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GLOBALIZATIONS: THE IRISH
SOFTWARE INDUSTRY AND THE
GLOBAL ECONOMY

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Introduction¹

The dilemmas of pursuing national economic development within an increasingly globalized economy have faced the Republic of Ireland since the late 1950s. It was during this period that the Irish economy began a decisive turn away from protectionism towards free trade and an industrial development strategy based on attracting foreign investment. This paper examines these dilemmas in the case of the Irish² software industry, analyses how a number of different modes of intersection with the global economy are combined within the industry and assesses the implications for national development strategies. The industry is dominated by two quite different and relatively autonomous global production/ innovation chains - one based on transnational corporations (TNCs) and concentrating on software localization³, testing and distribution, the other primarily consisting of Irish-owned firms producing niche software products for export. I examine how these two innovation chains shape one another and structure the options for national development strategies in the software industry.

The debate on globalization centered for quite some time on whether the global economy was

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² 'Irish' refers only to the Republic of Ireland in this paper as the software industry in Northern Ireland is much smaller, has its own set of quite distinctive characteristics, is subject to a different policy regime and has developed in relative isolation from the industry south of the border.

³ 'Localization' of software refers to the process of customizing existing software packages for specific national and linguistic markets. The main activity is the translation of the text but it may also involve changing date formats, letter formats and other culture-specific aspects of the software. In U.S. software companies the work of designing the software programme so that it can be customized in this way is called 'internationalization' and is generally carried out in the U.S. The work of actually customizing the programme for specific markets is called 'localization'. This work is relatively uncomplicated. This work of 'localization' should not be confused with the socio-economic processes of the 'localization' or 'territorialization' of production and innovation which has been discussed briefly above.

becoming more and more globalized (Bluestone and Harrison, 1982; Reich, 1991) or whether there was a countervailing trend towards the emergence of territorialized 'industrial districts' or 'learning regions' (Piore and Sabel, 1984; Saxenian, 1994; Storper, 1997). From the debate over these literatures has emerged a recognition that globalization consists of a diverse set of processes linking various locations and even 'learning regions' around the world in a new system which has "an enduring architecture and a variable geometry" (Castells, 1997: 145; Amin and Thrift, 1994). The global economy is not a homogenous entity characterized by an increasing 'placelessness' of economic activity and innovation (Reich, 1991). It is instead an economy where specific places are linked together through transnational corporate structures, alliances and strategies and where these corporate production and innovation chains are themselves embedded in institutional frameworks enabling them to function efficiently. The apparent homogeneity of globalization is mediated through a diverse array of corporate and institutional structures and strategies (Gereffi, 1994; Castells, 1997).

This paper describes how two innovation chains⁴ emerged in the Irish software industry and how each has developed together with a set of supporting institutions. The bargains made by the firms in these two innovation chains with the state and with the associational institutions which support their efforts structure their relationship to the local labour market and the local economy. The paper shows how the interests of these two sets of firms are sometimes at variance in the labour market and shows how the institutional embeddedness of these firms, so essential to their effective operation, makes finding a lasting accommodation between the interests of foreign and Irish firms more difficult. Ireland is an excellent case in which to examine these issues as it has become deeply globalized in terms of trade, investment and migration since the late 1950s. The Irish economy has been one of the fastest growing in the world in the past 10 years and the Irish software industry one of the most dynamic small software industries in the world. Indigenous Irish software companies have sales of the same

⁴Although there are other modes of intersection with the global economy within the Irish software industry, most notably a small number of TNCs which have relatively sophisticated development operations and an indigenous computer services sector which is oriented mainly to the domestic market, the two sectors analyzed in this paper are the most significant empirically and theoretically.

order of magnitude as India and Israel although they are more product oriented than India and perhaps more export oriented than Israel.

The Two Globalizations of Irish Software⁵

Employment in the Irish software industry is split relatively equally between foreign and Irish owned (indigenous) firms (see Table 1). However, the two sectors are quite different and although they intersect in some sub-sectors of the industry foreign and indigenous firms have developed relatively separately within the industry.

Table 2: Number of Companies, Employment and Revenues of Foreign and Irish Ownership in the Irish Software Industry, 1987-1993.

| <i>Year</i> | <i>Foreign Owned</i> | | | <i>Irish Owned</i> | | |
|-------------|----------------------|-------------------|------------------------|--------------------|-------------------|------------------------|
| | <i>Firms</i> | <i>Employment</i> | <i>Revenue (\$ m.)</i> | <i>Firms</i> | <i>Employment</i> | <i>Revenue (\$ m.)</i> |
| | | | (<i>% of total</i>) | | | |
| <i>1987</i> | 25 (15%) | 600 (33%) | NA | 140 (85%) | 1230 (67%) | 65 (NA) |
| <i>1991</i> | 74 (20%) | 3992 (51%) | 2465 (91%) | 291 (80%) | 3801 (49%) | 234 (9%) |
| <i>1993</i> | 81 (19%) | 4448 (50%) | 2739 (88%) | 336 (81%) | 4495 (50%) | 368 (12%) |
| <i>1995</i> | 93 (19%) | 6011 (51%) | 4125 (87%) | 390 (81%) | 5773 (49%) | 610 (13%) |

Source: NSD (National Software Directorate), 1995; An Córas Tráchtála, 1987

In the Irish software industry it is particularly important to take account of the different levels of technical sophistication of the work done in different firms. The role of the multinationals and

⁵The data in this paper come from 120 interviews carried out in Silicon Valley and in Ireland between October 1995 and September 1997, industry journals and other documentary sources and a survey of software firms in Ireland carried out in June and July 1997. The response rate to the survey was an above average 54.5%, the sample was reweighted to reflect the size and ownership of the survey population and 6 companies were removed from the sample because they received over 60% of their revenues from hardware.

the ongoing controversy over the quality of the work carried out in them is an area of particular interest. Table 2 shows the percentage of indigenous and multinational firms engaging in particular activities within the company.

Table 2: Percentage of companies engaging in particular innovation, production and business functions.

| <i>Activity</i> | <i>Irish</i> | <i>Multinational</i> | <i>Chi-Square Significance*</i> |
|---|--------------|----------------------|---------------------------------|
| Basic Research (not product development) | 41 | 35 | n.s. |
| Planned Development of New Products | 75 | 68 | n.s. |
| Testing of Existing Products | 69 | 75 | n.s. |
| Localization of Existing Products | 30 | 58 | .01 |
| Porting of Existing Products to New Platforms | 46 | 61 | .05 |
| Pre and Post Sales Product Consultancy | 72 | 67 | n.s. |
| Programming and Systems Integration Services | 69 | 66 | n.s. |
| Business Solutions Consultancy | 60 | 46 | .07 |
| Technical Support | 83 | 68 | .01 |
| Telemarketing | 29 | 28 | n.s. |
| Sales and Marketing | 76 | 67 | n.s. |
| Assembly and Packaging | 18 | 34 | .01 |
| Logistics and Distribution | 20 | 35 | .02 |

* indicates statistical significance level for difference between Irish and multinational firms

There are clear differences between Irish and multinational companies. The multinational companies are significantly more likely to be involved in the 'low-end' activities of localization, porting and assembly/ packaging and logistics/ distribution (and testing to a lesser extent). Irish firms are significantly more likely to be involved in technical support and business solutions consulting. Irish firms are also marginally more likely to be involved in carrying out basic research,

developing new products (despite the greater product orientation of the multinational sector) and sales and marketing. The differences between the Irish and multinational firms are not statistically significant in these areas however. This may be because the form of the question simply asks whether the companies engaged in the activity at all and does not measure the extent of the company's commitment to e.g. research or product development. It may therefore fail to distinguish between companies heavily focussed on technical development and those companies carrying out a minor amount of development alongside their main work of localization, porting and so on. It is clear that Irish companies are much less likely to be involved in the less technically sophisticated work, are marginally more likely to be involved in development and research (and interviews suggest that the difference is larger than the survey results reveal), and are much more likely to have technical support and business solutions operations. In short, Irish companies tend to have a more rounded software development business model while the multinational firms show greater specialization in the lower end of the software development life cycle - although there are also a number of multinationals carrying out relatively sophisticated work.

These results are broadly in line with the interpretation of the two sectors as occupying quite different positions in global software production and innovation chains (Gereffi, 1994). The subsidiaries of the TNCs are largely carrying out lower-level tasks while the main development tasks remain in the company's home country, despite some upgrading in the activities of foreign companies (Ó Riain, 1997). The Irish companies, although small, are often competing in technically sophisticated global niche markets. Although 11% of their workforce in 1995 was overseas (NSD, 1995) core corporate and development functions remain in Ireland.

Institutional Embeddedness of Global Innovation Chains

Foreign software firms have been attracted to Ireland by the availability of well educated, English-speaking technical labour (still relatively cheap compared to US software labour although cost is becoming a less important factor), attractive grants packages and a guaranteed

rate of 10% corporate tax until 2010, an excellent telecommunications infrastructure and a location with the European Union. This investment began to take off after the mid-1980s when Microsoft and Lotus located first software manufacturing and then software localization in Ireland. This localization sector grew rapidly and soon began, through the encouragement of the Irish Industrial Development Authority (IDA) and the Irish born managers of these new operations, to develop a supplier base of assemblers, manual printers, disk duplicators and so on. These manufacturing and logistics oriented firms are not included in the survey figures in this paper. These Irish suppliers grew rapidly and in contrast to an earlier round of 'branch plant' electronics investment this new software investment appeared to be much more deeply embedded in the local economy (Jacobson and O'Sullivan, 1994; Ó Riain, 1997; Coe, 1997). However the territorialized software localization complex in Ireland, while continuing to grow, was also subject to further rounds of internationalization with the most successful Irish suppliers becoming global partners to their main customers and international localization and turnkey services providers such as Stream, Gecap, Berlitz, Banta and so on either setting up in Ireland themselves or buying up local firms (Ó Riain, 1997; Jacobson and O'Sullivan, 1997). The TNCs which did build significant software development operations in Ireland were often able to do so through some corporate 'intrapreneurialism', taking advantage of the increasingly decentralized corporate structures to find opportunities for development work outside of their official corporate 'mandate'.

The foreign owned sector in Ireland, which remains the fastest growing sector of the economy, has been an object of industrial policy since the move during the 1950s away from protection and towards a reliance on foreign investment (Breen et al., 1990; O'Malley, 1989; O'Hearn, 1990). In this period the Irish state has built up a significant institutional capacity to attract foreign investment and to provide for its needs. The IDA has become a significant force in Irish industrial policy, dominating the setting of the industrial policy agenda as an independent force within the civil service and separate from the Department of Enterprise and Employment (Jacobsen, 1994; O'Malley, Kennedy and O'Donnell, 1992: 131). The institutional strength of the IDA has helped to perpetuate the foreign investment centered industrial policy agenda and

the IDA might be argued to be the representative of foreign industry within the Irish state as much as it is the representative of the Irish state dealing with foreign investors.

However, it has also built up its own capacities and fostered other institutions which assist it in its operations. The IDA has built a network of international offices, especially in the US which is the main source of foreign investment, and these offices are now staffed with very experienced executives. The IDA is recognized internationally as the most effective national agency at luring foreign investment and has been a model for many other countries' efforts to build up such a capacity. Within Ireland it has good relations with many of the universities and together with them tends to form an alliance in favour of expanding the education system over the complaints of the Department of Finance. The IDA has also helped to build up a tissue of institutions and programmes which increasingly underpin the effectiveness of software TNCs in Ireland - these include an industry group focussed on localization run through the Localization Resources Centre, a network of institutions which provide technical assistance and programmes within the IDA to support the development of linkages to sub-suppliers and to the universities. The foreign investment sector has become thoroughly institutionalized within the Irish industrial policy regime and this production and innovation chain, although still vulnerable to potential capital mobility, has become embedded in a set of national institutions.

The indigenous software industry developed quite differently although the national network of supporting institutions has been if anything more important in its development. The early focus of the Irish state on attracting foreign investment and the historical failure to create an indigenous bourgeoisie left Irish industry weak through the 1960s and 1970s and collapsing when economic crisis hit in the 1980s. However, the indigenous software sector grew steadily from the late 1970s on. The key factors which explain that growth are the emergence of Ireland (and in particular Dublin which contains 75% of all software employees) as a learning region, in sharp contrast to the earlier failure of the Irish state to develop an effective 'national system of innovation' (Mjoset, 1992). This had three main components - a decentralized small firm based industry structure which was given cohesion and integration by employee and managerial social

networks; an increasing emphasis within the state on developing indigenous industry from the mid-1980s onwards; and the creation of a set of institutions half-way between the state and industry which promoted business and technical learning within the industry in a flexible yet developmental manner. I will briefly review each of these three factors although limitations of space allow no more than an overview of the dynamics of each.

The infrastructure of open access to international technology, an educated labour force and an upgraded telecommunications system provided the conditions for a learning industry. However, these factors only provided the raw material for the development of the industry with the TNCs providing an early stimulus and a valuable training ground for some managers but not accounting for the later growth of a genuinely innovative and sustainable indigenous industry. Specialized communities of practice emerged in specific sub sectors of the Irish industry on the basis of a critical mass of interest and resources in certain areas. These leading sub-sectors were related to the state's efforts to upgrade the infrastructure - the early software exports were based on access to international companies, the Computer Based Training sector on the upgrading of technological education, the communications software and systems software sectors on the upgrading of the telecommunications system and the continuing development of third level computer science and engineering education. These sub-sectors became arenas which defined loose communities of practice within the industry which were the basis of further learning.

The learning system of the Irish software industry organizes itself through informal social networks which link an industry of decentralized small and medium sized firms (few firms have over 250 employees). These informal networks are structured by ties to users and to technologies and are made coherent by a common sociable culture and emergent 'counterculture' of 'technical capitalist development' opposed to the traditional clientelism of Irish politics and economics. These networks provide the basis for dynamic learning, organizational improvement and ultimately industrial development. The software industry also benefits from its place at the centre of an industry 'cluster' (O'Gorman, O'Malley, Mooney, 1997). In this respect the Irish software model of development is closer to the decentralized Taiwanese model than to the more

hierarchical Korean model (Amsden, 1989; Castells, 1997) and to the Silicon Valley model than to Route 128 (Saxenian, 1994). These decentralized networks and communities of practice are in large part consistent with the accounts of regional development provided by the 'learning regions' approach (Saxenian, 1994; Storper, 1997).

The second factor relates to a change in state policy regarding indigenous firms. The state, and the IDA in particular, came under severe pressure in the early 1980s regarding its focus on attracting foreign investment when a major consultancy report was severely critical of the policy (Telesis, 1982). This set off a debate on the role of the IDA which ultimately, albeit gradually, led to a shift in state policy towards a greater focus on indigenous industry, a greater selectivity in grant aid, and the use of grants to develop company capabilities in areas such as R&D, management development and marketing (O'Malley, Kennedy and O'Donnell, 1992; O'Malley 1992). In software the state agencies may have been somewhat surprised to find an indigenous industry developing under their nose but they did move to provide it with some resources. They increased grant aid to indigenous firm significantly from 1983 on and through a process of trial and error built an institutional infrastructure to support the industry, beginning with the ill-fated National Software Centre from 1984 to 1988. There was a clear shift in Irish industrial policy towards indigenous industry in the mid-1980s towards a more 'developmental' role (Evans, 1995). The state took a role as educator and promoter of best practice within the industry, bypassing the clientelist relations which had existed for years in large parts of the agricultural and property sectors (O'Toole, 1995; MacDonald, 1985).

This shift in state policy was made possible by a crisis in Irish industry between 1980 and 1987 when indigenous industry employment fell by 22% and foreign industry employment by 11% (O'Malley, 1992) rapidly undermining the legitimacy of the existing industrial policy model. Nonetheless, the foreign investment model remained dominant even as a more developmental approach to indigenous industry was put in place alongside it. These changes were reinforced in the late 1980s by the availability of EU funds for science and technology programmes. These funds allowed the creation of a new institutional space within which the new industrial policy

for indigenous firms could be developed. Finally the dual nature of the Irish industrial policy regime was confirmed when in 1988 the IDA reorganized itself into foreign and Irish industry divisions and ultimately in 1994 when three separate bodies were created - IDA Ireland to focus on foreign industry, Forbairt to develop indigenous industry and Forfás to provide strategic analysis and policy review.

The third factor supporting learning in the indigenous industry is the tissue of centres, programmes and industry fora which are state-sponsored organizations but which fall on the boundary between the state, industry and the universities. Included in this are centres (typically located on university campuses) such as the National Microelectronics Research Centre, National Microelectronics Applications Centre, the Centre for Software Engineering, a range of programmes for advanced technologies which promote networks of researchers and firms and a variety of innovation centres and technology centres which create links between universities and firms. These centres are typically set goals for earning a certain proportion of their own costs through consultancy but they are also set goals regarding their service to the industry, thus maintaining their developmental focus. For example the Centre for Software Engineering is evaluated in part on the percentage of software firms in Ireland conforming to ISO9000 quality standards.

Even the state body which has direct responsibility for the software industry - the National Software Directorate within Forbairt - falls somewhere between state and industry. Formed with EU funding in 1991 in response to demands from industry, the NSD staff is drawn both from within the IDA and from industry. Its two directors have been respected figures from within the industry - the first an MD of a successful indigenous firm, the current director the ex-MD of ICL Ireland. Indeed many of these centres and programmes are populated by people with work histories straddling state, industry and academia. The mode of state intervention in the Irish software industry certainly seems consistent with Peter Evans' model of the 'embedded autonomy' of the state where the state has close ties to private capital but is autonomous enough to maintain a developmental agenda for the industry (Evans, 1995). However, while Evans

emphasizes the personal social networks between capital and state elites and the bureaucratic administration of the state as the sources of embeddedness and autonomy respectively, the Irish software experience directs attention to how state development goals may be achieved through a mode of associational governance (Cohen and Rogers, 1992; O'Donnell, 1995). This analysis of the Irish state suggests that it is possible to combine the 'learning region' and 'embedded autonomy/ developmental state' perspectives by analyzing how these aspects of industrial development are integrated in empirical cases - in this case, and perhaps typically, through associational mechanisms of governance and industrial promotion. In the Irish case these associational mechanisms might be argued to be the glue which holds the broader set of state, educational and industry practices, networks and institutions together

We can see then that the two dominant sectors in the Irish software industry, characterized by their specific place in global production/ innovation chains, are embedded in quite different and largely separate sets of institutions within the Irish industrial policy regime. These institutions enable them to function efficiently and are the underpinning of the dynamic system of innovation which is at the heart of the growth in output, exports and employment in Ireland in recent years. These institutions also stabilize a certain set of relations and bargains between the various participants. However, these bargains may remain relatively impervious to changing conditions or may come into conflict with the requirements of bargains made in other institutionalized sectors of the industry and the economy. In the rest of this paper I will outline some of these conflicts in relation to the Irish software labour market, showing how underlying tensions between labour market practices in each of these sectors are being brought to the fore in the context of pressures on labour supply. This results in increasingly open political conflict between representatives of the two sectors. Finally I will briefly raise the issue of the relation of these conflicts within the software industry to an alternative mode of economic governance outside the industry - the neo-corporatist social partnership in place since 1987 which has also made a very significant contribution to the Irish economic upgrading (O'Donnell and O'Reardon, 1996).

Labour Market Dynamics and Global Innovation Chains

The different structure of the foreign and indigenous sectors is reflected in the variation between the sectors in the 'density' of engineers in the workforce - engineers as a proportion of total employees (Table 3).

Table 3: Percentage of Engineers in Workforces of Irish and Multinational Firms

| | <i>Irish</i> | <i>Multinationals</i> |
|---|--------------|-----------------------|
| <i>Percentage of Companies with the following proportions of engineers in their workforce</i> | | |
| 0-19% Engineers | 24.7 | 37.6 |
| 20-49% Engineers | 35.0 | 15.4 |
| 50-79% Engineers | 33.1 | 24.2 |
| 80-100% Engineers | 6.5 | 21.0 |

There is a greater concentration of firms at the higher and the lower ends of the spectrum among the multinationals. This reflects the broader range of business functions and occupations on the indigenous side of the industry. The tendency for multinationals to be focussed on a particular piece of the production process manifests itself in a low density of engineers when that process is particularly 'low tech' and a higher density when it is a more sophisticated operation. This variation among multinational firms is strongly related to the functions undertaken in the companies - the mean proportion of engineers in companies carrying out product development, porting and testing is above 50%, the mean for companies carrying out localization, sales consulting or business consulting is between 40 and 50% and the mean for those carrying out telemarketing, assembly and packaging or logistics and distribution is around 30%.

The same patterns are not as strong for indigenous companies and there is less variation among the Irish companies in any case. However there is a tendency for larger and more service-oriented indigenous companies to have a greater proportion of engineers in their workforce with a (relatively weak) correlation of .22 between proportion of engineers and total employment and a correlation of .24 with the proportion of revenues gained from services.

The level of demand for software engineering labour varies a great deal from company to company and from sector to sector within the industry therefore. This is a critical and controversial issue within the industry at the moment as increasing pressure on the labour supply has resulted in rising wages and higher turnover within the industry - in 1996/1997 a quarter of the firms surveyed had turnover of 25% or more. Pat Rabbitte, then Minister of State at the Department of Enterprise and Employment, suggested to not very receptive audiences at the annual conferences of the Irish Software Association in 1996 and 1997 that software companies had exaggerated their difficulties in finding staff, that they were unnecessarily using computer science degree graduates for tasks such as localization and testing and that they were ignoring the potential of training schemes for tapping the still huge pool of unemployed youth in Ireland. The Irish Software Association, representing mainly indigenous companies, issued a report in March 1998 calling on the government to put less resources into attracting TNCs which would only compete for labour with the indigenous companies. Indeed one CEO of an indigenous software company told me "The other thing I'd like is someone to go out to Dublin Port and put up a sign saying 'We're Closed'". Meanwhile the managers of many TNCs argue that they were promised graduate labour when they came and they regard it to be the responsibility of the state to provide that labour. As one well-known TNC General Manager put it "The job of the IDA and the companies is to create demand, and then point out our supply needs - to meet supply is the job of the government and the universities". Indeed the state did provide 250 million Irish pounds in 1997 to spend on future information technology skills needs. They also formed a commission, under the chairmanship of Chris Horn, CEO of Iona Technologies (one of the most successful indigenous companies), to decide how the money should be spent and to try and encourage companies to put up some matching funds for training and education. There is certainly conflict between the strategies and interests of the two sectors therefore. The rest of this section will examine the hiring practices of foreign and indigenous firms with a view to understanding the roots of this conflict and will then explain the persistence of the conflict in terms of the institutional bargains which underlie each of the two sectors within the industry.

Firms were asked to circle each of 10 levels of education at which they would usually recruit

employees into particular grades of work. Table 4 shows the results - the percentages will not add to 100% since companies could check as many answers as applied to their company.

For software development engineers, hired by almost every firm in the survey, computer science (CS) and engineering graduates are clearly the main source of employees. However, people with technical diplomas or certificates, a post graduate diploma in IT or a postgraduate degree can also find their way into the development role. In fact, software development is almost the only job into which Masters or Ph.D. graduates are hired. There seems to be little overqualification among employees with postgraduate degrees therefore, at least as measured using these relatively crude occupational categories.

CS and Engineering graduates also dominate the ranks of software localization engineers, although to a lesser degree. The only adjustment made for the lower skill level of this work is a somewhat greater willingness of indigenous companies to hire people with only a Leaving Certificate and of multinationals to hire people with a non-technical diploma. Nonetheless interview data suggested that this work was held in low esteem in the industry - one indigenous software development company MD claimed "localization isn't even software half the time" while an industry promoter who had worked closely with the software localization companies told me "the companies aimed at getting computer science graduates but they just got bored doing it, then they aimed at arts graduates with computing experience. But testing scripts is very boring, the graduates are looking for more money now. I'm quietly smiling now because the employees can choose jobs, it makes the companies think".

Table 4: Qualification levels at which Irish and Multinational companies usually recruit employees into a range of occupations

| Staff Grade | | Not Appl- icabl e | Leav- ing Cert.. | Diploma/ Certificate | | Degree | | | Degree plus IT Dip. | Mas- ters | Ph.D. |
|---------------------------------------|----|----------------------------|------------------------|-------------------------|------------------------|--|---------------|--------------|---------------------------|--------------|-------|
| | | | | Tech- nical | Non- Tech- nical | Comp -uter Sci. / Eng- ineer- ing | Other Sci. | Non- Sci. | | | |
| Engineer: Software Development | IR | 10 | 4 | 28 | 1 | 73 | 12 | 7 | 27 | 19 | 6 |
| | MN | 16 | 0 | 33 | 0 | 83 | 19 | 10 | 31 | 23 | 2 |
| Engineer: Software Localization | IR | 74 | 12 | 30 | 2 | 56 | 4 | 6 | 12 | 4 | 0 |
| | MN | 59 | 0 | 35 | 9 | 70 | 22 | 13 | 26 | 4 | 0 |
| Engineer: Software Test | IR | 41 | 10 | 51 | 8 | 42 | 6 | 4 | 11 | 4 | 3 |
| | MN | 38 | 3 | 57 | 9 | 53 | 9 | 9 | 23 | 0 | 0 |
| Technical Support Rep. | IR | 30 | 10 | 53 | 5 | 40 | 7 | 7 | 14 | 3 | 2 |
| | MN | 46 | 7 | 43 | 7 | 52 | 13 | 13 | 13 | 0 | 0 |
| Technical Writer | IR | 66 | 11 | 23 | 11 | 36 | 17 | 19 | 14 | 9 | 3 |
| Telesales Reps. | IR | 68 | 42 | 18 | 23 | 8 | 5 | 3 | 3 | 2 | 0 |

It is when we come to software test engineers and technical support representatives - occupations which involve little direct engineering of the product - that we do see a significant change. Technical diploma and certificate holders are the predominant source of employees. CS/ Engineering degree holders remain important but less so than diplomas and cert holders. Multinational companies continue to favour hiring CS/ Engineering graduates for technical support while Irish companies are more likely to draw on diploma and cert. holders. There are also some expanded opportunities for those with just a Leaving Cert. while science graduates and IT diploma holders remain a smaller but significant part of the labour pool. A third of all companies do not hire specifically for the software test function and these companies are likely to incorporate testing into the work of the software development engineer. However a significant number of companies do seem to distinguish software test work from development work and to

assign it to diploma and certificate holders. This was borne out in interviews where managers usually described either a separate test / QA department within the company or a separate role as 'test engineer' assigned to one team member in each team.

Technical writers are hired by one-third of indigenous companies (the figures for multinationals are not included as the overall number of hiring firms was too small). CS/ Engineering graduates are still the most popular employees but this is the most likely track for holders of other science degrees and non-science degrees. It is also the second most popular area in which Masters graduates are hired by the industry - presumably for their ability to clearly explain the more complicated technical areas.

The market for telesales representatives indicates the degree of professionalization of the other software occupations and shows the educational profile of the lower paid end of the information economy. People with a Leaving Certificate (a more demanding version of the SAT) only are the most popular employees with most other employees being hired from non-technical diploma, certificate and degree backgrounds. Nonetheless there are some people from technical backgrounds being hired into telesales. It should also be noted that even at this level of the industry the Leaving Cert is a minimum requirement for employees.

There are then relatively clear paths for people from particular educational backgrounds in entering the software industry. People with less than a Leaving Certificate are rarely hired (the percentages are so low, typically zero, that they were not reported above). Those with only a Leaving Cert. can hope for a job in localization, testing or tech support in an indigenous firm but can realistically expect a telesales job. Technical diploma holders are hired by about a third of firms for software development and localization but are more likely to be hired for non-engineering tasks such as test and technical support. CS and Engineering graduates are the basic source of employees for development, localization and technical writing and many are also hired into test and tech support. Masters and Ph.D. holders are typically found in development work and to a lesser degree in the technical writing field.

Multinational companies are less likely to hire people from either the higher or lower end of the educational spectrum. They also appear more likely to use CS/ Engineering graduates for the less challenging tasks of localization, test and tech support. Their labour market focus is clearly on CS/ Engineering graduates and to a lesser extent on technical diploma holders and science graduates. Indigenous companies solve their employment needs from a greater range of sources and appear to concentrate their graduate employees more in the more challenging technical areas.

Of course companies may employ people from more than one educational background to work side by side at the same work. However, Table 5 shows that this is less the case within individual firms than within the industry as a whole. For example, of those companies which employ CS/ Engineering graduates to do software development work only one in four also employ technical diploma graduates to do development or localization work. There are significant numbers of firms which employ CS/ Engineering graduates to do both development and localization work. This indicates that firms tend to have a hiring focus on either diploma or degree holders for development or localization work but rarely do they hire both diploma and degree holders, whether to work together on the same work or to divide the tasks between them. Firms hiring for localization work therefore draw on the same labour pool as do those firms hiring for software development work and make the pool of graduates available for development work smaller.

There is more division of labour between educational levels when it comes to test and tech support work. Although degree holders still predominate at these levels in multinational companies who hire them for development work, this is less clearly the case than for the localization function. Among indigenous firms there is a clear tendency for many firms which hire degree holders for development work to hire from a different labour pool - the technical diploma holders - when hiring test or tech support employees.

Table 5: Patterns of hiring of Computer Science/ Engineering degree holders and technical diploma/ certificate holders

| <i>Of those employing CS/ Engineering graduates for Software Development:</i> | | | <i>Of those employing Technical Diploma or Certificate graduates for Software Development:</i> | | | | | |
|---|----|--------|--|----|---------|----|-----|--------|
| <i>% employing CS/Engineering graduates for:</i> | | | <i>% employing Technical Diploma graduates for:</i> | | | | | |
| <i>Software Development</i> | | | | | | | | |
| IR | - | - | IR | 23 | (N=125) | IR | - | - |
| MN | - | - | MN | 25 | (N=40) | MN | - | - |
| <i>Software Localization</i> | | | | | | | | |
| IR | 81 | (N=31) | IR | 23 | (N=31) | IR | 79 | (N=14) |
| MN | 82 | (N=17) | MN | 24 | (N=17) | MN | 100 | (N=7) |
| <i>Software Testing</i> | | | | | | | | |
| IR | 56 | (N=82) | IR | 51 | (N=82) | IR | 78 | (N=32) |
| MN | 64 | (N=28) | MN | 46 | (N=28) | MN | 100 | (N=11) |
| <i>Technical Support</i> | | | | | | | | |
| IR | 49 | (N=90) | IR | 59 | (N=90) | IR | 83 | (N=36) |
| MN | 57 | (N=23) | MN | 30 | (N=23) | MN | 90 | (N=10) |

There are therefore a number of clearly distinct patterns of labour demand and a range of hiring strategies at work in the software labour market. Demand for software development and software localization workers is relatively homogenous with degree holders dominating. There would therefore appear to be a significant amount of over-qualification of employees among localization engineers and an under-use of skills. Indigenous and foreign firms are similar in this respect but the issue is most serious among the TNCs as they employ the bulk of localization engineers.

The demand for test and technical support workers differs between indigenous and multinational

companies with diploma holders more important to indigenous companies while degree holders still predominate as the multinationals' hiring pool. As the column on the right in Table 5 shows there is also a small pool of companies which are focussed almost exclusively on the technical diploma pool and who hire heavily at all levels from that pool.

The data above refer mainly to the labour market for less experienced employees. However, other data show that TNCs in particular rely on internal promotion as their main source of senior technical staff, project managers and senior managers. This suggests that these early employment decisions may have a very significant impact on the labour supply available to different sectors of the industry. The different strategies with respect to labour supply help to explain some of the conflict between the foreign and indigenous firms within the Irish software industry regarding how best to handle the 'skills shortage'. In the concluding section of this paper I will examine how the institutionalization of the two sub-sectors around different elements of global software innovation chains shapes these conflicts over the employment effects of globalization in a rapidly growing industry.

Conclusion: Globalizations, Institutions and Interests in the Software Labour Market

It is clear from the analysis above that individual companies tend to focus on particular segments of the labour supply in their hiring practices, disregarding other relevant labour pools. This is particularly true of the TNCs who focus very heavily on the undergraduate degree holder labour pool for almost all occupational categories within the industry. TNCs are more likely than indigenous companies to hire any type of degree holder or masters degree graduate. Irish owned companies are more likely to turn to certificate and diploma holders for testing and technical support positions and are generally more diverse in their sources of employees. The indigenous firms are somewhat more likely to hire people with only a Leaving Certificate qualification, although it is extremely difficult for people with such qualifications to enter the industry.

Other survey data show that TNCs are more likely to promote senior technical staff or managers

internally from within the firm while indigenous firms will turn more often to the local labour market (probably because they are significantly smaller companies). Overall then TNCs are more likely to hire computer science and engineering graduates out of the local labour pool when they are beginning their careers and they are also more likely to keep them within the firm. TNCs may also have a 'boom and bust' effect on the local labour market as the size of a new arrival's operation is often significant in relation to the overall size of the industry. For example my figures show that 27% of employees in the industry were in the nine largest TNC firms (out of a sample of 248 firms). The arrival of such a firm or the departure of an existing firm can have a significant effect on the local labour market at any particular time.

The different hiring strategies of the TNCs and the Irish firms are linked in large part to the nature of their embeddedness within the institutions which support them in the Irish economy. The availability of skilled graduate labour is a key component of the package which the IDA offers prospective foreign investors. Therefore the labour supply which the TNCs will draw on is defined by their bargain with the Irish state when they enter the country. This translates, except in a minority of cases, into the attitude that education and training of the potential labour force are the government's problem - except for firm-specific training which the TNCs see as appropriate for them to carry out. This makes the TNCs relatively inflexible in their approach to the 'skills shortage', an inflexibility rooted in their initial bargain with the state and institutionalized in their relationship with IDA Ireland which promises to be a one-stop shop to deal with their problems once in Ireland. Indeed IDA Ireland has put consistent pressure on politicians over the past two years to increase the supply of computer science graduates. I attended a business breakfast where the speakers were a leading figure in IDA Ireland and a professor from one of the universities and where the audience, almost all General Managers of US software companies, were encouraged to put pressure on politicians to increase spending on computer science and engineering graduate education. IDA Ireland, the TNCs and parts of the education system form a powerful bloc applying pressure around the issue of skills shortages.

Indigenous companies do not have such a bargain at 'the point of entry' into the industry. Instead

they are embedded in dense industry, associational and state networks. These more diverse networks and the lack of an institutionalized focus on degree holders seems to allow them to diversify their sources of labour. This is ironic in some respects as it could be argued that the industry would be better served if the degree holders worked in the indigenous development oriented companies rather than in the localization area. Indeed some of the universities explicitly see themselves as educating graduates for development and even specifically the indigenous sector. One longtime university lecturer and administrator told me "We don't aim to produce people for localization, we aim to produce people for indigenous high tech firms, we are providing grads with the ability to develop as the industry develops. We don't exclusively go for the indigenous industry but that's what we like to see".

These different institutionalized strategies, shaped by their different position in the global economy, serves to shape the interests of the two sectors in the politics of the skills shortage. The indigenous companies, as we have seen, resent the TNC draining of the labour pool for software developers - at least in part through the use of overqualified graduates. However, while the TNC managers (usually Irish themselves) may sympathize, they tend to argue that they are simply sticking to the bargain struck when they entered the country. Furthermore, a representative from the Department of Enterprise, Trade and Employment, while also sympathizing with the concerns of indigenous companies on this issue, cautioned in March 1998 that IDA Ireland "cannot remove themselves from the marketplace" (*IT's Monday*, March 29th. 1998).

The indigenous sector also seems to be somewhat ambiguous in its attitude to TNC investment. A recent strategy document from the Irish Software Association argues that "We must seek to attract industry which is higher up the added value chain, is less labour-intensive, and is not in direct competition with indigenous industry". However as one commentator pointed out: "Surely, though, international projects that are higher up the value chain are more likely to compete with native companies for the best available talent ? There now appears to be a genuine tension

between the demands of the indigenous sector for more action to combat the skills shortage and IDA Ireland's ongoing success in attracting mobile investment ” (*IT's Monday*, March 29th, 1998).

This ambiguity results in part from an unwillingness on the part of industry representatives to acknowledge the deep institutional roots of the various sectors of the industry. Indeed, the solution would seem to be a renegotiation of the institutional bargain with the TNCs (at least) and the opening up of diverse routes into the software labour market with appropriate institutional links to the sectors where that labour is best suited and best developed. However, this solution raises the spectre of state intervention in the dynamics of the labour market itself while the state has until now limited itself to managing labour supply in the software industry. If the state was to become involved in labour market ‘matching’ that might open the door to further future intervention.

There is certainly a potential constituency for a deeper state role in an active labour market policy for industries such as software. This constituency is the trade union movement which has been a driving force behind the neo-corporatist social partnership model of macroeconomic management since 1987 (Hardiman, 1992). The union movement is becoming increasingly concerned about the increasingly rapid growth of non-union sectors such as software and is putting increasing pressure on the state to facilitate union recognition and micro level enterprise ‘social partnership’. They would no doubt welcome a chance to build some state or associational institutional capacity within the software labour market. However, the unions are weak in these sectors and the firms are actively anti-union (Gunnigle, Morley, Turner, 1997) which means that this strategy for reconciling the difficulties within the labour market is unlikely to be put in place any time soon.

Perhaps the more likely strategy for the future is the emergence of a professional body for software engineers or information technology professionals which could be closely allied to the indigenous sector in particular. While such bodies currently exist they are of little consequence

to the everyday running of the software firms or to their labour policies. However, from the perspective of the indigenous firms, if a professional body emerged which could set a 'floor' as to the kind of work which computer science degree holders (for example) would do that might provide a solution to the problems of overqualification within the industry. The indigenous firms would be more likely to welcome an alliance with an elitist professional body than with the more solidaristic trade unions or a state body which was in some sense accountable to the unions and the broader population. There is also considerable support for a more developed professional identity among software developers within the universities.

We have seen then that the success of both TNCs and indigenous software firms in Ireland has been built firmly on a set of institutional compromises which put in place the infrastructure and promoted the industry-wide learning essential to an industry like software. These institutions may enhance competitiveness and learning but they also 'lock in' certain practices, strategies and interests in the labour market. It turns out that these institutionalized interests are now coming into conflict in the Irish software labour market in a context of increasing pressure on labour supply, wages and employee turnover. Resolving this conflict seems to require a renegotiation of the institutional bargains underlying the two sectors. The conflict also reveals however that an unspoken element of the institutional bargain with both sectors is the non-interference of the state in the employment relations of the firms. For example even though the state shapes the management, marketing, finances, employment levels and export strategies of indigenous companies it steers clear of interfering in employment relations within the firm - even though there are certainly reasons for concern regarding over work and burnout in particular (Ó Riain, 1998).

This lack of institutional capacity within the labour market is part of the negotiated bargain underlying these globalizations. It is now serving to undermine the capacity of the state and the industry to tackle the tensions arising within the industry. Given that trade unions and professional bodies are weak and that the Irish state seems unwilling to turn too far against the TNCs, it may be that these tensions will persist for quite some time. Globalization is not a

homogenous force but is mediated through different corporate production chains and sets of surrounding institutions. The corporate structures and institutions which enable globalization may also constrain the ability of nation states to tackle national development dilemmas and ensure further successful globalizations.

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