Regional Innovation Systems and the Labour Market: A Comparison of Five Regions

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Abstract

This paper reviews the concept of Regional Innovation Systems with particular attention on the labour market dimension. It argues that the labour force as a repository of skills and knowledge plays a key role in generating knowledge flows within Regional Innovation Systems. Then, by reference to a number of important dimensions characterizing innovation, five regions from northern Europe are contrasted. In light of research undertaken by the authors the paper highlights the problems associated with a regional system that may hamper innovation and it shows that Regional Innovation Systems can be underdeveloped by being too dependent on public support. Accordingly a combination of public and private governance at the regional level to promote systemic innovation is advocated. The paper also shows how the Regional Innovation Systems can evolve and how regions can become increasingly developmental knowledge laboratories influencing labour market conditions.

Introduction

Much of the early work on innovation systems was conducted at the national level (Edquist, 1997; Lundvall, 1992; Nelson, 1993; Edquist & Hommen, 1999), responding mainly to the issue of whether the globalization process was undermining the ability of individual nations to influence their own technological sovereignty. However, more recently, researchers have tried to explore how innovative capabilities are sustained through regional communities of firms and supporting networks of institutions that share a common knowledge base and benefit from their shared access to a unique set of skills and resources (Wolfe, 1997). Innovative actions are increasingly highly dependent on localized or regionally based sources of knowledge and learning and as production becomes more science-based, advantages such as developed research infrastructure, a highly qualified workforce and an innovative culture are becoming more important than natural resources. Heterogeneous and localized capabilities such as institutions, specialized resources and skills become invaluable assets to build firm-specific competences (Maskell & Malmberg, 1999). Regions are becoming increasingly centres of learning and innovation (Wolfe, 2002) and the breeding ground for local policy networks.

Within the same region different industrial agglomerations can co-exist and different

sectoral specialization may take place, in other words different systems of innovation may be found in the same region. To some extent, this gives impetus to the possible differ- entiation within regions and takes into consideration the differences that exist within the same region. Besides, regional systems of innovation are not found everywhere. Indeed, there are many regions which lack the concentration and localization benefits, because of low density, peripherality, lack of dynamic innovative firms and institutions and the fact that they are simply knowledge and information poor. The path dependency argument emphasizes that some peripheral regions would focus on transforming the activity of their industrial age economy strength and the skills associated with that industry. This might lead them in the direction of opto-electronics, biotechnology or the media/multi-media industries, or even any combination of these or other similar activities.

It is recurrently argued that such differences in economic performance between the relatively more or less successful regions can be explained looking at the mix of regional innovation policies and institutions that fosters dynamism (Cooke & De Laurentis, 2002). It is the ways policies pursued by regional governments give distinctive identity to the regions in question and it is the institutional capacity to attract and animate competitive advantage, often by promotion of cooperative practices among actors, that gives regions distinctive trajectories in regional economic development. To become attractive for companies, territories can set up specific institutions to support their innovation strategies. Regions, especially when they have developed clusters and appropriate administrative machinery for supporting innovative enterprise, represent more meaningful communities of economic interest, define genuine flows of economic activities and can take advantage of true linkages and synergies among economic actors. Regions have to seek competitive advantage from mobilizing all their assets including institutional and governmental ones where these exist, or press for them where they do not. As regions become more special- ized and pull the institutional support structure along, so foreign direct investment (FDI) seeks out such centres of expertise by following domestic investment as part of a global location strategy (Cooke *et al.*, 2000).

It is therefore clear that the network relationships among firms and the broader institutional setting that supports firms' innovative activities usually referred to as Regional Innovation System (RIS), can be seen as a framework for studying economic and innovative performance but it is also a tool to enhance localized learning processes (Asheim & Coenen, 2004; Asheim *et al.*, 2003). A RIS comprises a set of institutions, both public and private, which produces pervasive and systemic effects that encourage firms within the region to adopt common norms, expectations, values, attitudes and practices, where a culture of innovation is enforced and a learning process is enhanced.

This paper deals with the RIS framework and the importance of the labour force as a repository of skills and knowledge. Whereas the next paragraph briefly highlights the key dimensions of a RIS, the second section analyses the growing importance of labour market dimension within the regional system and the role this plays in generating

knowledge flows in systemic interaction. The third section introduces the case studies and outlines the multi-level governance aspects of innovation. In particular it explains how different varieties of capitalism may influence the development of a regional system of innovation. Then, by reference to a number of important dimensions characterizing innovation five regions from northern Europe are contrasted. In light of research undertaken by the authors the paper highlights the problems associated with a regional system that may hamper innovation and it shows that RISs can be underdeveloped by being too dependent on public support. A combination of public and private governance at regional level to promote systemic innovation is advocated.

RISs: Key Determinants

Previous work has identified two sides of an innovation system: a supply and a demand side (Braczyk *et al.*, 1998). The former consists of the institutional sources of knowledge creation as well as the institutions responsible for training and the preparation of highly qualified labour power. The demand side subsumes the productive systems, firms that develop and apply the scientific and technological output of the supply side in the creation and marketing of innovative products and processes. Bridging the gap between the two are a wide range of innovation support organizations which play a role in the acquisition and diffusion of technological ideas and know-how throughout the innovation system; these may include: technology centres, technology brokers, business innovation centres, organizations in the higher education sector and mechanisms of financing innovation such as venture capital systems. One of the assumptions of the RISs approach is that many innovative firms operate within regional networks, cooperating and interacting not only with other firms such as suppliers, clients and competitors, but also with research and technology resource organizations, innovation support agencies, venture capital funds, and local and regional government bodies. Innovation is a learning process that benefits from the proximity of organizations that can trigger this process. Furthermore, regional authorities have an important role to play to support this learning process by offering services and other mechanisms that augment the inter-linkages between all these actors. Figure 1 summaries the RIS assumption.

Where there is a rich innovation infrastructure, ranging from specialist research institutes, to universities, colleges and technology transfer agencies, and institutional learning is routine, firms have considerable opportunities to access or test knowledge, whether internally or externally generated to the region. A strong, regionalized innovation system is one with systemic linkages between external as well as internal sources of knowledge production (universities, research institutions, and other intermediary organizations and institutions providing government and private innovation services) and firms, both large and small. Most regions do not have these systemic innovation characteristics and in realistic terms an innovation system can be more or less systemic.

Following Cooke (1998) and Braczyk *et al.* (1998) different innovation systems can be measured upon two dimensions: the governance dimension and the business innovation dimension. Whereas the former comprises public policy, institutions, knowledge infrastructure and associativeness among representative bodies inside or outside public governance, the latter refers to the industrial base characterized in terms of "productive culture" and systemic innovation. Following these two dimensions, Braczyk *et al.* suggested a taxonomy of RISs, that is represented in Figure 2. Assuming that firms can

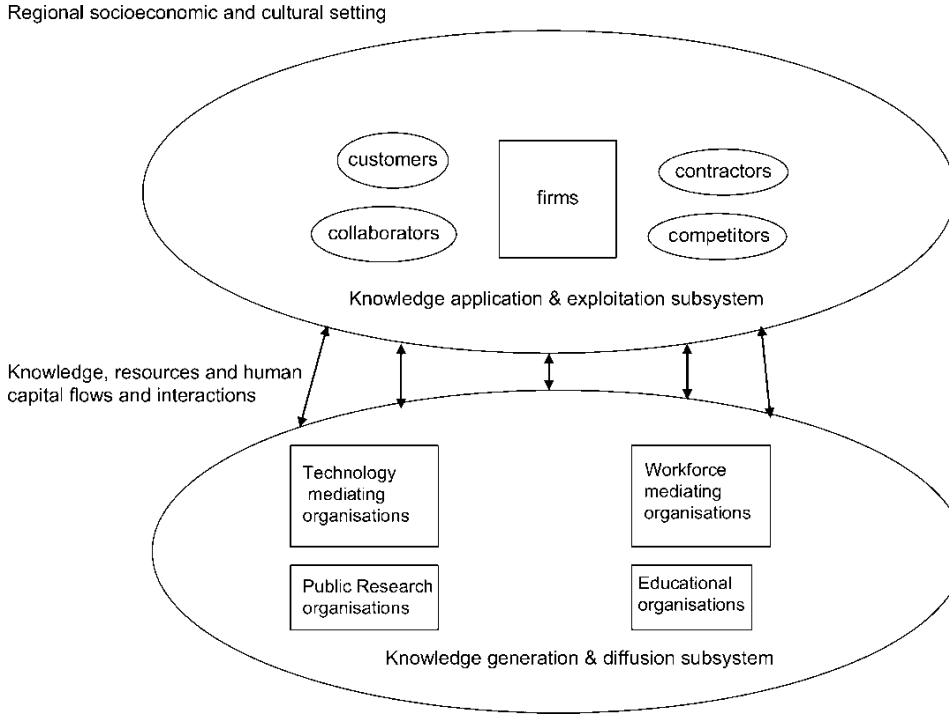

Figure 1. The RIS: a schematic illustration

range from possessing global to merely local reach, three different types of RISs emerge: the localist one is characterized by the extent of the lack of domination by large indigenous firms and where the business innovation culture is one in which the research reach of firms is not very great, although there may be a local research organization capable of combining with industry clusters within the region. A localist set up will probably have fewer major public innovation or R&D resources, but may have smaller privates one. Finally there will be a reasonably high degree of associativeness among entrepreneurs and

	Grassroots	Network	Dirigiste
Localist			
Interactive			
Globalised			

Business innovation

Governance of enterprise/ innovation support

Figure 2. RISs: a taxonomy

between them and local or regional policy-makers. An interactive RIS, however, is not particularly dominated by large or small firms but by a balance between them. The reach of this combination will vary between widespread accesses of regional research resources to foreign innovation sourcing as and when required. The mix of public and private research institutes and laboratories, in the interactive RIS, is balanced, reflecting the presence of larger firms with regional headquarters and a regional government keen to promote the innovation base of the economy. Concluding, in the third type of RIS, the globalized one, the innovation system is dominated by global corporations, often supported by clustered supply chains of rather dependent small and medium sized enterprises (SMEs). The research reach is largely internal and highly privatistic rather than public, although a more public innovation structure aimed at helping SMEs may have developed.

Hence, following Cooke (1998), the governance dimension can generate three different RIS: grassroots, network and dirigiste. The RIS can be defined as grassroots, where the innovation system is generated and organized locally, at town or district level. Financial support and research competences are diffused locally, with a very low degree of supra-local or national coordination. Local development agencies and local institutional actors play a predominant role. A network RIS is more likely to occur when the institutional support encompasses local, regional, federal and supranational levels, funding is often guided by agreements among banks, government agencies and firms. The research competence is likely to be mixed, with both pure and applied blue-skies and near market activities geared to the needs of large and small firms. A dirigiste system is animated mainly from outside and above the region itself. Innovation often occurs as a product of central government policies. Funding is centrally determined, with decentralized units located in the region and with a research competences often linked to the needs of larger, state owned firms in or beyond the region.

This offers the context within which we propose to develop the discussion that follows.

RISs and the Labour Market

Regional and external innovation interaction among firms and other innovation organizations has been regarded as playing an important role in fostering regional innovation potential; at the same time, labour demand and supply are increasingly influenced by innovation, growth potential and linkage among firms within a defined location. It follows from this, that the conditions of a system of innovation influence the labour market dynamic and the ability of localities to generate, attract and retain highly skilled workers that are essential for establishing and growing innovative companies, as argued in Florida (2000).

The interface between labour supply and demand is increasingly based on regional distinctiveness, influenced by the specific innovative system in place, the presence or absence of universities, the capacity of attracting new businesses, planning and housing policies, international migration, educational policies and the capacity and the ability to generate, attract and retain highly skilled labour force. Innovation activities require new ways of working, which pertain not simply to the relationships between firms, but also to interaction that reaches the public sphere of universities, research laboratories, technology transfer, training agencies and support organizations. These include project-work, flexibility and knowledge outsourcing. Access to resources for innovation (skills and knowledge) have therefore become central to the competitive strategy of firms, which have developed new flexible structures to better utilize and capture such advantages on a

global scale. Knowledge exchange and learning are embedded within global, national, regional and local networks. The rapidly changing pattern of knowledge demand is affecting traditional labour market models and firms do not necessarily need to employ labour directly to gain access to the knowledge they require. There is an increasing focus upon the need for reflexive practices in work, on the creation of "communities of practice" who can work reflexively in collaboration, on collaborative learning and innovation practice (Wenger, 1998).

Institutions, which are sensitive to the new context, will engage in partnership formation as a means of developing and promoting communities of practice, which becomes the focus of the generation and management of knowledge within organizations. It is widely accepted that innovation networks are likely to develop within regions where there is a widespread policy interest in strategies supporting the development of networks of firms engaged in formal and informal vertical interactions and removing constraints on the development and functioning of such interactive processes. One of the assumptions of the RISs approach is that many innovative firms operate within regional networks, cooperating and interacting not only with other firms such as suppliers, clients and competitors, but also with research and technology resource organizations, innovation support agencies, venture capital funds, and local and regional government bodies. Innovation is a learning process that benefits from the proximity of organizations that can trigger this process.

The labour market dimension, therefore, increasingly becomes an important element within RISs, and as suggested by Hommen and Doloureux, (2003) it can be argued that the embodiment of knowledge in the regional workforce is one of the primary mechanisms through which processes of learning and knowledge transfers occur. Two features appear of particular importance in understanding the link among RISs and labour market. On the one hand, accordingly to Breschi and Lissoni (2000) a crucial mechanism through which knowledge flows across firms and regions is represented by the mobility of individual workers. As workers that embody relevant knowledge move locally, they help diffusing this knowledge through a certain region and industry. This category of externalities was first identified by Marshall as labour market economies, where a localized industry attracts and creates a pool of workers with similar skills, smoothing the effects of business cycle (both on unemployment and wages) through the effects of large numbers (Krugman, 1991 as cited in Breschi & Lissoni, 2000).

In other words, the mobility of engineers, scientists and other skilled workers across firms, between firms and academic institutions allows knowledge to diffuse locally. The regional labour market therefore becomes an arena where a pool of technical knowledge and expertise is mobilized and a potential base of knowledge suppliers and users interact. The movement of people between labour markets, sectors and firms has therefore important consequences for industrial functioning and innovation (Power & Lundmark, 2004). It follows that labour market policies and institutions affect the scope for the firm to appropriate the rents generated through innovative activities and although product and labour market policies usually aim at objectives other than innovation, they may have important consequences for firms' innovative strategies (OECD, 2002).

On the other hand, it can be argued that labour mobility is likely to create bonds and links between firms, workplaces and institutions and thereby nurtures networking propensity (Power & Lundmark, 2004). The rise of the "entrepreneurial university" (Smilor *et al.*, 1993) and promotion of the so-called "triple helix" of interaction between industry,

government and universities as a key feature of the knowledge economy (Etzkowitz & Leydesdorff, 1997) testify how innovation and learning processes involve knowledge transfer and labour mobility as a key focus. This is also highlighted in the increasing interest into the so-called Vocational Educational Networks (VET) (Hommen, 2005), consisting of educational partnerships, collaborative activities, and cooperative ventures between universities and other educational providers and firms or other organizations that not only supply and maintain a skilled labour force but also enhance knowledge transfer within the economy through a variety of interactive learning and innovation processes (Rosenfeld 1998).

Access to skills and knowledge and labour mobility as resources for innovation become a major part of the competitive strategy of regions; it follows that regions become the focal point in which the localized/regionalized dimension intertwines with the globalized nature of the labour market. This is where the global/international partnership formation in recruiting more mobile skilled labour force takes place and where different actors come together to create strong and effective partnerships which set out clearer vision for the regions and shows how different agencies can work together to make planning and delivery more relevant to the needs of employers and individuals.

Hence, this highlights that labour mobility and networking propensity need to be supported by a local innovation culture, where the institutional and social context become increasingly central to foster knowledge exchange. Regional authorities therefore have an important role to play to support this learning process by offering services and other mechanisms that augment the inter-linkages between all regional actors. Not only has regional intervention become more important to economic success, but there has also been a qualitative shift in the form of local policy towards indigenous entrepreneurship and innovation, and to providing a more sophisticated environment for mobile capital so as to maximize local value added (R&D and other high status jobs, successful and therefore growing firms).

Linking National and Regional Dimensions: Introducing the Case Studies

The RIS approach is fundamental in the notion of the region as an important level at which strategic innovation support is appropriate (Cooke, 1992; Todtling & Sedlacek, 1997; Cooke *et al.*, 2000; Cooke, 2002). Attention to the concepts of interactive innovation, learning, proximity, associational networking and clustering activities of public and private governance actors needs to be coupled with the multi-level governance aspects of innovation systems. Region[1] recognizes the widespread existence of an important level of industry governance between the nation and the local. To varying degrees, regional governance is expressed in both private representative organizations such as branches of industry associations and chambers of commerce and public organizations such as regional ministries with devolved powers concerning enterprise and innovation support, particularly for SMEs. Furthermore, there are few regions thus-defined that do not possess increasingly important universities or polytechnics that can look outward to industry either for research commissions or as incubators for innovative start-up firms. This context highlighted acknowledges that, in line with the variation in RISs, there will also be different national components of each region that characterizes its capacity for transformation.

Following Hall and Soskice (2001), it could be argued that in some countries, coordinated market economies in contrast to the liberal market economies, firms tend to rely

more on strategic interaction among firms and other actors to construct their competencies. Coordination entails more extensive relational contracting and networking and actors rely more on collaborative relationship to build their competitiveness. Firms in coordinated market economies draw from a further set of organizations and institutions for support in coordinating their activities. However, in liberal market economies firms and other actors coordinate their activities primarily on competitive market arrangements, driven by competition and formal contracting. In liberal market economies, firms rely on competitive and self-regulating market mechanism to coordinate decisions and to structure relations with other actors such labour.

The institutional framework of the political economy, such as regulatory regimes, industrial relations, monetary policies and wage bargaining just to name a few, generate systematic differences in corporate strategy across liberal market economies and coordinated market economies (Hall & Soskice, 2001). In other words, institutions and organizations gravitate toward the mode of coordination for which there is institutional support; according to Hall and Soskice (2003) institutions are factors that mediate the relations among the core actors of the economy, influencing policies adopted in areas such as social welfare and education. These differences influence variations in firms' levels of exposure to the financial markets, the bases of firm ownership and control, the nature of inter-firm relations, the organization of labour–management relations, the patterns of production and innovation, and the role of the state in the economy. Different types of social protection—and in general terms varieties of welfare states—can also influence the propensity of individuals to invest in particular skills, determining the skills profile of an economy and a state ability to compete in international markets (Estevez-Abe *et al.*, 2001).

It is important to realize, before describing the RISs of the regions under investigation, that Sweden and UK are part of the coordinated market economies and liberal market economies, respectively. Sweden is usually identified as coordinated market economy, with the traditionally "enabling" state that facilitates collaborative inter-firm relations and cooperative labour management relations, with a high degree of labour cooperation, strong worker investment in skill acquisition, and a greater cooperation and consensus in labour–management relations[2] (Culpepper, 2004). These differences in the national institutional frameworks of coordinated market economies, such as Sweden, support different forms of economic activity, and their competitive advantage is mainly in diversified quality production, while liberal market economies are most competitive in industries characterized by radical innovative activities.

As argued, the UK is usually identified among the liberal market economies, such as US and Ireland; its institutional foundations are open and flexible markets, a competition state, residual welfare programmes and monetary stability. Despite its market-liberal nature, the UK has strong regional development agencies, especially over a quarter of a century in Scotland and Wales and since 1999, the nine English regions have also created regional economic development agencies. These agencies promote liberal market ideals but further, for example, entrepreneurship, innovation, clustering and talent formation through associative mechanisms. Hence, the UK government promotes networking and cooperation as an important driver in innovation. Table 1 confronts the different capitalisms of the UK and Sweden.

The highlighted differences influence modes of organization of the market, the education system, the labour market, the financial system, contributing to the formation of divergent "business systems" (Whitley, 1999), and influencing innovation processes.

Table 1. Coordinated and liberal market structures in the UK and Sweden

	Sweden	UK
Labour market	Strong centralized trade unions, interplay between the concentrated capital, trade unions and the state; high levels of employment protection; labour market less fluid and longer job tenure	Weak trade unions and industry organizations; fluid and deregulated labour market; contracts national and local
Education	Collaborative training schemes, industry specific skills; high level of institutional support for vocational training	Incentives in investing in general skills; little incentives to gain industry specific skills and little collaborative training
Finance and firm organization	Bank not equity firm financing low levels of venture capital; strong corporate governance rules; top managers have less scope for unilateral action; consensual style of decision-making	Large capital markets fund investment; equity based financing, venture capital; equity-based ownership structures; incentive scheme and performance-related pay, flexible, global supply-chain configurations
Innovation	Focus on university 'third mission' Universities as R&D spenders Role of technological procurement R&D agency- Vinnova	Asymmetric devolution; economic development agencies common; they manage much innovation support, regional venture; funds, cluster strategies

Source: Authors elaboration from Hall and Gingerich (2004) and Estevez-Abe *et al*. (2001).

However, it is by no means unusual to observe varieties of business and economic governance practices between regions within countries and, according to Asheim and Coenen (2004) these differences do not take full account of the competitive advantage and the systems of innovation that the regional arena experiences, as shown in the analysis of the five regions under investigation.

The RISs of Wales, Scotland, East Anglia, Stockholm and East Gothia

This section describes the RISs of five case study-regions across northern Europe. The aim of the section is to highlight differences among regions in their innovation strategies and trajectories. For each region, both dimensions of governance and business innovation in the RIS are investigated; focus is given to the strategies, policies and outcomes that underpin the innovation trajectories of the selected regions. The analysis starts from the UK regions of Wales, East Anglia and Scotland and follows with the Swedish region of Stockholm and East Gothia.

The Wales Innovation System

In political and economic terms Wales has achieved a degree of autonomy. Prior to the creation of the National Assembly Government for Wales in 1999, its policy development and delivery structures operated through the Welsh Office, located in Cardiff. Among the responsibilities of the Welsh Office then, and National Assembly Government now, was

regional development which was and still is delivered through the regional development agency, the Welsh Development Agency (WDA). This model of regional development is now being replicated throughout the UK, largely as a consequence of the perceived success of the Welsh model. The governance structure in Wales supporting the regional economy is rather distinctive, being stimulated by responsive state actions mediated through public– private representation on forums of various kinds. There are strong tendencies towards the development of a network form of governance structure as distinct from a strictly market or hierarchy-based regime.

Although the WDA never produced an economic plan for Wales, not even producing a corporate plan until 1992, nevertheless there developed a tacit sector strategy to intensify the level of investment, both domestic and overseas, in automotive and electronic engineering. This strategy took off spectacularly in the 1980s, mainly because this was the period of most intense job-loss in coal, steel and the first-round of manufacturing industries. Wales was being lifted by the arrival of global transplant firms, mainly from Japan and later the Asian "Tigers" specializing in electronics and automotive industries. These were used to operating in clusters and in concert with the WDA, vertical, supply chain clusters were being built, especially in south Wales. Where indigenous suppliers were competitive and innovative, firms received contracts, although these were a minority but regionally significant.[3] If the locals were unable to meet requirements, the WDA recruited suppliers, or firms like Sony and Matsushita brought them in from their own *keiretsu*. These Asian firms injected a propulsive innovation element into the economy by demanding globally competitive quality. Wales, in the early 1990s, was growing as a manufacturing economy within UK. Wales was the only part of the UK in which manufacturing employment was not in decline but actually showing an increase, 1991 – 1998, the prevalent perspective of the early and mid 1990s is that Wales was experiencing something of an "industrial renaissance" by comparison with elsewhere in the UK, and even large parts of the European Union (EU) (Cooke *et al.*, 1994). However, such a situation seems to have come to a halt and recent statistics show that Wales lost 44,000 manufacturing jobs in the period between November 1998 and November 2002 (Office of National Statistics, 2003).

A similar story can be told for the Welsh electronic industry, where the vast majority of production firms were final assemblers, many of them Japanese such as Panasonic, Orion, Sony, Sharp and Brother. Such firms sought to source their supply requirements within Wales and this largely explains how Wales became both more of a manufacturing economy than it was and, proportionately, more of a manufacturing economy than the UK. The Welsh electronics industry was based on the attraction of inward investment to replace the rapidly declining heavy engineering and extractive sectors. Inward investors were attracted into what was an entirely greenfield location (fresh land and employees), with no real history of electronics, which drove the firms there to compete effectively on the basis of their competitiveness (Phelps & Tewdwr-Jones, 1998). Inward investment firms and the linked remnants of the Welsh steel heritage have contracted, and their importance to the emergent RIS that had been evolving around engineering sectors or clusters is now beginning to unravel.[4]

The institutions responsible for setting up an economic development strategy seem to recently have abandoned the idea that economic development thrives from inward investment and its new economic development strategy documents shifted the strategic economic development focus on entrepreneurship, with a key instrument the

Entrepreneurship Action Plan. A new investment vehicle, Finance Wales, was set up to channel EU and private funds into loans and equity investments for SMEs and start-up businesses. A "Knowledge Exploitation Fund" was set up to facilitate exploitation of university research. Since 1995/1996 there has been considerable growth in Welsh HEIs' consultancy and contract research activities, this has been through exploiting existing partnerships and initiatives such as Industrial Liason Officers, the Entrepreneurship Champions programme and Help Wales—in 2001 consultancy and contract research revenues accounted for £40 million respectively (Welsh Assembly Government, 2003). A recent survey highlighted that 22 new spin-off firms were set up in Wales, accounting for over 10% of the UK total and 64 new business start-ups by graduates in Wales accounted for 19% of the UK total. However, these embryonic "triple helix" relations among universities, businesses and government agencies depends heavily on regional personnel to act as interlocutors and commissioners of research and they atrophy and die with its loss.

Although the Welsh Assembly Government overall aim is to "increase the knowledge, research and development, and innovation capacity in all parts of the Welsh economy", most strikingly Wales does not actually have a science policy to drive forward the R&D agenda, which acts as the Government's principal source on issues in science, engineering and innovation and relevant aspects of education and training and regional labour market. The Wales for Innovation plan and the more recent strategy "Towards a technology industry strategy for Wales" launched in early 2004 which aims at encouraging the industry's international competitiveness represent an attempt to drive the agenda forward; although these documents set out an effective rationale for promoting innovation and systemic interaction there is little evidence of this conceptual framework emerging at ground level in the region. Nonetheless, within the Welsh industrial-base, many sectors are represented by a forum that works to promote its members' growth and prosperity, developing and promoting the interests of the sector to improve competitiveness.

Wales now has the highest percentage share of employment in public administration (education, government, and health) in the UK. Indeed, employment overall in Wales has risen, with the ubiquitous "other business services" growing somewhat, but not the more knowledge-intensive financial services. It can be argued that the future of the Welsh economy is likely to be based chiefly on continued strong expansion in the service sector and relatively new industries for Wales such as IT, media/new media and biotechnology, which are thriving among the innovation support actors as revamped interest in networking and collaborative learning. The media sector represents an interesting case of regional innovation within Wales; although it presents problems, it shows some endogeneity, where a combination of public and private governance interacts promoting systemic innovation (cf. De Laurentis, 2006).

Science and Innovation in Scotland

A different story can be told for Scotland. Scotland's new deindustrialization hit earlier so that although it lost a lot of manufacturing jobs, 1998 – 2002, its share was lower and less were lost than in Wales. Nevertheless the situation caused the Scottish Parliament to commission Scotland's Science Strategy. This reviewed basic scientific research, costed it, assessed it in relation to world-class benchmarks, and prioritized three fields for which extra resources and attention would be forthcoming. The fields are Biosciences, Medical Science and E-Science. Activities to develop closer networking among public

and private research laboratories, to stimulate technology transfer from the Scottish health system and to promote a science-based economy were begun.

Regarding the last point, the Scottish Executive, then produced an economic strategy document charging Scottish Enterprise and economic actors generally, to espouse their vision of a "Smart, Successful Scotland". This made reference to the Knowledge Economy and proposed actions to: enhance knowledge inputs and outputs among global businesses in or relevant to Scotland; hasten the rate of spin-outs from scientific research; making Scotland's "talent" base more "sticky" and augment it by stimulating a more cosmopolitan image.

The Science Strategy makes it clear that, although Scotland's economy performs at about the UK norm, market forces alone cannot be relied on for economic growth to occur, but that of Scotland's basic science advantage and government activity more generally have to be directed increasingly at sustaining world scientific leadership in a few feasible areas and raising commercialization and entrepreneurship opportunities arising from science. This means maximizing targeted science research expenditure for these areas, including improving relationships between university and biological research institutes and research facilities in Scotland.

Three examples summarize in more details the type of actions undertaken. First, foreign owned firms now planning to leave are targeted to encourage them to replace production jobs with R&D. This has resulted in some success; one reason being that Scotland's science base is excellent, producing 28% of UK biotechnologists and 20% of medical doctors with only 9% of the UK population. Pharmaceuticals firms spend, at 17.5% twice the amount on R&D that other sectors average, hence knowledge linkage around healthcare makes sense.

A second example, concerning spin-out firms, is the ambition to enhance an already successful cluster programme by establishing new Intermediary Technology Institutes that will take basic research from universities, patent it as appropriate, transform it into near-market innovations and commercialize it by license, sale or new spin-out. In Scotland, three of these in life sciences, information and communication technology (ICT) and energy were announced in 2003 costing £450 million over 10 years and although aimed at contributing in three key sectors identified by Scottish Enterprise as growth industries of the future, they also have the role of knitting together important parts of Scotland's innovation system.

Finally, to enhance knowledge inputs and outputs, an extranet linking the Scottish business diaspora has been constructed, is functioning successfully and will be expanded externally and adapted as an internal knowledge management system first for all Scottish Enterprise staff and then for the Scottish "knowledge economy".

Scotland's problems of low industrial R&D and a high proportion of small businesses are to be moderated by connecting to economic growth initiatives such as the Scottish Executive's The Way Forward—a framework for Economic Development; The Knowledge Economy Cross-Cutting initiative; and the Digital Scotland Task-Force. These aim at revitalizing UK-originated small business research and technology awards, assisting academic entrepreneurship, using foresight to identify future challenges and opportunities and recruiting investment and scientists from overseas.

Scotland has a modern economy, with less than 3% of workers employed in agriculture, 27% in industry and 71% in the service sector. The IT industry is also particularly important with the Scottish software industry employing around 20,000 and the presence

of several world class biotechnology sector companies. The regional stakeholders, as seen, have focused primarily on the talent base for regional future success, stimulating a more cosmopolitan labour market by encouraging foreign students to remain in Scotland as entrepreneurs and employees. This is coupled with the growing awareness of Scotland's universities as a potential seedbed for a new generation of Scottish technology companies and the need to identify new business and role models possibly emphasizing knowledge entrepreneurship.

The Cambridge Phenomenon

The growth of a number of distinct but often inter-linked high-tech clusters in and around Cambridge in the eastern region of England, has been termed the "Cambridge Phenomenon", and, more recently, "Silicon Fen". With its proximity to London and its prestigious university, Cambridge has long been a centre of R&D; indeed, the origins of the Cambridge Phenomenon can be traced back to the formation in 1881, by two Cambridge graduates, of the company which later became Cambridge Instruments, which developed the first seismograph (Gillespie *et al.*, 2001). However, it was not until the establishment of Cambridge Science Park in 1970, coinciding with the advent of the microelectronics revolution, that a high-tech cluster of economic activities came into being.

There are a number of factors which have underpinned the formation of the software cluster in Cambridge, or which have contributed to its continuing success. On the one hand, the city of Cambridge was host of one of the UK's most prestigious and research active universities and this relationship between the ICT industry and the university, since its establishment, has been more complex than merely as a source of highly skilled employees and new high technology spin-off firms. The cluster is historically focused on the University of Cambridge with its global reputation for research and scientific activity and contains a diversity of technology based sectors, including both technology, manufacturing and services, the dominant growth sector in recent years. As argued in Keeble *et al.* (1999), the University of Cambridge is characterized by generally liberal and positive attitudes towards research collaboration, sharing of knowledge and economic development, such collaborative environment has helped to shape the wider culture of the local research business community, via university spin-offs, researcher recruitment and direct research collaboration. Such a common regional code of behaviour generated within the University of Cambridge, on the one hand, and a small group of large local R&D consultancies on the other hand has permeated the local cultural context, becoming one which is conducive to the development of innovative and cross-fertilizing research within and between local firms. Consequently, the small high-technology firms approach innovation in a very similar way as team-based research in university and semi-autonomy of fee-earners in professional partnership. The region "exhibits 'institutional thickness,' not only in the density of firms and supporting institutions and the linkages between them, but also in their common approach and shared structure of working" (Amin & Thrift, 1994).

Although few software firms use the University for research purposes, it was an important factor in the initiation of the cluster. Further, the prestige of the University, in international terms, has helped in marketing firms operating within the cluster. Although the cluster was initiated by graduates from the University, this is no longer the predominant source of labour supply; indeed, many skilled people have moved to the area to be part

of the cluster. It is now only the most technically-oriented companies, having strong links with the University's engineering and computing departments, which rely on the recruitment of Cambridge graduates.

It has been claimed that the essence of the competitive advantage of the firms located in the region is their dynamism and innovation in emerging activities. Although there is a distinctive Cambridge ICT cluster, success is spread across a number of sectors. Cambridge is host to a large number of technical and technological service firms. Much of the ICT growth has come from firms whose primary expertise is not necessarily in computing or IT, but in some other area such as geophysics, medical diagnostics or machine vision. These firms have developed electronic and software products which embody their expertise.

From the governance point of view, two main policy measures seem to have historically contributed to the creation and consolidation of the propagation of the Cambridgeshire high-tech clusters. The first element was a very stringent planning regime, both within the city of Cambridge and in the wider county of Cambridgeshire, which has contributed to the selection and concentration of high-technology firms boosting the prestige of small firms located in the area (Charles & Benneworth, 2000). However, government policy favoured the development of high-technology bioscience laboratories in the Cambridgeshire area, building upon university expertise as well as the natural evolution of agricultural research into biotechnology. Soft infrastructure and support is provided to small businesses in the form of serviced accommodation sites and business parks, such as the St John's Innovation Centre, which offers business advice and acts as an incubation unit for small but rapidly expanding businesses. There are also well-established formal and informal networks, such as the Cambridge Network, established in 1998 to link the business community in Cambridge to the global high-tech community. Support is also provided through local government funded or collectively organized business support and training agencies. Within the region, traditional financial short-termism has been overcome through the attraction of innovative forms of finance, particularly venture capital and listing on the Alternative Investment Market (Charles & Benneworth, 2000). The final important feature of the innovation system of Cambridge and the surrounding Easter Region is the presence of both informal and informal networking between businesses and research or service organizations and amongst businesses themselves. Cambridge Network Ltd was set up in March 1998 to formalize linkages between business and the research community, connecting both local and global networks in a systematic way.

The Regional Development Agency, East of England Development Agency (EEDA) has already become a major player in promoting the regional economy, marketing the region internationally, promoting the innovation base of the economy through grants, and trying to solidify business to business links and business to university links. The university is trying to go beyond it's historical role and become an active promoter of the regional economy providing a number of programmes to promote entrepreneurship and skills development in the local economy. Hence, the current and future skills supply of the east of England workforce is currently under scrutiny and a recent report (Elliott *et al.*, 2004) highlighted that if the supply of higher level skills is not increased the east of England could lose out on its regional competitive advantage. A number of initiatives have been put in place to tackle the problem such as the development of the east of England Framework for Regional Employment and Skills Action (FRESA),[5] that ensures a bottom-up approach to skills development.

Stockholm and Swedish ICT Development

The region of Stockholm is often regarded as the engine of Swedish ICT development and Kista Science Park its leading concentration of ICT business and research. A large proportion of elite companies in the ICT-sector is represented in Kista. Stockholm has in the past few years experienced a boom in telecommunications, information technology, media and entertainment sectors and is regarded as one of the leading ICT clusters in the world. The region is also at the centre of the Swedish healthcare industry and one of Europe's largest industrial healthcare clusters with 102 medical device companies, 24 biotechnology companies and 54 pharmaceutical groups. It can be argued that the boom has been triggered by the success of multinationals such as Ericsson; however, although Ericsson has been and is the dominant figure, a number of entrepreneurs and small firms are also playing a key role in the regional development of the Stockholm area.

This development draws its momentum from two factors, on the one hand the extensive innovation supporting infrastructure with universities and technology providers and on the other hand, the dynamic industrial growth that ICT sectors experienced. The Stockholm research and innovation infrastructure has played a predominant role in the success of the area. There are altogether 20 centres for higher education in the region including the Arts Colleges, The Royal Institute of Technology, Stockholm School of Economics, Stockholm University and Karolinska Institute (Feldman, 2002).

A number of R&D institutes with a yearly turnover of *E*110 million and a number of private initiatives are also presented in the area. Apart from Kista Science Park, the area counts two other science parks NOVUM—dedicated to biomedical research and development, providing support for start-ups in the form of business advice and incubator facilities—and Stockholm's Teknikho¨jden— which provides support for the commercialization of research results and business ideas originating from students, offering office space and information infrastructure and giving advice in patenting, licensing, marketing and financing. Presently, roughly 40 innovative firms are members of Stockholm's Teknikho¨jden. Courses in entrepreneurship are in many cases a part of the educational programmes arranged by public schools and institutions of higher learning in Stockholm. The Stockholm School of Entrepreneurship is an initiative of the Stockholm School of Economics, Karolinska Institute and the Royal Institute of Technology to develop common courses in entrepreneurship. Labour market organizations play a progressive role in the adoption of new technology and new attitudes. The labour unions have actively contributed to the extensive use of computers at home by offering low cost options. The Employers' organization, SAF, has been actively involved in developing training opportunities for students on running a business with the Young Enterprise initiative.

Improving cooperation between academia and industry and thereby breaking down the barriers between them has been an important issue in Sweden for several years now. The realization that actions need to be taken to improve cooperation has led to the "third task*"* of the colleges and universities and to several other initiatives in the region of Stockholm as well as in the whole nation (Hommen & Edquist, 2003). The Technology Transfer Foundation in Stockholm is one of seven in Sweden established by the Swedish Parliament, which aims to contribute to the exchange of knowledge between industry and universities and university colleges. The universities have recently created a common interface with industry in the region called Stockholms Akademiska Forum, including a web-based search engine that gives access to researchers and departments. Besides the

universities described earlier some prominent academic players are the 15 Industrial Research Institutes located in Stockholm. The institutes work in close cooperation with Swedish companies on R&D projects but also put much effort on facilitating and fostering start-ups and new firms. Compared to other regions a lot of money is spent on R&D in the Stockholm region. More than two-thirds of R&D expenditure is within private industry. Mainly development oriented R&D while basic research is being financed by the government and carried out at public universities.

In Stockholm a relatively large amount of funding is available to companies with growth potential and it is one of the first countries which has developed an innovative funding infrastructure designed to cover the different needs of the companies, that range from venture capitalists, business angels and governmental support. The development of the Ksita complex reflected support from both national government industrial policy initiatives and action by local boosters who successfully secured national government funds to provide ICT development alternatives to Stockholm's deindustrialization.[6] The recent evolution of Swedish industrial policy has effectively made the county responsible for developing and implementing economic development policy, including innovation policy, on a regional basis.

When the bust came, and the core corporate actors in the cluster started scaling down and moving out,[7] lots of minor establishments, some of them with a sustained potential for growth, wanted to move to Kista. Thus, corporate downscaling and deep cuts in supplier networks was to a certain extent compensated by domestic and foreign investments of new establishments (Mariussen, 2003). The ICT bubble burst and the significant number of lay offs at Ericsson, shifted attention on new form of investments to develop new services and applications. An entrepreneurial programme was also initiated, Kista Innovation and Growth, becoming the key platform for supporting spin-off and start up. Kista innovation system is experiencing a new phase, where diversification and science based entrepreneurship are supported.

East Gothia RIS

The East Gothia region is centrally located between two other economically important areas: Stockholm in the north and the Jonköping region in the south. East Gothia has developed a strong specialization in manufacturing, especially in the knowledge-intensive sectors of aerospace, communications and electronics. Most of these sectors are concentrated primarily in one city: Linko¨ping. The region is also endowed with the key elements of a RIS, such as private and public research facilities, universities, innovation support structures, and firms in high-tech sectors. In the case of East Gothia region, through a variety of initiatives, there has been an extensive mobilization of resources to promote the growth of new technology based firms via technology transfer, the financing of innovation, education of a high-tech labour force, and so forth (Doloreaux & Hommen, 2002). The origin of the RIS in this region can be traced back to the creation and development of Saab, the large local defence contractor in Linko¨ping, which generated a high concentration on defence-oriented production and a specialization in the aerospace industry within the region (Doloreaux & Hommen, 2002). Owing to its character as an R&D intensive industry, the aerospace has demonstrated higher technology dynamism than other "older industries" and Saab has "naturally" evolved its ICT capabilities. In the 1960s and 1970s, Saab tried to develop innovations in the medical, in response to declining

military orders, and because biomedical engineering was seen as a potential growth market in the 1960s. They promoted the location of a new university and associated university hospital in Linko¨ping and the development of resources that formed the basis for the anchor tenant of a Science Park. Saab also developed its capabilities in computer frames and this "earlier round of investments" opened up new possibilities for the surrounding regional economy. This provided the impetus for the development of Linköping University as a leading IT university. Subsequently Ericsson's purchase of Saab's mainframe computer business and the redeployment of this assets for the development of Radio Base Station (RBS) control system for mobile communications laid the foundations for the development of the mobile phone industry in the Linko¨ping area. The year 1984 marked a critical turning point in the developmental stage of the RIS of Linko¨ping: the University, in collaboration with the municipality of Linko¨ping, decided to build up a science park in Linko¨ping, the Mja¨rdevi Science Park (Doloreux & Hommen, 2002).

There is a wide array of regional public and semi-public organizations in East Gothia that provide critical support in identifying next generation industries and mobilizing resources for current and future regional development. Ericsson's decision to invest in Linko¨ping combined with the "spill-over" effects of the public investments already made in Linko¨ping University generated the necessary conditions not only for the birth of Mja¨rdevi Science Park but also represented an important factor influencing the supply of potential high-growth start-ups. The innovation support systems have been strongly oriented towards boosting the innovativeness and competitiveness of SMEs, especially those in ICT industries such as electronics, telecommunications, and software. It is obvious that the University with is high level of engagement has been a dominant actor in the development of high-tech industry in the region. This engagement has been realized through the combination of training, the generation of new knowledge, both basic and applied and the direct entrepreneurial role of the University, supporting spin-off of academic research into a network of industrial firms and other organizations.

The University has continued to found new science parks. The most recently established Science Park in East Gothia is the ProNova Science Park in Norrko¨ping, established in connection with the Norrköping Campus of Linko¨ping University. Since its first beginnings in 1987, ProNova's central technological focus has been on "knowledge and data". Linko¨ping University and Norrköping Municipality were the key actors behind the development of ProNova, but the ProNova foundation also includes a number of important public and private sector organizations, such as the National Civil Aviation Administration, the Innovation Fund of the Bank of Commerce, Ericsson Telecom AB, and several other major Swedish corporations. As in the case of Mja¨rdevi, the dominant sectors in the ProNova Science Park are information technology and telecommunications. ProNova has a strong orientation towards the formation and development of new business, through the provision of incubator and support services.

In recent years, important changes have occurred in the policy regime and governance arrangements affecting the development of innovation-based economic activity and its supporting "knowledge infrastructure" in East Gothia (Hommen, 2004). Historically, municipalities have been the key governmental actors in founding science parks and other technopoles in East Gothia, but the county administration has become an increasingly important actor in this respect. This trend has been reinforced by the national government's devolution of certain responsibilities for regional economic development to the county level. It has also been formalized through new national legislation requiring

regional "growth agreements" for defining 3-year economic development strategies to be drawn up at the county level. These developments correspond to a growing regionalization of industrial and innovation policy in Sweden, involving a devolution of certain formerly national responsibilities to the county level—and, at the same time, a consolidation at this level of decision-making processes that were formerly based primarily at the municipal level. One of the primary mechanisms for implementing this new policy regime has been the recent institution of "growth agreements" for defining 3-year economic development strategies at the county level (Niklasson *et al.*, 2004, quoted in Hommen, 2004). The partners involved in these agreements include municipalities, industry and business associations, labour organizations, and providers of higher education (e.g. universities) based within the county. In the case of East Gothia, for example, educational and labour market policies are now overseen by a competence council (Kompetensra˚det) that includes among its member organizations not only Linko¨ping University but also the County Labour Board, the County Management Board, and the County Federation of Municipalities, as well as the East Sweden Chamber of Commerce, the Federation of Private Enterprises in East Gothia, and regional branches of the three major labour organizations (trade union centrals) in Sweden (Abbes, 2001, quoted in Hommen, 2004). Tables 2 and 3 summarize and confront the RISs of the five regions under consideration.

Comparing the Five RISs

Given the two dimensions of governance of innovation support and business innovation and the analysis of each regional system offered earlier, the comparative analysis can be based on two important issues. On the one hand, we can compare the five RISs and appraise the type of governance systems and the position of firms in the regional economy both towards each other and in relation to other actors. On the other hand, this comparative exercise is also informative offering an opportunity to analyse the changes that have occurred to the RISs examined.

Firstly, some clear distinctions between the five regions emerge. The RIS of Wales is one characterized by *dirigiste* governance system and a globalized business innovation, where initiation has been typically a product of central government policies and research infrastructure playing a marginal role in the emergence of the ICT clusters. The Scotland system to a lesser extent can be seen as a *dirigiste* system where the government plays a key role in supporting innovation within the economy; RIS Scotland is also characterized by interactivity, where a combination of indigenous and foreign firms and public and private research infrastructure are interacting to promote and develop Scotland's position as a science-based economy.

The Cambridge Innovation System captures most of the features of the interactive RIS, in which innovation and research competence are mixed and structured in a networked innovation architecture (network RIS), with a good representation between associativeness in business, labour and entrepreneurial culture. Cambridge is also interesting for its indigenous public innovation institutions and its cluster building and strong networking oriented policies.

The Swedish cases of Mja¨rdevi and Kista draw attention in different ways to a more general pattern in Sweden of state-led local economic development. In Sweden, the role of the central state is not simply limited to social and educational policies, but also extends to economic development policy, including development initiatives at the local

Table 2. Typology of regional innovation support systems in regions under-investigation

	Grassroots	Network East Anglia, Stockholm & East Gothia	Dirigiste Wales and Scotland
Initiation	Local	Multi-level - in the three cases universities, regional authorities and firms have played an important role in starting and contributing to the success of the regions	Central government - in both Wales and Scotland the key initiators are the local government, the Welsh Assembly Government and WDA for Wales and the Scottish Enterprise for Scotland
Funding	Local agencies	Diverse - the three cases shows a mixture of different sources to finance innovation such as firms, venture capitalists, governments and banks	National agencies - firms and new source of funding are almost absent; funding is provided mainly by public agencies
Research & support	Applied/ near to market	Mixed - both pure and applied research is undertaken	Basic - research is often incentive-based and state-driven
Specialisation	Low	Mixed - different sectors are present such as ICT, electronics, software, biotech and medical	High - Wales high reliance on ICT manufacturing
Coordination	Low	Potentially high - the regions represented higher coordination, e.g. triple helix initiatives	Potentially high but often low - the Welsh region shows a varying degree of coordination among the different actors although a number of associations, fora and the like are presents (e.g. Wales); Scotland on the contrary is experiencing an increase in coordination thanks to the set up of the ITIs

or at the regional levels. This pattern is more pronounced in "outlying" regions, such as East Gothia. Thus, Saab's location in Linko¨ping, as well as the creation of Linko¨ping University, was decided by the Swedish central government. More recently, a lot of local agencies that support ICT industry in places like Mja¨rdevi—for example the Technology Bridging Foundation—have been established as local branches of national organizations supported by central government funding.

In the Stockholm case, however, the high-tech complexes are an illustrative example of a globalized RIS with a networked innovation architecture, with firms that have displayed rapid and high rates of growth influencing local supply industries. The development of Kista as a local growth pole has benefited to a great extent from economies of urbanization associated with location in a large capital city. Hence, the central state and lower levels of

Table 3. Typology of business innovation in regions under-investigation

	Localist	Interactive East Anglia, East Gothia, Scotland	Globalised Wales & Stockholm (before ICT downturn)
Domination by large enterprises	Few or no-large indigenous firms	Balance between large and small firms	Large global corporations
		- East Anlgia, East Gothia and Scotland present a balance of large and small firms in ICT sectors, both indigenous and FDI in origin	- for both Wales and Stockholm big firms have played an important role, foreign and indigenous, respectively. However, the recent ICT downturn has reduced the system dependence by Ericsson becoming more of an interactive itself
Research reach	Few public and private organizations	Mixed public and private	Internal and private
		- East Anglia, East Gothia and Scotland show a number of indigenous public innovation institutions and strong private ones; although Scotland is still predominated by public ones	- its largely internal and more privatistic, although a more public innovation infrastructure has developed in recent years
Associationalism	Potentially high	High - the degree of associationalism is relatively high in the regions represented by the number of initiatives that resembles triple helix networks	High/low - the level of associativiness depends on key players and it is relatively low in Wales and higher in Stockholm

government have played a less prominent "leading" role than in Linko¨ping/Mja¨rdevi. They are nevertheless certainly involved in a "supporting" role, especially in the current development of Kista Science Park, where they figure as important actors.

However, it is also true that changes have taken place in the past few years. As explained, Wales, as a reconversion economy, was learning how to network and build clusters, and focussed its effort in attracting inward investors. As hinted, Wales suffered major reverses with the slimming down of Asian transplants, and the new devolved Welsh Assembly government is increasingly becoming engaged in *neo-dirigisme* but without the advantage of guiding vision or informed leadership.

The East Gothia innovation system has also experienced some changes. As argued, the state played a key role in the establishment of the Mja¨rdevi Science Park. However, as for the Kista area, the Mja¨rdevi Science Park was created through a coalition of the local state, the local university, and leading private sector firms. The national government clearly

affected the growth of Linko¨ping through its planning policies, particularly in the establishment of Saab, specializing in defence aerospace, and Linko¨ping University; the development of the contemporary growth pole was more linked to local government action. The local state, through the Office of Trade and Industry, clearly led the initiative to found Mja¨rdevi, but found willing partners in Linko¨ping University and Ericsson. East Gothia RIS is becoming more of a "network" RIS, where institutional support has encompassed local, regional, national and supranational levels, funding is guided by agreements among banks, government agencies and firms, and research competences are usually mixed, reflecting an even balance between basic and applied research, and between large and small firm needs.

The regional system of innovation of Stockholm has also undergone several changes. As highlighted, the ICT bust has forced firms to move out from Kista and to change their specializations strategy. The outcome has been one of increased entrepreneurship-base, interactivity and collective learning. Skilled workers moved into temporary organizations, creating project teams and the support mechanism has provided a framework for a formalized innovation system, such as the Kista Innovation and Growth (Asheim *et al.*, 2003) (see Figure 3).

As the case studies show, the different systems of innovation influence several features of the labour market. From the discussion presented earlier, the network relationships among firms and the broader institutional setting that support firms' innovative activities affects the way knowledge flows as labour mobility, access to skills and knowledge become central in the competitive strategy of regions. Local and regional authorities and quasi-public sector bodies in both countries are responding to the new demand placed on them to play a leading role in economic and social development, assisting employment creation, developing a culture of collaboration and encouraging greater partnership to foster entrepreneurship, learning and innovation.

In the two Swedish regions where, as shown, universities play a key role in innovation, universities are fully engaged in the promotion and development of university– industry collaboration and the proliferation of science parks is aimed at facilitating knowledge transfer. Proximity, as well as sectoral and technological concentration, has positively affected entrepreneurship and skilled workers have the tendency to move into temporary organizations, creating project teams enhancing interactivity, collective learning and new firm formation.

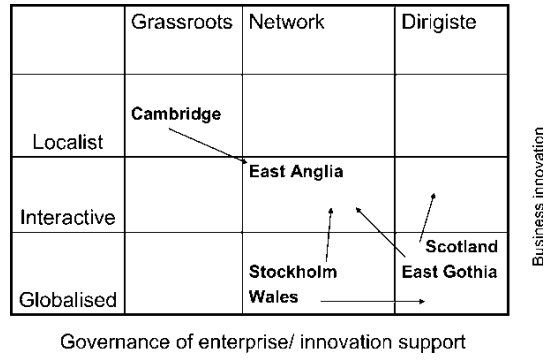

Figure 3. The typology and evolution of the RISs discussed

The other three case studies, Scotland, East Anglia and Wales, show how the new agenda of devolution has provided the ground for the enforcement and the establishment of development agencies that have among their remit the promotion of entrepreneurship, clustering and talent formation through associative mechanisms. Hence, the UK government encourages networking and cooperation as key drivers in innovation and knowledge transfer. As highlighted, the outcomes are different for the regions under consideration. Scotland's RIS reveals how important is the provision of a healthy supply of higher level skills at the centre of the region's economic development and efforts are in place in order to sustain the supply of higher skills to meet the future needs of the economy in the region. East Anglia, however, benefits from an active business sector and strong universities that foster entrepreneurship and talent formation. The RIS that emerges is one that nurtures high qualified scientist and engineers, the existence of considerable localized flows of research and local mobility of the highly skilled, increasing the flow of ideas and economic growth (cf. Lawton Smith & Waters, 2005). Regional partnerships, as shown, are also in place to develop and maintain a healthy regional labour market which is regarded as a key aspect of the region's success. In conclusion, the Wales RIS shows how the state-centric approach to innovation coupled with the relative immaturity of a critical mass of firms serving similar markets and creating employment opportunities for staff in other firms are hampering labour mobility and knowledge flows. The instruments put in place to foster entrepreneurship, academia and businesses collaboration have yet to produce the entrepreneurship-driven renewal of the RIS in Wales.

Concluding Remarks

This paper has sought to highlight variations among the regional economies under study. Firstly, we could argue that local urban regimes were established around the issues of growth in the ICT and science sector in many of our case studies. They show how a constellation of forces came together to promote growth through strategic use of resources and decision-making. Some of the cases under investigation, such as East Anglia, Stockholm and Sweden, showed how strong university involvement and an active business sector matched local, regional, and national government efforts. Wales and Scotland, however, relied more on public support to promote systemic innovation. Although the coalitions varied from case to case, all cases show how processes of learning and knowledge transfers occur. Knowledge become embodied within the local arena, the mobility of workers within different type of institutions allows knowledge to flow. Universities become key actors in this process of mobility and transfer, moving from a strict role of provider of skills; the case studies show how universities are now becoming more engaged in supporting innovation and leading local policies towards a more entrepreneurial approach providing a more sophisticated environment for mobile capital to maximize local value added. Other local players, the local innovation culture and the institutional context also become important in fostering knowledge. Regional authorities play an important role in providing the adequate infrastructure that can nurture networking propensity and augment the inter-linkages between all local, regional and global actors. However, as the case of Wales informs us, an innovation system heavily based on public knowledge generation and exploitation become more rigid and less adaptable to changes hindering systemic interaction and innovation within the region. As the case studies show, RISs evolve and regions become increasingly developmental knowledge laboratories.

The paper also argued that although the region is becoming increasingly the level at which strategic innovation support is appropriate, there will also be different national components that influence a region's capacity for transformation. The "Varieties of Capitalism" framework was suggested in order to understand some of the differences that the regions in the two countries, UK and Sweden, have experienced in their innovation trajectories. On the one hand it can be argued that within the two Swedish case studies, the national state played a key role in the formation and the success of their RISs. As argued, Sweden as a coordinated market economy has shown a natural bent to coordination and this facilitated networking and collaborative partnership among key actors. On the other hand, to some extent, in the UK the state has not played a key role in promoting interactive innovation and the market has been the dominant force, as the case of Cambridge and its science park showed. However, despite the liberal market nature of the UK, Wales and Scotland have developed over a quarter of century strong regional agencies, aimed at developing the regional economy and they are the main vehicles for managing policies in support of innovation and coping with the demands of the knowledge economy. Both are quite hierarchical, technocratic bodies but Scotland's agency has embraced knowledge economy principles closely while Wales is more wedded to a "public enterprise" mode of top-down stimulation of entrepreneurship and innovation, especially since FDI is no longer as prominent as it was as a source of new knowledge.

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Notes

1. Region can be defined as a meso-level political unit set between the national or the federal and local levels of government that might have some cultural or historical homogeneity but which at least has some statutory powers to intervene and support economic development, particularly innovation.
2. However, Sweden in recent years has moved to a lower coordination, with a more decentralized wage-bargaining to sectoral-level. This change was largely driven by employers, who were responding to the increasing attraction of firm-level bargaining due to technological change in the production process (Culpepper, 2004).
3. Sony, for instance, developed 25 regional suppliers in south Wales, from a total of 300 in the EU.
4. The unravelling occurs when, for instance, a firm like Hitachi, or Aiwa with its local suppliers association shared partly with its parent Sony, disappears. It impacts when a firm such as LG (now LG-Philips) that set up with fanfares and research grants for university academics retrenches and, in crisis, is forced by the South Korean government to sell its undeveloped, last generation semiconductor production and R&D facility to its rival Hyundai, who then sells it back to the WDA who built it in the first place. It occurs when Corus shuts down its 200-person materials research laboratory, as happened in 2001 (Cooke, 2004).
5. The East of England Framework for Regional Employment and Skill Action (FRESA) is the dedicated framework for the East Anglia Region. FRESAs were commissioned by the Government in 2001. They are plans, developed and led by regional development agencies (RDAs) and their partners, to tackle the skills and employment needs of regional economies.

6. The key champions for the development of Kista Science City (formerly Kista Science Park) as an ICT cluster were the national state, local state, Ericsson and its component companies, Asea (now ABB), IBM and the Royal Institute of Technology (KTH).
7. Kista specialization into third generation mobile phones were offset. This hit the major strategy of the core corporate players in Kista, who started to scale down and move out. The extremely focused strategy of the cluster of the 1990s, expressed in slogans like "WAP centre of the Wireless Valley" disappeared.

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