

Rethinking Clusters : Towards a More Open and Evolutionary Approach*

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전통적 산업집적지의 변화과정과 경제적 성과

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Abstract : Clusters have become a key focus of interest and analysis over the last decade or so, informed by the work of the Harvard business economist, Michael Porter. Recent research, however, suggests that the classic Porterian conception of clusters needs to be rethought. In particular, the idea that clusters are geographically bounded and integrated units whose primary link to the outside world is through the export of goods and services to global markets is highly questionable, if not untenable. Relational approaches to clusters and regional development stress the importance of the wider networks and 'pipelines' through which knowledge is exchanged with key partners and collaborators located outside of the particular cluster in question. Rather than the main external links being those between leading firms and global markets, firms may engage in a range of global relations with collaborators and suppliers. This paper address the challenge of rethinking clusters in the light of the recent emphasis on global networks and connections, drawing on experience from an old industrial region in Western Europe Scotland. In assessing cluster experiences and initiatives in Scotland, I examine the development of the oil and gas and electronics clusters. In conclusion, I suggest that cluster initiatives are only likely to generate lasting benefits for the region in question if there is significant local ownership and control of key industries and clusters.

Keywords : Clusters, networks, value capture, Scotland

요약 : 마이클 포터에 의해 소개된 클러스터는 지난 십여 년간 많은 학자들의 관심과 분석의 대상이었다. 그러나 최근 연구들은 포터가 소개했던 클러스터 개념이 수정되어야 할 필요성을 제시해 주고 있다. 특히 클러스터가 외부 세계와는 재화와 용역의 수출입만으로 연결된 지리적으로 국한된 지역이라는 개념은 의심의 여지가 충분하다. 지역발전에서 있어 관계중심적 접근은 클러스터 외부의 중요 협력파트너들과의 네트워크를 통해 이루어지는 지식과 정보의 교환이 가지는 중요성을 강조한다. 기업들은 이들 협력파트너들과 다양한 형태의 관계를 형성하는 것이다. 본 논문은 글로벌 네트워크를 중시하는 최근의 추세와 서유럽의 구산업지역인 스코틀랜드의 경험을 바탕으로 기존의 클러스터 개념의 재해석을 시도한다. 스코틀랜드 지역의 클러스터 경험을 평가함에 있어 본 논문은 석유와 가스, 전기 클러스터를 분석한다. 마지막으로 본 논문은 클러스터 정책은 해당 지역이 주요산업 및 클러스터에 대한 오픈십과 컨트롤을 충분히 가지고 있을 경우에만 지속적인 효과를 거둘 수 있다고 결론짓는다.

주제어 : 클러스터, 네트워크, 가치확보, 스코틀랜드

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1. Introduction

Clusters have become a key focus of interest and analysis over the last decade or so. Closely associated with the work of the Harvard business economist, Michael Porter, the cluster concept has attracted interest from academics, consultants and policymakers concerned with urban and regional development in an increasingly global economy. Cluster based policies have been adopted by a range of organisations operating at different geographical scales, including regional development agencies within a number of European, North American and Asian states, national government units such as the United Kingdom (UK) Government's Department of Trade and Industry (DTI) and supra-national bodies such as the Organisation for Economic Cooperation and Development (OECD) and the European Commission.

Recent research, however, suggests that the classic Porterian conception of clusters needs to be rethought (Amin and Cohendet, 2004; Bathelt et al., 2004; Saxenian, 2006). In particular, the idea that clusters are geographically bounded and integrated units whose primary link to the outside world is through the export of goods and services to global markets is highly questionable, if not untenable. Relational approaches to clusters and regional development stress the importance of the wider networks and 'pipelines' through which knowledge is exchanged with key partners and collaborators located outside of the particular cluster in question (Bathelt et al., 2004; Rychen and Zimmerman, 2008). Rather than the main external links being those between leading firms and global markets, firms may engage in a range of global relations with collaborators and suppliers. This point is reinforced by recent contributions to the regional development literature which stress the need to 'globalise' regional development by viewing regions

as open and porous social constructs whose boundaries are transcended by a range of economic flows and networks (Amin, 2004; Coe et al., 2004; Saxenian, 2006).

This paper address the challenge of rethinking clusters in the light of the recent emphasis on global networks and connections, drawing on experience from an old industrial region in Western Europe ? Scotland. The next section examines the key features of clusters thinking, focusing particularly on the classic Porterian model and highlighting the need to pay more attention to the evolution of clusters over time. This is followed by a review of recent approaches which adopt a global perspective on regional development, considering the implications of this for clusters research. I then assess cluster experiences and initiatives in Scotland, examining the development of the oil and gas and electronics clusters. In conclusion, I summarise the main points of the paper and try to draw out some broader lessons.

2. The Clusters Approach

An interest in the economics of spatial agglomeration or clustering can be traced back to the late 19th century and Alfred Marshall's observations about specialised industrial districts in the United Kingdom. According to Marshall, the advantages of agglomeration are rooted in the reduced costs that arise from the operation of three sets of 'localisation economies': the growth of various intermediate and subsidiary industries which provide specialised inputs; the development of a pool of skilled labour; and the establishment of a dedicated infrastructure and other collective resources (Malmberg and Maskell, 2002). While these basic factors have remained prominent in much subsequent research on agglomeration (Myrdal,

1957; Scott, 1988), recent studies emphasise the role of knowledge and information spillovers (Malmberg and Maskell, 2002; Storper, 1997).

Porter's work became highly influential in the 1990s, offering a coherent and accessible theory that emphasises the benefits of clustering and provides guidance for policy-makers on the selection and promotion of clusters. While Porter (1990) was originally concerned with the external conditions that support firm competitiveness at the national scale, he has increasingly focused upon the importance of sub-national business clusters in underpinning competitiveness and innovation in modern economies (Porter 1998). In his earlier work, Porter developed his famous diamond model, arguing that national competitiveness was rooted in the relationships between four sets of factors: firm strategy, structure and rivalry, demand conditions, factor input conditions and related and supporting industries (Porter, 1990). More recently, he has argued that geographical concentration enhances processes of interaction within the 'competitive diamond' by increasing the static productivity of constituent firms or industries; stimulating higher rates of innovation and thereby productivity whilst encouraging high rates of business formation (Porter, 2000, p.259). For Porter, clusters are defined as "geographical concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example universities, standards agencies and trade associations) that compete but also co-operate" (Porter, 1998, p.197). A key underlying assumption is that the relations between these constituent elements of clusters are local in nature, relying upon co-location within the cluster, with the main external link being that between 'leading edge' local customers and global markets (Porter, 2000).

Recently, however, the emphasis on local linkages in clusters research has been questioned with critics suggesting that proximity is not only a spatial phenomenon, but can also take social and organisational forms (Allen, 2000). According to advocates of relational thinking, 'close' long-distance relationships are also possible both within and between firms, although the former are likely to be more common. The argument that knowledge can be generated and exchanged through spatially distant but organisationally close relationships often relies on the notion of 'communities of practice', derived from organisational studies (Amin and Cohendet, 2004). This emphasises the close informal contact and ties built between individuals linked by their shared membership of business, professional and technical networks (for example, engineers, IT specialist or management consultants). Increasingly, it is argued, such communities of practice can be developed and maintained through networks that operate across distance, using technologies such as email, conference calls and video conferencing, alongside face-to-face interactions which require frequent travel.

Furthermore, much existing research on clusters focuses on incremental processes of innovation and learning, providing 'snapshots' of regional success rather than considering the capacity of particular clusters to sustain growth over time (though see Saxenian, 1994). This highlights an underlying tension, rarely perceived in the promotion of cluster policies, between the short-term benefits of clustering in encouraging innovation and learning, and the long-term risks associated with a narrow, specialised economic base (Chapman et al., 2004). In reality, clusters are subject to divergent processes of change with some able to successfully renew key assets and capabilities whilst others become locked into a spiral of decline (see Hudson, 1999; MacKinnon et al., 2002).

Evolutionary concepts such as path dependence and 'lock-in' are highly relevant here, emphasising the importance of historical and geographical variety, underpinned by the specific institutional rules, routines and practices that govern economic action (MacKinnon et al., in press; Nelson and Winter, 1982). Over time, particular choices, themselves framed by past decisions, open up new pathways of economic development, but preclude others. The down-side of this tends to be expressed in terms of lock-in to a fated path where development is constrained within a progressively narrower range of possibilities which lead to decline. Lock-in can be seen as a product of over-specialisation, associated with the progressive closure of knowledge systems and work practices in the face of wider technological shifts. In an effort to transcend deterministic notions of path dependency and lock-in, Martin and Sunley (2006: 419-423) identify different mechanisms of regional adaptation or 'de-locking', involving: the creation of a new endogenous development path, the harnessing of heterogeneity among agents, institutions and social networks, the transplantation of new technologies or organisational forms from elsewhere, diversification into technologically related industries and the upgrading of existing industries.

3. Globalising Cluster Development

Studies of well-known clusters such as the Boston biotechnology community, the Soho advertising industry and the Hollywood film production complex (Bathelt et al., 2004; Grabher, 2002; Scott, 2002) have highlighted the importance of extra-local linkages alongside more localised relationships. The concept of 'global pipelines', developed by a group of Scandinavian researchers, builds on these empirical insights (Bathelt et al., 2004). The key claim is that, in

addition to engaging in processes of localised learning with a cluster, firms seek to build channels of communication or pipelines with selected partners outside the cluster. Such strategic partnerships offer access to knowledge and assets not available locally, although their number and scope is limited by the cost and time involved in building them. Successful establishment of global pipelines requires firms to develop a shared organisational context which enables them to learn and solve problems together.

At the same time, such relationships complement and enhance local linkages, rather than acting as a substitute for them. While a firm's location in a cluster provides automatic access to a range of information and knowledge, requiring little investment in scanning the environment, pipelines provide access to more specialised forms of knowledge that are not locally available. This specialised knowledge may relate to the development of new technologies or new market opportunities. The role of external linkages in providing access to scarce knowledge provides a basis for the hypothesis that "the more developed the pipelines between the cluster and distant sites of knowledge the higher the quality (and value) of the local buzz benefiting all firms in the local cluster" (ibid, p. 46).

Bathelt et al. (2004) suggest that wider links are particularly important during the early stages of cluster formation, providing access to markets and knowledge before critical mass is achieved locally. Maintaining such links as clusters mature is also seen as important to avoid introversion if local linkages become too close and rigid, leading to lock-in as firms fail to respond to change. Successful renewal of a cluster is likely to occur through the up-grading of its industrial base, or diversification into new markets or technologies. As such, it will require external links, providing

information on market opportunities, new technologies, regulatory changes etc. In certain circumstances, a conflict is likely to arise between the need to protect and maintain local knowledge, on the one hand, and to access and plug into non-local networks on the other. Increasing dependence on external links may increase the vulnerability of a cluster to abandonment by 'leading edge' firms as localised relations become more marginal to their overall patterns of learning and knowledge exchange (Schamp, 2005), echoing the wider tension between spatial fixity and mobility identified by Harvey (1982).

Building on the 'pipelines' idea, Rychen and Zimmerman (2008) examine the creation and exchange of knowledge through local and global relations, identifying three types of network arrangement. First, 'multispot' configurations involve the physical location of a plant in an external (outwith the original cluster) location in order to gain access to local resources and knowledge there and tend to be confined to large, multi-national firms. Second, 'gatekeeper' configurations are defined by the role of a specific actor in managing relations between local firms and wider sources of information and knowledge. Third, 'temporary proximity' configurations are based on the temporary co-location of personnel in either a specific third place or one of the site of one of the participants (ibid, p.770). The construction of relations with external partners is a costly and time-consuming enterprise (Bathelt et al., 2004), and 'temporary proximity' allows firms to avoid both the 'sunk costs' associated with investment in physical sites and the risks of over-dependence on powerful 'gatekeepers'. It is often associated with project work and collaboration in creative industries such as advertising and film production (Grabher, 2002; Scott, 2002) and may also be apparent in high-technology industries like micro-electronics (Saxenian, 2006). From this perspective,

face-to-face communication and spatial proximity remains central to innovation and learning processes, but does not require permanent co-location and is supplemented by regular remote contact through information and communication technologies.

Another key concept is global production networks (GPN), highlighting the need to assess cluster development in relation to wider global networks (Henderson et al., 2002; Coe et al., 2004). A GPN is defined as "the globally organised nexus of interconnected functions and operations by firms and non-firm institutions through which goods and services are produced and distributed" (Coe et al., 2004: 471). From this perspective, regional development is a product of the "strategic coupling" between global production networks and regional assets whereby such assets must be built and harnessed to "complement the strategic needs of trans-local actors situated within global production networks." (ibid, p.470).

A key issue is the extent to which regions and clusters can create, capture and enhance value within GPNs (Coe et al., 2004, Smith et al., 2002). Value creation is central to the early stages of cluster development, involving the creation of supporting conditions for growth by regional institutions through training and education programmes, the promotion of firm start-ups and the provision of venture capital through private-sector investors (Coe et al., 2004). The further enhancement of value as a cluster matures can occur through knowledge and technological transfer, industrial upgrading, the provision of more advanced infrastructure and the development of specialised skills. In this sense, value enhancement can be seen as broadly corresponding to the upgrading form of 'de-locking' identified by Martin and Sunley (2006), although it could also involve efforts to harness existing forms of heterogeneity. By contrast, the other

mechanisms identified by Martin and Sunley - the creation of a new endogenous development path, transplantation and diversification - are likely to be based on new forms of value creation, involving the redeployment of regional assets away from existing industries and clusters. Both value creation and value enhancement raise the question of value capture in terms of which actors and territories capture the economic rent generated by growth. Relations of power, ownership and control are crucial here, implying that the prosperity and sustainability of regions and clusters will reflect the extent to which key firms are locally owned and controlled (Coe et al., 2004).

4. Cluster Initiatives and Experiences in Scotland

The Central Lowlands of Scotland were one of the key crucibles of 19th century industrialisation, resulting in the development of an integrated industrial economy - coal mining, textiles, iron and steel, heavy engineering and shipbuilding - focused upon Clydeside and the city of Glasgow. This industrial economy peaked immediately prior to the 1st World War with 20 per cent of world's shipping tonnage built on the River Clyde in 1914 (Devine, 1999, p. 250). But this economy was seriously undermined by the collapse of demand and growing international competition in the interwar period, although it subsequently recovered as a result of demand created by war and rearmament. The underlying problems of the heavy industries of Clydeside were becoming starkly apparent again by the late 1950s, reflecting a failure to innovate in response to technological advances made elsewhere, adversarial labour relations and the prevalence of short-term attitudes (Payne, 1996). Clydeside began to shed manufacturing jobs in 1960s as major shipyards become uncompetitive. This trend accelerated in the

1970s and 1980s with Glasgow losing 70 per cent of its manufacturing employment between 1971 and 1997 (Bailey et al., 1999, p. 13).

A key strand of Government policy to modernise the Scottish economy and replace the jobs lost from heavy industry has been the attraction of inward investment, stretching back to the late 1940s and 1950s (Sutherland, 1995). In the 1970s, as the deindustrialisation of Clydeside gathered pace, a special body, the Scottish Development Agency (SDA), was established to regenerate the regional economy. In 1981, the SDA and the Scottish Office - the department of central government responsible for the administration of policy in Scotland - set up a joint initiative, Locate in Scotland, to attract further investment.¹⁾ By the 1980s, it was apparent that inward investment has become particularly concentrated in the electronics sector. The SDA was replaced by Scottish Enterprise (SE) in 1991, which placed more emphasis on the encouragement of endogenous growth, although the attraction of inward investment remained important (MacLeod, 1999). One key element of SE's strategy in the 1990s was the promotion of selected clusters in which Scotland was seen to have strengths in terms of international competitiveness and growth potential. The main initial 'pilot' clusters were biotechnology, oil and gas, food and drink and electronics/information technology. Other 'identified' clusters were chemicals, textiles, forest industries, creative industries and tourism. In the remainder of the paper, I focus on two of these 'pilot' clusters - oil and gas and electronics - which can be seen as 'replacement' clusters for the declining heavy industries.

5. Adaptation in a mature cluster: the Aberdeen oil complex

Scotland's oil-related cluster is heavily concentrated around the city of Aberdeen which is estimated to account for 80 per cent of oil related employment in Scotland (Chapman et al., 2004, p. 385). The decision by predominantly US based multinationals to make Aberdeen the focus of supply operations in the North Sea sparked a period of economic boom from the early 1970s onwards that has made North East Scotland the most prosperous region in Britain outside the South East of England as measured by gross value-added (Figure 1). This reflects successive processes of value creation and enhancement, accompanied by a shift from a locally contained and owned economy to one dominated by external capital (Hallwood, 1988). Over time, however, a key trend has been the emergence of local small and medium-sized enterprises (SMEs) in some of the more technically sophisticated parts of the industry (MacKinnon et al., 2004), suggesting that some value capture has taken place. Additionally, some of the multinational oil companies and their leading contractors have consolidated aspects of their North Sea related operations in Aberdeen, strengthening the city's position as an international oil centre (Cumbers and Martin 2001).

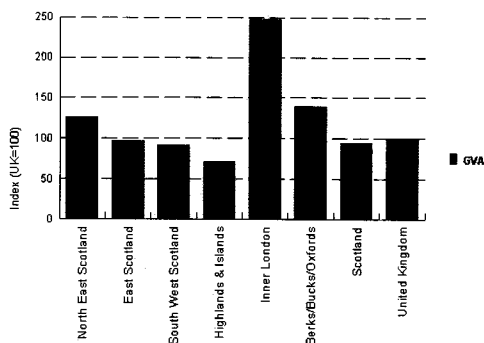


Figure 1. Gross Value-Added per head, Selected NUTS2 regions, 2004

Source: Office for National Statistics

As a resource-dependent cluster, with little alternative employment outside the public sector (Cumbers 2000), the Aberdeen economy is particularly vulnerable to long term decline. With the peak of oil production in the North Sea now passed, direct oil-related employment is forecast to decline from 41,000 in 2001 to 32,000 by 2016 (Figure 2) (Chapman et al., 2004).²⁾ Aberdeen thus faces the classic problems of a mature cluster in terms of the need for regional diversification and adaptation, although the short-term benefits of high oil prices have rather over-shadowed this long-term agenda in recent years compared to the period of lower prices in the late 1990s. At the same time, advancements in technology tend to prolong certain fields or result in the opening of smaller new fields, providing that wider economic conditions are favourable.

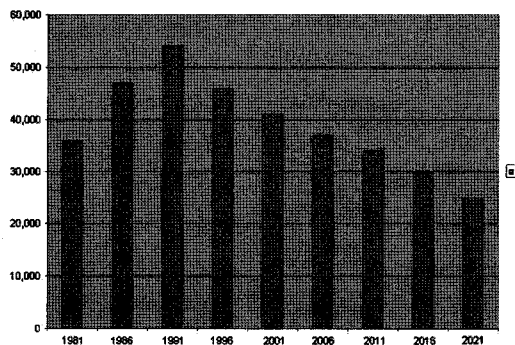


Figure 2. Energy Sector Employment in North East Scotland

Source: Aberdeen City Council / Aberdeenshire Council, 2001

The difficulties inherent in extracting oil and gas from a hazardous environment like the North Sea, and the increased depth of exploration activities, were important in stimulating innovation (Cumbers et al., 2003). As one of the first big offshore oil regions, the North Sea became a pioneer for the development of techniques subsequently applied more globally in the Caspian Sea, the Campos Basin off the coast of Brazil

and even in the deep water regions of the Gulf of Mexico. Aberdeen in this sense became the centre for the development and testing of a new generation of what have been termed in the industry 'North Sea technologies' at a key moment in the industry's product cycle. Consequently, its enhanced reputation within global oil networks provides firms who are based there 'with a source of identity and recognition in overseas markets' (Chapman et al., 2004, 389). This has helped to encourage the growth of oil-related exports, often involving the regular, temporary movement of specialist personnel to overseas markets. This form of 'temporary proximity' (Rycken and Zimmerman, 2008) involves Aberdeen-based staff visiting the sites of overseas partners and collaborators with industry networks and events (for example, exhibitions and trade fairs) often playing an important role in generating initial contacts (MacKinnon et al., 2004). The personal and social embeddedness of such personnel within the North East Scotland suggests that such labour circulation is likely to remain compatible with the maintenance of the Aberdeen cluster as long as it remains a centre of oil production, pointing to a certain convergence between the lifecycle of the cluster (with most projections suggesting another 20-30 years of significant production) and the employment lifecycle of mid-career staff.

Aberdeen can be seen as an important node within wider oil industry networks, linking up locally specific knowledge to wider information flows. In this context, respondents in a recent study viewed Aberdeen as a "hub of knowledge" whilst a representative of another export-orientated firm emphasised its continuing importance of Aberdeen as a centre of industry intelligence (Cumbers et al., 2003: 1702). A presence there enables firms to tap into new developments in the North Sea that might have applications elsewhere, whilst key international 'pipelines' transmit global

information to locally based firms (MacKinnon et al., 2004). Another respondent stressed the importance of being 'international' in the sense of having contacts and sources of information in different oil regions, something which is reflected the background of most personnel in having worked for international oil companies and contractors (Cumbers et al., 2003: 1702). These findings resonate with recent calls to bring together the study of clusters and wider global 'pipelines' (Bathelt et al., 2004), fostering a "reconciliation between networks - both firm and non-firm - and (would be) innovative locales" (Bunnell and Coe, 2001: 583). This is supported by empirical studies which indicate that firms engage in both local and extra-local networks to support innovation (Gertler and Levitte, 2005; Sternberg and Arndt, 2001).

6. The Contraction of an Established Cluster: The Scottish Electronics Industry

In contrast to the growth of the oil and gas cluster, which was the result of private-sector investment stimulated by the opportunities derived from the extraction, processing and servicing of a natural resource, government strategies exerted a more direct influence on the development of the electronics cluster. In particular, as we have seen, the decline of heavy industries spurred government efforts to attract new industries to Scotland in order provide replacement employment, promoting Scotland's available workforce and engineering skills. From only 6 US-based firms in the late 1940s, investment rose markedly in the 1960s with companies from Japan and East Asia becoming more important in 1980s and 1990s. This reflected the access that Scotland offered to the European market, a pool of available labour and government incentives (Sutherland, 1995).

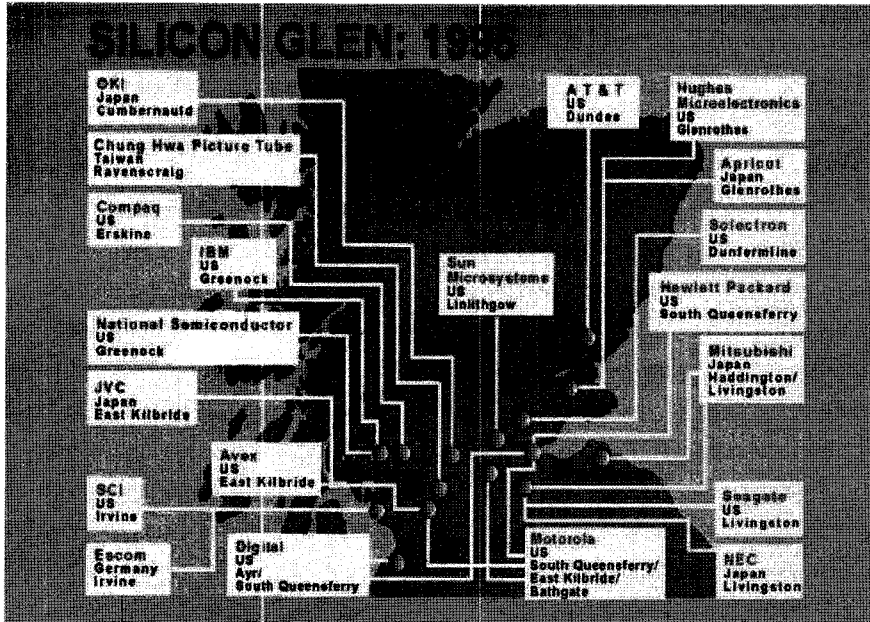


Figure 3. Major Investments in the Scottish Electronics Industry

Source: Keith Chapman, personal collection

By the early 1980s, the term 'Silicon Glen' was being used to describe the Scottish industry, reflecting the success of 'Silicon Valley' in California in spawning many of the key innovations in micro-electronics and computing from the 1960s. The cluster is focused on Central Scotland, but its geography is relatively dispersed in nature, stretching in a south-westerly line from Dundee to Ayrshire with a particular concentration in West Lothian and Lanarkshire, between the cities of Glasgow and Edinburgh (Figure 3). New town locations were particularly attractive to investors, offering greenfield sites with space for expansion, purpose-built factories, a local labour force and good transport links by road and air.

By 2000, electronics had become a very significant sector of the Scottish economy, accounting for over 40,000 direct jobs (and supporting another estimated 29,000 indirectly) and almost half of Scotland's manufactured exports by value (Scottish Government

2003, 2004). This reflects substantial value creation through the attraction of investment, infrastructure provision and workforce training with the SDA and SE playing a key role in linking regional assets to the strategic needs of focal firms within GPNs (see Coe et al., 2004). Considerable value enhancement occurred in the 1990s through additional innovation and skills development, reflecting an increasing emphasis on research and development and efforts to move into higher value-added activities. One of the most significant initiatives is the Alba Centre which is designed to provide a focus for the development of new microelectronics products and technology, based on a partnership between government, industry and academia. Other companies such as Sun Microsystems, Compaq, and NCR also added significant elements of research and development to their Scottish operations.

Such value enhancement has not, however, translated into significant value capture, reflecting a

continuing lack of local ownership and control. Despite talk of greater 'embeddedness' and quality flagship investment (see Phelps et al., 1998; Young et al., 1994), the concept of the branch plant economy, prevalent in the 1970s and 1980s (Firm, 1975), remains relevant. For instance, one study showed that Scotland accounted for only 12 per cent of material inputs by value in 1991 (Turok, 1993, p. 405-6). Above all, the impact of the early 2000s downturn in the global electronics sector on the Scottish industry demonstrates the persistence of many branch-plant characteristics. This resulted in a wave of closures and lay-offs from 2001, including the closure of Motorola's mobile phone plant in Bathgate in April 2001 with the loss of 3000 jobs, despite the visit of the then Scottish Government economic development minister's to Chicago to lobby Motorola head office. Other companies that have cut employment and reduced or closed operations in Scotland include NEC, Compaq, Chungwa, Fullarton and NCR. Competition from Eastern Europe and East Asia where costs are lower has compounded the problems of the Scottish industry with several examples of companies which have closed down their Scottish operations and moved jobs to Eastern Europe (particularly the Czech Republic and Hungary). The Scottish electronics industry contracted by 46 per cent in output terms between 2000 and 2005, compared to 27 per cent for the UK industry (Ashcroft, 2006, p.6).

It has been estimated that around half of the contraction since 2000 can be explained by the effects of the global downturn and increased global competition (ibid, p.8). The remaining half largely reflects the structure of the Scottish industry, characterised by a continuing specialisation in lower value-added activities, leaving the industry exposed to competition from Eastern Europe and East Asia for large-scale assembly production which is particularly cost-sensitive. This highlights the limits of an inward

investment-led approach to economic development, despite notable attempts at value enhancement since the early 1990s. Indeed, the difficulties of electronics have coincided with a changed approach to economic development which has placed less emphasis on inward investment and more on endogenous development, particularly in terms of commercialising scientific research, skills development and firm growth (Scottish Government, 2001). In electronics, the response has been to devote further attention to value enhancement, emphasising the attraction and development of jobs in research, development and design.

7. Conclusions

This paper has stressed the need to develop a more open and evolutionary approach to clusters in the light of globalisation and recent contributions to regional development studies. In particular, it has become increasingly apparent that the external relations of clusters are not confined to those that link leading firms to global markets as the work of Porter and others has tended to assume. Rather, such firms may interact with external collaborators at various stages along the value chain, including research, development and design and the supply of particular inputs and services, prior to the sale and marketing of finished goods and services. Similarly, the GPNs approach highlights the need to 'globalise' regional development by focusing attention on the 'strategic coupling' between regional assets and the needs of focal firms within GPNs (Coe et al., 2006). From this perspective, cluster development involves value creation, enhancement and capture. In policy terms, the approach developed in this paper highlights the need for regional development agencies to foster and support the external linkages that are central to the growth and expansion of clusters. This is only likely to generate long-term benefits if these relations are

relatively 'open', however, allowing the different parties to interact on a relatively equal basis without any one party dominating the exchange. Nonetheless, there is always a danger that encouraging external interactions may increase the vulnerability of a cluster to abandonment by leading firms as they become more focused on projects and collaborators based in other regions, reflecting the wider tension between spatial fixity and mobility identified by Harvey (1982).

The paper has also reviewed cluster development in Scotland, a 19th century industrial region on the periphery of Europe. Here, industrialisation was based on an integrated complex (cluster) of heavy industries focused on engineering and shipbuilding. Over the course of the twentieth century, however, such specialisation brought vulnerability, resulting in economic decline and culminating in severe deindustrialisation during the 1970s and 1980s (Bailey and Turok, 1999). Part of the policy response was the attraction of inward investment, which became particularly concentrated in the electronics industry (Turok, 1993). At the same time, the discovery of oil and gas in the North Sea stimulated the formation of an oil and gas cluster in North East Scotland. In the 1990s, Scottish Enterprise, the main government development agency, adopted a clusters strategy, seeking to focus support on those industries in which Scotland was judged to have a competitive advantage. The growth of the electronics and oil and gas clusters in the 1970s and 1980s involved substantial value creation and enhancement, generating vital employment, income and exports for the Scottish economy. Particularly in electronics, however, value capture proved more elusive, reflecting a lack of local ownership and control, as starkly demonstrated by the large-scale redundancies and closures of the early 2000s.

As such, cluster initiatives are only likely to generate

lasting benefits for the region in question (involving the capture of value) if there is significant local ownership and control of key industries and clusters. Once established, relations of external ownership and control become very difficult to change, channelling cluster development along a particular path and reducing the purchase of subsequent policy initiatives (Phelps et al., 2003). At the same time, however, efforts to create and enhance value will only foster growth if they match the strategic needs of key firms within GPNs (Coe et al., 2004). In this sense, regional agencies must endeavour to steer a difficult middle course between the opposing hazards of local introversion, which limits growth potential, and external dependence, resulting in a lack of value capture. As the experience of a limited number of clusters such as Silicon Valley demonstrates, local control can underpin continuing prosperity where it is combined with external openness, facilitating periodic technological innovation and upgrading (Saxenian, 2006). Local control does not guarantee ongoing value capture in the absence of such upgrading, however, as locally-owned firms may diversify into more profitable activities and industries located elsewhere, leading to abandonment and decline (Grabher, 1993; Schamp, 2005). The scope for value capture in peripheral regions which have historically played a subordinate role in wider spatial divisions of labour (Massey, 1995) is, moreover, likely to be limited, although cases such as Taiwan and Ireland suggest that the selective cultivation of external linkages, coupled with indigenous value creation and enhancement strategies, can stimulate the upgrading of national and regional economies (Saxenian, 2006).

Notes

- 1) Scotland was one of the regions of the United Kingdom which gained devolved powers in 1999,

meaning that a directly-elected Scottish Parliament and Scottish Government (known as the Scottish Executive between 1999 and 2007) took over most of the functions previously exercised by the Scottish Office.

2) A substantial proportion of the offshore workforce is resident outside North East Scotland, with the old industrial regions of West-Central Scotland and North East England playing a particularly important role in supplying labour. This mobile workforce generally only passes through Aberdeen as they commence and complete offshore shifts (typically following a two weeks on/two weeks off pattern), often involving only overnight accommodation. The resultant leakage of earnings should be borne in mind in the context of the gross value added figures cited above (Figure 1).

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