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**Third-Level Education, Foreign Direct Investment and
Economic Boom in Ireland**

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Third-Level Education, Foreign Direct Investment and Economic Boom in Ireland

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Abstract

Ireland's dramatic economic boom of the 1990s has been referred to as "the era of the Celtic Tiger". In a little over a decade, real national income per head jumped from 65 percent of the Western European average to above parity, unemployment tumbled from double to less than half the European Union average and numbers at work increased by over 50 percent. Much research has been carried out on the impact of each of the separate elements agreed to have been important in stimulating or sustaining the boom. The present paper focuses on one key under-researched synergy – the nexus between the country's industrial strategy, which focused on attracting foreign direct investment in certain high-tech sectors, and the orientation of the third-level educational system that had been developed in Ireland over recent decades.

Keywords: Science and Technology Manpower Policy, Education, Foreign Direct Investment, Ireland, Celtic Tiger.

Introduction

The dramatic economic boom that Ireland experienced over the course of the 1990s has attracted worldwide attention. Having achieved little or no convergence on Western European living standards over the previous thirty years, Irish real national income per head jumped from 65 percent of the EU15 average at the beginning of the 1990s to above parity by the beginning of the next decade.¹ Unemployment tumbled from a high of 17 percent in the late 1980s – a level double the EU average – to a historically low 4 percent – half the EU average – by the end of the 1990s. Substantial budget deficits were transformed into surpluses, the government debt-to-GDP ratio was slashed, and numbers at work increased by an astonishing 50 percent.

The underlying causes of the economic boom, which has come to be referred to as the Celtic Tiger era, have been well researched; see for example Honohan and Walsh (2000) and Barry (1999, 2000). These papers identify a series of beneficial shocks – policy-induced and otherwise – to which the economy was subjected in the late 1980s and which created a virtuous circle of economic progress.

The beneficial shocks included a change in fiscal strategy in 1987. Up to that point, successive governments had struggled to overcome long-running budgetary and debt problems by continuous tax increases. A switch to expenditure reduction policies coincided with the development of a corporatist ‘social partnership model’ of wage determination. The expenditure reductions made credible the offer of future tax reductions in exchange for wage moderation and industrial peace, both of which bolstered competitiveness. The doubling of the EU Structural Funds in 1989 in turn made it possible to implement the badly-needed infrastructural projects that had been put on hold as part of the change in fiscal strategy.

Airline deregulation, in 1986, facilitated a more than doubling of tourist numbers over the following decade, commercialisation of the telecommunications system made it possible to attract newly offshoring IT-enabled services sectors, while the lead-up to the Single Market saw a massive increase in FDI flows both into and within Europe – of which Ireland captured a sharply increased share. These beneficial shocks all occurred against a backdrop of EU membership, a long-standing commitment to outward orientation, a low corporation tax regime, and a rapidly expanding educational system.

The present paper explores one heretofore under-researched element to the story of the Irish boom. This is the nexus connecting the rapid expansion in educational throughput with the long-established national strategy of seeking to attract foreign direct investment inflows in certain key high-tech sectors.²

¹ The term EU15 refers to the 15 Western European countries that made up the EU prior to the enlargement of May 2004. This enlargement reduced EU average income per head substantially.

² Ferreira and Vanhoudt (2002) also conclude that “higher education, especially the vocational/technical slant of educational provision, and the sector composition of FDI in favour of high-tech industries, were self-reinforcing factors” behind the boom. Wickham and Boucher (2004) argue that the key feature of the Irish education system – in comparison to those of the Asian Tigers and the rest of the OECD – has been its inexpensive ‘volume production of technical graduates’, undertaken without incurring the ‘costs’ of tackling educational disadvantage or developing a research-based innovation system.

The paper is structured as follows. The next section outlines Ireland’s success in attracting FDI and details the changing nature of the foreign-owned sectors attracted to Ireland over the decades. Section 3 analyses the reasons for Ireland’s success in the FDI stakes. Successive surveys of foreign-owned firms reveal that two of the important determinants of their decision to locate in Ireland are the availability of skilled labour and the specific skills of the workforce. Section 4, which comprises the main part of the paper, then looks at Irish educational policy and the development of the country’s tertiary education system over recent decades in an attempt to understand how the synergistic relationship with industrial strategy emerged and strengthened. Section 5 presents some concluding comments, while a brief appendix offers a formal model of how educational policy can influence economic development even in an economy with a labour market as open to international migration flows as Ireland’s is.

2. Foreign-Owned Industry in Ireland

Table 1 presents two measures of Ireland’s success in attracting FDI. The column on the left shows the share of foreign-owned firms in manufacturing employment, while that on the right shows the inward FDI stock per capita. In both cases Ireland’s FDI-intensity relative to the average Western European EU country is readily apparent.

Table 1:

Share of foreign affiliates in manufacturing employment, and inward FDI stock

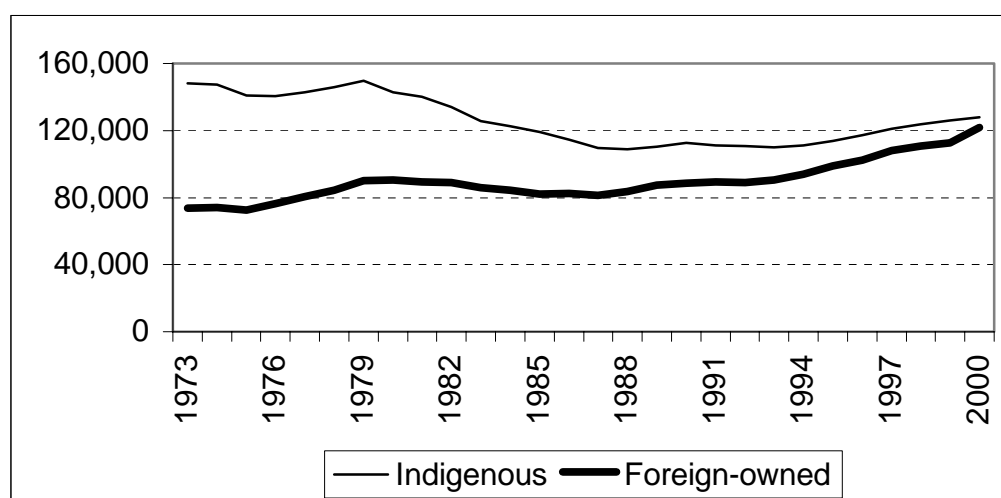
	Share of foreign affiliates in manufacturing employment (1998)	FDI inward stock (USD) per head of population (2000)
Ireland	48	37740
EU15	19	6032

Notes: share of affiliates in manufacturing employment comes from OECD (2001) Science, Technology and Industry Scoreboard; (EU15 here refers to the average of the 11 other member states for which the table provides data). FDI Inward Stock data come from the UNCTAD (2004) World Investment Report.

The growing importance of foreign-owned industry in Irish manufacturing employment is illustrated in Figure 1, while Table 2 charts the changing sectoral pattern of this employment over the period 1975 to 2000.³

³ We use employment rather than output data throughout because transfer pricing activities associated with Ireland’s low corporation tax regime are thought to distort the output and trade data pertaining to the country.

Figure 1: Employment in indigenous and foreign-owned manufacturing firms, 1973-2000



Source: Annual reports of the Irish state agency Forfás.

Large declines in the relative attractiveness of traditional sectors such as Food, Drink and Tobacco, and Textiles, Clothing and Footwear are apparent in Table 2. Having comprised 43 percent of foreign-sector employment in 1975, the share of these sectors had declined to 14 percent by the year 2000. The major expansions were seen in the Office and Data Processing Equipment, Pharmaceuticals and Medical Instruments sectors. Between 1975 and 2000 the share of this group of sectors in foreign manufacturing employment grew from 10 percent to 41 percent.

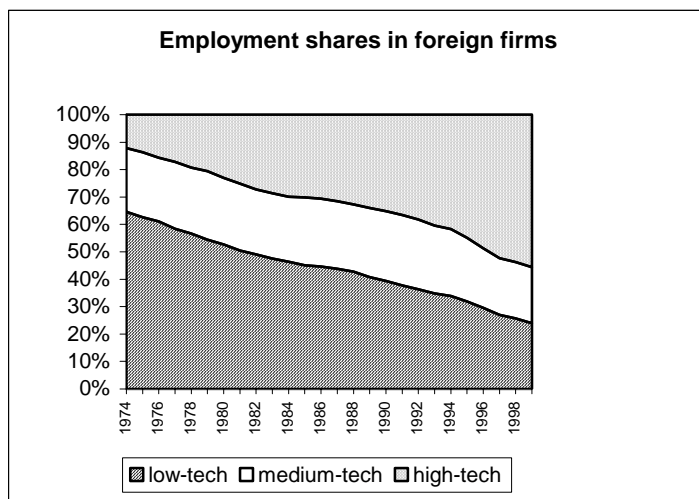
Table 2: Sectoral allocation of employment in foreign-owned firms in Ireland

	1975	1980	1985	1990	1995	2000
Food, Beverages and Tobacco	26	20	19	15	13	11
Textiles, Clothing and Footwear	17	16	14	13	9	3
Wood, paper, print etc.	4	3	3	3	3	2
Pharmaceuticals	4	4	5	7	9	11
Chemicals (excl Pharma)	6	7	7	6	6	5
Rubber, Plastics, Non-Metallic Minerals	8	9	8	7	6	5
Basic and Fabricated Metals	9	7	5	5	5	4
Machinery and Equipment nec	5	6	7	6	5	5
Office and Data Processing Equipment	2	4	6	7	11	19
Electrical Machinery and Apparatus	3	5	6	7	7	8
Radio, TV and Telecomm Equipment	1	3	4	5	7	7
Medical Instruments	4	7	8	8	9	11
Transport Equipment	10	8	6	9	8	7
Manufacturing nec	2	2	1	2	2	1
Total	100	100	100	100	100	100

Source: unpublished data from state agency Forfás.

These expanding sectors are all classified as high-tech by the OECD. Employment developments in foreign industry as classified by technology level are depicted in Figure 2.⁴

Figure 2: Technology mix of foreign firms.



Data on service sectors, unsurprisingly, are not as comprehensive as those available for manufacturing. Ireland is known, however, to have become a leading European location for offshored services in three separate areas: computer software and services, international financial services and other business process outsourcing (BPO) activities such as call centres and shared services.

Foreign firms in computer software and services currently employ about 21,000 workers (roughly the same number as are employed by foreign firms in Office and Data Processing Equipment), international financial services about 10,000 (around the same number as in foreign-owned Pharmaceuticals) and other BPO activities about 14,000 (close to the number in foreign-owned Medical Instruments). All of these offshored service sectors emerged in Ireland only over the course of the 1980s.

Most of these foreign-dominated sectors, furthermore, provide relatively more employment in Ireland than they do elsewhere in Europe. Computer equipment for example is ten times more important in Ireland than it is for the EU15, electronic components four times more important and software 1.3 times more important; Barry and Curran (2004).

Now consider the educational attainment levels of employees in these foreign-dominated sectors. The industries with the highest shares of their workforce possessing third-level educational qualifications are Chemicals, Rubber and Plastics; Beverages and Tobacco; and Metals, Machinery and Engineering – in each of which foreign-owned firms comprise around 70 percent of total employment.

⁴ By contrast, sectoral allocations of domestic-firm employment by technology level have hardly changed at all. The allocation to low-tech sectors remains at over 70 percent.

Table 3: Proportion of workforce in each sector with third-level (degree and non-degree) educational qualifications:

	1966	1971	1981	1986	1991	1996	2001
Manufacturing Industries	3.1	3.4	7.0	9.1	14.0	21.7	28.9
Food	4.1	4.5	6.4	8.5	11.6	17.0	21.6
Beverages and Tobacco	3.7	-	6.6	8.4	18.4	28.3	38.5
Textiles, clothing, footwear and leather	1.2	1.5	3.5	4.4	6.5	9.8	15.0
Wood and wood products	1.2	1.2	2.8	3.6	5.2	8.8	14.3
Paper, paper products, printing and publishing	3.7	4.2	7.6	9.0	15.1	23.5	32.2
Chemical, rubber and plastic products	8.9	7.3	11.7	14.4	25.0	29.8	38.8
Glass, pottery and cement	2.8	3.1	5.1	6.6	9.8	15.3	17.6
Metals, machinery and engineering	3.4	3.6	9.8	12.4	18.3	27.4	33.6
Other Manufacturing (incl transport equip.)	3.9	4.1	6.6	8.1	14.6	23.3	18.8

Source: Data calculated from the Census of Population and kindly provided by researchers at the Economic and Social Research Institute, Dublin.

As Barrett, FitzGerald and Nolan (2002) point out, the high-tech manufacturing sectors (engineering and chemicals), driven by the inflow of foreign firms, now employ nine percent of those with third-level qualifications, up from a figure of only three percent in 1966. Most of those with such qualifications continue to be employed in financial and professional services, however, though some segments of these service sectors too have been driven primarily by offshoring FDI.

3. **Reasons for Ireland's Success in Attracting FDI**

Ireland's success in attracting FDI can be ascribed to a combination of factors, which will be discussed individually below. These include:

- EU membership, a Western European seaboard location and an English-speaking environment (characteristics which the country shares with the UK of course)
- a low corporation tax rate
- the skills and experience of the country's Industrial Development Agency (IDA)
- the quality of the telecommunications infrastructure, and
- an educational system that is tightly integrated with the country's FDI-oriented development strategy.

The importance of the first set of factors is attested to by the fact that the UK and Ireland are particularly attractive destinations for US foreign investments, with the highest US FDI stocks per employee in the EU.

Numerous studies, including Gropp and Kostial (2000), Altshuler et al. (2001) and Slaughter (2003), have verified the importance of the corporation tax regime for FDI inflows. Ireland, as is well known, has the lowest rate of corporation tax in the EU15 and usually shows up as having the lowest effective rate as well, apart from Luxembourg whose tax incentives are targeted primarily towards the financial sector.

The skills and experience of Ireland's investment promotion bodies are also important. The Industrial Development Agency is recognised internationally as an example of best practice in the field.⁵ It has also used its bureaucratic clout to press for continuous improvements in education and infrastructure.

Its impact on the structure of the Irish education system will be discussed in the next section of the paper. In terms of its impact on infrastructure, MacSharry and White (2000) – the former an erstwhile Finance Minister in the Irish government and the latter a long-term Managing Director of the IDA – describe its role in wresting the state telephone system from the hands of the moribund Department of Posts and Telegraphs in the 1970s. The service was commercialised and the most advanced European digital-based network outside of France was brought into operation shortly thereafter. This allowed Ireland capture a range of newly offshoring IT-enabled services sectors in which first-class international telecommunications were a key factor.

Having already established itself as a major European location for export-platform activity, Ireland may have been in a unique position to benefit from the Single European Market initiative. MacSharry and White (2000) describe how several larger EU countries, in the pre-Single Market era, “had suggested to potential investors that publicly funded purchases of their products might be blacklisted if the new investment was located in Ireland” (rather than in the countries making the threatening noises). The restrictive public procurement policies that underlay these threats were outlawed under the Single Market legislation. This, along with the agglomeration and demonstration effects identified by Barry, Gorg and Strobl (2003), would appear to explain the sharp increase in Ireland's share of FDI flows into and within Europe when the Single Market came into being; Barry (2004).

As to the importance of education and skills in determining the European location of multinational companies, and as to their adequacy in Ireland, surveys of the management of MNCs invariably rank both highly. Gunnigle and McGuire (2001) for example, in a survey of executives of 10 major US MNCs, find that these factors rank second in importance after the corporation tax regime in drawing these firms to Ireland.

The International Institute for Management Development (2002) in Switzerland surveys executives across a range of countries and asks them to rank the performance of countries relative to each other. Here executives rank Ireland number 2 (after

⁵ See, for example, Loewendahl (2001).

Finland) out of a total of 49 countries in response to the statement “the educational system meets the needs of a competitive economy”, while the country is ranked number 3 (after Finland and Canada) out of the same 49 countries in terms of a positive response to the proposition that “university education meets the needs of a competitive economy”.

This is consistent with the evidence showing that Ireland has one of the highest proportions of population aged 25 to 34 in the OECD with a third-level educational qualification (Figure 3) and that a very high proportion of these have science and engineering degrees (Figure 4).

Figure 3:

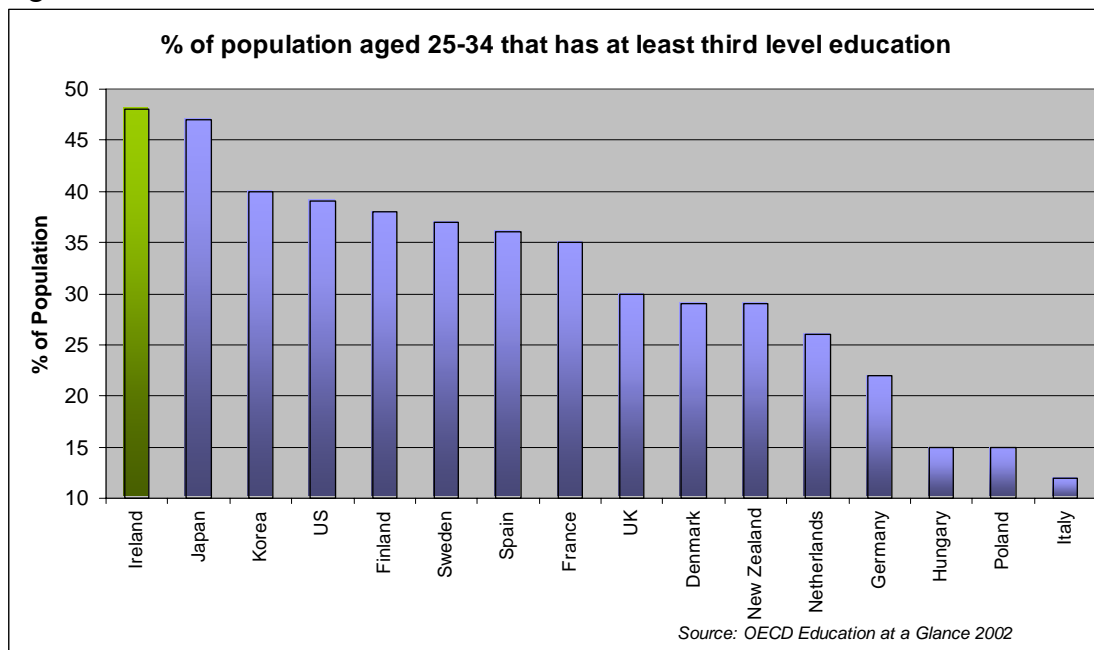
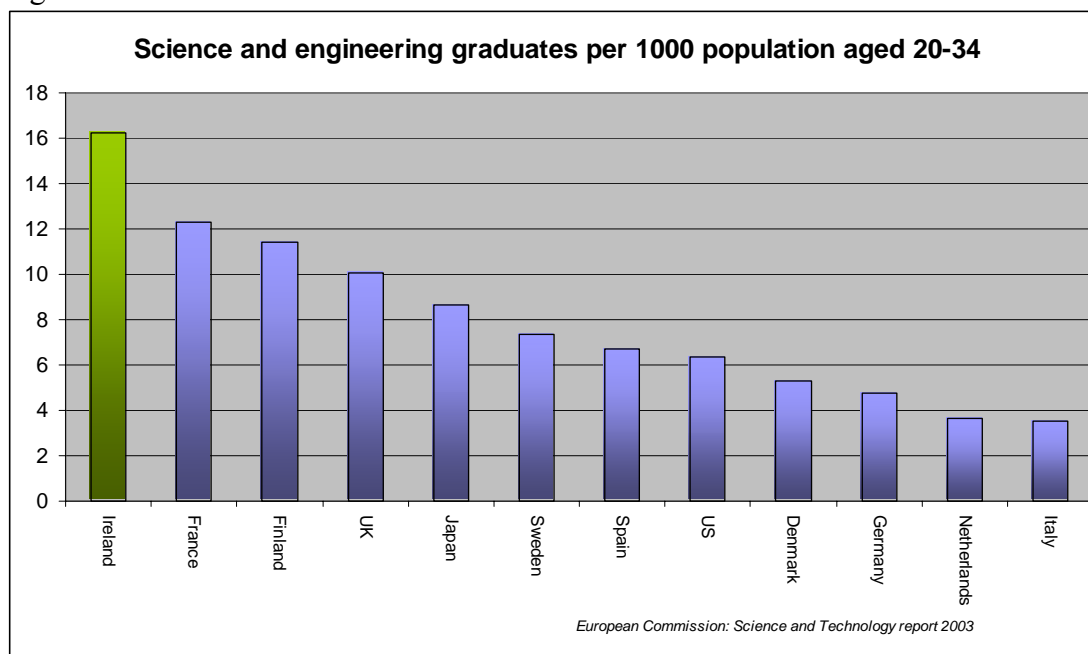


Figure 4:



The next section of the paper analyses how the Irish educational system has evolved to this position.

4. Irish Educational Policy and Industrial Strategy

Access to secondary (and hence also to third-level) education was broadened rather later in Ireland than in most of the rest of Western Europe. This is reflected in the OECD data on educational attainment by age cohort shown in Table 4.⁶ These data, expressed as a percentage of the OECD country mean, also illustrate clearly the convergence in educational throughput that Ireland has achieved over time.

Table 4: Irish educational attainment as a percentage of the OECD country mean

Age Group	Population that has attained at least upper secondary	Population that has attained at least tertiary level B	Population that has attained at least tertiary level A
55-64	69	79	56
45-54	71	80	54
35-44	85	96	73

Source: OECD (2001)

Note: Tertiary B refers to practically-oriented and occupation-specific tertiary programmes of at least 2 years full-time-equivalent duration, while tertiary A refers to university level programmes.

The current situation is depicted in Table 5, which shows that Ireland has now surpassed the OECD country mean in tertiary and post-secondary education, and has just matched the mean in terms of those with university qualifications.

⁶ The politics underlying the delay in expanding educational access are analysed by Garvin (2004).

Table 5:

	Percentage of cohort aged 25-34 that has attained at least upper secondary	Percentage of cohort aged 25-34 that has attained tertiary level B	Percentage of cohort aged 25-34 that has attained tertiary level A and above	Post-secondary non-tertiary graduation rates
Ireland	67	13	16	25.8
OECD country mean	72	9	16	8.5

Source: OECD (2001)

Note: Tertiary B and A as defined above. The post-secondary graduation rate refers to the ratio of post-secondary graduates to total population at the typical age of graduation. In Ireland the whole cohort included here are categorised as ISCED4C, i.e. in possession of a qualification which prepares participants for direct entry into specific occupations. This will include part of the Institute of Technology cohort as well as some PLC (Post Leaving Certificate) courses.

This extra Irish throughput in tertiary education, furthermore, is largely concentrated in the scientific area. Scientific degrees and diplomas are in strong demand within foreign-owned industry in Ireland and, to this extent, Ireland's overall industrial strategy – which has been targeted at attracting MNCs in certain high-tech sectors – can be seen to have influenced the setting of development priorities within the human capital domain.

Table 5 shows Ireland to have an unusually large cohort endowed with non-university 3rd-level educational qualifications, which are in technical and vocational fields. The major part of the present story is concerned then with how this system evolved and with the impact it has had on Ireland's ability to attract foreign direct investment.

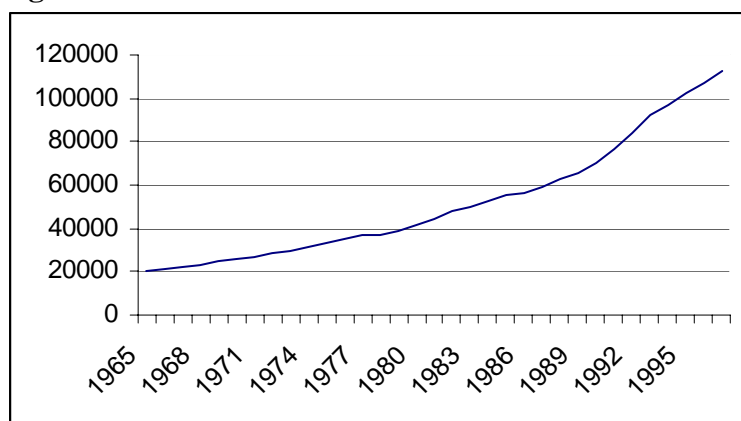
Analyses of Ireland's educational transformation accord a hugely influential role to the 1965 report *Investment in Education*, which was undertaken with the assistance of the OECD.⁷ The study was initiated because it was recognised that Ireland's changing occupational structure would place significant demands on systems of education and training. It was informed throughout by the perspective that education was a means by which society invested in its own future. The report's two central propositions were that a non-meritocratic education system was wasteful of natural talent, and that investment in the education of that talent had contributed significantly to European postwar economic growth. *Investment in Education* was scathing in its assessment of the Irish education system of the time. It reported that over half of Irish children left school at or before the age of thirteen, a finding that generated newspaper headlines and that presaged the introduction of 'free' second-level education and free access to special transport networks for all second-level school pupils in 1967. Though educational participation in Ireland had been expanding in previous decades, the introduction of these and other reforms – the abolition of the primary-school certificate in recognition that it was no longer an appropriate standard for admission

⁷ An important feature of the report was that, in the words of Logan (1999), "technocratic expertise was being given unprecedented attention and might now be heard alongside the political party and denominational interests which had previously dominated ministerial councils".

to apprenticeship, and slightly later increases in the compulsory-attendance age – still came a decade or more after other Northern European countries had moved in this direction.

In 1965 only 20 percent of the age cohort remained through to the final stages of secondary school. Thirty years later the numbers at school had trebled, with 80 percent completing the full cycle. Numbers at third-level, meanwhile, had increased even more substantially – by a factor of six – as illustrated in Figure 5.

Figure 5: Numbers of full-time students in third-level education



Source: White (2001), Appendix 1.

Over the period from 1965, as the third-level system expanded, the composition of the institutions comprising the system also changed. Seventy five percent of full-time third-level students in the mid-1960s were enrolled in universities, about 20 percent were in teacher training colleges and other specialist institutions, and only 5 percent were in vocational and technological education; White (2001, page 79, 90). By the late 1990s, universities accounted for a much lower 54 percent share, while that of the broad vocational and technological sector had risen to 37 percent. As will be documented below, the subject areas in which third-level graduates received their qualifications had also shifted towards a more vocational and technological orientation.

Table 6: Percentages enrolled in various elements of the tertiary education sector

	1965/66	1970/71	1980/81	1990/91	1997/98
Universities	75	75	55	54	54
Vocational/Technological/ Regional Technical Colleges	5	9	26	39	37
Other	21	16	19	7	9

Source: White (2001, Appendix 1).

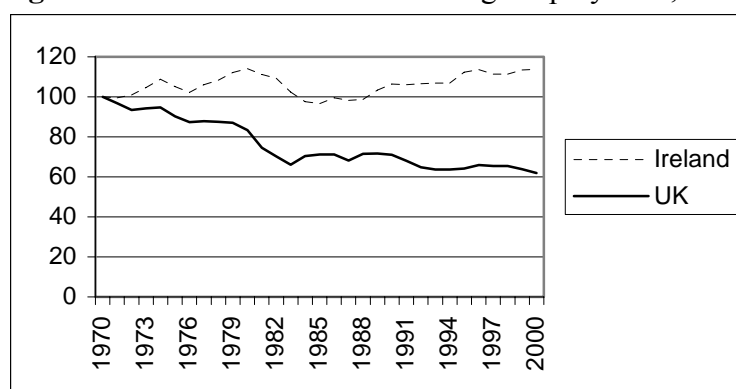
Note: The two National Institutes of Higher Education were awarded university status in 1989/90, and shifted from the vocational/technological category at that time.

Educationalists draw a distinction between Northern and Southern European models of higher education, with the former, because of the earlier industrialisation of these

economies, retaining a strong focus on the need for technical as well as traditional university education. Though a late industrialising economy, Ireland developed elements of the former ‘binary-type’ system when throughput began to expand in the wake of taxpayer funding of secondary education. Perhaps surprisingly, the development of the binary model in Ireland appears to have drawn more from the early advice of the OECD and from Ireland’s access to the EU Social Fund than from the experience of the UK, the country’s nearest neighbour.

The UK’s early industrialisation had ensured the evolution of a well-developed system to provide an intermediate layer of technicians. It was recognised in Ireland that the education system would need to provide this intermediate layer from scratch if human resources were to be available to sustain the industrial expansion, depicted in Figure 6, that followed on from Ireland’s relatively late trade liberalisation.

Figure 6: Irish and UK Manufacturing Employment, 1970=100.



Source: OECD

The main components of the technical-education system developed in Ireland over the course of the 1970s were the Regional Technical Colleges (RTC), for which there was no UK model. As initially proposed, these were not envisaged primarily as institutions concerned with third-level education. Their functions were to provide (i) senior-cycle post-primary courses leading to the Leaving Certificate (the national award made to second-cycle graduates), (ii) junior and senior Trade Certificate courses for apprentices on day or block release from work, (iii) courses for technician or in some cases professional qualifications at various levels, and (iv) adult education and retraining courses; White (2001). Course programmes were to be of shorter duration than those at universities, there was a limited range of subjects on offer – mostly in the fields of engineering and business studies, and curricula had a practical orientation designed to be responsive to the needs of local industry and business.

As the report of the Steering Committee on Technical Education (1967) put it: “The main long-term function of the Colleges will be to educate for trade and industry over a broad spectrum of occupations ranging from craft to professional level, notably in engineering and science, but also in commercial, linguistic and other specialities. They will however be more immediately concerned with providing courses aimed at filling gaps in the industrial manpower structure, particularly in the technician area”; Clancy (1993, page 125).

Five Regional Technical Colleges were established around the country in 1970 and a further four were established between 1971 and 1977. The colleges quickly shed almost all their second-level teaching however, to concentrate on the provision of third-level courses in engineering, construction and business studies, applied science and art and design.⁸ Their course offerings remain distinctive however in that they are mainly short-cycle and sub-degree level. The majority of courses are of two-year duration, leading to a National Certificate award. There are, in addition, a small number of one year certificate courses, a significant number of three-year courses leading to a National Diploma, and a limited number of four-year degree-level courses.

Besides the RTCs, third-level vocational education was also provided through five older Dublin colleges: a college of commerce, a college of catering, a college of marketing and design, and two colleges of technology,. These colleges, which would eventually be amalgamated to form the Dublin Institute of Technology in 1978, also saw their enrolments increase throughout the decade.⁹

This expansion in this system was financed with the assistance of European regional aid funds, which at the time came primarily through the European Social Fund (ESF). Since Ireland, at the time of EU accession in 1973, was by far the poorest of the EU member states, it received a disproportionate share of total Social Fund allocations, of which the Industrial Training Authority was the main beneficiary. In 1975 the EEC Council decided to make a special Social Fund provision to facilitate the employment and geographical and professional mobility of young people under 25 years of age. One of the applications, from the Irish Department of Education, covered the training of young persons in middle-level technician skills in the newly established RTCs.

The introduction of Social Fund aid to the RTCs was gradual and low-key and entailed an element of subterfuge on the part of the Irish authorities since EU regulations at the time permitted funding of training only, and not of education. In 1979 there were 2000 students obtaining such assistance, by 1982 numbers had grown by a further 50 percent, and by 1986 almost 90 percent of all new entrants to full-time courses at the RTCs – i.e. about 20 percent of those entering third-level education in Ireland – were in receipt of ESF grants. The benefits of this form of education and training, furthermore, show up as significant in terms of both employment prospects and earnings ability.¹⁰

⁸ This was facilitated by concurrent reforms undertaken at second level to blunt the sharp distinction between secondary and vocational schools. The latter, which took about 40 percent of the second level intake in 1963, concentrated on junior-cycle courses and, even at senior cycle, did not provide the range of subjects that would have allowed for university matriculation. In 1967, however, Leaving Certificate courses were introduced to vocational schools, facilitating access to tertiary level, while comprehensive and, later, community schools began to be developed from 1966 with curricula that spanned the academic and the vocational; Logan (1999).

⁹ In 1972, the National Council for Educational Awards was instituted to provide academic validation and act as the examining and awards body for the non-university tertiary sector.

¹⁰ Denny et al. (2000) show that for persons under 37 years of age in 1994, a 3rd-level (sub-degree) diploma increased men's hourly earnings by 15 percent and women's by 7 percent, as against those with just Leaving Certificate (secondary school) qualifications. They also show that the probability of being in employment is significantly enhanced by possession of a Middle Level Technician/Diploma level qualification.

From having had a tiny short-cycle third-level sector before 1970, by 1981 Ireland had internationally, after the Netherlands, the highest proportion of third-level students taking sub-degree courses. According to White (2001) “the quiet introduction of ESF funding in 1975 had played a major part in this transformation”.

At the same time, it came to be felt that the content of technological education needed to be further upgraded and that technological and higher technician roles needed to become ‘status carrying in their own right’; Clancy (1993). The universities were not viewed as best equipped to provide this form of education. White (2001) lists three grounds for this opinion. Firstly, it was held that universities were concerned with fundamental and theoretical studies while technology was concerned with the practical and applied. Secondly, there was, naturally, an academic bias within the university system. Finally, the concept of autonomy was central to the functioning of the universities, while government felt the need for institutions more amenable to its control and able to respond more rapidly to changing technological and manpower needs. Accordingly, two National Institutes of Higher Education, loosely based on the UK system of polytechnics, were set up; the first, at Limerick, in 1972 and the second, in Dublin, in 1980.

By that year, after just one decade, the new system was almost entirely in place. A characteristic of this new tertiary sector was that socio-economic disparities were less marked than within the traditional system. Clancy (1993) provides data on the extent to which various social groups are proportionately represented or under or over-represented within the system. The contribution of the new tertiary element can be seen by comparing participation ratios among university entrants relative to all third-level entrants; Table 7.

Table 7: Participation ratios in third-level education by social class

Socio-economic group	University Entrants		All third-level entrants
	1963	1986	
			1986
Farmers	0.79	1.13	1.45
Professional/managerial/ inter non-manual	3.21	2.27	1.82
Other non-manual	0.3	0.27	0.5
Skilled manual	0.4	0.31	0.51
Semi-skilled/unskilled manual	0.08	0.19	0.3

The table indicates that the professional and managerial class is over-represented throughout. Amongst all third-level entrants in 1986 for example, this group had 82 percent more places than would be justified on the basis of its proportionate share of the population. While students of semi-skilled and unskilled manual backgrounds are under-represented across all measures, their under-representation is seen to be less severe in the non-university than in the university tertiary sector.

It was noted earlier that the RTCs quickly shed virtually all of their secondary-level functions. A similar phenomenon – known as ‘academic drift’ – manifested itself within the new NIHEs. They rapidly began to operate primarily at degree level. Indeed when the second National Institute opened in 1980 it offered no sub-degree level courses. The same pattern had been recognised within the British polytechnics. Indeed Neave (1982) concluded that by the early 1980s, in terms of the structure of courses, length of study and distribution of the fields of study, the polytechnics has become universities in all but name. They were finally granted university status in 1992, signalling the end of the binary system in the UK.¹¹ The granting of university status to the National Institutes of Higher Education in Ireland in 1990 did not signal the end of the binary system in that country however, since there remained a range of publicly-funded institutions of higher learning that continued to be more responsive and amenable to government policy objectives than the autonomous universities.¹²

Since the late 1970s, furthermore, the universities themselves – at the behest of the national development agency, the IDA – had begun to accept increased responsibility for ensuring that manpower needs were met. The Manpower Consultative Committee was established in 1978 to provide a forum for dialogue between the IDA and the education system. The state agency, concerned by the looming disparity between electronics graduate outflows and its own demand projections, convinced the government to fund a massive expansion in educational capacity in these areas.¹³ The output of engineering graduates, as a result, increased by 40 percent between 1978 and 1983, while the output from computer science increased tenfold over the same short period. The IDA in turn was able to use the rapidity of this response – exemplified by the immediate introduction of a range of one-year conversion courses to furnish science graduates with electronics qualifications – as a further selling point to foreign investors; MacSharry and White (2000).

White (2001), in his history of the Irish 3rd level system, refers to this as the period when “the universities came in from the cold”. By taking on board the need to bear manpower requirements in mind, they bridged the gap between the two strands of the binary system and ensured that the bulk of the Irish workforce on offer would have a broad educational background, though with a high degree of technical expertise, rather than a narrow vocational one.

The changes in chosen fields of study across the two elements of the binary system also in fact mirrored each other. Table 8 shows the expansion in business studies in the non-university sector between the 1970s and the 1990s, which came there at the expense of engineering, while Table 9 shows that business studies also expanded in the universities, along with science and information technology, though in this segment of the tertiary sector it came primarily at the expense of arts.

¹¹ Australia had operated a binary system for twenty years before abandoning it in 1987; White (2001).

¹² Indeed Ó Buachalla (1992) suggests that the important distinction is not between universities and non-universities, but between autonomous and non-autonomous establishments.

¹³ The Irish system offers a finite number of places in most third-level courses. These numbers are decided within the universities but are subject to government influence given that the latter provides the bulk of university funding. Ó Riain (2004) points out that this system gives the Irish state a much greater capacity to mould the labour market for specific economic sectors than is the case in many other countries.

Table 8: Non-University Tertiary Awards by field of study

Year	Business Studies (%)	Engineering and Technology (%)	Humanities (%)	Science, Computing and Paramedical (%)	Total Graduating
1975	25	51	6	18	1035
1999	43	19	19	19	16,501

Source: National Council for Educational Awards, 25th Annual Report (1998/99)

Note: The NCEA has now been subsumed within the Higher Education and Training Awards Council (www.hetac.ie).

Table 9: University Enrolments by field of study.

Year	Arts	Business/Commerce	Social Science	Law	Science, computing and IT	Engineering	Architecture	Medicine	Agriculture	Totals
1971	46.6	10.3	2.5	2.7	11.7	7.6	0.9	13.1	4.6	19,522
2003	37.0	15.3	1.4	2.7	19.5	7.7	0.4	13.3	2.8	63,143

Source: HEA Report on University Reorganisation (1972); HEA Annual Report 2002/3 (available at www.heai.ie)

Notes: 1971/72 refers to full-time students; 2003 refers to undergraduate enrolments. Arts includes education, European Studies and communications; Medicine includes nursing and dentistry; Agriculture includes veterinary medicine and food science.

Combining both elements of the tertiary system, we see that the proportion taking business studies rose from 11 percent to 20 percent between the early 1970s and the new millennium while the numbers taking science and engineering increased from 23 percent to 28 percent, giving Ireland – as illustrated earlier – one of the highest proportions in the world of the 24-34 age cohort with science and engineering qualifications.

Finally, Table 10 shows that the non-university sector caters disproportionately to manufacturing industry, that science and engineering graduates from both elements of the tertiary system tend to be employed disproportionately in the foreign-dominated segments of manufacturing industry, and that business studies graduates – particularly from the university element – tend to service the high-tech segment of market services in which Ireland has also proved successful in drawing in FDI.

Table 10: Sectoral distribution of recent university and non-university graduates.

	Share of jobs in the Irish economy	University Sector					Non-University Sector				
		All Faculties	Business	Humanities	Engineering	Science	All Faculties	Business	Humanities	Engineering	Science
Manufacturing	15.5	20.1	9.3	7.5	55.5	32.9	26.5	14.5	7	49.7	29.4
<i>of which:</i> Chemicals, rubber and plastics, healthcare products	2.1	5.1	1.6	1.6	7.1	16.2	4.4	1.5	0.3	2.5	15.1
<i>of which:</i> Engineering, electronics and metal industries	6	10.7	3.8	1.9	46	10.8	14.4	3.1	0.8	42.2	5.2
Insurance, Financial, Business and Computer Services	12.5	26	43.9	21.3	12.6	28.4	13.9	22.1	3.6	2.8	23.4

Sources: Higher Education Authority (2000) First Destination of Awards Recipients in Higher Education; Quarterly National Household Survey (2000, Q1); Census of Industrial Production (2000).
 Note: Degree recipients from the non-university sector, comprising about 20 percent of that sector's output, are included in the data pertaining to the university sector.

Concluding Comments

The subject of this paper has been the nexus between Ireland's long-standing industrial strategy – which has focused on attracting foreign direct investment in certain high-tech sectors – and the orientation of the country's third-level system of education. It is clear that Ireland could not have upgraded into the high-tech sectors that it has been successful in attracting had it not been able to furnish the kinds of skilled workers that these sectors require. The paper has explored in turn the nature of the educational institutions that have provided these skills.

Science policy in Ireland until recently had been almost completely focussed on this issue of skilled labour supply. Convergence on average Western European living standards over recent years however has brought an increased emphasis on other elements of science, technology and innovation policy.

Part of this refocusing can be seen as a response to the growing phenomenon of *technology-sourcing* foreign direct investment (FDI). While traditional FDI consisted of firms setting up overseas to exploit on a larger stage the advantages such as brand names and patents that they had already accumulated, technology-sourcing FDI sees firms seeking to access resources that are only available in the overseas locations

targeted. Increasingly, multinational firms are setting up overseas R&D facilities where local conditions are such as to increase the likelihood of innovations emerging.

This likelihood depends on the local 'innovation system' – the process by which public and private-sector institutions, firms and national policies interact and coalesce to generate innovation. Recognition of the importance of developing an Irish national system of innovation was heralded by the release in 1996 of the first-ever Irish Government White Paper on Science, Technology and Innovation. Investment in these areas increased five-fold under the National Development Plan 2000-2006. Further developments saw the launch in 1998 of the Programme for Research in Third-Level Institutions (which established 24 research centres as well as major programmes in human genomics and computational physics), by the funding by Science Foundation Ireland of five joint partnerships between third level research institutions and industry, and by the introduction of a 20 percent tax credit for incremental R&D in the Finance Act of 2004.

Within ICT alone, the last two years have registered a number of significant developments under the new strategy. Bell Labs has announced its intention to set up a major R&D centre at Lucent Technologies' Dublin facility, linked with the establishment of a collaborative academic centre at one of the city's universities. Similarly, Hewlett-Packard announced the establishment of a world-class Technology Development Centre at its manufacturing facility outside Dublin, while its European Software Centre entered into collaboration with University College Galway in establishing the Digital Enterprise Research Institute. Intel has established an innovation centre at its main site outside Dublin, has increasing its investment in its research centre near Limerick and has partnered three Irish universities in an academic Centre for Research on Adaptive Nanostructures and Nanodevices. IBM, over this same period, announced further significant investments in its Irish R&D software facility in Dublin, influenced, according to one of the directors of the company, by the availability of the necessary skills, the strong support of the Industrial Development Agency and the growing emphasis on scientific research by Science Foundation Ireland.

While the Irish tertiary system appears to be developing in an appropriate direction, problems remain within the second-level education system, as evidenced by the fact that Ireland still lags behind the OECD in this segment (Table 5 above). Nickell and Bell (1996) – drawing on the work of Sig Prais of the National Institute of Economic and Social Research in the UK – argue that the most important factor determining the contribution of the education system to economic success within developed countries is the strength of the emphasis it places on sustaining a high level of performance on the part of the bottom half of the ability range.

In this regard the Irish pre-tertiary system is clearly lacking. The 1995 OECD Economic Survey of Ireland notes that "the performance of Irish schools is much more uneven than in other countries", and suggests that "the variability of school performance may be one explanation for the large differences in student performance according to the social status of their parents".

A comprehensive analysis of the performance of the second-level system in Ireland is provided by Hannan et al. (1996). Amongst their findings are that, even controlling

for pupils' individual ability and individual family background, having a high proportions of peers from an unskilled manual background leads to significantly poorer examination results. Thus the fact that working class boys are over-represented in the vocational schools system – which contains substantially greater proportions of children with numeracy and literacy problems – while middle class children are over represented in secondary schools, is of considerable practical significance.

They comment also on the process of transition from school to work, training and further education, pointing out that this has become increasingly dependent on academic grades, to the neglect of alternative certification arrangements or appropriate subject specialisations. This further acts to the detriment of those with vocational or practical rather than academic skills.

Nor does the Irish training system appear to be successful in overcoming the obstacles facing early school leavers. Thus O'Connell (2002) finds that, amongst graduates of Irish National Training Authority (FÁS) courses, those with educational qualifications find jobs more easily, and at higher rates of pay, than do those without second-level state examination qualifications.

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Appendix: Education and Economic Development in an Open Labour Market

Consider a region whose economy is small relative to that of the encompassing region with which it shares an open labour market. Interregional (or international) labour mobility is most easily modelled in this case by assuming that the regional wage is determined ‘abroad’, in which case the regional labour supply function is horizontal. In such a case, increased education or training in the region cannot stimulate regional growth. Unless increased labour demand is forthcoming, the increased supply of educated labour will simply migrate, as in Markusen (1988).

To surmount this, we adopt a model of imperfect rather than perfect labour mobility, with the focus throughout solely on educated/skilled labour.¹⁴ This model is taken from Barry (2002). Here migration is modelled using a “love of variety” approach, such that the proportion of their lives that educated individuals choose to spend in each of two locations – i.e. at home and abroad – is determined by the relative attractiveness of the locations.

Specifically, given a fixed amount of labour time (set at unity), individuals choose to work l_i hours in each of the two locations in order to maximise

$$(1) \quad U = (y)^\phi \left(\sum_{i=1,2} \mu_i l_i^\theta \right)^{1-\phi}$$

where $\theta < 1$, $y = w_1 l_1 + w_2 l_2$ and $l_1 + l_2 = 1$.

This yields the first-order condition:

$$(2) \quad (y/\sum \mu_i l_i^\theta) [(1-\phi)/\phi] \theta [\mu_1 l_1^{\theta-1} - \mu_2 l_2^{\theta-1}] = [w_2^* - w_1]$$

which yields positively-sloped labour supply functions; dl_1/dw_1 and $dl_2/dw_2^* > 0$

The ratio l_1/l_2 emerges as a positive function of μ_2/μ_1 and w_1/w_2^* , where w_2^* (the foreign wage that educated labour can earn abroad) is exogenous. Thus educated workers are seen to allocate their working life across locations in accordance with relative wages and their locational-preference bias.

An education-induced increase in the supply of skilled labour shifts the labour-supply curve to the right, reducing the domestic wage, w_1 , as in the shift from point 1 to point 2 in Figure A1 below, and triggering increased emigration. This is the kind of situation that characterised the Irish labour market in the 1980s, before the emergence of the Celtic Tiger economy. There was net outward migration between 1981 and 1991, at a rate of 5.9 per thousand, with the outflow heavily weighted towards those with a university education. The latter point is illustrated in Table A1 which compares the estimates of Fahey, FitzGerald and Maitre (1998) of the educational attainment levels of the net outflow from Ireland between 1986 and 1991 (of migrants aged between 15 and 29 at the earlier date) with the average educational attainment of this age group across the 1986 and 1991 population censuses.

¹⁴ As in Barrett et al (2002) we can assume that unskilled labour does not have the option of migrating. This can be justified for the period with which we are concerned because Irish rates of social welfare benefit had converged on those of the UK (to which most emigration was directed), while UK demand for unskilled labour was at historically very low levels.

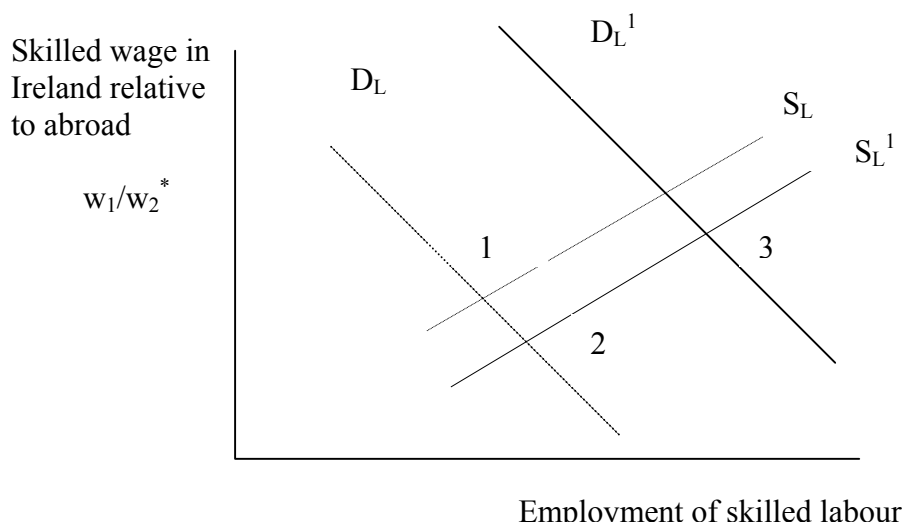
Table A1:

Educational Attainment of Emigrants and of the General Population, 1986-91

	Highest Educational Attainment (%)		
	Mid-secondary certificate or lower	Full-cycle secondary education	Third Level
Emigrants aged 15-29	19	46	35
General population aged 15-29	40	49	11

Now consider the demand for skilled labour, which in the present simple model is driven by foreign direct investment. The country's ability to attract FDI is a function of three variables. The first is a vector of country-specific characteristics such as the rate of corporation tax, the English-language environment etc. Since these remain constant throughout the analysis they can safely be ignored. The second variable is the relative price of skilled labour, w_1/w_2^* . Its role is to capture the kind of MNC behaviour implied by the account given by MacSharry and White (2000) of how Intel's choice of Ireland as its main production location in Europe was influenced by the assurances it received that adequate supplies of appropriately skilled electronics engineers would be forthcoming (in the form of Irish engineers prepared to return from Silicon Valley for example). The third variable is a 'shock' term to represent, for example, the coming into being of the Single European Market.

The model is graphically represented in Figure A1.



The Single Market shock shifts the labour-demand function to the right, to D_L^1 , driving the economy to a new equilibrium at point 3, triggering immigration of skilled labour. This result is again consistent with the Irish experience. By the late 1990s net immigration, consisting primarily though not exclusively of returning migrants, was running at around 4 per thousand of the resident population. These too were more highly educated than the resident population and resident labour force, as shown by Barrett and Trace (1998).