UNIVERSITA' DEGLI STUDI DI BERGAMO
DIPARTIMENTO DI INGEGNERIA GESTIONALE E DELL'INFORMAZIONE[°]
QUADERNI DEL DIPARTIMENTO[†]

Department of Management and Information Technology

Working Paper

Series "*Economics and Management*"

n. 13/EM – 2005

The Role of Regional Innovation Systems in Regional Transformation Models: the RIS-through process

by

Lucio Cassia, Alessandra Colombelli, Stefano Paleari

[°] Viale Marconi. 5, I – 24044 Dalmine (BG), ITALY, Tel. +39-035-2052339; Fax. +39-035-562779
[†] Il Dipartimento ottempera agli obblighi previsti dall'art. 1 del D.L.L. 31.8.1945, n. 660 e successive modificazioni.

[§] L'accesso alle *Series* è approvato dal Comitato di Redazione. I *Working Papers* ed i *Technical Reports* della Collana dei Quaderni del Dipartimento di Ingegneria Gestionale e dell'Informazione costituiscono un servizio atto a fornire la tempestiva divulgazione dei risultati di dell'attività di ricerca, siano essi in forma provvisoria o definitiva.

THE ROLE OF REGIONAL INNOVATION SYSTEMS IN REGIONAL TRANSFORMATION MODELS: THE *RIS-THROUGH PROCESS*

Lucio Cassia, Alessandra Colombelli*, Stefano Paleari
Department of Management and Information Technology, Università degli Studi di Bergamo

Abstract: In a reference framework towards the knowledge economy concept and in relation to the notions of Regional Innovation System (RIS) and Triple Helix, the purpose of this paper is to identify different paths of regional change with the aim of drawing some indication supporting local policy making. To this aim, the paper analyses six regions considered as virtuous models of economic and industrial renewal (Cambridge, UK; Baden-Württemberg, Germany; Göteborg, Sweden; Singapore; Milwaukee and Pittsburgh, US), particularly focusing on the time dynamics of the development process. From the analysis of the regional transformation process we classify three different regional development paths that in this paper we define as 'RIS-into', 'RIS-from' and 'RIS-through' processes. The first two find a confirmation in Asheim (2003)'s classification. The analysis in this paper made through case studies allows to identify a third development path, the RIS-through process, where the Regional Innovation System acts as a catalyst for the territorial transformation, easing the competitive repositioning of the regions involved.

Keywords: regional competitiveness, knowledge economies, regional development, regional innovation systems.
JEL codes: R11, R58

* ***Address:*** viale Marconi, 5 - 24044 Dalmine (BG), Italy
Phone: +39 035 2052 350; Fax: +39 035 562779; e-mail: alessandra.colombelli@unibg.it

The authors wish to thank Maria Sole Brioschi for very useful suggestions. The usual *caveat* applies.

1. Introduction

The most competitive modern economies are often referred to as *knowledge economies* meaning economies which are directly based on production, distribution and use of knowledge and information (OECD 1996). The basic thesis behind the emergence of the knowledge economy concept is that firms' competitive advantage and economic growth in general, both at national and at local level, are more and more determined by knowledge creation and technical progress (Foray and Lundvall 1995, Cooke 2002, Smith 2002). Knowledge, viewed as human and technical capital, has always been central to economic development, but only over the last few years has its importance been recognized and accounted for in the literature. The emergence of this new concept to conceive the economy has been favoured, particularly in the 1990-2000 decade, by the rapid technical progress in the areas of computing, biotechnology, telecommunication and transportation, that has changed the way in which economies, organizations and governments work. Furthermore, the rapid growth in high-tech and high-skill services and the new by-products and by-services have induced an in-depth change in the lifestyle and the nature of workplaces, signing the transition from the industrial to the post-industrial era. In this framework, knowledge accumulation and technological progress, together with the liberalization of international markets and globalization, have both created new opportunities for firms and increased competition, pushing firms to redesign their organizational structure in order to seize new opportunities for change and to maintain a competitive advantage.

The region, defined as a homogeneous administrative, cultural, social and political unit, is a unique economic system and represents a community of shared interests and rules. Regions, as the centre of value added activities, institutions and organizations, benefit from synergies and interdependencies among territorial actors and need to maintain a high level of competition and attention to local processes of change in order to support firms in their renewal processes. In the present economic context, in fact, firms' competitiveness relies more and more on the competitiveness of the territorial systems they belong to. The strategic effort of territorial actors must then be aimed at creating a favourable business environment, sustaining "a virtuous circle where knowledge attracts knowledge, knowledge workers attract knowledge workers and knowledge-based firms attract other knowledge-based firms"

(Normann 2001: 338). In this context, the most active regions take the responsibility to coordinate the local development process based on other examples of support of regional competitiveness.

In a reference framework towards the knowledge economy concept and in relation to the notions of Regional Innovation System (RIS) (Cooke *et al*. 1997, Asheim 2003) and Triple Helix (Etzkowitz and Leydesdorff 1997, 2000), the purpose of this paper is to identify different paths of regional structural change with the aim of drawing some indication supporting local policy making. To this aim, the paper analyses six regions considered as virtuous models of economic and industrial renewal (Cambridge, UK; Baden-Württemberg, Germany; Göteborg, Sweden; Singapore; Milwaukee and Pittsburgh, US), particularly focusing on the time dynamics of the development process. The analysis of the regional transformation process allows to classify three different regional development paths that in this paper we define as '*RIS-into*', '*RIS-from*' and '*RIS-through*' processes, depending on the role and the particular moment the RIS entered the process. In other words, the analysis in this paper made through case studies allows to identify three development paths. The first two find a confirmation in Asheim (2003)'s classification. In this work we identify a third development path, the *RIS-through process,* that assign to the R*egional Innovation System* the role of catalyst for the territorial transformation, easing the competitive repositioning of the regions involved. The lessons emerging from the experience of the regions considered in this research work may support local decision making and increase regional attractiveness and local entrepreneurship in the economic transformation process.

The paper is organized as follows. Section 2 reviews the main concepts of regional science the paper refers to. After describing the criteria employed to select the territories considered in the investigation, Section 3 analyses these regions trying to sketch the main trajectories followed in the transformation process. Based on the regional cases above, Section 4 attempts at identifying a classification of regional transformation paths. Section 5 concludes.

2. Literature Review

The idea that regions may act as key players in the economic growth process is embedded in the increasing attention that the economic literature has devoted in the last decade to regional dynamics. The challenge of competing in a global, knowledge based economy stresses the need to understand how different regional economies, with their own

specificities and features, influence the innovation process. In this respect, the analysis presented in this paper is focused on the Regional Innovation System literature (Cooke *et al*. 1997, Cooke and Morgan 1998, Braczyk *et al*. 1998) which, by now supported by the analysis of many case studies, gives relevance and emphasis to the institutional foundations of regions' competitive advantage, for example in the areas of education, research and development and financial services. Innovation is seen as a collective and interactive process emerging from the intensity of inter-firm networking, but, more importantly, supported by the pro-active role of local institutions. An important empirical contribution to the RIS literature is represented by the REGIS project, financed in 1998 by the European Commission within the Targeted Socio-Economic Research Programme with the aim to identify, through a statistical survey, the presence of a Regional Innovation System in eleven European regions: Baden-Württemberg (Germany), SE Brabant (Holland), Styria (Austria), Tampere (Finland), Wales (UK), Wallonia (Belgium), Paesi Baschi (Spain), Centro (Portugal), Friuli (Italy), Féjer (Hungary) and Lower Silesia (Holland). The study recognized a number of innovation systems both at regional and at local level with strong links to the national system.

The concept of Regional Innovation Systems integrates two different aspects: the systemic character of innovations and the regional dimension of innovation processes. The first aspect – the systemic and interrelated nature of innovation – is rooted in the National Innovation System literature (Freeman 1987, 1991, Lundvall 1992, Nelson 1993). In particular, Freeman (1987) defines a National Innovation System as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies". In other words, the system approach stems from the specific character of innovation being the result of social interaction between different actors in producing, diffusing and applying new and economically useful knowledge (Lundvall 1992). The active role of territorial actors within regional development dynamics was recognized in the economic literature more than a century ago. In fact, from Marshall (1890) on and until the end of the Nineties, the model of local development has always been bi-polar, built upon two fundamental components of change, firms and local institutions. More recently, Etzkowitz and Leydesdorff (1997, 2000) have highlighted the active presence of an additional variable, the (technical and scientific) university, and have developed the so called Triple Helix model. The conceptual model tries to account for the existence of a new configuration of institutional forces (university, firms and local institutions) within the innovation system. Within this model the university, defined as an institution aimed at the production and diffusion of knowledge (Etzkowitz and Leydesdorff 2000), represents a key

element for the innovativeness of the local system. In this sense, universities are referred to as 'entrepreneurial universities', involved in a 'spiral' of relations with the other two institutional spheres (public and private) along the paths of industrial innovation and policy-making.

The second aspect of the Regional Innovation System concept – the regional character of innovation processes – is based on the assumption that the regional level of economic coordination is crucial for the achievement of competitive advantages in a global competition framework. At the end of the past decade, researchers belonging to what is referred to as the 'new regional science' recognized the salience to cooperate locally in order to compete globally (Sabel 1989, 1995, Cooke 1992, Storper and Scott 1995, Scott 1996, Lundvall and Borras 1997, Tödling and Sedlacek 1997, Boekholt and van der Weele 1998). It seems that 'the essential of systemic interaction, tacit knowledge exchange, the building of "untraded interdependencies" (Dosi 1988), the forging of trustful relations and development of innovative networks are better understood at the sub-national or regional level' (Cooke *et al*. 1998).

Within the models of local development based on RIS and in a research work accompanied by a number of case studies on Scandinavian industrial clusters, Asheim (2003) has recently highlighted the existence of a (logical and time) relationship between the regional innovation system and the clusters which they insist on. The main idea behind this relationship is that firms' innovation processes are strongly shaped by their specific knowledge base and that it is possible to distinguish between two types of knowledge base: synthetic (engineering-based) and analytical (science-based). Synthetic knowledge is typical of engineering-based sectors such as plant engineering, specialised advanced machinery and shipbuilding, where innovations take place through the adoption, application and adaptation of existing knowledge or through new combinations of existing knowledge. According to Asheim, in these sectors applied research is more important than R&D, occurring often in response to the need of solving specific problems arising from the interaction with customers and suppliers; tacit knowledge is more important than codified knowledge, especially because in these sectors knowledge often results from experience gained on the job trough learning by doing, using and interacting and essentially stems from inductive processes of testing, experimenting, computer-based simulation or through practical work; finally, in engineering-based industries innovation is typically incremental, often oriented towards the achievement of certain efficiency and reliability standards of new solutions, or towards the user-friendliness of products for customers. By contrast, analytical knowledge is typical of science-

based sectors such as genetics, biotechnology and information technology, which are characterised by intense basic research, codified knowledge, systematic development of new products and processes and by strong university-industry linkages. In this context, innovations are typically radical in nature and spin-offs activities are more frequent than in the former case.

Asheim (2003) shows that the above classification of knowledge has implications for the relationship between firm clustering and the local Regional Innovation System (RIS). In engineering-based industries the relationship between the cluster and the local RIS (firms, institutions and universities) typically develops at a later stage of a cluster's life cycle so that the RIS often originates in response to the existence of 'pure' industrial clusters. In this respect, the logic behind building a RIS is to support localised learning and innovation and strengthen existing local specialisations, i.e. to promote technological trajectories of the region's historical cluster, developed thanks to a local 'sticky' knowledge base. By contrast, in science-based industries the presence of the RIS is a often a necessary input in the development of the cluster, and therefore the RIS may be viewed as providing the conditions for the very emergence of industrial clustering, which develops thereafter benefiting from the interaction and cooperation with local institutions and universities.

3. Regional Innovation Systems

With the aim of shaping the possible trajectories of regional development and formalize the drivers of structural change, it is useful to compare the development path of a sample of European, US and Asian regions that in the recent past have been able to restructure their economic base through a process of industrial and institutional renewal. The empirical investigation of regions considered as 'virtuous models' of economic and industrial renewal is of particular interest for the regions competing in a knowledge-intensive global context. In this vein, it is interesting to consider a recent study (Huggins 2004) which classifies and assesses the degree of competitiveness of a number of regions, considered as the main knowledge-intensive economies worldwide.

The selection criterion employed to build the benchmark draws on the level of productivity and allowed to identify the 125 world's regions with the highest per capita GDP or with the highest productivity growth rate (as is the case of the Asian regions). The conceptual model developed by Huggins defines the structure of a knowledge economy based on its ability to create and acquire knowledge (*capability*), and on the level of diffusion,

application (*capacity*) and use (*sustainability*) of knowledge. To assess a region's competitiveness, Huggins builds an index composed of 19 variables, classified in terms of *knowledge input* (human[1] financial[2] and intellectual[3] capital), *regional output*[4] and *knowledge sustainability*[5]. Among the regions identified and classified by Huggins, we find the areas investigated and compared in this paper: Cambridge (UK), Baden-Württemberg (Germany), Göteborg (Sweden), Singapore, Milwaukee (US) and Pittsburgh (US)[6]. In general, the selected regions' relative knowledge competitiveness shows a growing trend, as highlighted by the change in rank between 2003 and 2004 (table 1). In particular, the regions of Cambridge, Göteborg, Baden-Württemberg and Singapore gain in terms of *knowledge input* while the US regions' competitiveness is pushed by *regional output* and *knowledge sustainability*.

Table 1 – WKCI (World Knowledge Competitiveness Index), 2003 and 2004

Regions	*WKC Index* 2004*	*Rank 2004*	*WKC Index 2003*	*Rank 2003*	*Change in Rank*
Milwaukee-Racine, US	140.3	27	139.5	27	0
Pittsburgh, US	131.5	35	122.7	38	3
West Sweden, S (Göteborg)	115.9	44	93.9	69	25
Eastern, UK (Cambridge)	108.5	50	74.9	84	34
Baden-Württemberg, DE	103.9	55	95.4	67	12
Singapore	83.2	74	73.0	90	16

* Computed with the DEA methodology, through the use of 19 indicators (see notes 1 to 5), and indexed to 100, the latter corresponding to the average value of the 125 selected regions.

Source: Huggins (2004).

[1] Economic activity rate; number of managers per thousand inhabitants; employment in IT and computer manufacturing; employment in biotechnology and chemicals; employment in automotive and mechanical engineering; employment in instrumentation and electrical machinery; employment in high tech services (per thousand inhabitants).

[2] Private equity per capita.

[3] Per capita R&D expenditure by government; per capita R&D expenditure by business; number of patents registered per million inhabitants.

[4] Labour productivity; gross monthly earnings; unemployment rate.

[5] Per capita public expenditure on primary and secondary education; per capita public expenditure on higher education; secure servers per million inhabitants; internet hosts per thousand inhabitants; broadband accesses per thousand inhabitants.

[6] For the regions of Cambridge and Göteborg the area considered in Huggins (2004) is wider: level 1 and 2 according to Eurostat classification of territorial units. The regions considered in this research work are defined so as to correspond to the county level (NUTS3).

The choice of the above regions is motivated by the fact that, after experiencing in the past two decades a period of recession, or at least of economic slowdown, or a financial crisis, they currently show important signals of renewal. This situation seems to have given this set of regions the opportunity to foster a strategic change in the economy, leading to a rapid increase in the levels of productivity and employment, the latter witnessing a structural transformation and a recoup of competitiveness. In addition to the economic conversion, the above regions were selected for the active presence of a tri-polar innovation system, where the three poles (industry, government and academia) were able to interact and create a regional competitive advantage. In this framework, for each of the regions selected it is interesting to investigate which role the RIS had and in which moment of the transformation process the RIS 'entered the game'. In particular, the case of Cambridge is intriguing for the role played by the university in the formation of a high tech cluster, the Göteborg area for the ability of local firms to push the conversion-led diversification, and the Baden-Württemberg for the institutional component supporting already existing local businesses. Moving to the US cases, the selected regions are among the metropolitan areas whose crisis originated from deindustrialization and that were able to restructure their economy thanks to a strong coalition among local territorial actors (as opposed to other cities, such as Philadelphia and Detroit, where regional partnerships were established). Last, the case of Singapore, as many other Asian regions, raised our interest for the high growth rates registered in the last decades. According to Huggins (2004), Singapore represents the main Asian knowledge-economy just behind a few Japanese regions (that is, however, losing competitiveness at a country level), having become a strategic centre for commercial and financial trades of the Pacific Basin.

Table 2 summarizes and anticipates some of the main characteristics and the reference literature of the regions analysed in the paper, while in the next Sections the investigation goes on reconstructing the development trajectories followed by the territories under inquiry. The aim of the investigation is to highlight regularities and specificities, so as to draw some indication for a possible classification of the transformation paths and to give some tentative suggestions about the actions to undertake to foster regional development.

Table 2 – Features of the selected RIS

Features	*Indicators*	*Main References*
Milwaukee-Racine, US		
- Higher industrialization than US average - Lower tertiarization than US average	- Share of employment in manufacturing sectors=20.1% (US average=14.2%), 2000 - Share of employment in service sectors=71.2% (US average=72.4%), 2000	Norman 1989, Wood *et al*. 2000a, b, Orfield 2002, U.S. Bureau of the Census 2000
Pittsburgh, US		
- Lower industrialization than US average - Higher tertiarization than US average	- Share of employment in manufacturing sectors=13.4% (US average=14.2%), 2000 - Share of employment in service sectors=76.9% (US average=72.4%), 2000	Stewman and Tarr 1982, Jezierski 1996, Metzger 1998, Deitrick 1999, Austin 2000, U.S. Bureau of the Census 2000
West Sweden, S (Göteborg)		
- Higher productivity than EU average - Low unemployment - High innovativeness	- Per capita GDP in PPS=102.5 (EU-15=100), 2001 - Unemployment rate=4.9% (EU average =7,8), 2002 - R&D expenditures/GDP=5.27% (EU average=1.99%), 2001 - Patents per million inhabitants=299 (EU average=112), 1998	Lindholm-Dahlstrand 1998 , 1999, Blomstrom *et al*. 2002, Holmén 2002, Lindholm-Dahlstrand and Jacobbson 2003, Eurostat 2001
Eastern, UK (Cambridge)		
- Higher productivity than EU average - Low unemployment - High firms' birth rate	- Per capita GDP in PPS=101.2 (EU-15=100), 2001 - Unemployment rate=3.6% (EU average= 7.8), 2002 - 30 in 1960; 100 in 1975; 330 in 1985; 798 in 1998; 1000 in 2004	Segal, Quince and Wicksteed 1985, 2000, Cambridge County Council 1998, CBR 1998, Keeble *et al*. 1999, Druilhe and Garnsey 2000, Athreye 2001, Rosenberg 2002, Eurostat 2001
Baden-Württemberg, DE		
- High productivity - High industrialization rate - Low unemployment - High innovativeness	- Per capita GDP in PPS=114,1 (EU-15=100), 2001 - Share of employment in manufacturing sectors=38,2% (Stuttgard area), 1998 - Unemployment rate=4,7% (EU average=7.8%), 2002 - Share of employment in high-tech and medium-tech sectors=21% (EU average=7.6%), 2001; share of employment in high-tech sectors=3% (EU average=1.4%), 2001 - R&D expenditures/GDP= 4.82% (EU average=1.99%), 2001 - Patents per million inhabitants=445 (EU average=112), 1998	Sabel *et al*. 1989, Herrigel 1989, 1996, Cooke 1997, Cooke *et al*. 1998, Heidenreich and Krauss 1998, Eurostat 2001

Singapore		
- Fast growing productivity - Growing industrialization - High innovativeness	- GDP growth rate=7.5% in 1980-90, 8.4% in 1990-2000 - Share of GDP in manufacturing sectors=11.7% in 1960, 28.1% in 1980, 25.9% in 2000 - R&D expenditures/GDP=0.2% in 1970, 1.89% in 2000 - Patents per million inhabitants=142 in 1993, 902 in 2000	Hui 1997, Yun 1998,; Coe 1999, Mani 2000, Wang *et al*. 2002, Pereira 2004
- Growing use of venture capital	- Share of exports in high-tech goods and services=37% in 1989, 59% in 1998 - Cumulative funds venture capital (billion US$)=0.16 in 1985, 5.3 in 1995, 10.2 in 2000	

3.1 Cambridge

Since the Eighties the city of Cambridge has attracted international attention for what has been referred to as the 'Cambridge Phenomenon', that is the emergence of a high technology cluster of firms in a medieval town hosting one of the world's oldest ad most prestigious universities, located in a rural area and historically far from the country's primary centres of industrial development. Starting as early as in the Sixties a high number of high tech firms started to mushroom in town and in the surrounding areas: from 60 firms in 1960 to 100 in 1975, to 330 in 1985 up to almost 1000 firms employing more than 52 000 people in 2004.

The firms belonging to the cluster are typically local, small, independent and very young, mostly originating from spin-offs from other firms and local organizations, particularly from the university, and are the result of the entrepreneurial motivation of a few individuals. Firms' high birth rate stimulated the development of the manufacturing and the commercial sectors, contributing to the industrial dynamism of an area traditionally characterized by a steady economy. The lack of an industrial past shaped the features of the Phenomenon: new market opportunities, primarily arisen within the university environment, could not find a way out in the area lacking the industries to which to transfer the know-how, and so new firms accessed the local market. For the above reasons, the university played a crucial role in the transformation process of Cambridge. This is partly due to the historical influence of the university on many aspects of the city life, such as having attracted many researchers and scientists in the area and having contributed to the atmosphere of excellence

and prestige that one breathes in Cambridge. However, the main merit of the university is to have adopted a liberal policy towards faculty members who are free to engage in outside work and commercially exploit their know-how and skills. Such flexible attitude allowed single scholars and whole academic departments to approach industry and to stimulate and support the development of local young firms to the point that the majority of them 'was born' within the university, either directly or indirectly – through spin-offs from other firms originally developed inside the university environment (Segal, Quince and Wicksteed 1985, 2000, CBR 1998, Keeble *et al*. 1999, Druilhe and Garnsey 2000, Athreye 2001, Rosenberg 2002).

In sum, a number of factors, many of which Cambridge-specific and materialized in a fairly long time span, interacted to create a very original 'business environment'. In general terms, one of the reasons for the emergence of a high tech cluster of firms in the Cambridge area seems to be the particular combination of size, history and life of this town with the role of the university, its liberal policy and its influence on society. However, additional circumstances and events must be taken into account, such as Barclays Bank consulting and financing packages for young innovative firms, cooperation agreements between industry and local institutions, public policies supporting small size firms and, last, international development of new technologies in the sectors of specialization of the cluster firms.

3.2 Singapore

Since the independence in 1965, Singapore has experienced a rapid economic development, characterized by an average annual growth rate of about 8% between 1960 and 2000 (Mani 2000). As a consequence of high growth, the per capita income more than tripled between 1970 and 2000, reaching in the Nineties the level of most OECD countries. Rapid growth was favoured by important structural changes of the economy of Singapore. Originally born as a harbour crossroads, the city-state rapidly turned into an important centre of labour-intensive manufacturing activities, then moving to technology intensive and higher value productions, finally becoming a financial and service centre for multinational enterprises.

The main engine driving the development of Singapore seems to have been the local government, which is acknowledged to have invested in high growth sectors, encouraged human capital qualification and promoted the formation of numerous business support services. The main goal of the government in recent years has been that of transforming Singapore into a knowledge economy. Thanks to public incentives, in fact, Singapore

benefited from the establishment of many multinational enterprises, up to the point that they currently account for about 75% of industrial output and 80% of export. The government strategy to attract foreign direct investments to guarantee a rapid economic growth has coincided with the propensity of firms operating in the electronics industry to move manufacturing activities in labour-intensive geographical areas. To ease this process, the government supplied foreign multinationals with incentives and tax reliefs. Moreover, through the government agency Economic Development Board, the government helped foreign enterprises to establish and supported them in the organization of employee training programmes.

To meet a fast increasing demand of technicians and engineers and to strengthen technological infrastructures, between the Sixties and the Eighties the government founded engineering university majors and promoted the institution of research centres. As a consequence, the number of university enrolments more than doubled (from 9800 students in 1980 to 24 300 in 1990) with an increase of enrolments in S&T universities of about 70% (Lee 1992). Moreover, the government financed research through the sale of estates and buildings, and by financing the purchase of technological apparel and the realization of technical training programmes. Between 1970 and 2000, R&D expenses as a percentage of GDP grew from 0.2% to 1.89% while the number of R&D employees boosted from 10.6 to 83.5 every 10 000 (National Science and Technology Board). Last, parallel to the policies of support of human capital quality and technological infrastructures, the government launched an equity fund to attract venture capitals with the aim to support the local industry and to become an important venture capital hub for other Asian countries.

3.3 Baden-Württemberg

Since the first decades after the Second World War, the economy of Baden-Württemberg has undertaken a long path of economic development. Indeed, since the Fifties the German Land has, in terms of productivity, grown more than any other region of the Federal Republic of Germany. In particular, high economic growth must be associated to the development of manufacturing industry, which in the Baden-Württemberg has shown the highest increase, reaching in 1970 56% of total employment, against a national level of 49%. The industrialisation strategy of the region addressed the automotive industry, the mechanical engineering industry and the electronics industry. The expansion of the above sectors induced a rapid development in the area: between 1970 and 1993 Baden-Württemberg has grown

relative to the rest of Germany 20% more in terms of productivity and 6% more in terms of employment in manufacturing sectors (Heidenreich and Krauss 1998). Today, owing also to the ability to attract significant foreign investments, Baden-Württemberg represents the EU region with the highest share of employment in high tech manufacturing sectors (Stuttgart being the EU leading region in 2001, with 20% of total employment in high tech and medium tech manufacturing sectors) and one of the leading EU regions in terms of R&D investments (with about 5% of R&D expenditures as a percentage of GDP in 2001). The transformation process of Baden-Württemberg may be ascribed to a number of different factors. However, the post-war prosperity of the region seems to primarily derive from its strong economic and institutional organization. Just like the other states belonging to the German 'cooperative federalism' (Scharpf 1976, Sturm 1996), the Baden-Württemberg distinguishes itself by a highly cooperative and associative culture both civil-wise and industrial-wise. In particular, the frequent interactions among government, industry and centres of knowledge production and diffusion (universities and research centres) ease the knowledge transfer among local territorial actors. In the last decades, the efforts of the local system of production have been aimed at enhancing the degree of industrial innovation by increasing the expenditures in R&D, education and training and by easing firm financing from the banking system and local financial institutions. In sum, the creation of a single network of firms and firms' supporting institutions pursuing a common objective seems to have represented the main condition for the emergence of an 'innovative environment' in the region.

3.4 Göteborg

Together with other Baltic countries, today Sweden is among the wealthiest and most developed economies worldwide, but we need not forget that in the XIX century the Nordic countries were among the poorest and most isolated in Europe. The transformation process, begun in Sweden approximately in 1850, gradually changed the country from a poorly developed agricultural economy to a wealthy economy based on advanced manufacturing sectors.

One of the distinctive characteristics of Sweden's development is that the local economy, traditionally dominated by raw material industries, tried to move down the industry value chain, shifting to higher value-added products. The country was able to increase the technological level of low value added intermediate products, setting the foundations for an advanced and diversified industrial structure. In time, Sweden gradually moved its production

towards mechanical constructions, engineering-intensive products, transports and other services. Particularly, in the last decade the industrial structure showed a rapid change towards knowledge-intensive manufacturing and service industries, making Sweden one of the world's leading countries in ICT development and applications. For example, in 1990 the ICT sector accounted for less than 7% of Swedish exports, whereas in 2000 this share had surged to 20% (Blomström *et al*. 2002). Undoubtedly, the main source of the boost in ICT exports is represented by Ericsson, characterized by heavy investments in R&D (the R&D expenditures as a percentage of sales increased from 11% in 1990 to 24% in 1991; Åsgård and Ellgren 2000), and a strong orientation towards international markets. Key to Ericsson's success has been its flexibility, i.e. its ability to rapidly opt for the mobile phone market when in the Nineties an opportunity arouse.

One of the regions that best represents Sweden's transformation path is the Göteborg region. In this respect, it is interesting to notice that half of the total Scandinavian industrial capacity is located within a radius of 300 km from Göteborg (Lindholm-Dahlstrand 1998, 1999) and that Ericsson, headquartered in Göteborg, is, behind Volvo, the second largest company of the region in terms of employees. Moreover, Göteborg is characterized by an intense R&D activity, mainly undertaken by large firms located in the region and specialized in the areas of information technology, telecommunications, medical technology, automotive and industrial electronics. Furthermore, the region hosts two universities (Chalmers University of Technology and Göteborg University, together totalling almost 60 000 students), four Scientific Parks (among which the recent Lindholmen Science Park in Information Technology) and numerous research institutes. Large firms long operating in the region and the presence of the university (particularly Chalmers) seem to have been the main factors driving the formation of a high tech cluster of small and medium size firms, thanks to transfers of knowledge, people and technologies made possible through intense networking and spin-off activities. A survey, carried out in 1998 on a sample of 52 high tech small and medium size firms of the Göteborg area, shows that 73% of the clustered firms originate from spin-offs from other organizations, 42% of which directly or indirectly stemming from Chalmers University. In particular, since 1960 more than 250 firms were born as spin-offs from Chalmers University (Lindholm-Dahlstrand 1999). In 1995 the high tech cluster of the Göteborg area was composed of about 3,400 firms, half of which operating in the R&D consulting and information service industry (Lindholm-Dahlstrand 1998).

3.5 Pittsburgh

In the Seventies the main US industrial metropolitan areas started to lose dynamism as a consequence of the first effects of globalisation. Since then, the region's economic restructuring has represented the main objective of policy makers as well as of other local actors. In particular, the cities of Midwest and Northeast tried to react to the impact of the crisis caused from deindustrialization, the resulting closing down of many firms and the increase of unemployment. However, though many important US cities experienced similar problems linked to the same economic context, the transformation paths undertaken in order to recoup competitiveness have been quite different.

Pittsburgh in Pennsylvania represents an interesting case since (despite the crisis essentially depended on the steel industry) it was able to transform its economy moving production activities towards knowledge intensive services and high tech manufacturing activities. Indeed, in the last decades the expansion of the service sector has involved the whole US economy: between 1960 and 2000 the share of employment in the tertiary industry grew from 54.3% to 72.4%, while falling from 27.1% to 14.2% in the manufacturing industry.

Pittsburgh well characterizes this phenomenon as it shows a higher increase in the tertiary industry and a higher drop in the manufacturing industry than the US average: the share of employment in the service sectors rose from 48.5% in 1960 to 76.9% in 2000, while in the same period the manufacturing sectors witnessed a decrease from 36.5% to 13.4%. At present, only one third of employment in manufacturing is still linked to the steel industry while in the meantime other clusters developed in the areas of electronics and information technology.

The main factor driving the transformation of Pittsburgh seems to have been a close partnership between the public and the private sector (Stewman and Tarr 1982, Jezierski 1996, Metzger 1998, Deitrick 1999, Austin 2000) through the creation of a regional coalition among the local government, firms and institutions. In 1943 the Allegheny Conference on Community Development (ACCD) was founded by the private sector with the support of the public sector. Since then the coalition has remained active even if now Pittsburgh is by all means a post-industrial city specialized in advanced tertiary activities. The renewal strategy developed by the coalition was organized in three stages, defined Reinassence I (1943-1970), Reinassence II (1978-1988) and Reinassence III (still ongoing). After recouping competitiveness in the first stage, in the Eighties the coalition had to choose which strategy of local development to undertake, also to face the protests of a coalition born among "unions, church and citizens' committees, mobilized against capital divestitures in the manufacturing sectors" (Jezierski 1996: 171). However, also as a consequence of the rapid and continuous

decline of the steel industry, a particular strategy was implemented "supported by firms, local government and non-profit institutions [among which the university], aimed at the creation of a 'new Pittsburgh', based on service and high technology sectors" (Jezierski 1996: 171).

3.6 Milwaukee

Like Pittsburgh, also Milwaukee in Wisconsin suffered the effects of the manufacturing sector crisis. However, the strategy put forth by this territory to recoup competitiveness followed a different path with respect to the one considered above, the attempt being that of contrasting deindustrialization to remain an important industrial centre. Indeed, the initial economic structure presented in the Seventies a number of relevant differences. The economy of Milwaukee, like Pittsburgh's, was primarily based on the mining industry but depended on other industries too. In particular, the city hosted the headquarters of a number of large firms operating in the automotive sector (Harley Davidson) that were interested and actively involved in the restructuring of the local economy (Normann 1989). Up till now the manufacturing industry in the Milwaukee area counts more than in the rest of the US (in the year 2000 it accounted for 20.1% of the region's employment against a US average of 14.2%), particularly in the areas of automotive, mechanical and electronic engineering, biotechnologies.

Also for Milwaukee, key to local development has been the presence and the active role of a coalition, the Greater Milwaukee Committee (GMC), founded in 1948 under the leadership of the private sector. The GMC has always been operating in the attempt to diversify the regional economy to face the heavy losses in the manufacturing industry. Within the partnership between the public and the private sectors, local government played a crucial role in the involvement of the main regional public institutions, generating strong social consensus (Normann 1989, Wood *et al*. 2000a, b, Orfield 2002). The Wisconsin Regional Training Partnership (WRTP), stipulated in the Nineties with the aim to raise the regional qualification level, is an example of the strength of the coalition, able to place firms and government in close collaboration with union representatives and citizens' committees.

4. Regional Transformation Processes: the Cluster-RIS Relationship

Within the Regional Innovation System (RIS) framework and considering the time relationship between cluster and RIS introduced by Asheim (2003), we are now in the position to classify the development dynamics of the regions investigated above along the

paths of economic restructuring. The case studies allowed us to identify three different regional development paths, the first two finding a confirmation in Asheim (2003)'s classification.

The first path is typical of industrial clusters in sectors based on synthetic knowledge. Here the relationship with the regional system (other firms, local institutions and universities) is developed at a later stadium of the cluster's life. In this case, the region follows a transformation process here defined as '*RIS-into process*' because the RIS originates in response to the presence of the cluster and in support of the local economic development (figure 1.a). This is the case of Baden-Württemberg and Milwaukee, specialised in engineering-based sectors, where the Regional Innovation System was specifically designed to strengthen local industrial specializations, i.e. to support and promote the technological trajectories developed within the region. Indeed, for both regions the development strategy adopted was designed to strengthen manufacturing activities, focusing on the sectors that could still guarantee competitiveness to the local economy. Crucial to the effectiveness of this development path was the cooperation among the three poles of the economy (industry, government and academia), that aimed at recouping innovativeness by raising the region's technological infrastructures.

The second regional development path, typical of industrial clustering in sectors based on analytical knowledge, follows a different direction. In fact, in this case the RIS is the main source of the cluster creation. The cluster develops from the Regional Innovation System by exploiting all the local resources in terms of cooperation and interaction with universities and local institutions. This is the case of regions such as Cambridge and Singapore which followed a transformation process here defined as '*RIS-from process*', where the pre-existence of the RIS represented a key factor for the organization of a science-based industrial system (figure 1.b). In Cambridge, the development of a high tech cluster was made possible by the existence of a unique 'business environment' dominated by the active presence of the university. In Singapore, the economic transformation was fostered by the strategy pursued by the local government. Hence, the two cases are alike with respect to the creation of a local system of production from scratch, by means of a Regional Innovation System, but differentiate from each other for the degree of planning of the process. One might infer that the establishment of a RIS is a qualifying condition for the transformation to take place, being it planned or unexpected.

In the light of this classification and based on the regional cases analysed in the present work, a third development path has been identified. It is the result of a combination between

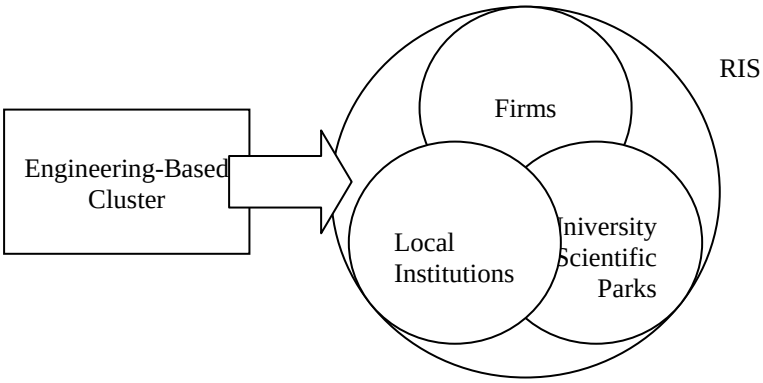
the two different base 'entities' of the regional development process described above. In fact, in regions such as Göteborg and Pittsburgh, science-based clusters, characterised by analytical knowledge, have developed from declining engineering-based sectors, characterised by synthetic knowledge, passing through the formation of a RIS. In this respect, the transformation process can be defined as *RIS-through process* (figure 1.c). In this group of regions, characterized by a long past of economic development based on traditional sectors of manufacturing activities, the Regional Innovation System was born after severe periods of industrial decline with the aim of supporting technological trajectories and strengthening local industrial specialization. In this vein, the RIS has acted as catalyst for the local system transformation process, driving the regional competitive repositioning through the development of clusters of innovative and high tech firms. In this respect, the process of territorial transformation has taken place thanks to a 'systemic effort' and as a result of social interdependencies among regional actors. This is particularly true for the regions under investigation, where the sectors which the local economy was based on showed signs of decline, and the ability to adapt to external changes was therefore crucial. Also in this case, starting out from similar conditions, the two regions then undertook an analogous transformation path, differentiating from each other for the degree of strategic planning. Again, the RIS seems to act as 'catalyst', i.e. as an element without which the activation of the transformation process is delayed.

5. Concluding Remarks

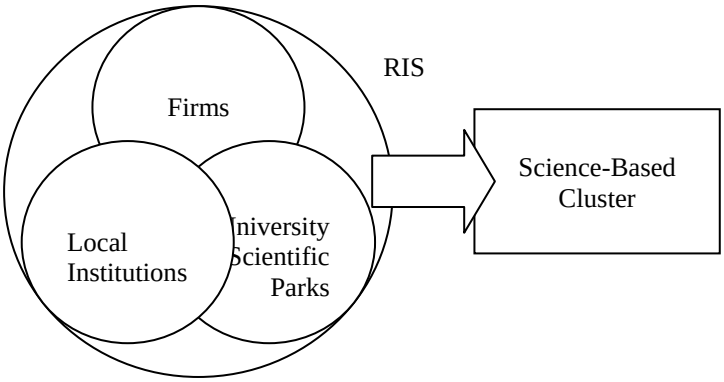
In this paper the development paths of a number of European, US and Asian knowledge economies have been analysed within a Regional Innovation System framework with the aim of gaining some precious strategic insights on the dynamics of regional transformation. Outlining the different transformation paths of the regions considered according to a time logic has highlighted that in all cases the innovation process occurred at a systemic level, as a result of strict interactions among economic actors, accountable for the intense production, diffusion and application of new ideas and knowledge. In particular, we classified three different regional development paths, that we have here defined as *RIS-into process*, *RIS-from process* and *RIS-through process.* The first two find a confirmation in Asheim (2003)'s classification. The analysis in this paper made through case studies allows to identify a third development path, the *RIS-through process,* where the RIS acts as a catalyst for the territorial transformation, easing the competitive repositioning of the regions involved.

In contexts like those described above, the role of policy makers consists in contributing to the transformation process by encouraging a culture of trust, cooperation and respect of a tacit code of behaviour in order to favour a process of continuous technological innovation and economic growth. Local governments should engage in the formulation of regional development strategies by working out projects with the support of other local organizations, public and private. Indeed, policy makers play the key role of setting the basic conditions so that the regional transformation may take place, intervening with a coordinated action of economic, financial, industrial, education, science but also cultural and social policies.

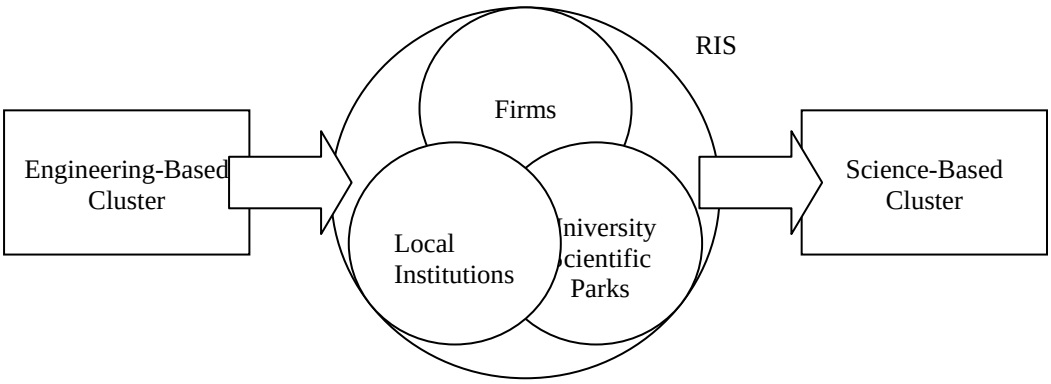
The analysis of the regions under investigation in this paper made it possible to identify a set of factors to leverage on, such as human resources, physical and technological resources, fiscal and financing incentives. The particular combination of such factors within a specific setting, the RIS, fuels the regional renewal process. In this setting, the institution of consortia and agencies, each aimed at the development of one of the factors highlighted above, is likely to be relevant.



(a) ***RIS-into process: Baden-Württemberg and Milwaukee***



(b) ***RIS-from process: Cambridge and Singapore***



(c) ***RIS- through process: Göteborg and Pittsburgh***

Figure 1 – Regional Transformation Paths: the Cluster-RIS Relationship

References

Athreye, S. 2001 Agglomeration and growth: a study of the Cambridge high-tech cluster, *SIEPR Discussion Paper 00-42*, Stanford Institute for Economic Policy Research.

Austin, J. E. 2000 Private-Public Partnerships, *Harvard Business School*, Social Enterprise Series, **15**.

Åsgård, L., Ellgren, C. 2000 *Ericsson: historien om ett svenskt foretag* (Nordestedt: Stockholm).

Asheim, B. 2003 Clusters and Regional Innovation Systems: a knowledge based perspective, paper presented at the Conference *Reinventing space: the geography of globalisation*, Bergamo, Unversità degli Studi di Bergamo, 19-20 December.

Blomström, M., Kokko, A. and Sjöholm, F. 2002 Growth and innovation policies for a knowledge economy: experiences from Finland, Sweden, and Singapore, Working Paper.

Boekholt, P. and van der Weele, E. 1998 Southeast Brabant: a regional innovation system in transition, in Braczyk, H. J., Cooke, P. and Heidenreich, M. (eds.), *Regional Innovation Systems* (UCL Press: London).

Braczyk, H. J., Cooke, P. and Heidenreich, M. 1998 *Regional Innovation Systems* (UCL Press: London).

Cambridgeshire County Council Researh Group 1998 *The high-tech community in Cambridgeshire* (Cambridgeshire County Council: Cambridge).

CBR 1998 Territorial clustering and the innovative milieu, unpublished executive summary for participating firms, mimeo, Centre for Business Research (ESRC), University of Cambridge.

Coe, N. M. 1999 Emulating the celtic tiger? A comparison of the softare industries of Singapore and Ireland, *Singapore Journal of Tropical Geography*, **20**: 36-55.

Cooke, P. 1992 Regional Innovation Systems: competitive regulation in the new Europe, *Geoforum*, **23**: 365-82.

Cooke, P. 1997 Regions in a global market: the experience of Wales and Baden-Württemberg, *Review of International Political Economy*, **4**: 349-381.

Cooke, P. 2002 *Knowledge Economies. Clusters, learning and cooperative advantage* (Routledge: London).

Cooke, P., Uranga, M. and Extebarria, G. 1997 Regional Innovation Systems: institutional and organizational dimensions, *Research Policy*, **26**: 475-491.

Cooke, P., Boekholt, P. and Tödling, F. 1998 Regional Innovation Systems: designing for the future. Final report to DG12 of the REGIS TSER project, Centre for Advanced Studies in the Social Sciences, University of Wales, Cardiff.

Cooke, P. and Morgan, K. 1998 *The associational economy: firms, regions and innovation* (Oxford University Press: Oxford).

Deitrick, S. 1999 The Post Industrial Revitalization of Pittsburgh: Myths and Evidence, *Community Development Journal*, **34**: 4-12.

Druilhe, C. and Garnsey, E. 2000 Emergence and Growth of high-tech activity in Cambridge and Grenoble, *Entrepreneurship & Regional Development*, **12**: 163-177.

Dosi, G. 1988 Sources, procedures and microeconomic effects of innovation, *Journal of Economic Literature*, **26**: 1120-71.

Etzkowitz, H. and Leydesdorff, L. 1997 *Universities in the global economy: A triple helix of university-industry-government relations* (Cassell: London).

Etzkowitz, H. and Leydesdorff, L. 2000 The Dynamics of Innovation: from National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations, *Research Policy*, **29**: 109-123.

Eurostat 2001 *Regional Statisical yearbook* (European Communities: Paris).

Foray, D. and Lundvall, B. 1995 The knowledge-based economy: from the economics of knowledge to the learning economy, *Employment and Growth in the Knowledge-based Economy* (OECD: Paris), 11-32.

Freeman, C. 1987 *Technology and Economic Performance: Lesson from Japan* (Pinter: London).

Freeman, C. 1991 Networks of Innovators: A Synthesis of Research Issues, *Research Policy*, **20**: 499-514.

Heidenreich, M. and Krauss, G. 1998 The Baden-Württemberg production and innovation regime. Past success and new challenges, in Braczyk, H. J., Cooke, P. and Heidenreich, M. (eds.), *Regional Innovation Systems* (UCL Press: London).

Herrigel, G. 1989 Industrial order and the politics of industrial change: mechanical engineering, in Katzenstein, P. (eds.) *Industry and Politics in West Germany* (Ithaca: Cornell University Press), 185-220.

Herrigel, G. 1996 Crisis in German decentralized production, *European Urban and Regional Studies*, **3**: 33-52.

Holmén, M. 2002 Regional Industrial Renewal: The Growth of 'Antenna Technology' in West Sweden, *Technology Analysis & Strategic Management*, **14:** 87-106.

Huggins, R. 2004 *World Knowledge Competitiveness Index 2004* (Robert Huggins Associates: Wales, UK).

Hui, W. T. 1997 Regionalization, Economic Restructuring and Labour Migration in Singapore, *International migration Review*, **35**: 109-130.

Jezierski, L. 1996 Pittsburgh: partnership in a regional city, in Savitch, H. V. and Vogel R. K. (eds.), *Regional Politics: America in a post-city age urban affairs* (Thousand Oaks: CA), 159-181.

Keeble, D., Lawson, C. and Moore, B. 1999 Collective learning process, networking and 'Institutional Thickness' in the Cambridge Region, *Regional Studies*, **33**: 319-332.

Lee, T.Y. 1992 Economic Restructuring Policies in the 1980s, in Low, L. and Heng, T.M (eds.), *Public Policies in Singapore: Changes in the 1980s and Future Signposts* (Times Academic Press: Singapore).

Lindholm-Dahlstrand, Å. 1998 The development of technology-based SMEs in the Göteborg region, Collective Learning and RTD in Regionally-clustered High Technology Small and Medium-sized Enterprise, Regional Reports prepared by the TSER European Network on Networks, ESRC Centre for Business Research, University of Cambridge.

Lindholm-Dahlstrand, Å. 1999 Technology-based SMEs in the Göteborg region. Their origin and interaction with universities and large firms, *Regional Studies*, **33**: 379-389.

Lindholm-Dahlstrand, Å and Jacobsson, S. 2003 Universities and Technology-based Entrepreneurship in the Gothenburg region, *Local Economy*, **18**: pp 80-90.

Lundvall, B. 1992 *National systems of innovation: towards a theory of innovation and interactive learning* (Frances Pinter: Londra).

Lundvall, B. and Borras, S. 1997 *The globalizing Learning Economy: Implication for Innovation Policy*, Targeted Socio-Economic Studies, DG XII, Commission of the European Union, Luxemburg.

Mani, S. 2000 Policy Instruments for Stimulating R&D in the Enterprise Sector. The Contrasting Experiences of two MNC Dominated Economies from Southeast asia, *Discussion Paper*, INTECH, Maastricht, Olanda.

Marshall, A. 1890 *Principles of Economics* (MacMillan: Lonon).

Metzger, J. T. 1998 Remaking the Growth Coalition: The Pittsburgh Partnership for Neighborhood Development, *Economic Development Quarterly*, **12**: 12-29.

Nelson, R. 1993 *National innovation systems: a comparative analysis* (Oxford University Press: Oxford).

Normann, J. 1989 Congenial Milwaukee, in Squires, G. D. (eds.), *Unequal Partnerships: The Political Economy of Urban Redevelopment in Postwar America* (New Brunswick Rutgers University Press).

Normann, R. 2001 *Reframing Business, When the Map Changes the Landscape* (John Wiley & Sons Ltd: Chichester, England).

OECD 1996 *The knowledge-Based Economy* (OECD: Paris).

Orfield, M. 2002 *American Metropolitics: The New Suburban Reality* (Brookings Institution Press: Washington, D.C.).

Pereira, A. A. 2004 State entrepreneurship and regional development: Singapore's industrial parks in Batam and Suzhou, *Entrepreneurship & Regional Development*, **16**: 129-44.

Rosenberg, D. 2002 *Cloning Silicon Valley the next generation high-tech hotspots* (REUTERS: Great Britain).

Sabel, C. 1989 Flexible specialization and the re-emergence of regional economies, in Hirst, P. and Zeitlin, J. (eds.), *Reversing Industrial Decline?* (Berg: Oxford), 17-70.

Sabel, C. 1995 *Experimental regionalism and the dilemmas of regional economic policy in Europe* (OECD: Paris).

Scharpf, F. 1976 Theory of Politikverflechtung, in Scharpf, F., Reissert, B. and Schnabel, F. (eds.), *Politikverflechtung: Theory and Empirics of Cooperative Federalism in Germany* (Kronberg, Scriptor), 3-30.

Scott, A. 1996 Regional motors of the global economy, *Futures*, **28**: 391-411.

Segal, Quince, Wicksteed 1985 *The Cambridge Phenomenon: the growth of high technology industry in a University town (*Segal, Quince and Wicksteed Ltd.: Cambridge).

Segal, Quince, Wicksteed 2000 *The Cambridge Phenomenon revisited* (Segal, Quince and Wicksteed Ltd.: Cambridge).

Smith, K. 2002 What is the 'Knowledge Economy'? Knowledge Intensity and Distributed Knowledge Bases, *Discussion Paper*, United Nations University, Maastricht.

Stewman, S. and Tarr, J. A. 1982 Four Decades of Public-Private Partnerships in Pittsburgh, in Fosler, R. S. and Berger, R. A. (eds.), *Public-Private Partnership in American Cities* (Lexington Books: Lexington).

Sturm, R. 1996 Economic Regionalism in a Federal State: Germany and the Challenge of the Single Market, *Occasional Paper No. 1*, European Centre for Federalism Research, Tübingen.

Storper, M. and Scott A. 1995 The wealth of regions: market forces and policy imperatives in local and global context, *Futures*, **27**: 505-26.

Tödtling, F. and Sedlacek, S. 1997 Regional economic transformation and the innovation system of Styria, *European Planning Studies*, **5**: 43-64.

Wang, C. K., Wang, K. and Lu, Q. 2002 Do venture capitalists add value? A comparative study between Singapore and US, *Applied Financial Economics*, **12**: 581-588.

Wood, D. E., Orfield, M. and Rogers, J. 2000a Milwaukee Metro-patterns: Sprawl and Social Separation in Metro Milwaukee. Report prepared by the Center on Wisconsin Strategy and the Metropolitan Area Research Corporation.

Wood, D. E., Whitford, J. and Rogers, J. 2000b At the Center of It All: The High-Road Strategy for Milwaukee's Menomonee Valley. Report prepared by Menomonee Valley Partners, Center On Wisconsin Strategy, University of Wisconsin-Madison.

Yun, H. A. 1998 Innovative milieu and cooperation networks. State initiatives and partnership for restructuring in Singapore, in Braczyk, H. J., Cooke, P. and Heidenreich, M. (eds.), *Regional Innovation Systems* (UCL Press: London).