AN OFFSHORE SILICON VALLEY?

Seán Ó Riain

ABSTRACT

This paper assesses the development potential of local inter-firm networks in Newly Industrializing Countries. This is done through an analysis of the role of such networks in the growth of the software industry in the Republic of Ireland. Transnational software companies located in Ireland developed extensive local supply networks. Local social networks and a local culture of innovation contributed to the growth of an indigenous software development sector.

While local networks can generate significant competitive advantage for a region they are inevitably internationalized as successful firms organize globally or as the region attracts further foreign investment. Corporations utilize local networks to solve problems of cost, control and innovation management in the globalization of production and corporate organization.While fostering local networks can be an effective public policy, it is not sufficient for development. The role of the state in supporting, guiding and bargaining with local firms in these networks remains a crucial aspect of development strategy.

INTRODUCTION

In December 1994 a headline in *The Irish Times*, a major newspaper in the Republic of Ireland, announced that Ireland was `Inching closer to aim of becoming Europe's offshore Silicon Valley'. This headline captures perfectly the opportunities and contradictions of local economic development in a global information economy. Newly Industrializing Countries (NICs) seek to emulate the dynamic growth and innovative environment of regions such as Silicon Valley while in a subordinate `offshore' relationship to the major

centres of the global economy, including Silicon Valley itself.

Recent research on local networks of firms has argued that such aspirations are plausible because local learning networks can at least weaken the impact of global inequalities in resources and power. Other authors argue that such local networks will inevitably be dominated by global flows of resources and transnational forms of corporate organization and that development strategies based on such networks have limited potential. This paper considers the potential and limits of fostering local learning networks as a development strategy for semi-peripheral countries by analyzing the growth of the Irish software industry over the last 10 years. It analyzes the intersection of local and global networks which characterizes the industry and shows how they constitute each other over time.

The Republic of Ireland is an ideal case in which to assess the prospects for NICs of achieving these goals. Since the late 1980s it has attracted a greatly disproportionate share of U.S. information technology foreign direct investment in Europe. It has also developed a healthy indigenous electronics sub-supply sector and a growing indigenous software industry. The information technology sector has been the driving force behind the fastest GNP and employment growth levels within the European Union in recent years - although some of this growth is illusory due to the repatriation of profits by transnational corporations (Shirlow, 1995).

Nonetheless, the Irish experience offers some valuable insights into the possibilities for building innovative local economies in an era when participation in the global economy has become a fundamental part of successful economic development strategies. Ireland's `industrialization by invitation' policy has attracted considerable public and academic skepticism over the years. However, now in the 1990s, a new debate is taking place over the effectiveness of such a policy. In this paper I examine the variety of ways in which the Irish software cluster or agglomeration intersects with the global economy and the implications of this for efforts to build a `territorial learning economy' on the Silicon Valley model. I draw on 50 interviews carried

out with managers and executives in the software industry in both Silicon Valley and Ireland between October 1995 and March 1996.

THE CHALLENGE OF GLOBALIZATION

The appeal of local learning networks to communities and policy-makers can only be understood within the context of the increasing global integration of the world economy. Before considering the dynamics of local networks we need to analyze the process of deterritorialization, the reduced dependency of certain economic functions on the particular places in which they are located, which is the focus of most theorists of globalization.

Early analyses of globalization concentrated on the search for low-cost labour by capital as a response to the crisis of Fordist accumulation in advanced capitalist countries. This search for ever cheaper labour was said to be an imperative for leading corporations if they were to sustain their competitive positions (Frobel et al, 1980). Capital mobility and the transnational organization of production cemented the power of transnational capital over local labour and drove down wages and benefits. Network forms of organization allowed the most powerful firms to shift the burden of productive flexibility onto their suppliers in particular (Harrison, 1994; Shaiken, 1994; Burawoy, 1985; Amin and Robins, 1990). The organization of regional economies into positions in hierarchical 'global commodity chains' created patterns of uneven international development (Gereffi, 1994). The ability of localities to develop relatively autonomous development strategies was constrained by the capacity of transnational corporations to use capital mobility to improve their cost structure and cement their power.

Other authors argue that a more or less fully integrated global economy has come into existence as production, technology and markets are organized on a transnational basis. Corporations do not so much pursue globalization as a strategy, rather they experience it as a condition of their existence (Castells, 1989).

The localities, firms and individuals who were able to develop their own conceptual skills and competencies and to build connections to the centres of excellence in the world economy would become the `world class' (Kanter, 1995). These connections could be based on `virtual' work teams and organizations (Reich, 1991) or on corporate organizational structures (Kanter, 1995) but the crucial connections were on a global scale. Localities should mold themselves into `milieux of innovation' and centres of learning but development would only come as they fully integrated into global networks and institutions. From this perspective the demands for flexibility, constant innovation and global connections were a fact of life for both workers and corporations, presenting both with new challenges but also opening up new opportunities.

Cost, *power* and *innovation* have all therefore been advanced as reasons why regional economies have no option but to integrate themselves as fully as possible into global networks. Within these frameworks different regions may have particular advantages over others but only the most dominant regions can assert control over their own economic and social development. Even for those regions which could forge connections to the global economy these connections were a mixed blessing. Not only were they unable to control the global processes they were part of but the pre-existing hierarchical organization of the global economy constrained their ability to create a regional dynamic of development.

THE LOCAL AND REGIONAL RESPONSE

Such analyses of the globalization of the economy could easily lead to despair on the part of both analysts and policy makers concerned with regional development, not to mention the populations of declining or excluded regions. However, over the past 15 years, a great deal of research has focused on the continuing territorial basis of economic activity and the persistent role for the region as a force in economic development. The success of certain localities, highlighted most prominently by Piore and Sabel's *The Second Industrial Divide* (1984), sparked a resurgence of hope that localities could generate a relatively

autonomous and self-sustaining dynamic of growth rather than being caught in the trap of dependency on core firms and regions.

Localities were encouraged to refashion themselves as `industrial districts' (Piore and Sabel, 1984), `industrial clusters' (Porter, 1990), `technopoles' (Castells and Hall, 1994), `regional networks' (Saxenian, 1994), `territorial learning economies ' (Storper, 1992) and so on. Although these localities were often acknowledged to have strong connections to the global economy, local networks were implicitly assumed to be the basis of self-reproducing development. Economic globalization was usually thought of as the globalization of markets and the impact of global organizational links on local networks was rarely examined explicitly. .

The literature on territorial economies provided a number of reasons why regional production systems could solve the cost, power and innovation challenges of globalization. Significant cost economies were said to result from the agglomeration of firms and industries in a specific region as traded and untraded interdependencies developed between employers, workers and regional institutions which made production more efficient (Scott, 1995;Storper and Walker, 1989). “In very general terms, territorial complexes not only lower tangible costs of transport and communication, but ease information-sharing, allow pooling of labor and fixed capital, stabilize physical and social relations, help people identify with each other (and against outside competitors), and generate distinct cultural practices over time” (Storper and Walker, 1989: 139). These factors meant that localities could develop significant sources of competitive advantage and cost economies based precisely on the fact that they were `local'.

Furthermore, although the output of ‘informational goods’ (such as software packages, books and magazines, videos) are highly portable around the world, the conditions of effective innovation and design of such ‘information-intensive’ goods (i.e. their inputs) are fundamentally territorial, according to these authors.

Innovation could be attained through collective learning and adaptability founded on relationships of cooperation and trust. Dense networks of face-to-face social relations between firms, between managers and employees, and within the local labour market were the critical sources of innovation and adaptability in the industrial system and were possible only on a spatially limited scale. Saxenian (1994) outlines the key elements of the Silicon Valley 'regional advantage' - loosely linked teams within firms, various forms of cooperation and flows of information between firms, and close links between firms and universities, business services firms and other local institutions: "Silicon Valley has a regional network-based industrial system that promotes collective learning and flexible adjustment among specialist producers of a complex of related technologies ..... The functional boundaries within firms are porous in a network system, as are the boundaries between firms themselves and between firms and local institutions such as trade associations and universities' (Saxenian, 1994:2-3). It is these interlocking institutions which sustain the social relations which are the basis of continuous learning, innovation and therefore growth. Firms which fail to develop these fluid relationships with other firms are doomed to commercial failure - firms which detach themselves from their local networks do so at their peril.

While the early emphasis in the literature was on craft traditions and networks of small firms (Piore and Sabel, 1984), the literature soon elaborated the social relations and institutional frameworks underlying these economies and extended its analysis to a variety of high-technology industries and networks including a range of types and sizes of firms (Saxenian, 1994; Scott, 1991; Sabel, 1994). The literature began to shift from an emphasis on `industrial districts', which had an almost mythical status, to the more recognizable `territorial learning economies' (Storper, 1992).

The territorialization of economic life held out the prospect to some authors of weakening some of the power inequalities observed by the theorists of globalization. Sabel (1994) argues that the paradigmatic social relations in such economies are neither historically given patterns of trust and collective sensibility, nor

purely strategic cooperation based on repeated interactions - although both of these may play a part. Instead, he argues, relations of `learning by monitoring' are at the core of these economies. Drawing on examples from the Japanese economy, he points out that parties to a business relationship monitor each other out of distrust and in the normal course of the relationship. However, monitoring can become, under the correct conditions, a way for the parties to the relationship to learn from one another through the information which is exchanged in the monitoring process. As the relationship continues in this cycle of learning and monitoring, the parties become involved in a collective project through working on a common problem. Workers in firms which are involved in such relationships begin to share certain identities and interests, although never being required to make the `leap of faith' into mutual trust which the early literature on industrial districts seemed to require of any potential candidates for participation in a network. There is at least the implication of an increasing equality and reciprocity in these relations between firms.

THE GLOBAL AND THE LOCAL

Globalization theorists tend to see localities as almost completely constrained by the structure of the global economy and transnational systems of production and innovation. Localities are forced to make themselves willing conduits of global flows in case they suffer the most disastrous fate - being ‘switched out’ of this ‘space of flows’ (Castells, 1996). Localities can move up the global hierarchy but the hierarchy remains essentially beyond the influence of the localities themselves.

Theorists of local and regional economic dynamics tend to see the global economy as the context for local economies. Inputs and outputs move between regions largely by trade and markets, not through corporate organizational structures (Storper, 1992). Where these organizational structures exist their global integration is implied to be of a loose enough nature that the dynamics of the region can be analyzed with little reference to these global networks (Sabel, 1989). Where globalization theorists take local dynamics as over-determined by global forces and flows, localization theorists take the global as merely a context which provides inputs

and takes away outputs but which has little impact on the dynamics of local development.

The historical development of the Irish software industry can shed some light on these competing claims about network forms of organization and their implications for developing regions and countries trying to move up in the international division of labour by developing such local networks. An examination of the Irish case shows that the global penetration of local networks is inevitable and that, while the network form of corporate organization does offer some opportunities to developing countries, the developmental impact of local networks is severely constrained unless specific policies exist to guide the evolution of the networks. The role of the state in guiding the development of these networks and in supporting the local agglomeration is crucial.

The new social relations of cooperation and teamwork, 'learning by monitoring' are the new `contested terrain' upon which conflicts and power struggles take place. Cooperation and power relations can coexist and indeed may operate *through* one another rather than simply having effects *on* one another. Relations of `learning by monitoring' will nearly always involve inequalities of power and resources. This means that the patterns of learning may be unequal, that the returns to learning in the relationship may be unequal and that one firm may become the dominant partner which controls the direction of the relationship.

Regional economic agglomerations and their dense business and social turn out to be crucial to the management of global flows and to the creation and maintenance of the social relations which make global networks work. Global networks do not simply flow through these regional agglomerations but are themselves *organized* by the activities of those in the regions. These regions form a 'grid of places' which are not so much receptacles of global flows nor obstacles to them but turn out to be engaged in constantly making and remaking these global connections and processes, albeit not under conditions of their own choosing (Sassen, 1995). The activities of innovative regions such as Silicon Valley and its many imitators

are closer to those of ‘global cities’ and state bodies than has sometimes been thought (Sassen, 1991, 1995).

THE GROWTH OF THE IRISH SOFTWARE INDUSTRY

The most dynamic sector in the Irish economy, particularly in the 1990s, has been the information technology sector - prompting Castells and Hall to list "Ireland's electronics agglomeration" as one of the emerging `technopoles' in the world economy (1994: 7). In 1993 electronics accounted for one third of all industrial exports, over $6 billion, and for 9% of all industrial employment with an estimated 30,000 employees in the industry (Trench, 1995). Just over 10% of employment in this industry was in Irish firms, similar to the 9% recorded in the 1980s (O'Brien, 1986). The electronics industry, and in particular computing, has been growing at a rapid rate with prominent PC makers such as AST, Gateway and Apple investing in Ireland; an influx of network product manufacturers such as 3Com; and the location of one of Intel's new wafer fabrication plants just outside Dublin (see Ó Riain, 1997).

My research however concentrates on the emerging software industry in Ireland. Software accounted for $2.8 billion in exports in 1993 and employed 9,000 people (National Software Directorate, 1993). By 1995 this had risen to $4.4 billion and 11,784. Ireland is currently the second largest exporter of software after the US - although this figure is deceptive as a great deal of revenues come from the translation, duplication and assembly of packaged software for transnational corporations such as Microsoft, Claris and Symantec. Nonetheless, indigenous software company exports increased 89% from 1991 to 1993 to reach a level of $190 million, and by another 95% to $357 million by 1995. These figures compare favourably to the performance of the much talked about Indian and Israeli software industries (see Table 1).

Table 1: Sales and Exports in the Indigenous Software Industry in India, Ireland and Israel 1993-1995*

Year	Sales ($ million)			Exports ($ million)			Exports as % of total sales		
	India	Ireland	Israel	India	Ireland	Israel	India	Ireland	Israel
1993	388	368	700	225	190	175	58%	52%	25%

1994	554	-	790	330	-	220	60%	-	28%
1995	823	610	-	485	357	-	59%	59%	-

Sources: NASSCOM (1996), NSD (1993), Israeli Association of Software Houses (1995).
Note: Figures may not be strictly comparable as survey coverage and methodologies are different.
** Figures for India include TNCs, figures for Ireland and Israel do not.*

Before going on to the analysis proper, I will briefly outline the structure of the Irish software industry. The rapid growth of the industry is illustrated in Table 2 below. Industry revenues and exports are dominated by foreign companies, although domestic companies' exports are growing both in volume and as a proportion of their revenues (see Table 1). Employment is split evenly between the Irish and foreign companies. This is very unusual in Ireland where sectors tend to be dominated either by foreign or domestic firms. 90% of employment in the electronics industry was in foreign firms in the 1980s, and this trend has continued with the renewed growth in the 1990s (O'Brien, 1986; Trench, 1995). The software industry is a perfect case therefore in which to examine the interaction of local and global factors and how they affect the growth of an industry. Furthermore, 75% of software companies and employment are located in the Dublin area and my interviews indicate that a local industry culture is emerging within the Dublin industry.

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

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

Source: NSD (National Software Directorate), 1993; An Córas Tráchtála, 1987

However, these tables give a highly aggregated view of the industry. As I have noted above, the industry is characterized by a number of quite distinct segments and production networks.

The two which I analyze in detail are:

(i) Software Logistics and Localization[1]: dominated by US transnational corporations who are carrying out low-end software development and language translation and are serviced by an extensive vendor base of printers, translation bureaus and other suppliers;

(ii) Software Development: dominated by small and medium sized Irish-owned firms who are gaining growing recognition in international technical markets, are building partnerships with US firms and in some cases even going public in the US;

The first sector is globally dominated but has an extensive local supplier base while the second emerged from a local set of dynamics but is being integrated into global business networks. The first reflects a state strategy of attracting a disproportionate share of foreign investment in a specific sector and hoping for the emergence of a local learning network around this foreign investment. The second is an example of the emergence of an indigenous industry which may then become a force internationally. In the following sections I examine the nature of the relationship between local and global actors in each of these sectors of the Irish software industry and how these relations structure the flow of resources into and out of the local economy. The co-existence of these two sectors offers an opportunity to examine different combinations of localized and globalized development and their impact on patterns of economic development.

[1]'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 and is one of the primary activities of software TNCs in Ireland. 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 above.

LOCALIZING THE GLOBAL? TRANSNATIONAL CORPORATIONS AND THEIR LOCAL NETWORKS

Most of the TNCs located in Ireland, particularly those from the US, are carrying out software manufacturing, localization and distribution. There is a small degree of actual software engineering being carried out by the TNCs but this in many ways resembles the picture from India where "local critics accuse [TNCs] of generating `software exports' by directing their local software engineers to routine tasks that US software people would like to avoid, like debugging existing software, extending the life of old operating systems, or porting existing applications to different platforms" (Evans, 1995: 195). This is particularly clear among U.S. software companies which account for the bulk of TNC revenues and employment in Ireland and which are the focus of this paper. There are a small number of foreign owned companies serving purely local markets - predominantly the service arms of mainframe companies. However, most foreign owned companies are almost completely export-oriented and the sector is dominated by a small number of large companies (by Irish standards). Despite intense competition from Scotland and Holland among others, Ireland has become the undisputed premier location in Europe for software ‘localization’ - that is, the translation of already developed software products into the languages and cultural and technical formats which make them suitable for sale in new markets. The key activity here is the translation of the text of the programme itself but there is some low-level programming involved in preparing the text for translation and in reincorporating the translated text back into the programme. I will describe the historical development of this sector in terms of the interaction of the globalization and localization of economic activity involved at each stage and their impact on patterns of access to technological learning and commercialization opportunities.

(i) Betting on the Global: Attracting Software TNCs

In the early to mid-1980s a number of US TNCs invested in software manufacturing operations in Ireland -

duplicating disks, getting manuals printed, and assembling them into shrink-wrapped packages. Lotus in 1985, and Microsoft in 1986, set up manufacturing operations in the Dublin area. They were attracted by the viability of a low cost base within Europe and a friendly political environment.

The financial and political environment was particularly hospitable. Export-oriented foreign companies only had to pay 10% corporate tax (compared to the standard 40%, now reduced to 38%) and this rate was guaranteed until 2010. This creates a net transfer from the European economy to the Irish economy and mainly to the TNCs due to TNC transfer pricing policies to take advantage of these tax rates. Irish industrial policy had been one of `industrialization by invitation' since the 1960s and the Industrial Development Authority (IDA) had developed significant skills in servicing the needs of multinationals. Successive governments pursued orthodox macroeconomic strategies which kept the financial environment very stable for these companies (particularly after 1987 when neo-corporatist wage-bargaining was institutionalized) and, despite some grumbling, there was little political opposition to the TNC-focussed industrial policy.

IDA and government policy had structured the labour force specifically for international investment - investing heavily in new technical colleges in the 1970s in anticipation of new mobile international investment. When the investment was not initially forthcoming in the early 1980s emigration rates shot up but this investment in education has been crucial in providing a supply of well-educated technical and professional workers in recent years. Furthermore, Irish workers were highly educated and English speaking.

Irish wages, and particularly professional wages, were significantly lower than in other locations within the European Union and were likely to remain so with a young population, high unemployment (between 14 and 18% for the last 10 years), enormous reserves of expatriate labour and relative industrial peace. Firms maintain a core workforce who are willing to work through the intense peaks of product releases and use

temporary and contract workers when necessary. The IDA reports that 12,740 jobs were added in all foreign companies in 1994, of which almost a quarter (3,000) were temp jobs. The long working hours characteristic of the industry are significantly out of step with most of Irish working life. Nonetheless, TNC managers in the US say they are extremely happy with the Irish `work ethic'. Overtime pay is extremely rare and work hours can extend to the point where one ex-manager of a major TNC told me that `if you count up the hours they worked then I don't think we were actually paying them that much per hour'. The Irish case can so far be seen as justifying the pessimism of many globalization theorists - Ireland was constrained to low cost production and political accommodation to the TNCs by the realities of the intense inter-state competition for corporate location and investment.

As the 1980s went on however the TNCs, starting again with Lotus and Microsoft, added software localization work to their Irish operations. Driven by the potential for making a quick killing in international markets with very little extra development work, companies such as Microsoft invested heavily in customizing their products for US markets (68% of Microsoft's revenues in 1995 were from international markets (Cusumano and Selby, 1995: 5)). Companies were particularly eager to locate inside the European Union as 1992 and the Maastricht Treaty approached and they sought to establish themselves in the European market.

While some TNCs did their localization work in the US, using immigrants and some US citizens with the appropriate language skills, the tendency was to decentralize the localization and translation function, thereby incorporating countries like Ireland into the lower end of the software design ‘commodity chain’ (Gereffi, 1994). Very few companies decentralized the process completely however - Borland is one of the few who carries out all localization in their sales offices `in-country' (i.e. in the country which the localization is servicing). Most companies sought to establish a hub in Dublin which could manage the various international links which were essential to the localization process. Some companies kept localization and translation `in-

house' and brought immigrants from the rest of Europe to Dublin. Most others outsourced the actual translation - either to independent contractors in the country of destination or to translation bureaus in Dublin which then managed the relations with the people doing the actual translation work (many of whom work at home at the end of a modem in locations scattered around Europe). So even where the labour force for a particular process is dispersed there is a tendency to manage the process from a centralized and specialized location. US managers said they liked to have a hub in Europe because that meant that they could consolidate their relationships between HQ and other firms and concentrate on the key strategic relationships from the US. They could deal with the subsidiary or main vendor in Ireland and then leave the web of European sub-supply relationships to be managed by them directly. Thus corporations are able to maintain the dense network of relationships necessary for their operations by consolidating relationships around particular poles in the global structure. In particular, the subsidiary can handle the more unpredictable external relationships locally while it is easier to handle global relationships within the structure of corporate communications (sustained by constant travel, E-mail, videoconferencing and so on) and shared intra-corporate understandings. The local organizational networks prove to be a crucial resource in stabilizing and maintaining control over global corporate networks.

The increasing supply of computer science and language graduates in Ireland was critical to the growth of the localization function among the TNCs. Furthermore the ability to organize a supply of European labour - either through immigration or through international contracting - was a crucial factor. The development of a pool of experienced workers in a local labour market was therefore crucial (Scott, 1993). The labour markets are also however thoroughly internationalized - European migration to Dublin has increased, emigration through TNCs to core regions is quite significant and return migration from these regions has been a factor in the success of a number of companies. While localization is not particularly challenging work for computer science graduates some programmers take these jobs with a view to going to the US HQ to do genuine software development work.

The story of software manufacturing and localization in Ireland partly supports globalization theories as Ireland was restricted to the lower reaches of hierarchical global production chains (Gereffi, 1994). However, these theories fail to recognize the crucial role of territorial production complexes in making deterritorialized socio-economic organization possible. Furthermore, the Irish software localization complex does not fit neatly into a spatial hierarchy of countries or regions around global input-output chains. The inputs (designs, investment, labour) to the production complex are largely from 'core' countries and the products are sold into the core markets of Western Europe. The Irish software localization complex is clearly low down the software commodity chain but it has a crucial role to play in managing relations between 'core' regions. As such, it defies conventional global production or commodity chain analysis. It also differs from the East Asian regional division of labour utlined by Henderson (1989) in that a 'semi-peripheral' country is mediating between 'core' countries' rather than creating its own 'periphery' as the 'Asian Tigers' have done with Malaysia and the Phillipines among others.

(ii) Local Bricks on Global Sand? Developing a Supplier Base

The 1970s had seen significant foreign investment in electronics in Ireland but the hoped-for development of a supplier base for these companies had failed to materialize (O'Brien, 1986; Eolas, 1989). However, the software manufacturing and localization investment of the 1980s and 1990s did create a local base of vendors supporting these industries.

The first industry to benefit was the printing industry which had a pre-installed base in Ireland and was helped by the fact that the TNCs never printed their own manuals in-house. The Irish-born managers of these TNCs reputedly told the local printing firms `we have the business for reprinted software manuals, it's there for you if you can get it'. These companies invested heavily in new technology and the industry grew from $9 to $135 million in 5 years, based almost totally on the demand of the software TNCs (IDA, n.d.; Jacobson

and O'Sullivan, 1994). It is important to note the role of Irish-born managers in trying to develop other industries within the country. Indeed, it has been striking in my interviews the extent to which these managers see themselves as serving a project of national economic development through promoting the Irish operation and agitating for more sophisticated work for the Irish operation. `There's a feeling that we're all in this to develop the industry in Ireland, so we help each other out by letting people over from the States visit each others' places and so on' (Irish Manager, US TNC). This outlook has been prominent among Irish managers since the 1970s, emerging from the Irish management of Digital in particular.

TNCs were also beginning to rely increasingly on outsourcing as a strategy during the 1980s to take advantage of external economies of scale and the potential for shirting costs onto suppliers. This trend intensified over the period - for example Lotus and Microsoft, which set up in the mid-80s, do nearly all of their own work in-house, while Oracle (set up 1990) and Novell (1995) outsource practically all their work and simply manage these relationships from their Dublin operations.

This led to opportunities for a number of spin-off companies from TNCs or suppliers which grew solely on the basis of TNC contracts, such as BG Turnkey which was set up by an ex-Apple employee across the road from Apple in Cork. These companies tended to start with very basic operations and expanded to full turnkey operations where they would take responsibility for a whole segment of the production process. As more TNCs invested in Ireland the supplier base grew - with turnkey services growing from zero to $150 million in five years (IDA, n.d.). In the localization area, a number of Irish owned translation bureaus emerged which offered full translation services to TNCs doing localization in Ireland. Some of the founders of these companies had also worked for TNCs and their companies were also relatively dependent on TNC business. While this expansion has created some very successful firms, the firms remain vulnerable to their dependence on the TNCs and the sector as a whole is vulnerable to technological change. In particular, any moves to distributing software over the Internet would severely damage the manufacturing and distribution

sector within the software industry.

The software logistics and localization industry in Ireland is characterized by an increased flattening of organizational relationships and the growth of external economies through supplier relations. Small inventories, manufacturing to order in very short time periods and increased use of suppliers result in dense inter-firm networks and intense communication. Jacobson and O'Sullivan (1994) document this process for software manual printers in Ireland but point out that the suppliers have retained a dependence on their TNC customers. Vendors' access to the TNC is improved but the TNCs are careful to control the terms on which the negotiations take place. One Irish TNC manager told how the company wanted to be the first or second most important customer to a supplier so that they could get "the necessary attention". Relations with suppliers are close with constant monitoring of processes being accompanied by the provision of advice from TNCs to suppliers through regular meetings and information sharing. However, suppliers do not receive substantial resources from the TNCs to deal with problems that may arise. 'Learning by monitoring' brings efficiency and weakens formal hierarchies - it does not eliminate power differences and dependencies on large customers however. One TNC executive in Silicon Valley said one of the reasons they located in Ireland was that a TNC partner "had pre-bashed the suppliers for us".

Supplier sectors absorb most of the demands for flexibility within the industry but they can make healthy profits where successful. There are ways in which companies can begin to escape their dependence on TNCs, largely by moving into new but related lines of business. One Irish-owned company whose founders had worked for major software TNCs in Ireland and the US used this experience to go into a business not simply servicing the TNCs but becoming republishers of already developed software in their own right. This company was able to use their international contacts to build markets and is doing well localizing and republishing the products of US companies for international markets. The key to their success is that they have managed to avoid a dependent supplier relationship and in fact own the software products they localize,

paying a royalty to the original developer on each copy sold. They have managed to negotiate a piece of the intellectual property rights for themselves rather than simply servicing the production needs of others. Logistics sub-supply companies may be able to use their knowledge of distribution channels and international business to move into servicing a broader range of sectors or to themselves build up skills in 'online' delivery and support of products.

There are some clear signs from this sector that even TNC-dominated sectors are experiencing a `new internationalization', with closer links and more extensive networks into the local economy, in place of the `old internationalization' model of isolated branch plants (Evans, 1995; Morris, 1992). New business strategies which emphasize outsourcing have produced a certain transfer of TNC expenditure into the local economy (Morris, 1992). However, in Irish software this expenditure remains much less than that of Irish-owned companies and the value added by TNCs within the country remains quite low. There are new opportunities for local development, certainly compared to the electronics industry, but the sector remains highly dependent on the TNCs.

The ability to sustain relations with local suppliers while maintaining control over the parameters and conditions of the relationship is a crucial resource for TNCs in decentralizing production while maintaining centralized control (Harrison, 1994; Sassen, 1991). This points up the false dualism in the literature between globalization theorists' view of localities as overwhelmed by global power structures and localization theorists' view of local networks as a buffer against global domination and control. In fact, as regards the issue of power, local social relations are critical resources in the creation and maintenance of global networks of corporate control. Global power operates through and is constituted by local and regional social networks and agglomerations (Sassen, 1991).

(iii) Re-Globalizing the Local: The Supplier Base goes Global

It seems than that there is a self-reinforcing dynamic of development at work here - foreign investment has created some opportunities for suppliers and the development of the supplier base has reinforced the attractiveness of Ireland as a location for TNC business. However, this tale of TNC-led development of a local supplier agglomeration at the lower end of the technology chain in order to support its global operations is not the whole story. In fact each round of localization breeds further rounds of internationalization (Evans, 1995:217). The most successful vendors have tended to `go global' with their main customer(s) - so that BG Turnkey has operations next to Apple in Ireland and Sacramento and in the two other major European IT manufacturing regions - Scotland and Holland. These vendors also seem to take on US business practices - generally being non-union firms which use a variety of US-style Human Resource Management organizational strategies.

There has also been an influx of foreign investment in the vendor base itself in the 1990s, often at the prompting of the IDA. Manufacturing and fulfillment companies such as KAO Infosystems of Japan and Logistix of Fremont, California, set up operations through investment in greenfield sites. Stream, a major US company, bought out Irish Printers and then expanded from its traditional printing and publishing business into localization and turnkey services. Other companies simply purchased Irish companies - a US firm called Banta purchased BG Turnkey, while Berlitz International (itself owned by Fukutake Publishing of Japan) bought out an Irish translation bureau called Softrans.

These phases of internationalization of the industry bring resources into the industry infrastructure but weaken the structures of local accountability and ability to direct the development of the industry. Ireland has established itself as a location for these types of activities - an advantage which seems unlikely to disappear in the near future. The ability to release U.S.-designed products into global markets simultaneously with the U.S. release results in huge returns on TNCs' intellectual property. The localization and logistics functions located in Ireland, although relatively low-tech, are critical to the capture of these returns. This is a

significant difference from the previous international investment of the 1970s and early 1980s. However, as we have seen, the ability to negotiate the parameters of this development is very restricted and the whole localization and logistics sector remains highly vulnerable to changes in TNC strategies and technological shifts towards provision of CD-Roms in the short-term and, more fundamentally, towards on-line provision of software in the long-term.

(iv) Regional Hubs in Europe: Expanding the Irish Operations

In the last couple of years, the TNCs have tended to self-consciously centralize their operations into a hub or hubs within the European market. While sales and marketing generally stays in the major commercial centres of London, Paris and so on, other countries like Ireland, Scotland and Holland now compete for the `operations hubs' of the TNCs. These countries have all developed their own information technology agglomerations or districts - this has become the basis of getting your foot in the door of international chains of production and innovation.

The prospects of those TNCs doing localization work moving into software development seem quite dim and the links between those few companies doing genuine software engineering and local software development firms are weak. Many managers said that getting TNCs to locate product development in Ireland, or anywhere outside the US, is `a constant struggle'. `It's keeping an eye on the crown jewels, they won't let them go. They are afraid of losing control, that's a big issue for them' said one Dublin engineer with extensive experience in a TNC. Another manager in a US TNC said that while HQ might worry initially about the technical ability in Ireland it becomes an issue of control: `I don't think it's a skill thing, it's a control thing. Its a distance thing too, they can't see what's going on'.

A manager in a third TNC which does all the porting for its `European' computer platforms in Dublin had experienced similar problems in getting development work moved out of the US. `They like to keep control

of development. And then communication problems are a big issue when you can't just walk down the hall to talk to someone and you have to deal with the time differences ..... Some people in the US don't even know we're here, it's such a big organization ..... Our group had an idea for collaborating with a leading Irish company on some quite sophisticated development but HQ in California was very reluctant. They also had another strategy which affected their decision not to go ahead with that'. While some more development work may move to the TNCs' Irish subsidiaries the impulse towards centralized control and the continuing difficulties (social rather than technical) of transnational communication mean that this process is likely to be very slow and quite limited. This clearly fits the argument I have made that the Irish regional software complex is very important to TNC efforts to simultaneously be cost-effective and to maintain corporate control. Moving development work abroad threatens this control even if it might be more cost-effective.

The last few years have however seen an expansion of call centres, and the movement of distribution, logistics management and finance and human resources functions to these regional hubs. This demands new skills in management and communications and places further demands on the telecommunications infrastructure of the countries involved. However, it does not offer much prospect for the Irish economy obtaining access to the key competencies of software - development and marketing - through these channels. Marketing remains tied to the major cities or at least must be close to the major markets in order to facilitate information flows and development, as we have seen, is likely to remain in the home country.

Nonetheless, the emergence of their Irish operations as regional operations hubs for some TNCs does mark a significant departure from the earlier experience of dependent development where the role of the Irish operation in coordinating international functions was highly limited. Ireland has emerged as a locality which manages relations with economic actors in a whole range of other countries - many more developed than itself. If Ireland is still dependent on TNCs, it is dependent in new ways with new opportunities. And if it has been able to build a learning economy of sorts in this sector, it is a learning economy which is defined as

much by the local ability to support the performance of a role in a global corporate chain, and to play a critical role in supporting that chain, rather than in a local 'innovative milieu'.

But agglomeration and territorial specialization does not necessarily insulate a region from global competition, as Storper (1992) suggests - it is the basis of getting to compete at all. Global competition is increasingly moving towards more intense competition between a few leading contenders in each field - be they firms in product markets or regions in the 'market' for industrial locations. Each time local networks generate improved productivity this becomes the assumed baseline for the next round of inter-firm negotiations - at each stage the requirements for even entering the game are forced up a level. Localization theorists are therefore correct to argue that agglomeration and local networks can provide production and innovation efficiencies. However they fail to recognize that these efficiencies become the assumed basis of further rounds of cost competition as the dominant firms can set regions, suppliers and work forces against one another. Just as we have seen that 'cooperation' and 'learning by monitoring' can be the terrain of new forms of power relations, so agglomeration economies are the basis of new forms of cost competition. New development paths open up but regions remain heavily constrained by the dominant firm' ability to set the cost and technological conditions for this development.

LOCAL LEARNING? THE EMERGING SOFTWARE DEVELOPMENT INDUSTRY

One of the striking aspects of the development of the Irish software industry has been the emergence of a dynamic indigenous software development industry at the same time as the arrival of the TNCs doing manufacturing and localization. However, the indigenous sector has had few direct links with these TNCs. In fact, it represents an example of a very different process from that outlined above - it emerged largely from a set of local dynamics and over time has been increasingly incorporated into global innovation and business networks. There are a number of relatively large Irish companies but two thirds of the companies employ less

than 10 people. Irish companies differ in their emphasis on export and import markets but reliance on export markets is increasing all the time, encouraged by government subsidies. Managers in Irish software development firms are perhaps more likely to know someone in Microsoft's head office in Seattle than they are to know someone in Microsoft's European Operations Centre in Sandyford, County Dublin.

(i) The Growth of a Local Software Development Industry

An awareness of international technical developments (facilitated in part by the emergence of the Internet), return migration of people who had worked in TNCs abroad and the experience of some employees in TNCs in Ireland helped to build some local firms However, the key organizational dynamics behind the emergence of the Irish software development industry were local and indigenous Irish firms generally emerged relatively autonomously of TNCs.

In 1987 the software industry was dominated by tiny firms providing services and consultancy to businesses which were beginning to adopt IT systems (An Córas Tráchtála, 1987). India has expanded its software industry by providing these programming services on a global basis, largely to US firms, and then building their own firms on the foundations of this business. Ireland did not go as far down this road of providing international programming services. Its labour costs would not have been low enough to compete directly with India in any case. One TNC manager in California claimed that his company could get approximately 4-6 engineers in India and two in Ireland for the price of one Silicon Valley engineer. However, Ireland has gradually developed a range of firms which sell software products in international niche markets in systems software and in some business applications markets. As such the products which the Irish industry provides tend to be quite technical and can avoid having to directly challenge the dominance of the major US firms in consumer packaged software markets.

Some crucial local factors, such as heavy investment in education (especially engineering and computer

science), an English-speaking workforce and an investment in telecommunications, prepared Irish firms to take advantage of opportunities in the newly created independent software industry. Internship programmes in computer science degrees and the development of software engineering quality programmes in universities helped to foster industry-university links. There was little state policy encouraging local software development. In fact it occurred almost `by accident' - the crucial factor being heavy educational investment which was originally prompted by the desire to attract TNCs to Ireland. While some individuals in state bodies were quite active in promoting the industry and working with Irish firms, the overall level of resources devoted to the industry was low. However, the youth of the industry and the speed of technical change meant that there were a wide range of market opportunities. The industry culture was relatively open in the early years and something of a technical community, linked to international trends, developed - especially around the Unix environment which is a particular strength in Ireland. Furthermore, start-up costs are low in software as the main initial costs are those for labour.

By looking briefly at the sources of firms in this sector we can see the importance of the emergence of local factors:

a. Some firms which provided `bespoke' or custom services to businesses expanded this business into making consultancy kits and then into products, gradually expanding into export markets. These firms did rely to a degree on TNCs in all industries in Ireland for IT development projects and it could be argued that Irish companies wouldn't have demanded the same level of IT work in the absence of the TNCs. The dynamic was basically local however, with individuals with particular skills setting up shop and some of them managing to turn this into a longer-term future. These `firms' basically provided labour services but could demand higher premiums as contractors than as wage-workers due to the extensive skill shortages in the industry.

b. A second group were firms in other industries, such as telecommunications or computer hardware, which

began to spin off their software divisions. Some of these were TNCs, some were semi-state bodies and others were private Irish firms. Again however the dynamic was local as domestic managers created new competencies and business for their divisions and convinced the management of the parent company to support their projects. A number of Irish firms were founded by users of software in vertical markets such as banking and training who used their knowledge of these markets to open up opportunities for their business.

c. Other firms emerged almost directly from academia, being set up by professors and graduate students based on their own on-campus research.

The growth of Irish firms was supported by the emergence of a local culture among software developers in Dublin. `There was a lot of swapping of ideas going on from about the mid-80s on. Anything real that goes on is informal" (Developer/Entrepreneur, Irish Software Development Firm). Another developer's comments revealed the way that informal associational networks can have an important impact even when not explicitly recognized by the actors involved: "Those industry groups are really just talking shops, they don't have any real impact. But in fairness I suppose I'm being a bit bilious towards them. I do meet a lot of people there. The informal human networks are more important than the formal industry or professional association stuff. Then I'll ring up Michael and say `what was that tool you were talking about to debug program X? And where would I get it?' So it's good that way. There's a lot that goes on among the people that go there" (Developer/Manager, US TNC doing development in Ireland).

There is a great deal of `job-hopping' within the industry. Although this has increased in the last couple of years, as a labour shortage begins to bite, the institutional preconditions for it have been created over the course of the development of the industry. Flat organizational structures with few opportunities for internal promotion, local concentration of firms, `loaning out' of workers and work teams among firms and an uneven distribution across firms of opportunities for technically challenging work have all helped to generate high

levels of inter-firm mobility. The dense social networks within the various segments of the industry help to hold the system together. Employees know each other from their county of origin and local neighbourhood (particularly from rural and urban middle class neighbourhoods), from schools and colleges and from inter-firm career patterns. Ireland is a country of dense and interlocking social networks (at least within social classes). This helps to facilitate both local and global networks - sometimes resulting in patterns of `chain migration' between firms as friends follow each other to new careers. There are also the formal associations which provide a forum for such networks. Information flows relatively freely through the industry about the reputations of employees and companies - facilitating job hopping as well as making it workable. In many ways then the growth of the indigenous Irish software development industry matches the localization theorists' view of 'industrial districts' or 'innovative milieux'. However, the story does not end there.

(ii) Global Competition: Taking the Local Global?

The opening of global markets is generally seen as a factor in firms' environments which increases the external threats to them from competition but has little direct impact on the organization of the firm itself. However, `going global' and competing in export markets involves profound organizational changes for the firms involved. Irish software firms cannot sustain themselves in local markets alone and therefore the industry as a whole has been faced with a rush of firms into global markets. This export focus has been facilitated by the focus of Irish companies on products rather than services. Not only are they easier to export but products make relative labour costs less critical than in computer service markets since it is possible to amortize development costs over the sales of many copies of the product (Schware, 1989). Nonetheless labour costs remain a significant portion of Irish development companies budgets, in part because of their early stage of growth and heavy focus on development tasks and technology rather than on market-building activities.

The issue in the software industry is not, despite the hype, a lack of technical excellence and innovation in

emerging industries. As one manager put it `People think the software industry is 90% technical development and 10% marketing. In fact it's 60-40 marketing, but you can't tell the developers that'. There seems to be plenty of great ideas to go around. The issue is who will get to commercialize these ideas and under what conditions.

The image which dominates the industrial districts literature is one of local networks of firms which compete on global markets but remain essentially local in nature. In fact, competing globally requires a reorganization of the company itself - in particular because of these marketing needs. A local firm cannot simply sit at their computers and then drop their latest creation on the world market - they must access the crucial marketing and distribution networks, which tend to be very crowded. While start-up costs in software may be very low, the costs of expanding beyond this initial phase may be very high with the result that many companies go out of business at this stage. An increasing number of Irish firms set up their own offices abroad to market their products. In 1993, 9 software companies had offices in the US. This has increased in 1996 to 17 and another 7 are said to be considering setting up an office (IT's Monday, June 3rd., 1996). Total overseas employment of Irish software companies was 367 (8% of their total employment) in 1993 and this almost doubled to 714 (11% of the total) in 1995. The impact on the organization and culture of these companies remains to be seen. However, an Irish Trade Board consultant in the US recently advised such Irish companies that in order to market successfully in the US `you must become, look and feel like an American company ' (quoted in IT's Monday, June 3rd., 1996).

`Going global' can be costly and risky. Therefore, for many firms, it often means forming an alliance of some kind with a firm from another country - typically a US firm in the Irish case. Irish firms have formed a number of alliances with US companies - some of these focus on technology sharing but others involve a combination of the Irish company's technology with the US company's marketing networks. While many of these alliances have developed through direct inter-firm links, many have also been prompted by government

and trade association efforts to build contacts between Ireland and the US. The Irish Software Association (a trade association) and the National Software Directorate (a state body) have led trade missions to Massachusetts and Silicon Valley in order to build up these kinds of links - resulting in a number of joint ventures. Similarly the Radius scheme, attached to the peace process in Northern Ireland, offers contacts for software companies in the border areas between Northern Ireland and the Republic to get involved in joint ventures with US firms. The importance of social networks in going global as well as in local economies is illustrated by the importance of one man to these developments in the Irish industry. John Cullinane, the founder in the 1960s of Cullinet (one of the first software companies), was approached by the director of the National Software Directorate in the early 1990s to try to build contacts between Massachusetts and the Irish software industry. Suitably impressed by the potential of the Irish development industry he was involved in promoting the Irish industry in the US and in the development of the Radius scheme. Early this year he founded the Cullinane Group Ireland which is looking for investment opportunities in Irish software companies and which recruited the head of the National Software Directorate as its Irish manager.

While joint ventures offer increased access to resources and valuable social networks to Irish firms they also reduce the autonomy of the firm and the industry as a whole. This tension is exacerbated in another trend which is likely to become quite important in the next few years - Irish companies going public on the stock exchange in the US. One Irish company has already had a successful launch in the US and the President of the US stock exchange visited Ireland in March 1996 in order to promote the stock exchange to Irish companies (in all industries). Approximately 40 Israeli high technology companies (7 of them software companies) are trading on the US stock exchange, so Ireland has quite a long way to go before it reaches that level. Nonetheless this is a trend which is likely to continue. In many cases, and in particular in the most successful firms, the situation is close to how one managing director of an Irish owned company (and a leading company in its market) described his company which may soon go public in the US: `We happen to be in Dublin but we are a US company. 65% of our revenues are from the US. It is very important for us to

get the mind share of analysts and standards bodies in the US'. Another Irish manager told me that they were coming up to an initial stock flotation on the stock exchange in the US and that `we may have to move some more of our development to the US since we need to have a significant presence there in order to convince investors. We don't want them to think that the development is all offshore'.

The `local' social world of the US industry demands international investment opportunities but does not trust them unless they have a local presence in the US - thus setting in place a globalizing process for the Irish industry. We find that the local social relations of core markets and industries create a need for semi-peripheral industries to go global in order to access crucial resources. The question becomes how to strengthen the hand of local firms in their negotiations with global actors while maintaining the embeddedness of these Irish firms in the local economy so that their contribution to local development intensifies rather than weakens. Innovation is not a simple matter of technical creativity in a borderless world. In fact it involves complex strategies of alliance-building and negotiation within the organizational and spatial hierarchy of the industry. While this may prove to be a fruitful process for successful firms, it poses significant challenges to the development of the locality or region.

(iii) Global Investment Following Local Success

In the last two years, US venture capital firms have shown increased interest in software firms in newly industrializing countries, including Ireland. Venture capital has always been lacking in Ireland and the banks are unwilling to support software firms (being generally less than supportive of industrial investment). While it remains to be seen how interested these investment companies are in the Irish industry, a growth of venture capital interest in Irish firms would mean an influx of resources with a loss of autonomy as the venture capital firms tend to manage their investments quite closely. Furthermore, it may well be a requirement of venture capital investment that firms move their top management to the US, and even to near the venture capital firm. Some venture capital firms in Silicon Valley require even US firms to relocate to within 200

miles of their offices. However, the state has taken some action recently by setting up a 10 million pounds venture capital fund for domestic software companies.

A typical pattern for Irish software firms has been the acquisition of successful firms by TNCs once they reach a certain level of turnover. This was particularly prevalent with the earlier, late 1980s, generation of firms but the pattern continues today. Indeed, many markets within the software industry are being consolidated and there has been heavy merger and acquisition activity in recent years. For some top software companies, such as Computer Associates and Symantec, acquisitions have been a large proportion of their growth in recent years. The importance of mergers and acquisitions is indicated by the fact that Symantec reviewed an average of one possible deal per day, from 1992 to 1995 (Gordon Ciochon, VP, Symantec Corporation, presentation at Software Manufacturers' Association, San Jose, November 1995).

There have been a variety of results to this process in Ireland. A small company called Workhorse was bought by Aldus, a US firm, and disappeared altogether when Aldus left Ireland. On the other hand, one of Ireland's biggest software companies, Kindle Banking, was bought by a British TNC and continued to grow and maintain employment levels in Ireland. That TNC has recently merged with another TNC which is involved in a similar business to Kindle so it remains to be seen what the implications are for Kindle in the long run - in any case, the potential for local control over the firm and the industry is weakened.

For the TNCs which dominate their particular industries, acquisition of small innovative start-up companies is not simply an exercise in profit-taking but is a critical element of their strategies to both foster innovation and control its speed and direction. Controlling the trajectory of technical change is the key to success in informational industries. The combination of heavy venture capital investment in start-ups which then typically cash out through acquisition by an industry leader is typical of regions such as Silicon Valley and, from the perspective of the leading firms, can result in a ‘manageable’ level of innovation.

Therefore, and echoing earlier discussions of cost competitiveness and power relations, local agglomerations and networks may be critical to the activity of innovation but the overall technical trajectory of informational industries is increasingly set by global alliances and acquisitions. The reason why analyses of high technology regions which focus almost exclusively on local dynamics (Scott, 1993; Saxenian, 1994) have been nevertheless been highly informative and insightful is precisely because regions such as Silicon Valley, Route 128 and Los Angeles are at the top of the software global commodity chain. Within these regions relations between powerful global firms are often simultaneously local relations, masking the global character of the regions. This is clearly not the case for an emerging region like Ireland.

NETWORKS AND DEVELOPMENT

The story of the Irish software industry represents a very significant departure from previous eras in Irish industrial development where TNC branch plants remained relatively isolated from the local economy and essentially operated as isolated export processing zones (Sklair, 1988; O'Malley, 1989). The emergence of networks of local suppliers around the TNC operations is a new and promising phenomenon - one that is mirrored to some extent in other sectors (such as computer component sub-supply). These networks between firms have been a crucial part of the upgrading of the productive capabilities of the Irish economy and in some cases the networks have developed to the point where TNCs make the decision to simply contract with the members of the local agglomeration rather than setting up their own operations in Ireland. Furthermore, the emergence of a local infrastructure and culture of innovation has helped the indigenous software development industry to have an impact in international markets. While firms are small the industry as a whole has benefitted from local information sharing and the development of a local labour market with many experienced employees available to small, emerging firms.

Networks, therefore, can provide a region with many competitive advantages and have a crucial role to play in the development of Newly Industrializing Economies. However, these networks cannot bear the burden of

the huge expectations which have been placed upon them. As the Irish case shows, while networks may emerge locally they will inevitably be internationalized as they become more successful. Some inter-firm networks such as the Irish printers and translation vendors are built from the start around global organizations and their needs. Others, such as the software development agglomeration, emerge from essentially local processes but their own success leads their most successful members to themselves become globally organized. Furthermore, any successful region will soon attract the attention of international business organizations who seek to benefit from the competitive advantage of the locality and to maintain control over the technological trajectory of their industry - whether by buying local firms, getting involved in partnerships with them or setting themselves up locally as competitors trying to obtain some of the newly generated local business. Even when the basis of growth is local, the network will inevitably be linked to other localities over time and become part of linkages and production chains on a global scale.

Therefore, the global constraints and resources available to localities are not limited merely to the demands of global competition in global markets, strenuous as these demands may be. In fact, the locality is likely to face global organizations on its own doorstep as its success is widely recognized. Even participating in global markets itself tends to push the competing organizations to organize on a global scale. It is the very need to be close to the most crucial markets which requires a global organizational structure.

I have argued in this paper that local and regional agglomerations are in fact constitutive of global networks and make it possible for such networks to operate smoothly. Globalization theorists have generally argued that the imperatives of cost competitiveness, power relations and/or innovation mean that global networks will overwhelm local patterns of organization. Localization theorists argued that local social relations and organizational networks could provide a buffer against the pressures of the global economy - precisely because of the cost and innovation advantages of local agglomeration and the relations of cooperation within those regions. In contrast I have argued that both local and global networks are deeply dependent on each

other along each of the three dimensions I have mentioned - power relations, cost competitiveness and innovation.

The Irish software agglomeration allows TNCs to consolidate their relationships between HQ and other firms, leaving their subsidiary or main vendor in Ireland to manage more unpredictable European sub-supply relationships directly and concentrating on the key strategic relationships from the US. The local organizational networks prove to be a crucial resource in stabilizing *power relations* and maintaining control over global corporate networks.

Each time local networks generate improved productivity this becomes the assumed baseline for the next round of inter-firm negotiations as regards *cost competitiveness* - at each stage the requirements for even entering the game are forced up a level. Agglomeration and local networks can provide production and innovation efficiencies but these efficiencies become the assumed basis of further rounds of cost competition as the dominant firms can set regions, suppliers and work forces against one another.

Finally, local agglomerations and networks help stimulate *innovation* but the overall technical trajectory of informational industries is set on a global scale and marketing products successfully requires substantial investment in a global organizational network. Information may travel across the globe instantaneously but communication and innovative activity is still heavily dependent on face-to-face communication in local social networks and the commercialization of innovation involves participating in the organizational politics of global networks. Once again, the global and the local are completely intertwined.

This global penetration of localities changes the local economy as it raises the possibility that the flow of resources will tend to be out of the locality and into the global organizations. This has implications for local firms but even more so for the economic well-being of the region as a whole. Local sub-supply sectors are the most vulnerable to changes in technology and the global economy. They are also the most obviously

constrained by the structures and strategies of global firms. Nonetheless, local firms which become integrated into global networks may profit quite handsomely from these links. However, if the most successful firms become detached from their local regions the regions may prove unable to reproduce the local developmental dynamic which lead to the original success of the firms themselves as they find themselves losing the resources necessary to invest in the reproduction of the local knowledge infrastructure. It is crucial that the locality organize itself so that successful firms remain integrated into local institutions and the circulation of resources on balance serves to reproduce and extend the development of the local region. The extent to which local and national states can bargain with mobile TNCs is severely limited. However, the emergence of local networks of firms does create a basis for integrating emerging local firms into a broader development project.

The role of the state here becomes crucial. The state, even where it did not realize it, provided many of the conditions which enabled the development of the software industry in Ireland - in particular, education, telecommunications infrastructure and a local infrastructure for technological communication and learning. However, the Irish state has tended to provide these resources in order to attract foreign firms and has passed up on the possibility of integrating local firms into the institutions which support them. The state's unconditional support of international business seems to have weakened its institutional inclination to bargain with local business. Nonetheless many opportunities to do so still present themselves - major efforts in training a new generation of computer personnel and the creation of a world class research infrastructure are two crucial areas where the state should act to support local industry but where it will also have the opportunity to get concessions from business. The state must also prompt firms in technologically vulnerable sectors, such as disk duplication, to diversify into other areas where they may be able to gain a foothold. These state policies create the opportunity to make local firms more integrated into and dependent upon local institutions and to make them more accountable to local social and community forces through making particular bargains with the local firms, changing the contribution of local firms to the locality one bargain at

a time.

Local networks of firms can be a crucial part of an economic development strategy and policies aimed at promoting such networks should certainly be put in place. However, such networks will inevitably become integrated into global networks and must face the issue of their relations with the major regions and firms in their industries. Local inter-firm networking alone does not guarantee that global networks will be beneficial to the local economy. The most powerful firms in the industry have significant power to set the parameters of the relationships which exist between firms. They also pursue strategies, in particular fostering competition between suppliers, which tend to maintain their position of power in these relationships. Nonetheless, these large global firms have increasingly pursued outsourcing and partnership strategies which do create opportunities for developing regions. Moving beyond dependent agglomerations to local networks with greater ability to direct their own technological development and business strategy requires the support of policy institutions and the state.

The bargaining over the conditions under which these supports are provided provides states with an opportunity to direct the development trajectory of the economy and to integrate local firms into a social project of development. While the ability to ‘anchor’ transnational firms in this way is limited, there is significant potential to shape the development of emerging locally dominated industries. Sassen (1995) argues that the global economy is not so much a ‘placeless’ entity but a ‘grid of places’ constituted, at least in part, by the actions of cities and nation-states. We have seen in this paper how regional agglomerations also play a constitutive role in creating and maintaining this ‘grid of places’. This grid may ultimately provide the socio-economic infrastructure around which the global economy can be politically regulated and through which the political alliances necessary to develop such forms of governance can be forged. In this way local networks do provide an opportunity for states and communities to have a significant say in economic development, even in an age of economic globalization. However, simply promoting networks will not of

itself provide this opportunity. States and other socio-economic actors must be prepared to build upon the opportunities provided by the development of inter-firm networks to pursue broader social and economic projects.

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