innovative cluster interactions in electronics and automotive components as multinationals became more locally embedded, with assistance from public subsidies (COOKE, 2003). This was not integrated with a specific policy of enterprise development. FDI in Wales was relatively innovative, and thus its declining presence weakened regional innovation in Wales generally, including that from SMEs in the supply chain (COOKE, 2003). The relative lack of local sourcing (ROBERTS, 1996; MUNDAY and ROBERTS, 2001) may have limited the beneficial diffusion of management and production knowledge via buyer-supplier relations to SMEs in the supply chain. Beneficial resource transfers can take the form of importation of capital and technology as well as the diffusion of skills and techniques. Japanese electronics companies located in South Wales did not conduct many high-level functions and thus did not have a demand for skilled employees (MUNDAY, 1995). Studies report

limited resource transfer (e.g. MUNDAY, 1995), and particularly limited technological development (MUNDAY and ROBERTS, 2001). The lack of local sourcing is a clear cause for concern, as is the fact that the electronics, electronic components and automotive industries (in which FDI was mainly concentrated) have the lowest level of incremental local sourcing over time, and a tendency to source less locally as plant size increases. In terms of training, DRIFFIELD and TAYLOR (2001) generally argue that inward investors tend to recruit from existing labour markets, whilst others saw costs imposed on the local economy through the need to offer training packages as part of the initial offer to the multinational. PHELPS *et al.* (2003) also report that 70% of foreign investors have some links with local training providers, though this tended to be at the level of school and Training and Enterprise councils, with only 7.7% making use of relevant degree schemes, again emphasizing the relatively low level of the skills requirements.

CONCLUSIONS

In recent decades, Ireland and Wales are both characterized by weak knowledge-creating capacity. Consequently, the two countries' lagged economic development led to proactive policies to attract inward FDI. We have shown, using the GEM dataset, however, that there are differences between Ireland and Wales in terms of the nature and scope of entrepreneurial activity. Specifically we have demonstrated that there is a higher level of high technology manufacturing entrepreneurship in Ireland compared to Wales, and that these entrepreneurs in Ireland are more growth and export-orientated.

Does the knowledge spillover theory of entrepreneurship therefore provide at least a partial explanation for the greater emergence of knowledge-based entrepreneurship in Ireland compared with Wales? We argue it does. The cases suggest that FDI in Ireland assisted the emergence of high technology entrepreneurship to a much greater extent than has been the case in Wales. The GEM data indicates,

broadly, that Ireland has a more robust entrepreneurial sector than does Wales and crucially it also appears that Ireland invoked policies to both encourage and to take advantage of knowledge spillovers from FDI, (for example, in the software industry), to a greater and more coordinated extent than has occurred in Wales. In Ireland, policies directed at attracting inward FDI were also linked over a longer time period to those focused on indigenous entrepreneurial activity, seeking therefore to maximize the benefits of inward FDI on indigenous industry. In contrast, Wales does not appear to have taken full advantage of FDI, partly as a result of an original policy focus more related to pure job-creation in deprived areas.

In these times where attraction of general FDI has become much more competitive (with the expansion of the EU into central and Eastern Europe and the opening up of China), Wales appears to require much more focused FDI-attraction polices that have greater potential to lead to spillovers that local entrepreneurs can then exploit. This will also, of course, require entrepreneurship policies that also encourage entrepreneurial activity among those with the resources and knowledge to exploit such knowledge spillovers. Crucially, of course, this will require these policies to be integrated both with each other and with science and technology policy more generally to increase levels of knowledge creation and utilisation, as highlighted exists in the Ireland situation by JONES-EVANS (2002), in ways that may also support and initiate clusters.

More generally our results suggest that policy choices matter. Our analysis suggests that countries characterized by weak indigenous knowledge-creating regimes can at least partially compensate by attracting inward FDI and that, depending on the nature of this FDI and the nature of supporting policies, knowledge spillovers may lead to an increase in knowledge-based entrepreneurship.

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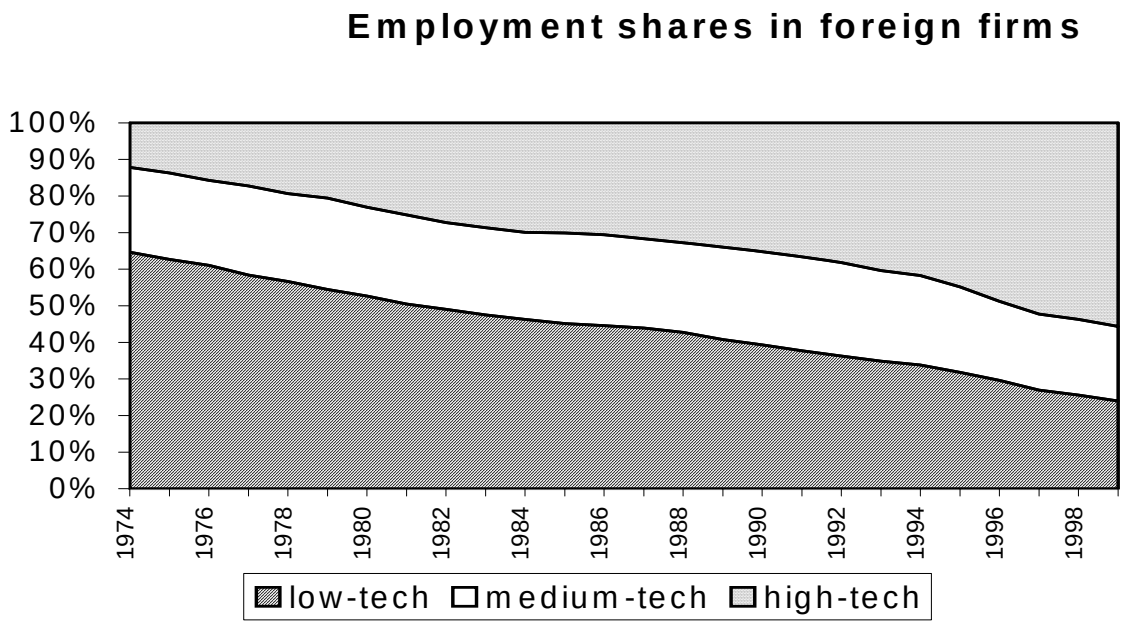
Figure 1: Manufacturing FDI in Ireland by sector, 1974-1999



Source: (Naveretti and Venables, 2004)

Table 1: R&D as a percentage of GDP, 1982-2004

Year	Ireland	Wales	UK	EU15	OECD
1982	0.67				2.01
1984	0.71			1.75	2.12
1986	0.83		2.26	1.86	2.23
1988	0.80		2.14	1.89	2.22
1990	0.83		2.15	1.92	2.27
1992	1.04		2.03	1.85	2.16
1994	1.27	0.5	2.01	1.80	2.06
1996	1.32	0.9	1.88	1.78	2.10
1998	1.25	0.9	1.80	1.79	2.15
2000	1.14	1.1	1.86	1.87	2.23
2002	1.12	1.0	1.89	1.91	2.24
2004	1.21	1.3			

Source: OECD (2006b); Regional Trends (various years)

Table 2: Distribution of early stage entrepreneurial activity (2003-2006) and FDI

(Ireland 1998-2002; Wales 1990-1999) by sector

	Ireland		Wales	
	Early stage entrepreneurship (n=470)	FDI	Early stage entrepreneurship (n=910)	FDI
Total Manufacturing	**8.5%**	**53.0%**	**6.6%**	**94.5%**
- Food	0.6%	4.0%	0.8%	3.3%
- Textiles	0.2%	0.001 %	1.1%	0.6%
- Wood/paper and publishing	2.3%	0.001 %	1.8%	6.6%
- Fuels and man made fibres	**0.0%**	**20.0%**	**0.2%**	**12.1%**
- Minerals	0.9%	1.0%	0.1%	2.5%
- Metals	0.2%	0.5%	0.4%	11.1%
- Equipment	1.1%	10.0%	0.1%	1.1%
- Radio, TV, electrical goods	**1.5%**	**15.0%**	**0.1%**	**39.6%**
- Vehicles	**0.0%**	**0.5%**	**0.7%**	**15.7%**
- Other	1.7%	2.0%	1.3%	1.9%
Agriculture	5.5%	0.001 %	4.7%	0.0%
Mining	0.6%	0.001 %	0.3%	0.01%
Wholesale, retail, repair of motor vehicles	13.2%	8.0%	14.5%	2.8%
Construction	13.2%	1.0%	13.4%	0.1%
Hotels and restaurants	5.5%	0.010 %	7.5%	0.0%
Transport, storage, post	6.6%	10.0%	4.4%	0.0%
Real estate, business services	**28.5%**	**22.0%**	**26.0%**	**2.4%**
Electricity, gas, water supply	0.9%	4.0%	0.3%	0.0%
Education, health and water	6.6%	0.001 %	10.8%	0.0%
Other sectors	10.9%	0.0%	11.4%	0.0%

Source: Ireland figures based on UNCTAD (2005); OECD (2005); Wales figures based on Regional Selective Assistance data; * includes high technology

Table 3: Attitudes towards entrepreneurship in Ireland and Wales, 2003-2006[1]

	Ireland (Yes)	Wales (Yes)
Do you personally know an entrepreneur who started a new business in the last two years?	42%	25%
Are there good opportunities in your local area?	43%	34%
Do you possess the skills and knowledge to start a business?	49%	48%
Would 'fear of failure' prevent you starting a business?	38%	34%
Is entrepreneurship considered a desirable career?	67%	55%
Do entrepreneurs have a high status?	81%	74%
Is there is good media coverage of entrepreneurship?	82%	57%

[1]Only includes those aged 18 to 64.

Table 4: Early Stage Entrepreneurial Activity and Components for Ireland and Wales, 2003-2006 (average)

	Ireland	**Wales**
Nascent Entrepreneurship	4.9%	3.1%
Baby Business Ownership	3.8%	2.9%
Early Stage Entrepreneurship	8.2%	5.7%
Opportunity Early Stage Entrepreneurship	6.9%	4.8%
Knowledge-intensive Early Stage Entrepreneurship[1]	3.2%	2.4%
High Tech Knowledge-intensive Early Stage Entrepreneurship[2]	0.9%	0.3%

1: Includes only those early stage entrepreneurs classed as knowledge-intensive; 2: Includes only those early stage entrepreneurs who operate in high technology, or medium-high technology manufacturing sectors, or the high technology knowledge-intensive service sectors.

Table 5: Age of Early Stage Entrepreneurs by Sector Knowledge-intensity, 2003-2006

	Ireland			Wales			T-tests/Chi-Square test significance levels		
	Knowledge-Intensive Entrepreneurs	Less Knowledge-Intensive Entrepreneurs	All Early Stage Entrepreneurs	Knowledge-Intensive Entrepreneurs	Less Knowledge-Intensive Entrepreneurs	All Early Stage Entrepreneurs	Knowledge-Intensive Entrepreneurs	Less Knowledge-Intensive Entrepreneurs	All Early Stage Entrepreneurs
Age of entrepreneurs (mean)	37.5	35.3	36.3	42.2	41.4	41.7	***	***	***
Gender: % of male entrepreneurs	66.4%	69.1%	67.9%	57.2%	56.5%	56.8%	**	***	***
Education									
- Some secondary	6.3%	12.9%	10.0%	7.5%	9.6%	8.7%			
- Secondary	22.0%	27.1%	24.8%	34.6%	45.8%	41.0%			
- Post secondary	43.4%	47.8%	45.9%	16.5%	20.0%	18.5%			
- Post Graduate	28.3%	12.2%	19.3%	41.3%	24.6%	31.8%	***	***	***
Growth expectation									
- No Jobs Expected	21.1%	15.5%	18.1%	28.9%	24.0%	26.1%			
- 1-to 5 Jobs Expected	42.7%	47.9%	45.5%	39.9%	47.4%	44.2%			
- 6-to 19 Jobs Expected	18.9%	25.1%	22.3%	19.0%	18.7%	18.8%			
- 20 or More Jobs Expected	17.3%	11.4%	14.1%	12.2%	9.9%	10.9%	None	**	***
Expect intentions									
- Expect >50% customers overseas	18.0%	12.4%	14.9%	9.3%	10.5%	10.0%	***	**	**

** p <0.05; *** p<0.01

NOTES

[1] Ireland experienced unprecedented growth of output, exports, incomes and employment during the 1990s. The effect of recent growth was that by the year 2000 Ireland had a GNP per capita that was at the same level as the average for the fifteen members of the EU. Compared to Ireland's economic performance prior to the 1990s and to the economic performance of other under-developed European economies such as Spain, Portugal and Greece, this was a remarkable achievement. This dramatic economic performance is generally referred to as the 'Celtic Tiger'.

[2] This was replaced with a 10% tax on all corporate profits from manufacturing in 1980.

[3] Indigenous firms could avail of the 10% manufacturing corporate tax rate in 1980. However this incentive was of less value to indigenous firms as those that did manufacture tended to have low rates of profitability.

[4] IDA activities were divided into two separate organizations following a review of industrial policy in 1982.

[5] Unpublished internal IDA data.