

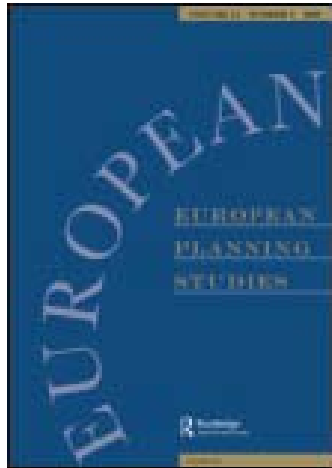
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Achievements of the industrial 'high-road' and clustering strategies in Singapore and their relevance to European peripheral economies

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Achievements of the Industrial 'High-Road' and Clustering Strategies in Singapore and Their Relevance to European Peripheral Economies

LEO VAN GRUNSVEN and CHRIS VAN EGERAAT

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ABSTRACT *This article examines the high-road and clustering strategies in Singapore. The focus will be on the circumstances and factors governing the feasibility of a high-road strategy and on the implications for cluster development within national borders. While substantial results have been achieved as far as upgrading of the industrial structure is concerned, this appears to hold much less with regard to the aim of localized cluster development. Upgrading has been accompanied by the partial disintegration of the local production structure and regionalization of the production system. In relation to the relevance of the analysis for European peripheral economies it is important to account for the set of specific local and regional conditions that inspired the industrial development path of Singapore.*

1. Introduction

Theorists in the field of industrial policy are increasingly advocating what has been called the 'high-road' industrial development strategy. Cooke (1996), defines such a strategy as "one in which the aim is to develop an economy characterized by a high value-added profile in the output of goods and services, a high skills profile of the work force and high wages amongst citizens". The alternative 'low-road' strategy is associated with opposite features.

Countries taking the 'high road' are supposed to embark on a route of continuous innovation, learning and upgrading. This idea has principally been advanced by institutional and evolutionary economists employing concepts such as 'systems of innovation' (Lundvall, 1992; Edquist, 1997; Nelson, 1993) and 'clustering' (Porter, 1990). The 'high-road' concept also has a strong spatial connotation, emphasizing embeddedness in the local economic (and socio-cultural) milieu. The presumed relevance of agglomeration (at whatever scale) for competitive advantage has partly been inspired by new ideas in economic geography, echoed in the literature on 'new industrial spaces' (Scott, 1988) and 'neo-Marshallian industrial districts'.

Elements of the 'high-road' strategy have made inroads into the industrial policy debate in the Celtic Penumbra (Ireland, Scotland and Wales). Policy makers in tandem stress the importance of indigenous (small- and medium-sized) enterprises, innovation, upgrading,

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co-operation, linkages and networking. Related to this, Porter's clustering concept also has received a warm reception. In Ireland, it has even served as a model for industrial policy after the Industrial Policy Review Group (IPRG) (1992) concluded that the cluster strategy should be an important element guiding direct intervention by state agencies.

This is not to say that the 'high-road' concept is universally accepted as the best strategy for industrial development. First, there is the long-running ideological debate concerning the question whether a strategic industrial policy is needed at all. According to critics, ideas such as 'strategic cluster-building' carry the danger of undesirable and wasteful intervention. This may partly explain the limited formal policy response to Porter's clustering concept in the neo-liberal environments of Wales and Scotland. More specific issues are related to the question whether it is possible to transpose a model of industrial dynamics from one region to the other. Many of the theoretical insights that make up the 'high-road' concept are supported by empirical findings from a limited number of—regions in—industrialized core economies of the western world (Gertler, 1992). Similarly, Porter's recommendations are based on case studies in core economies such as Sweden, Switzerland, Germany, the United States, Japan and Italy (Porter, 1990).

At least in Ireland, there is growing dissatisfaction with 'foreign' models and calls are made for, at the least, adaptation of these models to the local situation (O'Donnell, 1998). Two issues in particular are often brought to the fore: the small size and open character of the economy, and the significant role of subsidiaries of foreign multinationals in the industrial structure. In line with international critique of Porter's diamond model (e.g., Rugman & D'Cruz, 1993), it is argued that it might not be feasible in a small open economy like Ireland's to develop broad and deep clusters within the national territory. The relevant geographical scale of clusters (or, more generally, production networks) differs by industry and some are bound to cross national borders (Jacobs, 1995). As to the second issue, a dominant presence of foreign subsidiaries contrasts with the role assigned to small indigenous firms. Porter does not impute a strong innovative role for foreign subsidiaries. Others disagree, arguing that the continuous reproduction of the innovative capacity of milieux actually requires the presence of multinational companies (MNCs) (e.g. Camagni, 1995). Research in Wales (Cooke, 1995) and Ireland (Clancy *et al.*, 1998) suggests that MNCs do integrate with the indigenous sector. However, the degree to which entire clusters are *localized* and the level of upgrading and innovative activity within those clusters varies strongly. Whether the development of localized clusters and a 'high-road' industrial profile constitute policy goals which should or can be pursued in tandem remains open to question.

In this article, we consider the 'high-road' and cluster-based industrial development strategies in the Asian Pacific Rim context, particularly the case of Singapore. The aim is to review the specific conditions, which have governed the adoption of these strategies, their implementation, as well as their achievements. An analysis of industrial development experiences in the Asian Pacific Rim context may well provide useful insights in relation to the dynamics of industrial development in the 'Celtic Fringe'. It might facilitate the formulation of a more appropriate, local, strategic industrial development model. In this respect, Singapore is of particular interest since it shares some similarities with parts of the 'Celtic Fringe'. Like in the Celtic Penumbra, its industrial development has been highly dependent on foreign direct investment (i.e. foreign multinationals). A large number of multinationals operating in Singapore also have production facilities in the Celtic Fringe. Furthermore, Singapore shares its smallness and openness of the economy with economies like Ireland's. Third, Singapore does not assume a core position, neither in the world economy, nor—as yet—in the Asian Pacific Rim. However, there are also some major differences, impacting its global and regional roles. The focus of the discussion will be, on the one hand, on the circumstances and factors governing the feasibility—and success—of a 'high-road' strategy, and, on the other hand—

given the intertwining that is often implied—on the implications of a ‘high-road’ industrial development strategy for cluster development within national borders.

After a brief review of Singapore’s economic and industrial development since Independence, the next section will deal with industrial restructuring in Singapore, focusing on what the ‘high-road’ and cluster development strategy has entailed in this case. Subsequently, the main achievements of the strategy, and the particular conditions which have determined the outcomes, will be dealt with. Next, the question whether cluster development within the framework of a ‘high-road’ industrial strategy has been accomplished will be addressed. The emphasis here will be on the evolving geographical patterns of production systems of core industries, which will lead us also to a brief consideration of processes occurring in the context of the Singapore-Johor-Riau (SIJORI) Growth Triangle. This will be followed by some concluding remarks.

2. Singapore’s ‘High-Road’ Strategy and Cluster Approach

2.1 Initial ‘Low-Road’ Strategy

Over the past three decades, major structural changes have taken place in the Singapore economy. These concern an initial transition from an entrepôt economy to a ‘low-tech’ manufacturing and trading economy during the 1960s and 1970s (revealed by a significant increase of the share of manufacturing in GDP), and subsequently (over the past decade) to a ‘high-tech’ manufacturing, and financial and business services, economy. The latter is revealed by a drop of the share of manufacturing and a significant increase of the share of financial and business services in GDP in the period from 1980 to 1995 (Table 1). ‘High-tech’ instead of ‘low-tech’ manufacturing indicates a significant transformation within the manufacturing sector. In relation to this, it is useful to briefly consider the more specific phases of development of the Singapore economy, linked to the roles of government (specifically, its strategies and policies) and of international capital. Table 2 shows the successive phases of economic planning and development.

After Singapore became an independent Republic, the government adopted a strategy which aimed to industrialize by attracting export production, internationalized by capital from the core economies of the world in the search for lower-cost production sites. Thus, the government deliberately chose an alliance with foreign capital. It put much effort into creating a suitable infrastructure (e.g. industrial estates) and a low-cost business environment, highly conducive and attractive to foreign business. To this end, it established a strong grip on labour relations.

Foreign manufacturing activities were indeed attracted by Singapore’s low labour costs and stable social and political conditions. The city-state rapidly developed into an offshore production and export base for international capital, as indicated by cumulative foreign manufacturing investment (Table 3). In the early 1980s foreign-controlled companies commanded about 70% of total cumulative investment in the manufacturing sector, and about three-quarters of its total output, exports and value-added.

In line with the emerging New International Division of Labour, most manufacturing activities internationalized to Singapore during the 1960s and 1970s concerned labour-intensive, low-value added production. This suited the government very well as foreign capital created the necessary employment and solved the unemployment problem.

2.2 Changing Local Conditions and First Attempts at a ‘High-Road’ Strategy

In fact, by the end of the 1970s a tight labour market arose, despite an extraordinary high participation rate of both males and females in the labour force. Although this initially led to

Table 1. Singapore: sectoral structure of the economy (percentage distribution)

	Gross Domestic Product at Current Market Prices					
	Manufacturing	Utilities	Construction	Commerce	Transport & communications	Financial & business services
1965	15.2	2.2	6.5	27.2	11.5	16.6
1970	20.2	2.6	6.9	27.4	10.7	16.6
1975	23.3	1.8	7.9	24.8	10.8	18.2
1980	28.1	2.1	6.2	20.8	13.5	19.0
1985	22.0	1.9	10.0	15.9	12.6	25.6
1990	27.2	1.8	5.2	17.9	12.2	25.0
1995	24.9	1.5	6.7	18.6	11.1	26.9
						17.6
						12.9
						11.1
						8.8
						11.0
						10.3
						10.0

Source: Department of Statistics, 1995.

Table 2. Economic planning and development in Singapore

1959–1965	Economic Diversification Industrialization through the ISI strategy (Import substitution), on the basis of domestic capital within the Federation of Malaysia
1965–1979	Integration in the New International Division of Labour through the EOI strategy Export-oriented Industrialization; offshore production base for international capital , with emphasis on low value-added labour-intensive production activities
1980–1985	Second Industrial Revolution Start of industrial restructuring: shift towards higher value-added industrial activities; more capital—and ‘skill’—intensive
1985	Economic Recession Economic Report
1986–1990	Total Business Centre Strategy More emphasis on service sector and non-production activities in the value chain of foreign industrial enterprises operating in Singapore and elsewhere in the Asian region; Financial and Business Centre
1990– ...	Total Business Centre and Core of an Economic Growth Triangle SIJORI Growth Triangle, shift of position in the international Division of Labour
1991	Strategic Economic Plan —Deepening of Industrial Restructuring; emphasis on: —building of industry clusters in high value-added manufacturing branches —non-production corporate activities, i.e. R&D and Operational Head Quarters —attracting globalizing service sector activities —export of services —regional relocation of low value-added labour-intensive production —besides receiver of foreign investment also foreign investor
1995	‘External Wing’ —Internationalization of the economy —Developed country status

the importation of a substantial number of foreign workers, guest labour was not seen as a sufficient and viable solution in the longer run. Faced with the increasing labour shortage, the state in 1980 adopted a strategy of industrial restructuring, presented as the Second Industrial Revolution. The strategy aimed at restructuring the manufacturing sector towards productivity-driven growth and higher value-added activities. To this end, it implemented a three-year wage correction policy so that wage increases would reflect the tight labour market. There was also a renewed emphasis on education and training, encouragement of automation, mechanization and computerization, more selective investment promotion, and increased emphasis on R&D.

However, at this juncture, the strategy met with little response from international capital. The steep increase in labour and other business costs in fact led to a rapid erosion of

Table 3. Singapore: stock of foreign direct equity investment

	Total (S\$Million)	Share Manufacturing	Share Financial & Business Services
1970	1724.1	52.1	18.4
1975	4649.5	50.3	19.8
1980	11 201.7	56.6	14.7
1985	22 354.9	50.5	26.8
1990	49 830.6	39.7	33.3
1993	62 766.9	35.7	36.7

Source: Department of Statistics, 1995.

international competitiveness, causing a stagnation of foreign direct investment. The chain of responses in the economy as a whole led in 1985 to a steep recession. Immediately measures were adopted to restore international competitiveness, with the effect of halting industrial restructuring.

2.3 Reaffirmation of the 'High-Road' Strategy in a Changing International Environment

This does not mean that industrial restructuring was abandoned. On the contrary, in terms of economic strategy, the second half of the 1980s marks a watershed. The report *The Singapore Economy: New Directions* (Ministry of Trade and Industry, 1986) again emphasized that the possibilities for—further—horizontal expansion of low- and middle-level export manufacturing and export would be rapidly eroded by a number of factors. First, inevitable cost increases (due to renewed labour cost increases associated with labour shortage, restrictions and levies on foreign labour, as well as other production cost increases). Second, insufficient productivity increase. Third, another set of countries in the region entering the arena as competitors in labour-intensive, low value-added, export production—principally other ASEAN countries (Malaysia and Thailand) and China. Fourth, currency appreciation made exports more expensive. Fifth, growing protectionism, and particularly the further loss of competitive position for labour-intensive exports as a result of more stringent export-quota and the loss of preferential trading position. Sixth, the increasing pressure on other domestic resources, particularly land.

The core of the vision and associated strategic thrusts concerned Singapore moving beyond a low- and middle-level manufacturing and export base for international—and domestic—capital to a future position as a Total Business Centre. Besides high value-added manufacturing, this vision targeted the service sector, particularly financial and business services, and non-production activities in the value chain (R&D, logistics, management) of foreign industrial enterprises operating in Singapore and elsewhere in the Asian region, as the main growth areas. At the same time, it was envisaged that low value-added, labour-intensive, production would be relocated out of Singapore by foreign and domestic firms. The government could encourage and guide this process through a proper framework. The idea, first expounded in 1989, of establishing a cross-border Economic Growth Triangle with the adjoining regions, of which Singapore was to be the core, served several elements of the overall vision.

The *Strategic Economic Plan* (Ministry of Trade and Industry, 1991) reiterated this overall vision, the more specific strategies and the instruments. It also elaborated on the enabling and guiding role of the state, providing the institutional and infrastructural framework for the achievement of the strategic thrusts. In addition, it carried the *new directions* in the Singapore economy further, by addressing what by then was perceived a pressing issue related to two decades of industrialization and economic development under globalization, namely rather unintegrated production or industry structures and the emphasis on 'screwdriver' operations. The Plan therefore emphasized firstly, the deepening of industrial restructuring through the building of industry *clusters* in high value-added manufacturing branches. Here, local(ized) forward and backward linkages in the production segment of commodity chains were targeted. This constituted a response not only to perceived deficiencies in the industrial structure, associated with Singapore's insertion hitherto in globally or regionally organized commodity-chains and, more specifically, production-chains, but also to perceived opportunities, related to changing procurement strategies of MNCs. Second, and linked to the first point, the attraction of a wider range of activities in production-chains, especially higher value-added skill- and technology-intensive operations, down- or up-stream to current manufacturing operations, became a new target. Third, the explicit aim was to attract forward non-

Table 4. Programmes linked to the Strategic Economic Plan

Strategic programme	Aim
Manufacturing 2000	To sustain the GDP share of manufacturing at more than 25% and employment share at 20% in the medium to long term. M2000 will seek to upgrade capabilities across the entire value chain of each industry cluster including product and process development, production, manufacturing engineering and strategic marketing.
International Business Hub 2000	To enhance Singapore's position as a business services gateway to the region. Singapore will add value and assist the flow of goods, people, capital, technology, information and ideas by providing highly skilled services. These services include internationally tradable and high value-added activities that complement the M2000 programme. The four key clusters are Regional Headquarters (including those serving as a base for business expansion into the region), Logistics (total capability hub), Communications and Information (broadcasters/programmers; advanced telecommunication applications; satellite communication; data-hubs and call centres; multimedia content development), and Lifestyle services (publishing and electronic media; film/television/music; healthcare and education).
Regionalization 2000	To build an external economy that is closely linked to and which enhances the domestic economy by participating in the growth of Asia. This programme seeks to form a network of strategic zones in key markets with emphasis on building good linkages between regional projects and domestic clusters. Key elements are: the Singapore-Johor-Riau Growth Triangle; flagship regional industrial parks as gateways to regional economies for local companies and MNCs; facilitating regional investment out of Singapore through the Co-Investment programme.
Promising Local Enterprises 2000	To strengthen the role of local enterprises in key clusters and to groom a group of promising local enterprises (PLEs) into MNCs and industry leaders of tomorrow. The PLE programme target is to nurture 100 local enterprises with sales of more than S\$100 million in the next ten years. Key elements: promoting strategic business management and planning; expanding the Local Industry Upgrading Programme; increasing the pool of Venture Capital Funds.
Co-investment 2000	To build on and extend the relationships with leading companies through co-investment partnerships in projects of significance and thereby reduce risks for partners. Key elements: supporting the cluster development plan by addressing critical gaps in the industry clusters and enhancing core capabilities.

production segments of international producer- and buyer-driven commodity chains, i.e. non-production corporate functions, particularly R&D and Operational Headquarters (OHQ). Fourth, attracting globalizing service sector activities, including firms specializing in up- or down-stream non-manufacturing segments of producer- or buyer-driven commodity chains (e.g. involved in—the control of—sourcing, distribution and marketing). Fifth, export of services and regional relocation of low value-added labour-intensive production. In fact, it reformulated relocation of production out of Singapore to the broader thrust of internationalization/regionalization of the Singapore economy, creating an 'External Wing'. Thus, besides continuing to be a receiver of foreign investment, Singapore should also become a foreign investor, in other countries in the region and the core areas of the world economy. The major—current—strategic programmes, elaborating the Strategic Economic Plan, are listed in Table 4.

As to the aim of developing manufacturing clusters, profiles were drawn up of several of such clusters. The main one, the electronics cluster (comprising a significant part of total

manufacturing output) would consist of both foreign and local producers of final products (e.g. colour TV, computers for industrial use, personal computers, printers, typewriters, audio equipment, communications equipment) and intermediate products (e.g. disk drives, tape drives, fabrication of PCB, assembly and test of semiconductors, wafer fabrication of semiconductors, electronics automotive components, colour picture tubes), as well as electronics supporting industries (e.g. production of connectors, PCB assembly, die casting) and general supporting industries (e.g. tool and die, plastic injection moulding, precision machine parts, plating, metal stamping). The development of the cluster is driven by, on the one hand, world demand and, on the other hand, by competition, technological capabilities, skilled and professional manpower, supporting industries and start up speed. The interconnection between main producers and supporting industries is supposed to lead to a wider range of activities in production chains, and increased localization through local subcontracting. Clusters therefore incorporate the transition from intra-firm vertical integration to integration within inter-firm networks, partly based on farming out work to specialized firms. Such integration is seen to occur within the *local* complex.

3. Achievements of the New Strategies

To understand the results of the strategies, it is relevant to put firm responses and new developments, manifested in Singapore, in context by briefly referring to changing MNC behaviour in the Southeast and East Asian region at large. At the same time as production conditions in the Newly Industrializing Economies (NICs) altered fundamentally and new strategies were put into place by states, many MNCs from the core economies have started to modify their global and regional strategies. These modifications reflect changing conditions in the home economies and corporate organizational changes. Moreover, the Southeast and East Asian region rapidly became an important growth area and market in its own right (Rodan, 1993), as a result of which the significance of the region for many—production—MNCs was no longer derived from cost advantages alone but also from its strategic importance. Changes in the organization of production, and in the industrial policies pursued by countries, as well as alterations in export and investment regulations have provided further stimuli to modification (van Grunsven, 1994). A range of other factors are involved as well, at the levels of individual firms, industries and the local and international environments in which firms and industries operate. As to the environment, the availability of trading preferences (and the conditions attached to these) and changes in currency exchange rates have been obvious influences.

Consequently, many MNCs have changed towards more comprehensive and regionally focused operations (Rodan, 1993). All factors combined have led to a substantial widening and deepening, both structurally and geographically, of the operation of production MNCs in Southeast and East Asia. This is expressed in *inter alia* the following elements: first, MNCs from the core economies have transferred a wider range of product lines, additional manufacturing processes (often involving specific steps in the production chain of individual end products), non-manufacturing functions, as well as other labour processes (sometimes reflecting evolving product and process technology, necessitated by the market and by global competition, rather than a response to local forces) to the region. Second, in order to maintain competitiveness in an increasingly 'crowded market', particular types of production have been geographically reallocated (transferred towards more cost-effective locations in the region). This not only applies to Western and Japanese MNCs, but also to a significant number of newly emerging NIC-MNCs. Third, associated with the first two elements, the evolution of the operations of large MNCs is marked by both a (much) more extensive plant structure—linked to a geographically (much) more dispersed pattern of operation, product and/or labour

process substitution and decanting—and the rapid growth of multi-functional non-production units, either physically integrated with existing production units or physically separated from them (in an increasing number of cases officially being designated as Operational Head Quarter). Fourth, there has been a transition from ‘stand alone’ branch plants to branch plants integrated or embedded in networks. Such networks assume various forms and perform various functions, depending on functional and production organization. As such, the geographical scale on which networks operate varies substantially too, from the local to the macro-regional scale. Regional intra-firm networks are a common phenomenon now, associated with the internal regional division of labour in firms. Such networks give rise to substantial intra-firm trade across borders. The tendency of increased localization has given rise to procurement networks, whereby large branch plants, carrying out final assembly, have become flagships which are involved in organizing such networks. While local firms do participate in such networks, associated with localization, foreign dependent firms (followers), specializing in specific operations or steps in the production chain, have in large numbers established production units in the region. Though the proximity factor is important in these networks, giving rise to a localized segment in sourcing/supply structures, the imperatives of comparative advantage (of places) appear to dictate that such networks are also marked by ‘supra-local’ segments. The importance of each of the segments seems to be related to the characteristics of the local environment in which the flagship plant operates, corporate strategy dictated by competition in the industry, market access demands, institutional regulations laid down by government policies, regional trading arrangements, as well as the range of options which these demands, regulations and arrangements offer. In practice, such networks seem to be in a constant flux in terms of the geographical scale on which they operate. A third example are the regional procurement or sourcing networks organized from international procurement centres of international firms of different sizes and operating in various industries, established in the region.

The phenomena listed above hardly do justice to the complexities and diversity of the changes taking place. In essence, what is found in the region as to activities in production chains, functions in the value chain of firms and in the commodity chains of a range of industries has tremendously changed. This is significantly impacting the function(s) performed by ‘places’ (dynamic ‘geographies’), reflecting the local and regional configurations of firms and industries, as well as the local, national and regional forces shaping these configurations.

It is necessary to add that changes taking place at firm level seem to be highly differential, according to the industry in which firms operate, their size, period of establishment and scale of operation in the region, origin of firms as well as the competitive strategy adopted by individual firms. For example, the structure and geographical configuration in the region of Asian NIC firms seem to deviate in probably significant ways from that of much longer established firms from Organization of Economic Co-operation and Development (OECD) countries. The same may be said of large MNCs in the electronics industry versus smaller MNCs in other industries.

It should also be observed that in the Asia Pacific a range of ‘other types’ of internationally operating non-manufacturing firms or corporations have become more prominently present, through establishing a branch plant or a regional office, by taking over existing firms or through joint ventures. These include firms in financial and business services (including international banks); branded companies, buying houses and retailers in buyer-driven commodity chains from outside the region (in part linked to changing markets and diversification of their sourcing patterns, in terms of the number of subcontractors and the number of countries involved); supermarket and department store chains which also have established regional offices to oversee their operations in the region, as well as distribution centres (to the extent that this function has not been contracted out to independent firms); finally, associated

with externalization processes, specialized firms in specific segments of commodity chains (e.g. distribution and logistics) are now more prominent in the region.

Given the trends noted above, a number of the strategies pursued by the Singapore state have proved successful. They targeted a range of activities and work in industrial MNCs, as well as in financial, business and other services, at a time when the internationalization of these to the Asia Pacific region gained momentum. Singapore provided the right conditions to compete with other metropolitan areas in the region (e.g. Hong Kong) to attract these activities. Unlike in the early 1980s, at this juncture international business responded much better to the strategies, as they fitted their trajectories of regional expansion and the operational and geographical strategies pursued in the region. Firm responses in the Singapore context have been discussed at some length in Clark and Kim (1995) and Chiu *et al.* (1997). The main points will be summarized as well as expanded on here. Two basic adjustment strategies have been adopted, namely reorganization of production and labour use, and geographical reorganization of production and other functions. The first strategy has entailed the adoption of a more flexible labour strategy, upgrading the technological level of production processes and of products (towards higher value-added), process automation, increasing labour productivity, and increasing the return on capital investments, e.g. by introducing a third shift. A more flexible labour strategy has comprised a range of measures: the reduction of full-time and permanently employed workers, increasing the number of part-time contract workers, local or regional subcontracting (out-processing) of production tasks (to minimize labour content), subcontracting of services, and internal training of workers to enable them to perform multiple tasks.

In the process of geographical reorganization, labour-intensive routine assembly has been shifted out of Singapore to other, more suitable, locations in the region. Linked to this, firms have engaged in product-line substitution, low value-added products with a relatively low technology content being replaced by higher value-added products with a substantially higher technology content. Thus, the decanting process has been very evident in Singapore. An element of the process, particularly evident in the case of main firms in buyer-driven commodity chains, has been the geographical rearrangement of—international—subcontracting networks. Another element has been the diversification of the structure of functions performed in Singapore. Noteworthy are the introduction of R&D, procurement, distribution and logistics functions, as well as management tasks. In a substantial number of cases, a regional office or headquarter (OHQ) has been established to carry out these functions.

While these responses are clearly seen in MNC establishments, large- and medium-sized local enterprises, which had started to penetrate independently in major export markets with 'own-brand' products, have followed suit. The same goes for local supply firms. These have entered a path of internationalization/regionalization and expansion, similar to the 'moving out and moving up' trajectory of MNC establishments. Evidence is growing that in a number of cases, hardly any manufacturing operations are retained in Singapore. It should be noted that firm responses have not been uniform but have been influenced by the nature of markets, characteristics of particular industries and the institutional environment (Chiu *et al.*, 1997).

Complementary to the firm and industry changes associated with responses of existing firms, are the new industry developments or activities which have been rather mixed in terms of the characteristics of the labour process, but increasingly appear to conform to what was targeted by the 'high-road' strategy. In the course of the 1980s firms in more technology-driven industries in the process of internationalization have targeted Singapore as a production base. A significant development in this respect was the establishment of firms in the disk drive industry, which have been attracted to Singapore because of the availability of skilled workers at a cost still substantially below that in the country of origin. Disk drives and

related components now take up a large share of Singapore's domestic manufactured exports. Assembly, initially 'screwdriver' operations, using a substantial amount of labour, has remained an important characteristic of production operations. However, with the evolution of the industry and its products, the labour intensity, type of labour used, value-added, and technological content of products and processes have substantially altered. Many international firms in the industry, located in Singapore, now also perform R&D related to new product development.

Overall, after the mid-1980s new investment in manufacturing has rapidly moved away from the type of activities prevalent in the 1970s and the first half of the 1980s (new investments in such activities were also actively discouraged) towards high-end activities in existing industries and the setting up of activities in new—technologically advanced—industries. An example of the former is the growth of wafer fabrication, linked to the semiconductor industry. Besides, in specialized branch plants of semiconductor producers, wafer fabrication is increasingly carried out also by specialized firms, frequently in branch plants located near the clients. To cater to such firms, three Wafer Fab Parks have been developed in Singapore, with specialized infrastructure (adequate and uninterrupted supply of electricity and water) and environment (vibration free). To date, there are a number of leading firms in this field operating in Singapore. The three Parks must contribute to most of the world's leading wafer producers operating in and shipping from Singapore by the year 2005.

The Wafer Fab Parks are cases of Specialized Industrial Parks catering to firms in—technologically advanced—industries with very specific locational or infrastructural requirements for their operations. Reflecting the 'moving up' strategy adopted by the state, besides the Wafer Fab Parks currently two International Business Parks have been developed, designed to serve high-tech companies. They offer such companies greater operational efficiency, convenience and greater flexibility to integrate under one roof 'high-tech' manufacturing, data processing, marketing, R&D, administrative and other activities. They accommodate the rapid growth of *inter alia* the multi-media industry.

As noted above, a large number of firms now carry out R&D locally, boosting the development of Singapore into a major regional centre for R&D. The latter is epitomized in the Singapore Science Park which was set up under a government initiative in 1980 to promote R&D in Singapore. The objectives were to provide a focal point for the high quality infrastructure essential for industrial R&D, as well as an environment conducive to interaction between industry, academic and research groups. Totalling over 63 hectares, the Park is being developed in three phases. Phase one consists of 30 hectares and is now fully developed. Phase two is expected to be fully developed by 2001. It is located in the west part of Singapore, in an emerging 'Technology Corridor' which comprises a number of academic and R&D institutions (National University of Singapore, Singapore Polytechnic, Ngee Ann Polytechnic, Singapore Science Centre, German-Singapore Institute and French-Singapore Institute), allowing closer networking and collaborative efforts.

Currently about 170—mainly foreign—firms are located in the Park, carrying out R&D in a range of technology areas. Information technology is the main area of R&D (many of the more than 70 firms in this area are housed in the Centre for Information Technology), followed by chemicals/petrochemicals (18 firms), materials testing and engineering services (15 firms), manufacturing technology (13 firms), electronics (11 firms), telecommunication (9 firms), and biotechnology (8 firms). Quite a number of firms also have production facilities in Singapore. Corporations like Sony, Seagate, Exxon, Motorola, Shell, Sumitomo, Digital and Fujitsu have located local R&D facilities in the Park, rather than on their own premises. Recently opened facilities in the Park include the Innovation Centre and Technopreneur Assistance Centre, mainly catering to small innovative enterprises, which commonly use facilities in the centre.

It was also noted above that over the past ten years a significant number of large MNCs have set up a Regional Headquarter in Singapore, attracted by the high quality infrastructure and government incentives. In this respect, Singapore has competed successfully with other metropolitan centres in the region. The number of regional headquarters which have been 'bestowed' the OHQ status by the Economic Development Board, currently stands at about 100. In these OHQs regional management activities (organization, coordination, control, sourcing, distribution and logistics) are concentrated. In addition, some 300 foreign companies have set up a regional office in Singapore. This is a rather mixed group and includes foreign branded companies, buying houses and retailers in buyer-driven commodity chains, super-market and department store chains etc.

Singapore is also developing into a regional base for globally operating companies in the communications and information services industry, like broadcasting. A very recent phenomenon therefore is the development of Singapore as the media-hub in South east Asia (see article by Hing Ai Yun in this issue). There has been a significant growth of leading third-party logistics service providers and regional distribution centres, also attracted to Singapore because of its excellent infrastructure.

The 'External Wing' has grown rapidly. The latest available figures show that at the end of 1993, Singapore(-based) companies in the private non-financial sector had invested some S\$50 billion abroad (Department of Statistics, 1996; Tan Chwee Huat, 1995). By the end of 1996, total foreign investment in the target countries in the region had reached S\$35 billion (Sunday Times, April 1997). This is interpreted as indicating the success of the regionalization programme. A little over half of the total investment has originated from foreign companies in Singapore, the remainder from wholly- or majority-locally owned companies. As to the sectoral structure, a quarter of total investment abroad concerns manufacturing operations, a large share is taken up by financial and business services. The sectoral origin of foreign investment shows a similar structure, with a not insignificant amount of intersectoral flows (comparing the sectors of origin and destination). One observation that should be made in this context is that the characteristics of outgoing investments and those of incoming investments (as to the latter, particularly the large share of investment holding companies) suggest that Singapore's traditional *entrepôt* function has now broadened to international investment capital. In regional investment in manufacturing, the 'flagship' industrial parks developed elsewhere in the region (China, Vietnam, Indonesia and India) by state-linked Singapore companies have played a significant role. Thus, elsewhere in the region, major industrial complexes which are functioning as satellites to Singapore's production complex are rapidly emerging.

The achievements under the process of restructuring have effectively lifted its role—in the global and regional order—to a higher plane, in line with the 'niche' position which the Singapore state has envisaged. Over the past ten years the Singapore economy has moved away from the role it assumed during the 1970s under the New International Division of Labour (NIDL). New strategies and the associated reworking of competitiveness towards the end of the 1980s and in the early 1990s started to produce a role, or pattern, which reflects the opportunities presented (as discussed above) as well as (in a positive sense) the limitations imposed by resource availability.

4. National Cluster Development?

At the same time, evidence is growing which suggests that some of the aims of the new economic strategies, and some of the more concrete strategic programmes are difficult to accomplish. The relevant case in point here is the aim of building *localized* integrated industry clusters.

No doubt, at the industry level, significant alterations have taken place as to inter-industry relations and integration. Increased outsourcing has resulted in the emergence of networks, shaped by 'flagship' firms and incorporating firms in a range of industries. Not only foreign but also local firms participate in these networks. However, the actual dynamics at firm level—which derives from position in the production chain, product and labour process characteristics, competitiveness factors as well as changes in the local and regional configuration of comparative advantage of 'places'—and the related structural and geographical trajectory of production controlled by firms in interrelated industries, do no longer appear to have the potential of producing sizeable *localized* inter-industry clusters. While in the structural dimension cluster formation does occur, it appears that more and more the relevant geographical scale at which clusters should be considered is not the local but meso- and macro-regional. In the Asian context, this more or less parallels the regional divisions of labour which have been shaped by firm behaviour over the past decade or so, taking advantage of differences in local and subregional environments and further enabled by fewer impediments to intra-regional intra-firm, intra- and inter-industry trade. Later, this point will be illustrated first of all by the structural and geographical dynamics of the audio production system in Singapore under restructuring. It will also be illustrated by some of the processes shaping the Singapore-Johor-Riau Growth Triangle, specifically production relations within the Triangle.

As to the former, the main findings summarized here are from a study carried out in 1995 in Singapore into the implications of industrial restructuring for the global-local dimension of the system governing the organization of the production of audio equipment (Van Grunsven, 1998). The production system, and the global-local dimension in particular, was understood to refer to global procurement versus localization (as reflected in local sourcing and local content) and the local growth and role of supplier firms as an integral segment of industries. In discussions about the global-local (and internalization-externalization) dimensions in the organizational aspect of production systems employed by firms, implicitly the focus often has been on main producers in industries and large establishments, be they transplants or local firms. This seems to be unwarranted and too limited in scope in situations where production systems in the recent past have undergone substantial change (associated with a localization trend) resulting in the growth of a substantial local supplier segment. This holds even if it is acknowledged that this segment can be associated also with the onset of restructuring in the recent past. There seems to be no a priori reason why the supplier segment in the course of time should not also feel the imperatives of restructuring. The production of audio equipment in Singapore has gradually become characterized by a sizeable local supplier segment. Thus, the study departed from the assumption that in Singapore at this stage this segment might very well be also involved in a restructuring process. For this reason surveys have been conducted among both the main producers and supply firms.

The findings pertaining to the main producers (ten Japanese firms, two European firms and one US firm) confirmed changes in the activities carried out in the Singapore plant and strategic responses to changing local conditions, which are in line with what has been discussed above. In all cases, products have been substantially upgraded and the products currently manufactured are generally considered to be in the high-end range of the audio equipment produced by the company. Nine of the eleven plants reported the use of 'state-of-the-art' product and process technologies. In addition, in the majority of the transplants product lines are now highly automated. The main motive for process automation was to alleviate the growing constraints as to the availability and cost of labour. In some cases, the labour force has declined as a result. In most cases, process automation has resulted in a substantial change of the composition of the labour force. The share of unskilled and

Table 5. Relocation of production by the audio transplants

Est.	Product	Year	Location
A	Components	1994	Indonesia
B	Portable CD players	1991	Thailand
	Portable audio, radios	1994	Indonesia
C	—	—	—
D	Low-end audio	1988	Malaysia
E	Magnetic tape heads	1982	Malaysia
	Components	1984	Malaysia
	PCBs	1990	Malaysia
F	Portable radio cassette players	1988	China
G	—	—	—
H	Low-end HiFi	1988	Malaysia
I	Low-end radio cassette recorder	1985	China
	Portable audio	1987	Malaysia
	Car audio	1989	Malaysia
J	Car audio	1990	Malaysia
K	Radios	1977	Malaysia
	Portable audio	1990	Malaysia
	Portable audio	1995	China
L	Portable radio cassette players	1980	Malaysia
	(Portable) CD players	1990	Indonesia
	Portable audio	1990	Indonesia
M	Cassette players/recorders	1993	Malaysia
	CD players	1993	Malaysia
	Amplifiers	1993	Malaysia

low-skilled workers has declined, while the share of (semi-) skilled production workers and technically trained personnel has increased. The share of males in the labour force has increased also.

Spatially, in tandem with the upgrading process most companies have relocated product lines out of the Singapore plant. Table 5 shows the broad findings as to this process, which appears to have gained momentum in the second half of the 1980s and early 1990s. As expected, most of the relocation concerned lower end products. In a few instances it also concerned in-house production of components. Two establishments have transferred production altogether out of Singapore. Most of the relocation has occurred to other countries in the region, significantly to Malaysia. Some of the transplants expect the relocation of additional production activities in the years to come. The two establishments referred to above now concentrate on other activities, i.e. R&D and technical support. Though in the other transplants production is still the main activity, towards the end of the 1980s or in the early 1990s in the majority of cases other corporate functions have been added: R&D, marketing and sales, purchasing and/or technical support functions. This reflects the trends and factors discussed earlier. Two of the establishments are now operating under OHQ (Regional Headquarter) status, which implies that they are also overseeing production which is carried out elsewhere in the region. In this context it may be noted that in some additional cases the parent companies of the transplants have an OHQ in Singapore which is physically separated from the production plant(s).

While production remains the main activity in most cases, as observed, the transplants increasingly have narrowed or confined production activities to final assembly. This is reflected in the pattern of sourcing. Only one of the establishments currently still produces part of the material input in-house. Component production earlier carried out in-house in the other transplants, in all cases has been relocated or externalized. Japanese transplants procure

part of the material input from the home country (generally around 20% or less). This involves intra-firm, extra-firm or both types of sourcing and usually concerns key components. In some cases inputs are procured intra-firm from 'the region', meaning one or more of the ASEAN countries. This is related to relocation and/or the transfer of component production by the parent company to some of the ASEAN countries. On average, some 25% of material inputs are obtained intra-firm (in most cases outside Singapore).

The percentage of input materials procured locally and extra-firm varies considerably, from 20% to 90%, with an average of 48%. Components which are sourced locally include stuffed PCBs, encasings, ICs, CD and cassette mechanisms, capacitors, resistors, magnetic heads, plastic parts and metal parts. These are either purchased at arm's length or the production has been subcontracted/contracted out to local suppliers. Contracting out arrangements are most common for the production of stuffed PCBs, encasings, and CD and cassette mechanisms. Such arrangements have grown substantially during the 1980s. It may be noted here that in a number of cases the assemblers provide part of the inputs needed to produce the components. These do not necessarily originate from Singapore and are often obtained through the sales and purchasing offices of the company. The suppliers which receive inputs from the clients (less than half) do however still source a substantial part of the inputs which are needed. More than half of the suppliers do all sourcing which is needed. Procurement is from Singapore, Japan, US, Europe, Malaysia and other countries in the region. Some of the assemblers have recently also engaged in the contracting out of the final assembly of finished products to independent firms in Singapore, under an Original Equipment Manufacturer (OEM) agreement. In this way capacity problems are solved and/or problems with respect to labour, which would have been encountered in case of expansion 'in-house', can be avoided. Also, it increases the flexibility of production.

The findings suggest a substantial degree of localization. However, for several reasons this is deceptive. First, increasingly the contracting out of the production of components like stuffed PCBs and encasings, as well as the assembly of finished products under OEM, is also to supply firms outside Singapore, particularly in Malaysia. This is done for the reason of costs. This indicates that besides from/to suppliers in Singapore material inputs which require substantial input of labour are also purchased from or subcontracted/contracted out to— independent firms in—Malaysia, Thailand or Indonesia. This indeed indicates that the suppliers in Singapore are experiencing cost problems (i.e. have started to feel the triggers of restructuring). The second reason then concerns the strategic responses of suppliers to these cost problems.

The suppliers included in the research are quite diverse in terms of origin, status and period of establishment. Half are Singapore establishments and the other half are foreign. Given the predominance of Japanese establishments among the assemblers, it is not surprising that most of the foreign suppliers are of Japanese origin as well. Logically, all the foreign establishments are subsidiaries. This also holds true for one-third of the Singapore establishments. The majority of the latter were set up during the 1980s, in contrast to the Japanese and other foreign establishments which have been operating in Singapore since the second half of the 1970s. Most of the parent companies of the subsidiaries (including three of the five parent companies of the subsidiaries of Singapore origin) have other subsidiaries in the region, in number ranging from one to eleven. Besides Singapore (six cases), these are located in Malaysia, Thailand, China, Indonesia, Korea, Taiwan and Hong Kong.

As to production carried out by the suppliers, one can distinguish between production in the narrow sense (that is non-assembly) and assembly. The activities of 70% of the establishments are in the former category and include injection moulding, painting, printing, stamping and wire harnessing. The latter category comprises 30% of the establishments and is predominantly PCB assembly.

Most establishments have departments dealing with marketing and sales, purchasing, technical support and operational management. Many of the suppliers have a range of clients, though in many cases the 'market' of the Singapore establishment is restricted to Singapore. Eleven of the 15 Singapore establishments and eight of the 12 Japanese establishments only produce for clients in Singapore (the 13 assemblers). Only nine establishments export a usually small part of the output to clients outside Singapore, commonly located in one of the other countries in the region. For most of the establishments it is not profitable to expand in foreign markets through export from the Singapore facility. As will be shown later, a number of establishments use alternative strategies to achieve that.

Fundamental changes were observed in the patterns of operation of the supplier firms. The findings reveal that these patterns currently are quite dynamic. Though about half of the establishments have engaged in process automation to alleviate the cost problem, production processes are in many cases still characterized by high labour intensity and low value-added. The size of the establishments in terms of number of workers varies substantially (from as low as 24 to as high as 990, the average number of employees was 235 and about three-quarters of the establishments employed less than 300 workers), but all made use of foreign workers (mostly guestworkers from Malaysia) and all had reached the maximum allowed (40%). In view of the labour situation, most of the establishments were not expanding the facility. Rather, the opposite is already occurring in some cases and may become a trend in the near future.

In relation to this, the research revealed some significant phenomena. Firstly, besides attempts by a number of establishments to upgrade their operations by substituting products, the adoption of new process technologies and going into R&D, a substantial number of establishments (17 out of the 29, two-thirds of the Singapore establishments and half of the foreign establishments) in the course of the 1980s have engaged in contracting out activities. This involves either part of the production process or specific product lines. Operations performed by second tier subcontractors include injection moulding, subassembly, plating, metal cutting and manufacture of subcomponents. The second tier subcontractors are overwhelmingly located in Singapore.

Secondly, many suppliers have started to relocate operations out of Singapore. Table 6 shows that, so far, half of the total number of establishments (a majority of the Singapore establishments and somewhat less than half of the foreign establishments) have relocated production out of Singapore. This gained momentum in the early 1990s and more establishments will adopt this strategy in the years to come. Malaysia, Indonesia and China are the favoured countries for the relocation of production. The products are shipped back to Singapore for further processing and/or delivery to the clients. However, in a number of cases the products are also delivered to local clients. This is related to the relocation of production by main producers and puts the remarks made above as to expansion strategies in context.

Related to relocation, it can be observed that a significant number of establishments have set up one or more subsidiaries outside Singapore. The subsidiary establishments also make use of other subsidiaries of the parent company in the region for the purpose of relocation. So far eight of the 15 Singapore establishments and three of the 12 Japanese establishments have set up one or more subsidiaries outside Singapore, mostly in Malaysia and Indonesia. As relocation will continue in the years to come, it is to be expected that more establishments will internationalize. Subsidiary establishments have been set up even though no relocation of production has taken place yet. This most reflects the fact that internationalization is an outcome also of expansion strategies which (necessarily) have assumed a regional scope. In relation to this, it was observed that the factors underlying internationalization are two-fold. One factor, mentioned in the majority of cases, is similar to the main reason why the main producers engaged in relocation, the limited availability and increasingly prohibitive cost of

labour in Singapore (cost push). The second factor is the following of clients in order to stay in the market, maintain market share, or on request of the client (market pull). Thus, as suggested above, relocation by the main producers—and the fact that the expansion of the branch now takes place elsewhere in the region—has an impact on the spatial strategies pursued by the suppliers in Singapore.

The interviews made clear that in some cases relocation had resulted in a—significant—scaling down of operations in the Singapore facility. This may become a trend too, given the expectations for the future expressed by the plant managers. Most of them stated that in the near future the neighbouring region will be much more important for the operations of the establishment and company than Singapore. If expansion does take place, this will occur outside Singapore. Only a minority of the managers (eight out of the 29) stated that production in Singapore would definitely be continued. Thus, the focus of operational strategy in the future will be regional rather than local.

Regionalization is a striking new course the supplier segment has taken. Whether the dynamics will result in the gradual disintegration of the localized supply segment remains to be seen. However, a more regionalized supply structure seems to be in the making, after a phase of the development of a localized supply structure. The overall process is depicted schematically in Figure 1. The global dimension remains, and the global-local configuration seems to be transformed into a global-regional-local configuration (from the perspective of the main producers). This may not necessarily have any consequences for 'local content'.

Thus, in the process of restructuring, the production system and localization appear to be reshaped. The relocation by main producers and the market pull responses of suppliers, coupled with the main prospect of contraction of local production in the supply segment (rather than stability) also because of the cost push, may imply that for the near future hollowing out of the branch as a whole is a possibility which may turn into reality. It may be noted here that, overall, the findings reveal changes which conform to those observed in other segments of the electronics industry in Singapore (Natarajan & Tan, 1992). Likewise, the observations with respect to the supply segment of audio production appear to be applicable to local supply firms in other electronic branches. This can be derived from the 14 case descriptions of the internationalization of Singapore companies presented by Lee Tsao Yuan in a recent publication (Lee Tsao Yuan, 1994). In other words, the findings appear to conform to what is occurring elsewhere in the electronics industry (and the other way around).

The restructuring processes outlined above may be further illustrated by the characteristics of industrial development in Johor, one of the partners in the Singapore-Johor-Riau (SIJORI) Growth Triangle (Figure 2). The SIJORI is the cornerstone of the regionalization initiative driven by the Singapore Government. The Indonesian Riau Islands (in particular Batam and Bintan) and the Southern part of West Malaysia's Johor State constitute the Southern and Northern wings respectively of the Growth Triangle. After 1985, the Southern part of Johor has experienced rapid industrial development, reflected in an increase of the share in GDP from 18% in 1985 to nearly 32% in the mid-1990s. The rapid growth of the—largely export-oriented—industrial economy is linked to a post-1985 foreign investment 'boom'. The role of international capital is illustrated well by the fact that 87% of the 1800 investment projects approved over the period 1987–1996 involved foreign equity. Over the same period, foreign equity amounted to 68% of total equity of investments. It is estimated that over the past 10 years some 800 branch plants have been set up by foreign companies, with the majority located in one of the 15 newly developed industrial estates managed by the Johor Corporation. Most of the industrial estates are located in the southern part of the state, the Johor Bahru Metropolitan Area, in close proximity to Singapore. Many branch plants are operating as a Licensed Manufacturing Warehouse, which exempts them from paying import and export duties.

The investment data of Johor strongly reflect the important role of Singapore. The most

Table 6. Relocation of production and internationalization of suppliers

IID	Origin	Subsidiary	Own subsidiaries			Relocation			Future relocation		
			No.	Location	Product(s)	Year	Location	Product(s)	Year	Location	
1	Singapore	yes	—	—	Cassette mechanisms	1991	Malaysia	Injection moulding	1997	China	
2	US	yes	—	—	—	—	—	—	—	—	
3	Singapore	no	1	Malaysia	PCB ass.	1994	Malaysia	—	—	—	
4	Singapore	yes	1	Malaysia	PCB ass.	1991	Malaysia	—	—	—	
5	Japan	yes	—	—	—	—	—	—	—	—	
6	Japan	yes	—	—	—	—	—	—	—	—	
7	UK	yes	—	—	Metal components	1993	India	—	—	—	
8	Singapore	no	—	—	—	—	—	—	—	—	
9	Singapore	yes	1	Malaysia	—	—	—	—	—	—	
10	Singapore	no	—	—	—	—	—	—	—	—	
11	Japan	yes	2	Malaysia Indonesia	Speakers	1988 1991	Malaysia Indonesia	Speakers	1995	China	
12	Singapore	no	4	Malaysia Indonesia Malaysia Indonesia Japan	Cassette mechanisms	1988	Malaysia	—	—	—	
13	Japan	yes	—	—	—	—	—	PCB ass.	1995	Malaysia	
14	Japan	yes	1	Singapore	Injection moulding	1994	China	—	—	—	
15	Japan	yes	—	—	—	—	—	—	—	—	
16	Singapore	no	1	Malaysia	Audio ass.	1994	Malaysia	—	—	—	
17	Japan	yes	—	—	Ceramic capacitors	1993 1994	Thailand Malaysia	—	—	—	
18	Singapore	yes	1	Malaysia	PCB	1989	Malaysia	PCB	1995	China	

19	Japan	yes	—	—	—	—	—	—	—	Assembly electrical parts	1995	Malaysia
20	Singapore	no	—	—	—	—	—	—	—	Injection moulding	1995	Malaysia
21	Singapore	no	—	—	—	—	—	—	—	—	—	—
22	Japan	yes	1	Indonesia	Assembly car audio parts	1991	—	Indonesia	—	—	—	—
23	Japan	yes	—	—	—	—	—	—	—	—	—	—
24	Japan	yes	3	Malaysia	Assembly parts	1988 1993	—	Malaysia Malaysia	—	—	—	—
25	Japan	yes	—	—	home audio magnetic heads	1992	—	China	—	—	—	—
26	Singapore	no	—	—	—	—	—	—	—	Metal parts	1995	China
27	Singapore	yes	1	Indonesia	PCB ass. testing	1990 1993	—	Indonesia Indonesia	—	—	—	—
28	Singapore	no	—	—	—	—	—	—	—	Injection moulding	1995	Malaysia
29	Singapore	no	3	Singapore Malaysia Vietnam	encasings	1993	—	Vietnam	—	—	—	—

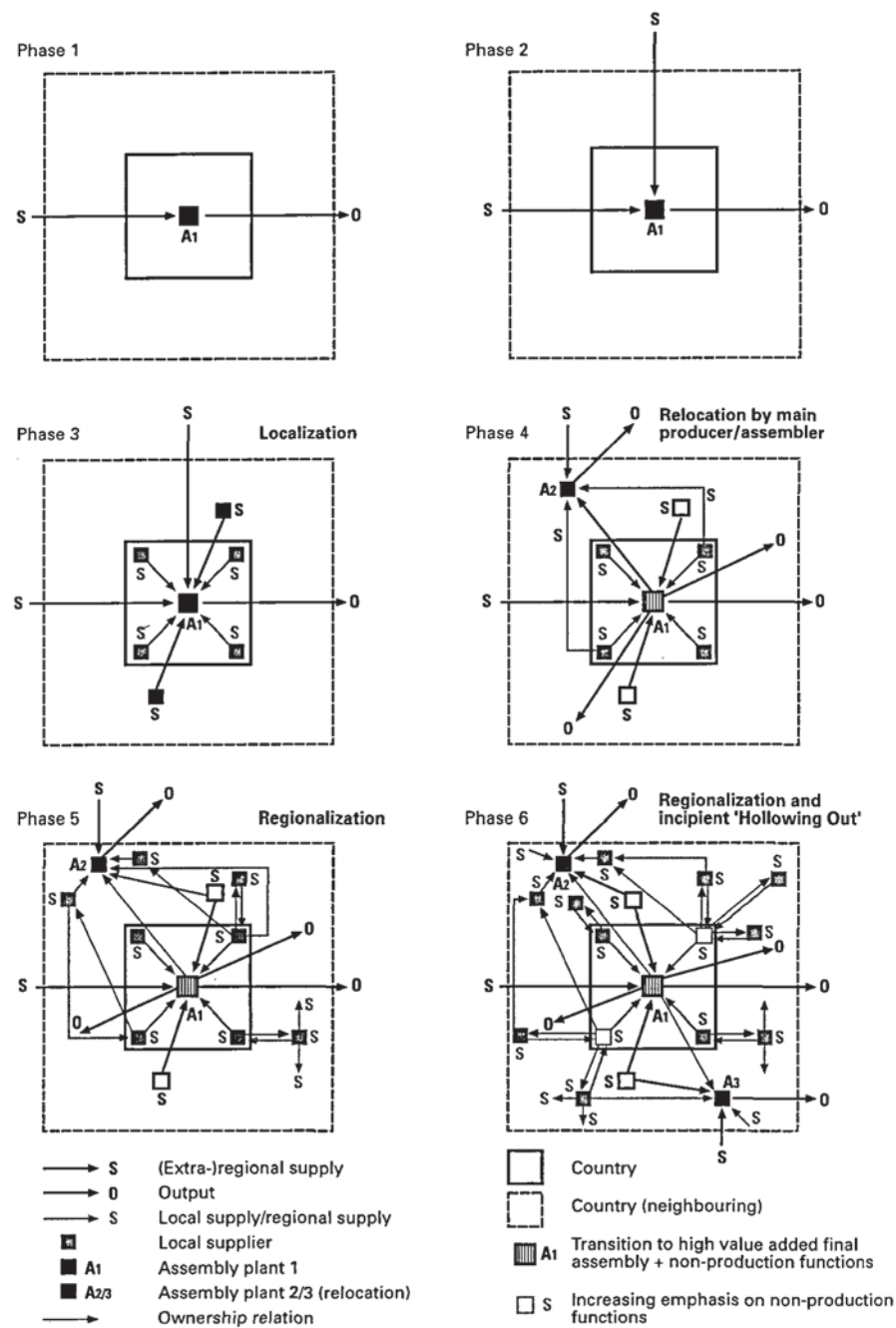


Figure 1. The dynamics of the audio production system in Singapore.

important sources of foreign investment in Johor are Japan, Singapore, Taiwan, South Korea, Hong Kong, the US and Europe. Combined, these countries contributed more than 80% of foreign capital investment in approved manufacturing projects over the period 1981–1993. With a share of 22% in the total foreign capital investment, Japan was the most important source, closely followed by Singapore (20%) and Taiwan (17%). However, in terms of the

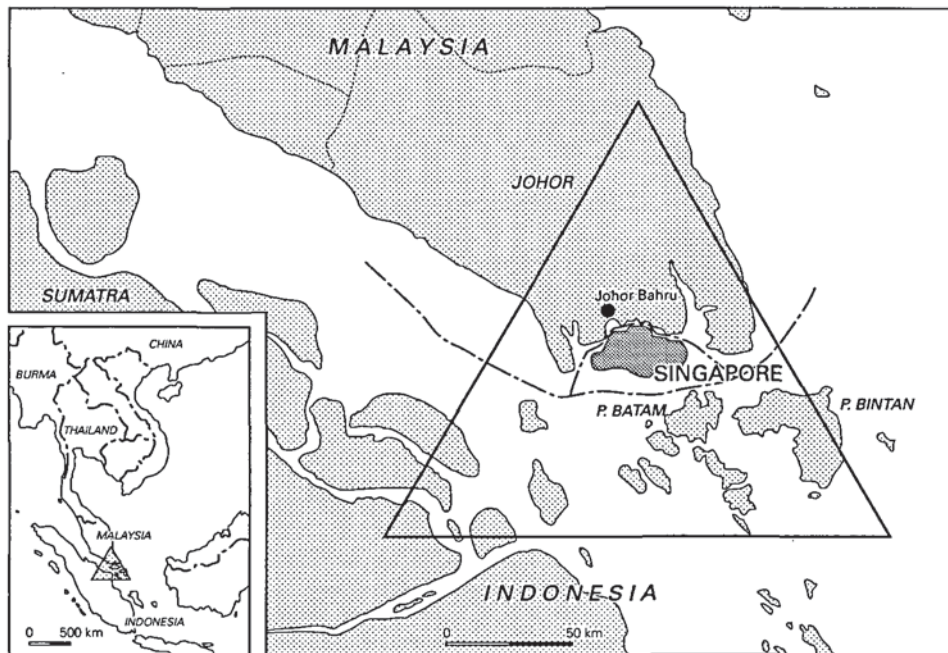


Figure 2. The SIJORI Growth Triangle.

number of approved projects, Singapore is by far the most important source, responsible for nearly half of the projects. Singapore's role is even larger than these figures suggest. If one accounts for the investments by US, Japanese and European MNCs made via and by their Singapore subsidiaries, Singapore turns out to be the most important source, both in terms of capital investment and number of establishments. Furthermore, Singapore investments account for almost half of the 250 000 jobs generated between 1985 and 1995. The relative importance of Singapore is brought out clearly also by the fact that its share in foreign investment in Johor is more than five times its share in total foreign investment in Malaysia.

While the above clearly shows the extent to which the recent industrial growth in Johor has depended on Singapore as a source of foreign manufacturing investment, it does not tell us much about the characteristics of actual relocation processes, nor about the extent and forms of integration (structural integration in the form of cross-border production or service linkages and local linkage) which are forged in the process. Findings of a study carried out in Johor has provided some insights into these questions (Van Grunsven *et al.*, 1995). This study pertained to the ownership, production and linkage characteristics of manufacturing establishments located in three large recently developed industrial estates in southern Johor. Of the 141 establishments interviewed, 39 were Malaysian-owned (the majority of which were involved in less sophisticated activities in traditional industries). The remainder were foreign-owned. Of these, about two-thirds were either Singapore or Japanese owned. While a number of the Singapore companies were involved in more traditional branches characterized by low entry-barriers (e.g. wearing apparel and wood products), the large majority of these establishments were involved in relatively sophisticated subcontracting activities such as the production of plastic, metal and electronic components for the electronics industry. Nearly half of the Japanese-controlled establishments were concentrated in the electrical and electronics industry. In contrast to the Singapore establishments, a number of these were involved in the final

assembly of audio and video equipment as well as television sets, besides component manufacturing for the electrical and electronics industry.

The analysis of the broader strategic context of the companies' decision to invest in Johor clearly illustrates the cost push and market pull driven relocation/expansion processes described earlier. First, among the foreign establishments interviewed, 32 were the result of a corporate decision to relocate at least part of the production (one or more product lines) from a foreign location to Johor. Twenty of these relocations emanated from Singapore. This involved both Singapore companies and overseas MNCs. In four cases, MNCs had consolidated production lines previously located in different countries. Second, a large number of foreign establishments interviewed were the result of expansion of existing product lines (51 establishments). In many cases this involved Singapore companies or MNCs with a facility in Singapore that, in the face of an expansion decision, chose not to expand in Singapore, but to start up production across the border. Hence, in a number of cases part of the equity of the Johor expansion was controlled by the Singapore subsidiary.

Third, the investment decisions of the companies in the electrical/electronics complex (including manufacturers of plastic and metal components) may be singled out for discussion. The 45 companies in this complex can be divided into assemblers and suppliers. When the companies producing sub-assemblies to be integrated into the finished product ('system integrator') are treated as 'assemblers', 17 establishments can be considered as assembler and the remaining 28 as supplier. Of the assemblers, 11 produce consumer electronics. These are all export-oriented establishments (mainly producing for the US, Japan and Europe) that primarily set up operations in Malaysia to enjoy lower production costs. Eight of these cases are subsidiaries of large Japanese MNCs. One Japanese MNC relocated its production from Japan to Johor. The establishment of another Japanese MNC is the result of an expansion as well as a relocation of the production capacity in Japan. Two Japanese MNCs used their subsidiary in Singapore as a springboard for further expansion in Johor. One establishment started as a relocation from Singapore and yet another as an expansion of the production capacity in Singapore. In the remaining four cases the two processes (relocation/expansion from Japan and a relocation/expansion from Singapore) are very much intertwined. One establishment constitutes an expansion of the capacity in Singapore as well as a relocation from Singapore/Japan. Three establishments are the result of an expansion of the production capacity in Japan and Singapore.

The other six assemblers produce electrical products. These include one Japanese MNC that expanded its production capacity in Japan with a plant in Johor producing for the Japanese market. Two British MNCs are clearly export-oriented as well. One of these establishments represents a relocation from Singapore. Three other MNCs (Singapore, Taiwan and New Zealand) expanded their Singapore production capacity with an establishment in Johor to supply the Malaysian market with finished products.

Of the 28 interviewed suppliers, 21 came to Johor to supply the local market. In 11 cases these concern Japanese companies. Six of these establishments are expansions of existing production capacity in Japan. The other establishments are expansions or relocations (or both) of existing production capacity in Singapore. In most of these cases, the two processes (relocation/expansion from Japan and relocation/expansion from Singapore) are strongly intertwined. In three instances the expansion of production capacity already established in Singapore to Johor coincided with a relocation/expansion from Japan.

Apart from these Japanese suppliers, four Singaporean suppliers are also strongly, though not exclusively, orientated to the local market. In two cases the cost push in Singapore had led to the relocation of the entire production. In one of these cases, initially the facility was mainly producing for the Singaporean market, but at the time of interview 80% of the output was sold to customers in Johor. The two other cases are expansions of existing production

Table 7. Geographical destination of finished and semi-finished products (average %)

Country of destination	All industries (N = 141)		Electrical/electronics (N = 33)	
	Finish (N = 58) (%)	Semi (N = 83) (%)	Finish (N = 11) (%)	Semi (N = 22) (%)
Johor	24.4	30.2	5.4	14.3
Other Malaysia	21.7	19.2	6.7	18.8
Singapore	8.3	15.8	5.4	20.9
Japan	9.2	8.4	13.8	14.1
Europe	8.6	6.7	18.5	8.6
USA	9.6	8.6	32.7	15.0
Other regions	18.2	11.1	17.5	8.3

Source: research (1994).

capacity in Singapore. One of these companies followed a customer that relocated from Singapore to Johor (market pull). The other establishment supplied inputs to an affiliated establishment that relocated to Malaysia some years earlier. In addition to the Japanese and Singaporean establishments, there were six other suppliers with a strong orientation to the local market. This concerned three indigenous (Malaysian) suppliers, one Korean firm that expanded existing production capacity in Singapore through an establishment in Johor, and two suppliers that relocated from Korea.

Seven of the 28 suppliers have no local customers. These companies primarily located in Johor to enjoy low production costs and land prices. Three Japanese MNCs relocated or expanded their existing production capacity in Japan to Johor in order to supply their customers in Singapore and Japan. The three other cases were Singaporean MNCs that expanded existing capacity in Singapore through an establishment in Johor. These establishments mainly produced for customers in Singapore. Finally, one Swiss MNC relocated part of a production line in Singapore to Johor in order to supply (among others) inputs to an affiliated plant in Singapore.

The findings presented above illustrate the extent to which industrial development in Johor is a result of the regionalization of the Singaporean manufacturing base. Another way to deal with the question of integration is by looking in detail at the production linkages between the two countries. For this purpose Table 7 shows the geographical destination of finished and semi-finished (components) products manufactured by the firms in the sample. Although, Singapore constitutes a relatively modest (final) market for finished products, on average 16% of the semi-finished products is sold to manufacturing establishments located in Singapore. Furthermore, Singapore constitutes the most important market (21%) for semi-finished products of the electrical and electronics sector.¹

On average, the respondent firms obtained only 7% of their material inputs from Singapore. This percentage was the same for manufacturers of semi-finished products and manufacturers of finished products. However, Singapore played a more important role in the supply of inputs for the electronics industry. Establishments in this industry on average obtained 13% of their inputs from Singapore.

The organizational aspects of input and output flows provide a final indication of the level of integration. Almost a quarter of the respondent firms sourced part of their input requirements from affiliated companies (intra-firm). These intra-firm inputs comprised only 10% of the aggregate input value of the firms. Thus, the amount of intra-firm inputs turned out to be very limited. However, a substantial part of the inputs originating from Singapore (13%), Johor (11%) and Malaysia (8%) was produced by affiliated companies. On the output side,

intra-firm organizational structures were less prominent than on the input side. Only 16% of the establishments sold part of the output to establishments of the same organization, comprising only 4% of the aggregate value. This low figure is mainly the result of the way intra-firm output was defined in the research. Despite the fact that in many cases the finished products were 'sold' to the parent company, these supplies were not treated as intra-firm, since there is no further processing. There was, however, a large intra-firm component in the exports to Singapore (26%). These findings further corroborate the idea of an integrated regionalized production structure.

At the same time, the simultaneous location of complementary assembly and supplier facilities as a result of relocation/expansion processes out of Japan and Singapore has also led to a degree of localization within Johor. On average, the firms obtained 25% of their input requirements from the state of Johor. If the inputs, the origin of which was unknown (sourced from local distributors and wholesale firms), are excluded, the share drops to 19%. On average, the whole of Malaysia is responsible for 42%. This is the more impressive as these figures do not include the (mainly local) expenditures on packaging material. Within Johor a more or less integrated supply structure is developing around the electronics industry. Local suppliers already produce a range of inputs. In turn, the suppliers are able to obtain part of their inputs locally. For example some producers of plastic components obtain their input from the basic chemical industry. The boards for printed circuits and the material to produce these boards (copper-clad laminates and chemicals for etching) are also produced in Johor. However, the local inputs often involve the 'lower-end technologies', such as plastic and metal components. Most suppliers of 'high-tech' inputs for PCB assembly, such as ICs, are still located outside Johor. Some of these more sophisticated inputs are produced in Malaysia (Penang and Kuala Lumpur) but Singapore and the Japan are still the most important sources.

In spite of this localization trend, Johor's electronics 'cluster' is still very much part of a cross-border industrial complex. This is illustrated also by the 29 establishments producing semi-finished products (metal, rubber, plastic and electrical/electronic parts and components) for the electronics industry.² Twenty-one establishments sell part of their output to manufacturers in Singapore and 19 establishments supply part of their output to customers in Johor. Six of these establishments sell part of their output to customers in Johor and export nothing to Singapore. Eight companies export part of their output to Singapore and sell nothing to Johor (in two of these cases a considerable share of the output is sold to firms elsewhere in Malaysia). However, almost half of the establishments (13) has both customers in Johor and Singapore.

Earlier we pointed out the regionalization process in Singapore, stimulated by the 'high-road' strategy of the Singapore government, possibly leading to some 'hollowing-out' of the manufacturing base. The findings on the processes in one part of the Growth Triangle suggest that at least part of the electronics cluster, that the Singapore government aimed to develop, has leapt over the Causeway and is acquiring a self-sustaining momentum in Johor. It must be noted that the control functions in the production 'system' appear to remain in Singapore. Nevertheless, serious doubts may be raised as to the viability of the strategy of *local* cluster-based development, in the light of firm behaviour under changing global, regional and local forces. In a small economy with many resource constraints a *localized* cluster-based development strategy does not in all major industries appear to be compatible with a 'high-road' strategy.

Manufacturing industry is taking advantage of the regional differentiation in comparative advantage within the different segments of the Growth Triangle, thereby creating a new division of labour within cross-national/regional networks. The presence of resource complementarity in close geographic proximity provides an excellent environment to carry out activities along different segments of the value-chain without losing the beneficial effects of

geographical proximity as suggested by Porter. Incidentally, the Johor authorities, no longer content with their role as a low-cost manufacturing satellite of Singapore have embarked on an aggressive industrial upgrading programme (Van Grunsven *et al.*, 1995). Interestingly, an important component is '*cluster-based industrial development*', strongly based on the ideas of Porter (1990). Theoretically this could mean that, from a position of complementarity in resources, the two segments of the cross-border production region are moving towards direct competition in at least a range of activities or industries. On the one hand, as yet, Johor's headway in upgrading its industrial structure is limited compared to Singapore's, and its industrial structure is still very much dependent on and subordinate to that of Singapore. On the other hand, one could argue that Johor is more successful than Singapore in its *localized* cluster-based industrial development strategy.

5. Conclusion

In the foregoing we have examined Singapore's 'high-road' industrial development path and the linked cluster development strategy. We have argued that this development path was inspired by a set of specific local and regional conditions. We have also attempted to show that the achievements of the 'high-road' path may be related to a significant extent to a new set of regional and global conditions. The ensuing responses of large multinational firms have opened new windows of opportunity at a time when the new path was reconfirmed by the Singapore state. While substantial positive results have been achieved as far as the upgrading of the industrial structure (and indeed the economy as a whole) is concerned, this appears to hold much less with regard to the aim of *localized* cluster development. It appears that conditions which stimulate upgrading do not necessarily also promote *localized* cluster formation (i.e. within the national territory). The dynamics at the microlevel, i.e. the firm, appear to indicate an outcome which, rather than as identical agglomerations at the national level, may be identified as differential agglomerations, nested within cross-national/regional network structures in which the role of each agglomeration is derived from a regional division of labour based on specific, yet differential, comparative advantages of places. Of course, any conclusion critically depends on the specific definition of cluster which one wishes to employ. What we can say is that, although much of the control of production chains still appears to be exercised from Singapore, the current industry structure conforms less to clusters as defined by Singapore's policymakers than the plans had aimed for.

It may be argued that it is not feasible for Singapore to develop 'broad and deep' clusters within its national territory. Upgrading inevitably drives out a large part of the low-end manufacturing activities and leads to regionalization and subsequent disintegration—of course leaving Singapore with the more technology-intensive R&D and corporate service functions. However, if one diverges from Porter's idea that clusters are necessarily contained within nations and recognize that some clusters cross national borders (Jacobs, 1995), one could portray the situation in for example the electronics industry as a transnational cluster. One may extend the argument further by postulating that regionalization was a necessary element of Singapore's upgrading process. The wings of this transnational cluster are, however, strongly subordinate to the Singapore segment. Most of the flagship facilities are located in or controlled from Singapore. Thus, this transnational cluster differs from the '*Double Diamond*' concept as put forward by Rugman and D'Cruz (1993) in the context of the North American cross-border production complex.

When considering the relevance of the described high-road strategies and clustering experiences for industrial policy in the Celtic Fringe, it is important to reflect on the specific local and regional conditions that governed the adoption of these strategies. Like Singapore, the Celtic Fringe received substantial amounts of foreign direct investment. However, the

sheer scale of FDI in Singapore created resource problems that have not been experienced to the same extent in the Celtic Fringe, as of yet. A policy of relocation and active discouraging of low-end manufacturing projects has never been 'necessary' nor, given the structure of the workforce, desirable.

Next, like Singapore, the Celtic Fringe is benefiting from international corporate reorganization and changing production concepts. The possibilities for a cluster-based industrial development strategy have certainly increased and there are cases where a concentration of foreign production plants led to the formation of a localized cluster. However, the potential for local linkage creation differs from industry to industry and is strongly dependent on accustomed practices of the investing MNC. Singapore attracted a large number of Japanese companies that have a particularly high disposition to subcontract and become locally embedded in the host economy. Furthermore, initially Singapore received a large number of consumer electronics assembly projects, characterized by extensive component requirements with a technology content feasible for local companies. It was exactly the same investment characteristics that led to competitive cluster formation in the Welsh electronics industry, one of the few examples of such cluster formation in the Celtic Fringe (Cooke, 1996).

Interestingly, the Welsh electronics cluster has not experienced the same 'hollowing-out' process that we have seen in Singapore. The cluster is comprised of assemblers, system integrators and part suppliers, including the low-end metal and plastic component manufacturers. The contrast in experiences may partly be explained by the difference in regional context. The Singaporean context, characterized by nations with highly differentiated competitive advantages, is different from the Welsh context, consisting of nations with far less differentiated advantages in an integrated European Union. In this less differentiated regional context there was less incentive for firms to relocate low-end activities and, from a local resources perspective, this has not (yet) been desirable. In the European context MNCs created a less pronounced regional division of labour in which Wales was bestowed with a more complete range of activities. However, the level of upgrading and innovation has been less impressive than in Singapore's electronics cluster.³ Thus, the Welsh example shows that it is possible to develop clusters around a concentration of foreign subsidiaries, even for small open peripheral economies in Europe. However, the low-end manufacturing activities in the Welsh electronics cluster appear to be supported by local conditions and policies that are less conducive to further upgrading.

Again, successful localization is highly dependent on industry characteristics. Ireland and Scotland attracted proportionately more American MNCs, particularly in the office machinery and data processing industry and the semi-conductor industry.⁴ Although, personal computer assemblers in Ireland have some local backward and forward production linkages, as yet the formation of competitive embedded clusters around the large groupings of MNCs in these two countries has been less impressive (for Scotland see Turok, 1993, 1997). A large part of this might be explained by industry characteristics less conducive to local agglomeration (Angel & Engstrom, 1995) or, in the case of the semi-conductor industry, requiring a limited number of highly sophisticated inputs. As regards the computer industry it will be interesting to investigate the possible existence of a transnational cluster between Ireland and Scotland. However, the structure of such a possible transnational cluster, characterized by integrated but more or less equivalent segments in each nation, will be different from that of the Growth Triangle.

Furthermore, recent developments related to the economic boom in the Celtic Tiger might be a further illustration of the friction between upgrading and localized cluster strategies. The recent investment boom, has brought higher value-added activities with an increasing technology content, notably in the electronics and software industries. The scale of this unforeseen boom has led to wage rises and labour shortages in certain sectors of the

economy. The upgrading of the Irish economy seems to be coinciding with a partial disintegration of the computer sector. Partly driven by cost push, assemblers such as AST and Intel have discontinued the production of low-end products such as personal computers in Ireland. Similarly, a number of component suppliers involved in low-end, labour-intensive production processes (e.g. Mitsumi, Acco, Seagate and Applied Magnetics) are relocating or consolidating their activities outside Europe, notably Malaysia, China and the Philippines (Sunday Business Post, January 25, 1998). Although, there are examples of product-line substitution (e.g. Intel), a process like in Singapore, where relocation coincided with product-line substitution and the introduction of R&D, logistics and control functions, is less likely. In a number of cases (e.g. Dell and Intel) sales and control functions were always carried out nearby, in the established core regions of Europe. For many control functions these regions will remain the preferred locations for European operations.

Finally, a brief comment on the political framework. Singapore's upgrading process has been guided by a strongly interventionist government. In the Celtic Fringe economic intervention has been more limited. State agencies have been involved in linkage stimulation programmes such as the Source Wales programme (Cooke & Morgan, 1998) and, in Ireland, The National Linkage Programme. However, both programmes are more concerned with the promotion of linkages than with 'building' sectoral clusters per se. Ideas, along the lines of 'addressing critical gaps in the industry clusters' (Singapore's *Co-investment 2000* programme) would not receive much support, at least in Irish policy circles.

Notes

1. Note that the electrical and electronics *sector* sample differs from the 45 establishments in the electrical and electronics '*complex*' referred to above. The *complex* does include non-electrical and non-electronic components. The *sector* does not.
2. Again, note that this sample of 29 suppliers of semi-finished products differs from the sample of 28 'non-assembled product' suppliers mentioned earlier.
3. The Welsh electronics cluster does not show particularly high levels of innovative activity. The Gross Expenditure on R&D for this cluster is relatively low and R&D is limited to low-end basic research and some applied research (Cooke, 1995).
4. On the other hand, the volume of Japanese FDI is disproportionately small (Maruya & Jacobson, 1991).

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