The Changing Face of Innovation Policy: Implications for the Northern Ireland Economy

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1. Introduction

Innovation is central to ensuring economic growth and improvements in social welfare. The pressures for economies to innovate have increased in response to global changes in the division of labour and increased international competition. In the UK, these pressures have been reinforced by the recent economic crisis – as innovation is seen as essential to ensuring long-term recovery, job generation and the rebalancing of the economy (Martin, 2010; NESTA, 2010).

The challenge for regional economies, such as in Northern Ireland, is to ensure that innovation policy is appropriate to the structure and competitive strengths of the local economy. A major limitation of many innovation policy initiatives is that they are still focussed on the needs of high technology manufacturing - with a particular focus on technology transfer and policies to increase research and development (R&D). It is important to recognise the importance of fostering wider innovation: this includes innovation, in products, processes and practices; and innovation in all parts of the economy – including the service sector. One of the central features of successful wider innovation is collaboration by all actors in the innovation system promoting effective knowledge exchange.

This report considers how wider innovation can be fostered in the Northern Ireland economy. This is based on an analysis of innovation performance in the European Union and an in-depth analysis of innovation policies in five regions (in addition to Northern Ireland) within the EU. The report emphasises the need to build collaborative structures that encourage knowledge exchange and promote open innovation. Such structures are currently in their embryonic phase in Northern Ireland – and their further development and expansion should help promote innovation and economic growth.

This report is organised as follows. Section 2 considers alternative approaches to innovation policy – including the recent, and growing, emphasis on wider innovation and the importance of knowledge exchange. Section 3 considers the empirical evidence of variations in innovation performance in the EU regions. Section 4 considers the lessons of an in-depth analysis of

innovation policies in 5 benchmark regions in the EU. Section 5 considers the implications of the study for innovation policy in Northern Ireland.

2. Alternative approaches to innovation policy

2.1 The importance of innovation

At its basic and fundamental level, innovation is 'the successful exploitation of new ideas' (DIUS, 2008, p.12). At a more detailed level it is important to recognize that innovation can vary in terms of products, services, processes and business practices – and that it can take place in the private, public and third sectors.

Innovation is considered one of the main drivers of economic growth. According to the modern Treasury view it is one of the five main drivers, the others being investment, enterprise, skills and competition (HM Treasury, 2000; 2001). Although intuitively appealing, the drivers approach has a number of limitations when applied at the sub-national or regional levels. First, it is implicitly assumed that drivers are equally important in all areas, whereas local economic structures and local development paths will have a major impact on the role and impact of individual drivers. Thus 'innovation' policies may have different impacts in different locations. Second, the appropriate spatial scale of intervention may vary across locations. Therefore, processes of regional competitive advantage may be highly localised, while others may operate at different geographical scales, with some being national or global (Kitson et al, 2004). The limitations of simply applying the drivers approach to Northern Ireland have been highlighted by the Independent Review of Economic Policy (IREP) which has argued that the drivers: 'fail to sufficiently prioritise exports and inward investment as the key drivers at the regional level to grow the economy' (IREP, 2009, p.7) and that it is 'important to acknowledge the role of the public sector as a driver of regional economic growth in NI' (IREP, 2009, p.32). In terms of innovation policy it is, therefore, important to consider the economic, social and institutional context in Northern Ireland, particularly when considering whether initiatives or policies implemented elsewhere would be appropriate for the Northern Ireland economy.

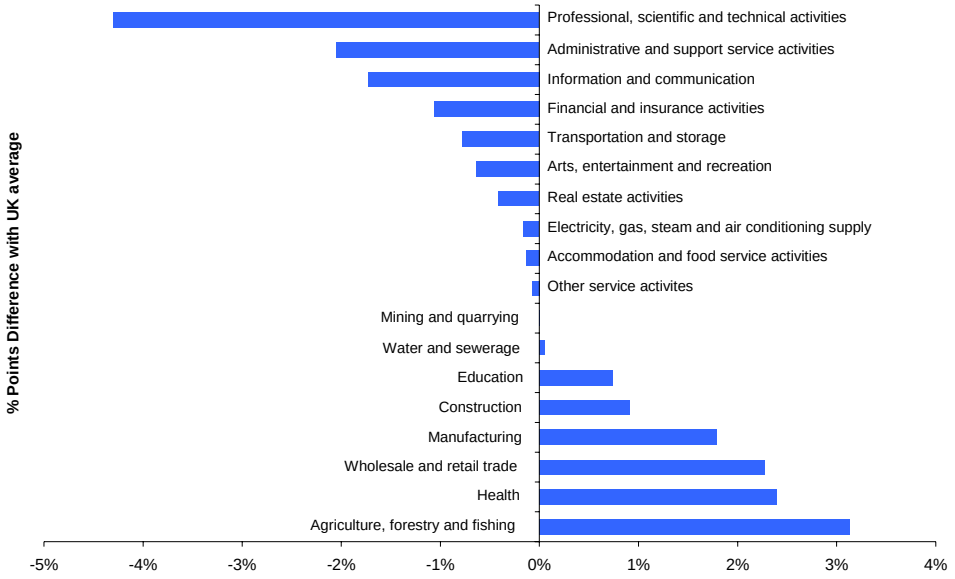
The types of support for innovation in advanced economies have evolved as these economies have grown and restructured. In particular, the relative decline of manufacturing and the growth of knowledge-based services has led to a reassessment of innovation policy and instruments.

2.2 Mode 1 Innovation Policy

Much of the recent and current focus of innovation policy reflects the needs of manufacturing. There is a focus on support for R&D and on mechanisms to support technology transfer from the science base. Furthermore, policy has tended to focus on the production of technologies (such as information technology) rather than the diffusion of such technologies to other sectors of the economy. Although these are important components of an innovation strategy, they do not support much of the 'hidden innovation' in the economy (NESTA, 2007).

There has been significant restructuring in all advanced economies since the early 1960s, with the growth of services and a shift away from low value-added manufacturing. But the UK has moved to a more services-based economy more quickly than most of its competitors. More than 75 per cent of the UK economy is based on a diverse range of services including retailing, financial services, insurance, business services, leisure and tourism (Abreu et al, 2008). Although services are important in the Northern Ireland economy, many sectors are relatively smaller than in the UK as a whole (see Figure 1) – for instance, business services, other personal services and the finance sector (IREP, 2009).

Figure 1: Industrial Structure 2010 (Relative to UK)



Source: DETI

Note: Employment is used as the measure of industrial structure

Services need to play a major role in closing NI's overall productivity gap with rest of the UK. The size of NI's services sectors means increasing their performance is necessary to close this gap. Improving the performance of services firms would raise NI's aggregate productivity, but also, given their role, their improved performance would lead to increased productivity in other firms and sectors.

2.2.1 The focus on R&D

In the UK, and the rest of the EU, there has been a focus on the notion that innovation can be increased through policies to encourage R&D. The underlying assumption is that private sector businesses do not do enough R&D because they do not capture all the benefits from doing it – simply because other businesses can copy what they do. Thus, polices such as R&D tax credits are assumed to encourage more innovation and economic growth. The case for policy support of R&D rests on two assumptions. First, that R&D is a good indicator of knowledge generation by firms. Second, that such knowledge generates spillovers to other firms and parts of the economy. There are some empirical studies that rely on standard techniques that suggest that there are

positive spillover effects of R&D - although this is not a universal conclusion and some recent studies do not indentify positive spillovers (Haskell and Wallis, 2010). Furthermore, many parts of the economy that innovate often do so without spending on R&D – especially in parts of the service sector (Abreu et al, 2008).

2.2.2 The focus on high technology manufacturing

R&D is important in the high technology manufacturing sector - but it is important to note that high technology manufacturing is a small part of most advanced economies (including the UK). According to the Sainsbury Review, high-value 'knowledge-based services' generate more than five times as much for the UK economy as generated by advanced manufacturing (Sainsbury, 2007). Furthermore, much of the UK economy consists of traditional sectors – such as conventional manufacturing and conventional services. It should be emphasised that there is significant potential for innovation in these sectors and because of their significant size they can make an important contribution to overall productivity growth. For instance, the three sectors that contributed the most to the productivity surge in the USA during the 1990s were (in order), wholesale trade, retail trade, and security and commodity brokers (Solow, 2001). All three are service sectors, and the first two are conventional services. The key to the productivity growth in these sectors was the use of technology, such as ICT, to improve process innovation and business practices.

2.2.3 The role of universities and technology transfer

There is increasing pressure from governments on universities to engage more actively with the business sector (see Lambert, 2003). In particular, it has been argued that increased and improved technology transfer from the science base will increase innovation and economic growth (see Kitson et al, 2009). Popular examples, which have been frequently cited as exemplars include: Cambridge University in the UK; Stanford University and the 'Silicon Valley' phenomenon in the US; and Massachusetts Institute of Technology (MIT) and the other Boston universities' contributions towards the economic dynamism of Route 128 in the US. The focus on technology transfer – through such mechanisms as patents, licenses and spin-outs – has been at the centre of the policy debate. These are, however, only some of the range of mechanisms through which universities can influence innovation and business performance (see below).

2.3 Mode 2 Innovation policy

The limitations of mode 1 innovation policy have recently led to a wider and more holistic approach to innovation policy (BIS, 2010a). Increasingly it has been recognized that innovation takes place within a 'system' with multiple players, multiple actors and multiple interactions. Furthermore, such systems vary according to regional and local characteristics – including local economic structure and local economic history.

2.3.1 Location and the role of clusters

At the regional level there has been a focus on 'clusters' often associated with work of Michael Porter (and with the earlier work of Marshall). The cluster concept suggests that regional competitive advantage is primarily based on the dynamics of geographically localised activities encompassing local competition, factor input conditions, local customers, and locally-based suppliers and supporting institutions. One of the most important factors that determine regional competitiveness is the degree of effective collaboration and the existence of facilitative social networks and institutional structures.

The strength of the clusters approach is that it stresses the importance of collaboration, trust and networks. Where the cluster approach is weaker is that it is often assumed that clusters (or policies to foster cluster development and growth) are similar in different places – places that have different histories, structures and institutions. As Martin and Sunley (2003, p.28) argue: 'there are now so many different varieties of clusters and so many confusing claims about their theoretical basis, form, identification and significance that the concept is peculiarly elusive and hard to pin down'. Second, the approach tends to stress 'local' collaborations – whereas, in a globalised knowledge economy, it is important to consider the importance and impact of collaboration across multiple geographies (from very local to global). Third, the approach tends to lack specificity about how to build or sustain appropriate and effective collaborative structures.

2.3.2 The shift to open innovation

A recent development in the corporate world and in the policy domain has been the recognition that much innovation involves multiple interactions between different research teams and corporate entities and is not developed by a single research team or a corporate laboratory

(Chesbrough, 2003). For the vast majority of sectors and technologies, most researchers and specialists do not work within one company - indicating that expertise is widely spread. Thus, tapping into the research being conducted outside the company - or outside the region or locality - is vital for both corporate performance and economic growth. The open innovation model emphasizes the importance of letting ideas both flow both into and out of the business – and similar flow processes are important for regional growth. A variant of the open innovation model emphasizes the importance of customers as facilitating user-led innovation (von Hippel, 1988, 2005).

The recent emphasis on open and user-led innovation provides important insights, but a number of issues should be highlighted regarding the implications for policy. First, accessing external knowledge may be difficult and costly - particularly for SMEs - often because of a lack of information about who to collaborate with and how to do it. Second, accessing external knowledge needs to be combined with the internal capacity to absorb, assimilate and exploit such knowledge.

The emphasis on open innovation has a variety of complex spatial implications. Globalisation and developments in information technology indicate the importance of accessing ideas and expertise on an international scale. Conversely, the importance of tacit knowledge and human interaction stresses the importance of proximity and local networks to encourage and foster knowledge exchange and promote economic dynamism and innovation.

2.3.3 Triple Helix: universities and knowledge exchange

Universities are especially important to local economies because of their stability – put simply, they do not move. The impact of globalisation and the response to economic shocks, such as the current recession, often results in the movement of key economic actors – as workers and businesses relocate. This can place a major strain on local economies – and major economic actors that do not move, such as universities, can act as both as important ‘shock absorbers’ and as a stimulus to long-term growth.

Universities are powerful economic actors with important roles in the innovation ecosystem (Kitson et al, 2009). First, they are a source of ideas and technologies – many of which can be exploited for economic and social benefit. Second, universities act as significant employers and purchasers in many local economies. Third, they produce a skilled workforce that is often a crucial resource for local businesses. Fourth, they provide a locus for coordinating local activity, benefiting local firms both through the informal exchange of knowledge and expertise, and by offering an anchor around which regional clusters can form. Effective collaboration between businesses and universities is associated with improved business performance, including new market entrance and increased market share; production of an increased range of goods or services; producing higher quality goods or services; and generating higher value added (Kitson et al, 2009). Those collaborative structures that include business, universities and the policy community are frequently termed as' triple helix' models (Etzkowitz, 2002).

Much of the collaboration between universities and businesses has focused on technology transfer from the science base - frequently focusing on patents, licenses and spin-outs. There are three significant limitations to the notion of 'technology transfer'. First, university engagement with businesses includes a wide range of mechanisms including: problem-solving such as contract and cooperative research; and public space functions such as informal social interactions, meetings and conferences (Lester, 2005a, 2005b; and Lester and Piore, 2004). Second, engagement between universities and business is not solely limited but also encompasses other forms of knowledge from disciplines such as the social sciences and the humanities (Abreu et al, 2009). Third, engagement between universities and business is best considered as 'exchange' rather than 'transfer'. Knowledge transfer implies a linear process, from the university researcher to the corporate sector. This oversimplifies many of the relationships between academia and the business sectors - which are characterized by continual interactions, feedback loops, and the co-production of knowledge.

2.3.4 The need for 'boundary spanners'

There are a number of factors that constrain or limit interactions between universities and businesses. Commonly cited constraints include cultural differences (academia is 'different' to business) and conflict over intellectual property (IP) issues. Empirical evidence, however,

shows that the notion of cultural differences is vastly exaggerated and IP issues tends to be confined to a narrow range of interactions concerning technology transfer. Conversely, the evidence shows that the major constraints are a lack of information on how to engage and a lack of resources to initiate and manage interactions – and these constraints are most acute for SMEs (Abreu et al, 2009). To overcome these constraints, it is important to develop 'boundary spanners' – collaborative structures, organizations or individuals that can act as bridge between academia and business –and who can manage relationships for the interests for both parties. Such boundary spanning initiatives should reflect the structure, needs and objectives of individual local economies.

2.4 The future: Mode 3 innovation policy?

Recent developments have led to significant shifts in innovation policy. There are also new areas that innovation policy is starting to embrace. First, a new and recent focus on innovation in the public and third sectors. The public sector is major consumer in the macroeconomy and its purchasing strategy can have major impact on the innovative activities of its suppliers. Furthermore, innovation can improve the production, delivery and reduce the cost of public services. The third sector - which encompasses charities, social enterprises and other not for profit organizations - is now considered as an important supplier of community services (as suggested by the notion of the 'big society') although how innovation takes place in the sector has not been fully researched.

Other factors which are increasingly important in understanding and developing local innovation systems include social capital and the development of a creative and innovative environment. Social capital encompasses issues such as trust, civic engagement and networks. Evidence suggests that knowledge is more effectively exchanged in areas with high levels of social capital (Iyer et al, 2005). In terms of creativity is important to create a social and physical environment that both retains and attracts creative people. Such 'talent' magnets not only have high levels of social capital but also have effective physical infrastructures and a buoyant cultural environment. Such places have a 'buzz' which can contribute to a dynamic innovative environment – generating a virtuous cycle of growth as a creative environment will attract more creative people. A final factor to consider is that the main current focus of innovation policy has been directed at

improving economic performance – with metrics such as increases in economic growth or productivity. An alternative is to focus on the impact that innovation may have on well-being and the quality of life. This would require innovation policy to put greater emphasis on such factors as working conditions, the transport system, the quality of the built environment and the environment.

2.5 Summary and implications for policy

Regional and local economies are increasingly being influenced by global forces - as shown by the impact of the financial crisis and the rise of newly industrialised nations. Although these shifts are global, many of the most important responses to such shifts will be local or regional. For advanced regions such as Northern Ireland, future prosperity will depend on the further development of its knowledge-based economy – and this does not refer exclusively to high technology sectors – as the use of knowledge and improvements in innovation are important for **all** sectors of the economy. The analysis discussed below shows that although innovation policy in many regions in the EU (such as in NI) is rooted in a Mode 1 policy framework; other regions (such as North Brabant (The Netherlands), Etelä-Suomi (S. Finland) and Västsverige (Western Sweden)) have shifted to a Mode 2 framework. And in some cases (such as North Brabant) there are some indications of a movement towards a Mode 3 framework – with an increasing focus on social capital trust and creating innovative spaces. Knowledge-based growth requires innovation and the development of skills, networks and the use of local assets (such as universities). And this requires a high degree of local connectivity - as ideas are most effectively exchanged and exploited through people communicating with one another - most knowledge is 'tacit' and is held by people and is not 'codified'.

The types of initiatives that would benefit from this approach would be the development of 'innovation communities' which would build and help to maintain networks to promote collaboration and knowledge exchange between businesses, universities and other actors (including from the public and third sectors). Innovation communities require people with specialist skills and knowledge to help foster collaboration between partners with different motives and competences. Such skills may require 'T-shaped' individuals – skilled workers who

have in-depth industrial or technological expertise but also have a wide range of business skills that enable them to connect with both the business community and with academia (CIHE, 2010).

3. Innovation performance in the EU 27[1] regions

This section provides an overview of innovation performance in the EU regions. It also explains the rationale of the choice of case study regions which are subsequently analysed in depth.

3.1 An overview of EU regional differences in innovation performance

The most comprehensive empirical evidence on EU regional innovation performance is provided by the Regional Innovation Scoreboard (RIS), compiled under the EU Policy initiative (Hollander et al, 2009). The RIS systematically monitors EU regional differences in innovation performance, by evaluating a variety of indicators, including patents and R&D expenditures (see Hollander et al, 2009). More specifically, it includes – amongst others, indicators on:

- Human resources in science and technology (% of population)
- Participation in life-long learning (% of 25-64 years age class)
- Employment in medium-high and high-tech manufacturing (% of total workforce)
- Employment in high-tech services (% of total workforce)
- Public R&D expenditure (% of GDP)
- Business R&D expenditure (% of GDP)
- EPO patent applications (per million population)

The RIS, when measuring innovation performance, focuses on human capital indicators and R&D expenditures as well as on traditional innovation outputs such as patents. The range of information provided is very rich and – most usefully – comprehensive and comparable across EU regions.

[1] Nomenclature of Territorial Units for Statistics (NUTS) is the standard EUROSTAT classification of territorial units: NUTS 1 are based on countries' boundaries; NUTS 2 are based on regional boundaries and it is the level of analysis considered in this study.

A further important source of information on innovation performance – both in terms of input and outputs – is the European Community Innovation Survey (CIS). This is compiled across Europe by national statistical offices and is in line with the guidelines on innovation provided by the Oslo Manual[2]. The CIS is based on various indicators of innovation activities related expenditures – such as extra- and intra-mural R&D; capital equipment, training, knowhow and the acquisition of external knowledge. Also, the traditional way of measuring innovation output performance - by patents and intellectual property rights (IPRs) - is strengthened by providing additional information on the number of firms successfully introducing a product, service and process innovation.

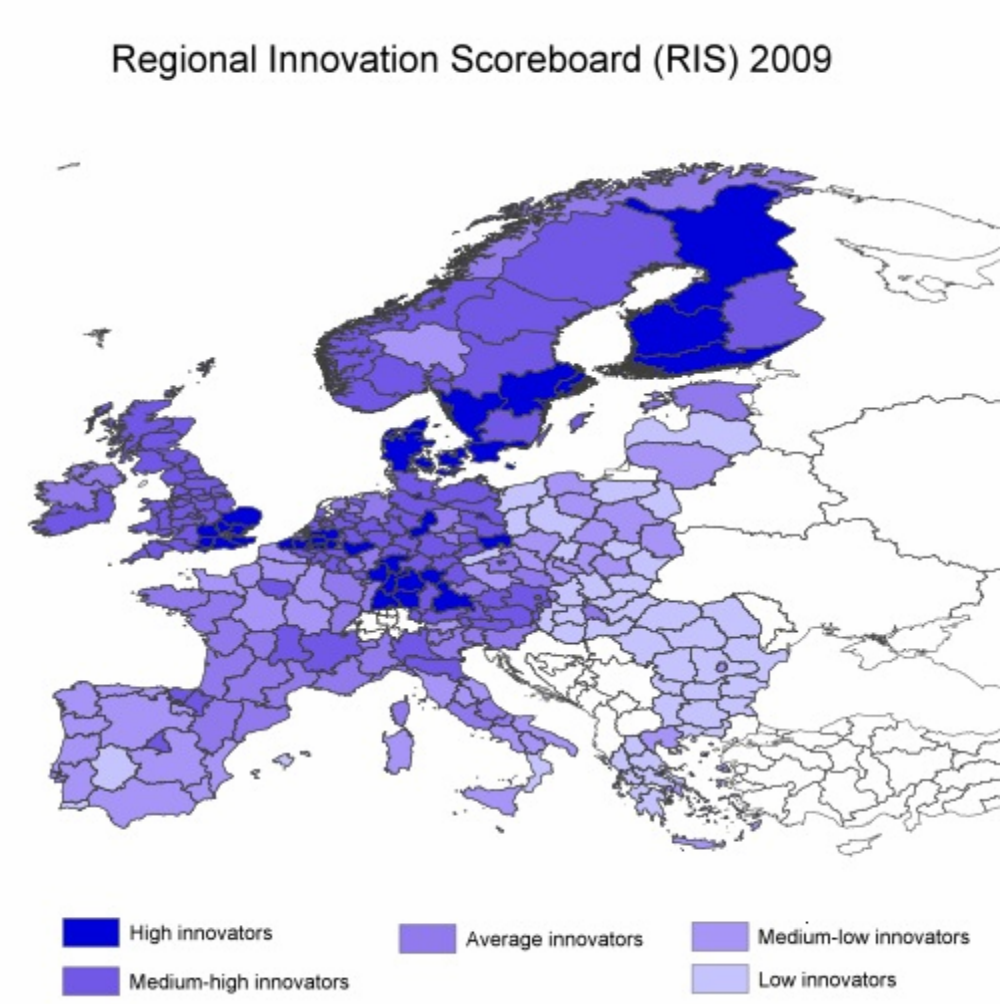
The CIS, however, does have some shortcomings with respect to regional comparability. In some cases, the CIS samples are not stratified across regions, casting doubt on the reliability of cross-regional evidence. Furthermore, CIS data is not comprehensive for the entire EU, making it difficult to undertake cross-country and cross-regional comparisons for the EU 27 level. For these reasons, we have mainly used the RIS data to provide an overall picture of EU27 regional differences in innovation performance, relying therefore on traditional indicators such as private and public expenditures on R&D, patents per million of population as well as a broader composite RIS indicator of overall regional innovation performance. We have provided a more in depth picture of the regional innovation differences based on the CIS for the UK.

To provide an overview of innovation performance we have produced maps based on data from RIS (Figures 2-5) which show a range of innovation indicators across the EU 27 regions. Figure 2, based on overall innovation performance (a combination of 16 innovation indicators), shows that high innovation regions are clustered in Finland, Sweden, Denmark, South England and Central Germany. Conversely, the low innovation regions (with the usual exception of capital cities) are clustered in Southern and Eastern Europe. It should be emphasised, however, that there is a high overall degree of heterogeneity across regions in terms of overall innovation performance. There is a general picture of a persistent north-south divide in Europe (see for instance Sterlacchini, 2008), as well of course a west-east divide after the less-innovative Eastern

[2] See OECD (2009) Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition

European regions joined the EU (see below and Verspagen, 2007 for an empirical assessment of the innovation divides at the level of EU27).[3]

Figure 2: Regional Innovation Scoreboard: High, Medium and Low innovative regions in EU27[4]

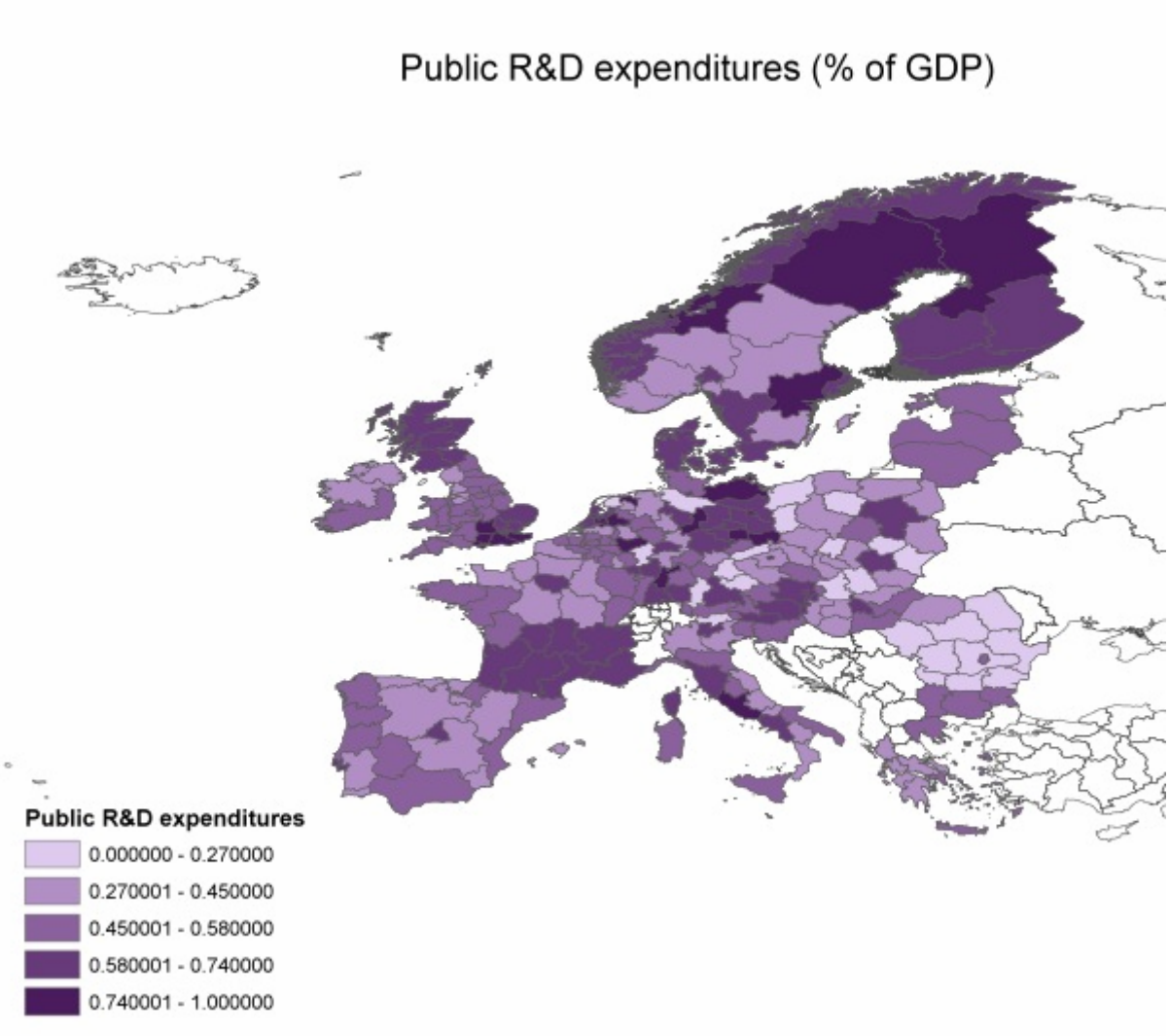


Source: RIS (2009)

[3] In this latter respect, CIS data covering new Eastern European countries are available, though there is still some doubts on whether they are reliable enough to allow cross-regional comparability (see for instance Stare (2005) and Stare and Rubalcaba (2009)).

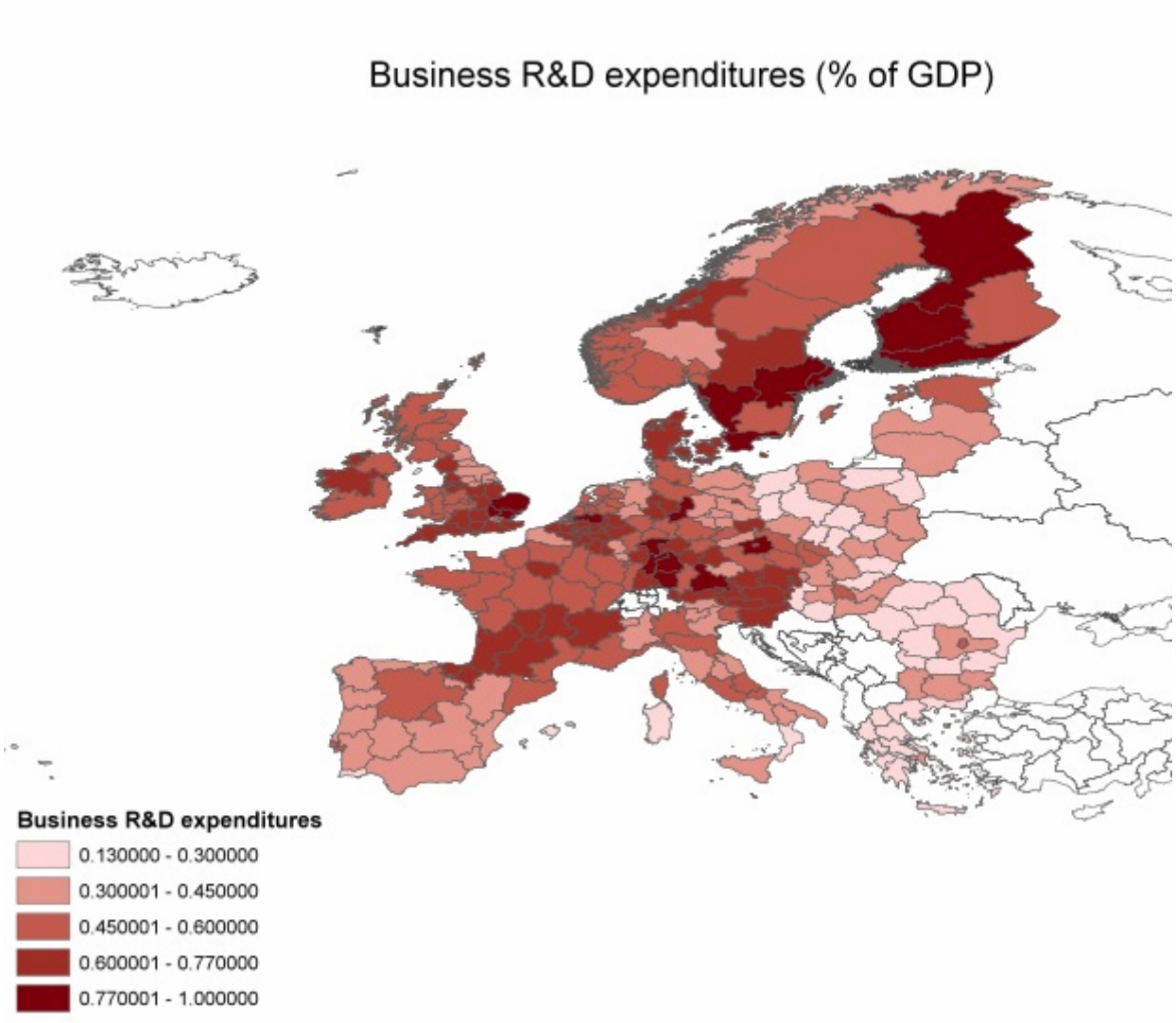
[4] The RIS Scoreboard combines 16 different indicators of innovation performance, for more details on the methodology behind the construction of the RIS composite indicator see Hollander et al. (2009).

Figure 3: Public expenditures in R&D in the EU27 Regions



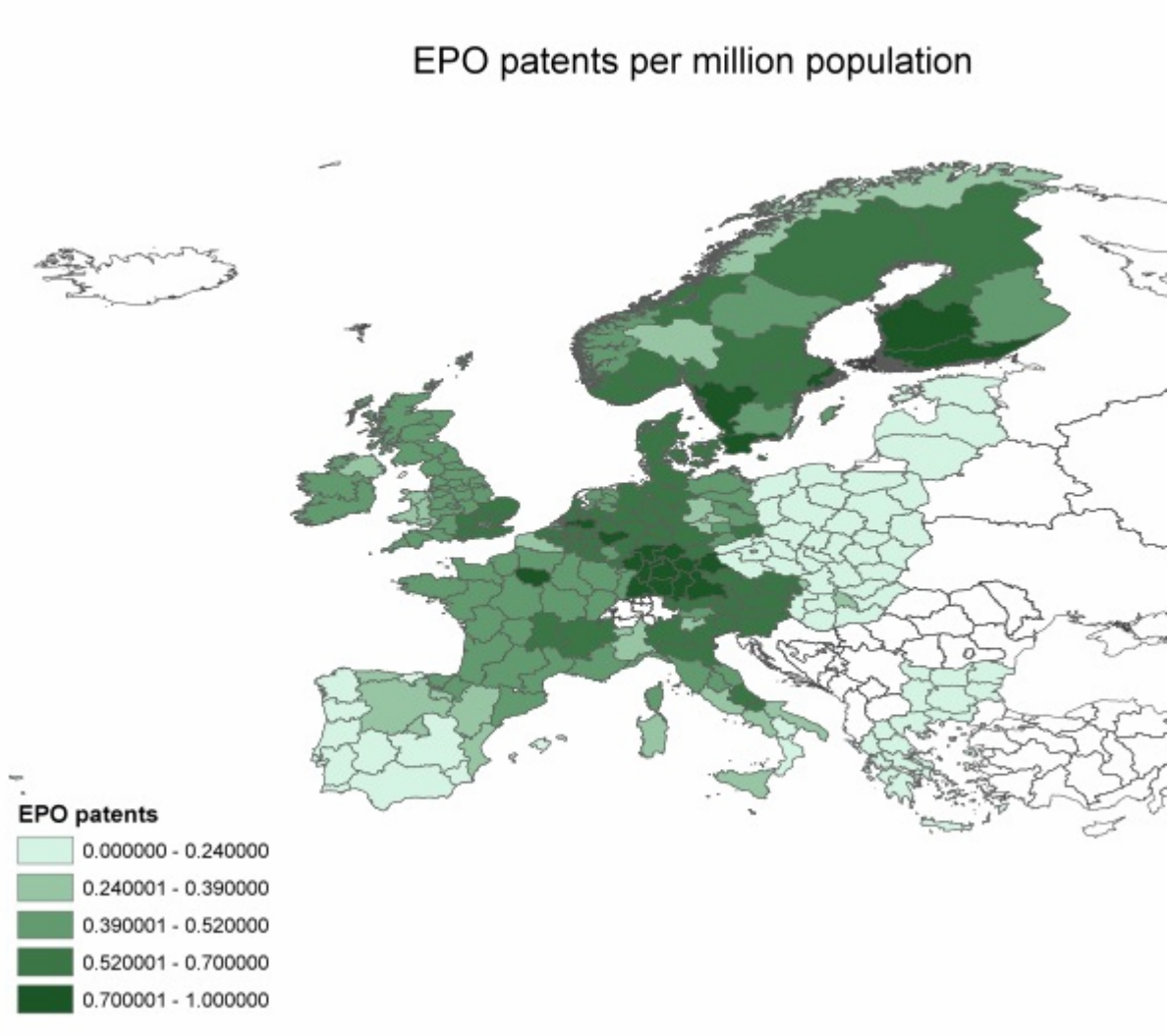
Source: RIS (2009)

Figure 4 – Private R&D expenditures in the EU27 Regions



Source: RIS (2009)

Figure 5: Innovation Output in the EU27 Regions: EPO patents per million population -



Source: European Patent Office (2009)

When we look at specific aspects of innovation performance, both in terms of inputs and outputs, the RIS data reveals a more nuanced concentration of regional innovation intensity. Figures 3 and 4 show the distribution of public and private R&D expenditures across the EU regions. This allows a more in depth examination into the determinants of innovation performance across Europe: business R&D expenditures are traditionally considered as innovation inputs whereas public expenditure devoted to R&D is also a traditional indicator of innovation policy.

The innovation picture based on individual innovation indicators is much more fragmented across regions than the summary data shown in Figure 2. Business and public R&D expenditures are both high in the south of France, in some regions across Eastern and central-eastern Europe and in western Ireland. This contrasts with the picture in Figure 5, which is one indicator of innovation outputs. This may suggest the presence of bottlenecks in these regions, which hamper the effective translation of innovative efforts – both public and private R&D – into successful innovative output performance. The data in Figure 5 are consistent with the picture Figure 2, with clear north-south and west-east divides.

We considered the empirical support and explanations for the regional differences across the EU27. Some contributions in the innovation literature have tried to identify whether European regions show marked differences in their innovation performance and growth potential (among others, Fagerberg and Verspagen, 1997; Bottazzi and Peri, 2003; Meliciani, 2006; Verspagen, 2007, Sterlacchini, 2008). These contributions also aim to provide empirical support to the rationale which has informed both the Lisbon Strategy for innovation and – more generally – the debate and policy practices of the European Structural Funds for economic and social cohesion, as applied at the NUTS 2 spatial level.

For instance, Sterlacchini (2008) looks at the link between regional differences in economic growth of the EU15 and the knowledge and human capital endowment of regions. Besides R&D, the share of adult population with tertiary education is included and is found to be an important explanatory factor of regional growth divergences. Interestingly, the author finds that while the educational variable is significant and largely responsible for regional growth differences, the

R&D investments exert a significant impact on regional growth only in those areas which have a certain threshold of GDP per capita. This seems to enforce the view that policies exclusively focused on enlarging the R&D base of regions do not necessarily allow backward regions to catch up. This applies especially in the case of the north-south divide, as the paper focuses on the EU15 only.

Verspagen (2007) provides one of the most comprehensive empirical analyses to explain regional 'hierarchies' of innovation performance in the EU27. Verspagen uses the REGIO EUROSTAT and EPO matched databases and takes into account various indicators – including the level of education, share of advanced services and manufacturing, GDP per capita, employment rate, population density – to construct three dimensions of innovation performance (which act as a counter factual to the picture provided by the RIS). Verspagen identifies three dimensions by which the EU regions are clustered[5]: relative backwardness, level of education and urban development.

Four clusters are identified, which are consistent with the data discussed above, and which confirm the presence of innovation (and economic) gaps across Europe. The first cluster includes Southern regions (29) scoring high in terms of relative backwardness and with low education levels - with the exceptions of the Barcelona and Madrid regions in Spain and the Lazio (Rome) region in Italy. The second cluster that is relatively backward includes many of the new member states (in Eastern European), which score high in terms of relative backwardness although slightly better than the previous cluster in terms of educational levels. This pattern is common to all Eastern European regions except the Prague region in Czech Republic and the Budapest region in Hungary. The remaining two clusters score high in terms of education and urban development and low in terms of relative backwardness. The third cluster is the largest (including 67 regions) – which includes most of central European, UK and Ireland. The final cluster includes 'a geographical sub-cluster of German-Dutch regions another sub-cluster of Danish and Swedish regions and a number of isolated highly urbanised regions such as Paris and London' (Verpagen, 2007, p. 21).

[5] Details on the methodology of Principal Component Analysis to identify the synthetic indicators and cluster analysis to identify the clusters of regions are provided in Verspagen (2007).

In order evaluate the relative position of Northern Ireland with respect to the other UK regions, Table 1 below, based on the data from the UK innovation Survey (2009) shows the spatial distribution of innovative firms. The overall indicator (an 'innovation active' firm) is defined as a business that has engaged in any of the following (BIS, 2010b, p.7):

- Introduction of a new or significantly improved product (good or service) or process for making or supplying them;
- Innovation projects not yet complete, or abandoned;
- Expenditure in areas such as internal research and development, training, acquisition of external knowledge or machinery and equipment linked to innovation activities.

This evidence complements the innovation inputs indicators focused on R&D expenditures, by providing an output based indicator of innovation (although it is limited to the UK due to data limitations).

Table 1: Innovative firms by region and type of innovative activity (%)

Type of activity	North West	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Wales	Scotland	Northern Ireland	North East
Innovation active	**56.3**	**60.7**	**55.5**	**58.7**	**59.1**	**55.8**	**63.3**	**57.8**	**58.6**	**54.8**	**54.8**	**59.5**
Product innovator	22.7	24.1	24.5	25.1	23.6	22.9	27.8	25.6	24.4	21.3	16.8	21.0
Process innovator	10.6	13.1	11.9	12.9	13.7	13.2	14.2	11.2	13.1	12.5	10.6	11.7
Abandoned innovation projects	2.5	2.8	3.2	2.9	4.5	5.2	4.0	3.1	3.3	2.5	2.7	3.1
On-going innovation projects	4.9	4.5	5.7	4.4	6.5	6.9	6.6	5.5	4.4	5.3	4.3	4.3
Activities related to innovation	53.0	57.1	50.0	55.5	57.3	53.5	59.9	52.6	55.6	53.1	53.2	56.0

Source: BIS (2010b)

Overall, the regions with the highest propensity of innovation active firms are the South East of England and Yorkshire and the Humber; and the regions with the lowest are Scotland and Northern Ireland. This ranking is partially driven by differences in industrial structure; and the picture is more complex if we distinguish between product and process innovation. Overall, the data in Table 1 suggests that Northern Ireland shows a slightly inferior level of overall innovation

compared to the rest of UK. Although Northern Ireland is one of the lowest ranked areas in terms of the share of innovation active firms – its share is only 3.4 percentage points below the UK average. Overall, the CIS data tends to provide a different picture compared with many other innovation indicators, such as those based on R&D, which suggest a much lower level of innovation in Northern Ireland compared to many other parts of the UK. In part, this can be explained by industrial structure - with Northern Ireland having a lower concentration of R&D-intensive sectors.

The evidence provided by the most recent data and the key findings in the innovation literature has informed the following analysis carried out in this study. In the next section we detail the empirical criteria according to which the benchmark regions are selected.

3.2 Rationale for choice of benchmark regions

This section summarises the methodology, analysis and findings, which have led to the identification of the benchmark regions, which form the basis for the in-depth case study analysis. The main initial criterion was the degree of similarity to Northern Ireland – in terms of industrial structure, economic and institutional characteristics as well as different profiles of innovation performance.

Following an analysis of the empirical evidence, we focused on the EU and excluded the US and other OECD countries. This choice was dictated by reasons of comparability and completeness of data series. Furthermore, most of the European regions are broadly similar in terms of size to the regions of the UK and Northern Ireland in particular.

We assembled a range of empirical evidence including data on industrial structure and innovation. The data - discussed in detail in section 3.2.1 - have been constructed from Cambridge Econometrics data (2006) and the Regional Innovation Scoreboard (2006) (note that comparable international CIS data is not available). Furthermore, data used for the Regional Competitiveness Index (RCI) were used as a robustness check.

Following the initial regional profiling, a second stage produced the final short-list of the benchmark regions in consultation with DETI. Sections 3.2.2 and 3.2.3 illustrate in detail the evidence on sectoral structure and innovation performance on the basis of the regional profiling exercise. This was followed by the final selection of the benchmark regions, which formed the basis for the in-depth case studies.

The third stage involved a more in depth analysis of the benchmark regions' characteristics, governance structure, innovation policy priorities, highlighted innovation initiatives and policy gaps based on in-depth interviews with policy makers, academics, and regional government agencies. The findings are discussed in detail in Section 4.

3.2.1 Methodology

The empirical methodology is based on a measure which gives a quantitative indication of the economic similarity of regions. The main indicator that is estimated is the Euclidean distance measure, combined with a Spearman rank correlation index as a robustness check.

The methodology consists of the following processes. First, we calculated the sectoral share of GVA (and employment) in total GVA (and employment) for each region using data from Cambridge Econometrics. We also calculated the sectoral share ranks in terms of GVA and employment. Second, we then calculated the 'distance' of each region from Northern Ireland in terms of industrial structure, this latter accounted for both in terms of GVA and employment shares and rank shares:

$$\text{Distance}_{jk} = \left\{ \sum_{i=1}^{I} \left(S_{ij} - S_{ik} \right)^2 \right\}^{1/2}$$

Where S_{ij} and S_{ik} are the shares of (employment or GVA) of sector i in regions j and k and distance is measured in terms of differences between regions j and k of the shares of employment and GVA of sector i. The Euclidean similarity index allows the ranking of all EU regions with respect to their similarity to Northern Ireland. A Euclidean distance index of 0 denotes high similarity between regions whereas if the index is equal to 1 the two regions are highly dissimilar

(see Table A1 in the Appendix for all the indices used). Regional similarity in terms of innovation and competitiveness are based on simple distance to Northern Ireland so that a positive value indicates that the index is higher than in NI, whereas a negative one that it is lower.

Scatter plots of the similarity index against innovation indices show the correlation between sectoral similarity and innovation rates and allow to visually identifying those regions closest to Northern Ireland in terms of industrial structure. The plots are reported in Appendix B.

On the basis of the analysis above, the 10 regions that are closest to Northern Ireland in terms of industrial structure are:

- Luneburg, Leipzig and Schleswig-Holstein in Germany
- Overijssel, Gelderland, Drenthe and Noord-Brabant in The Netherlands
- Liguria in Italy
- Lisbon in Portugal
- Wales in the UK

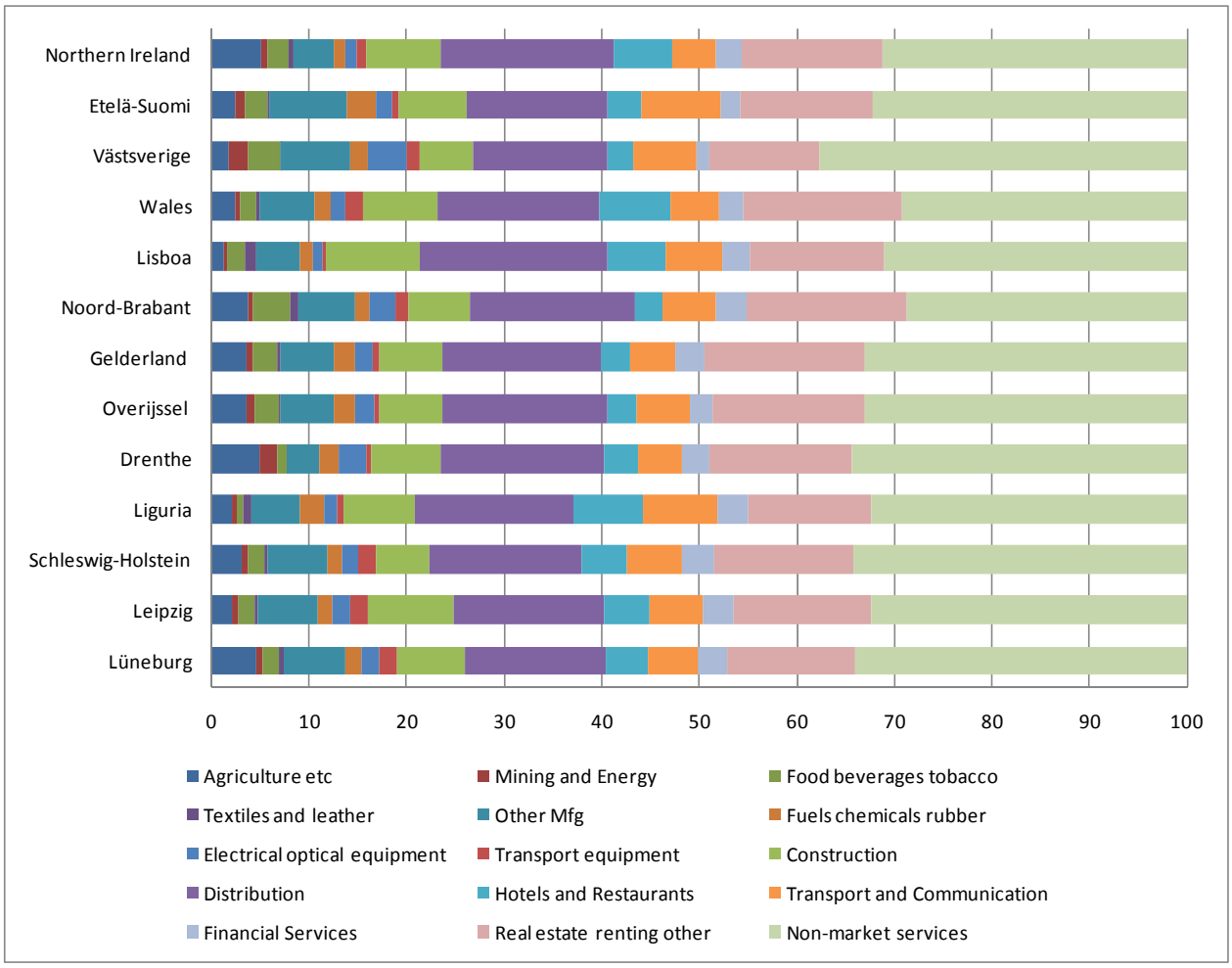
These 10 regions had a variety of levels of innovation performance - but none were in the group of very top EU innovation performers. This is not surprising, as there will be some correlation between industrial structure and innovation performance - and highly innovative regions are likely to have different industrial structures compared to regions with moderate or low innovation performance. It was therefore decided, following consultation with DETI, to add two high innovation regions to the group to act as 'aspirant' or benchmark comparators. The additional regions chosen were Southern Finland (Etelä-Suomi) and the Swedish region that includes Gothenburg (Västsverige).

The next sections report in detail the empirical evidence on the structural characteristics and innovation performance of Northern Ireland and the twelve selected regions.

3.2.2 Sectoral specialisation and structural characteristics

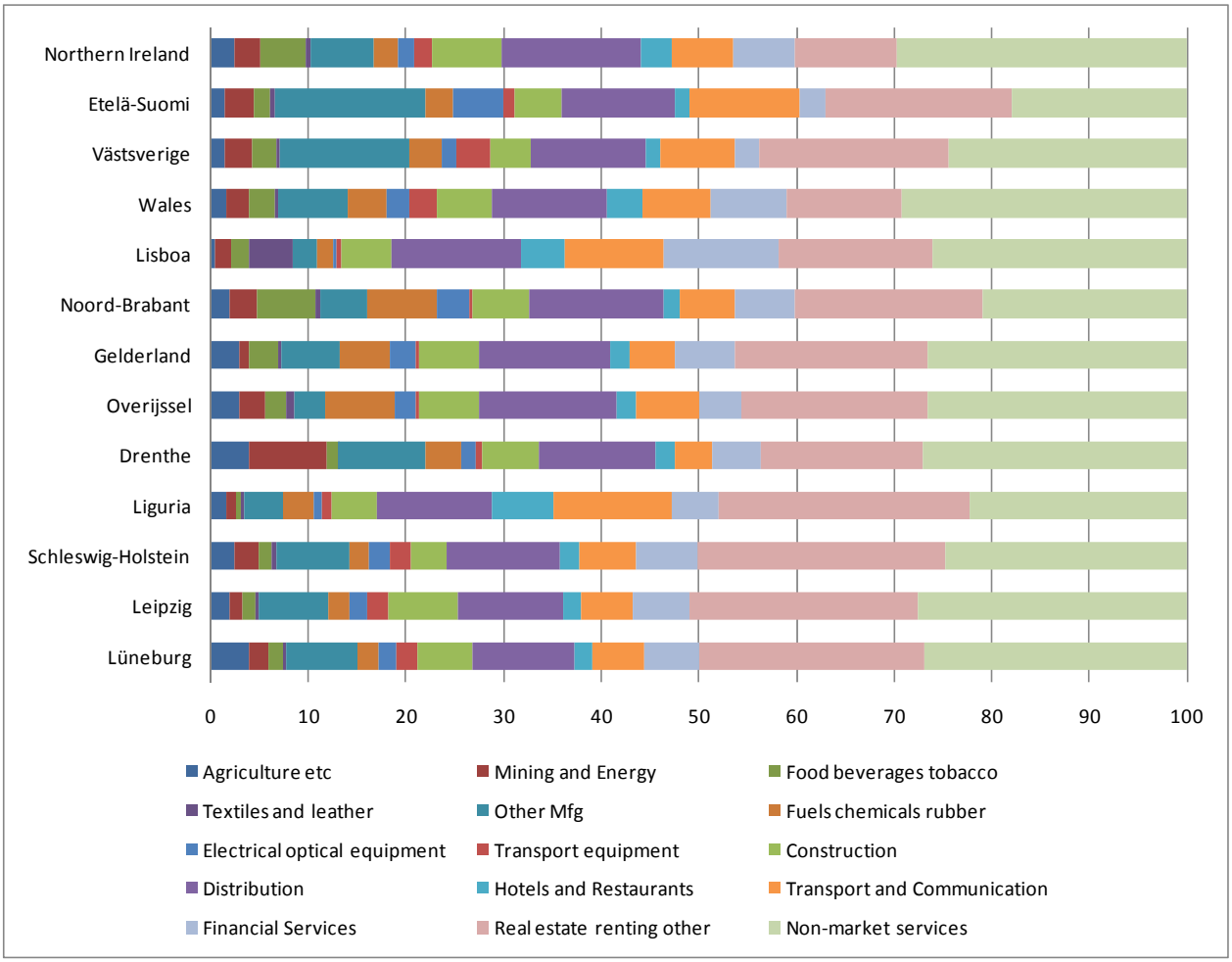
As discussed above, the regions identified on the basis of the empirical analysis share similar structural characteristics. Furthermore, the regions are broadly similar in terms of population structure, except for Lisbon which is a largely dense populated capital. In terms of specific differences, the Dutch regions generally have population densities higher than the European average whereas the Scandinavian regions are, on average, less populated. The remaining regions are all only slightly more densely populated than Northern Ireland (See Appendix D, Figure D1). The active population density is also similar across regions and there is no appreciable gap between the total and active population density across regions with the exception of Liguria. Thus, overall, the sizes of the benchmark regions are similar in terms of population and active population. Below we discuss other economic indicators such as industrial structure, GDP per capita and GVA per employee.

Figure 6: Total employment by sector in selected European regions, 2006



Source: Cambridge Econometrics database

Figure 7: Total GVA by sector in selected European regions, 2006

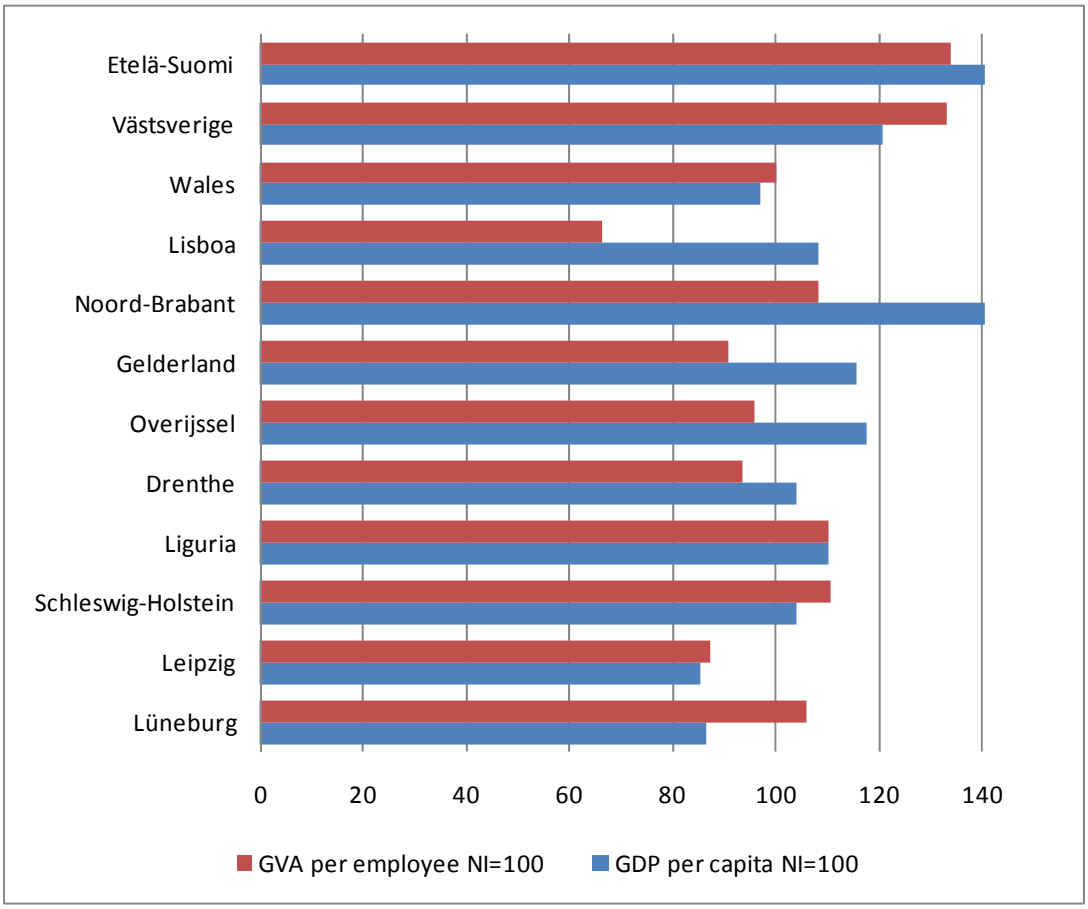


Source: Cambridge Econometrics database

Indicators of sectoral structure are shown in Figures 6 and 7 which report the structure in terms of employment and GVA shares. The economic composition of the majority of the regions is similar – as expected as they were chosen based on an indicator of their similarity. It should be noted that, as in all advanced regions, service sector activities comprise a larger share of employment and GVA compared to manufacturing in all regions. Large service sectors include non-market services, real estate and business services. The chemical and related industry employment share is slightly higher in Liguria (see the evolution of the industrial structure in Section 4.2).

A comparison of productivity levels (GDP per capita and GVA per employee) is shown in Figure 8. The two indicators provide some contrasting pictures. The productivity level of Northern Ireland is higher compared to some of the regions considered – particularly when measured in terms of output per employee. Its comparative performance in terms of output per capita tends to be inferior – probably reflecting different employment levels in the regions. Furthermore, GVA per capita in Northern Ireland is lower than the Dutch regions and (not surprisingly) is much lower than the highly innovative Swedish and Finnish regions.

Figure 8: Relative Productivity levels in selected European regions, 2006

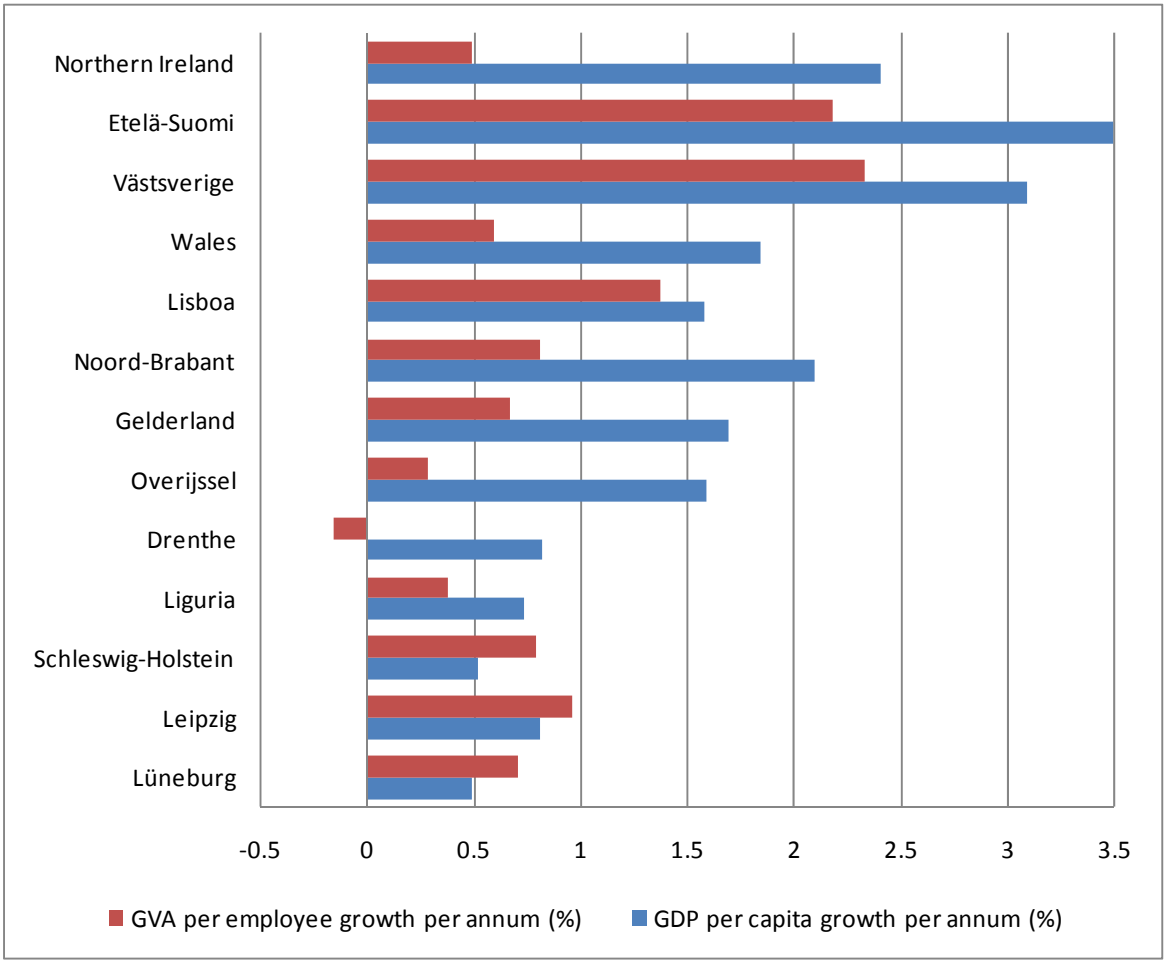


Source: Cambridge Econometrics database

The data on GDP per capita growth during the decade from 1996, as shown in Figure 9, shows a variety of performance. In terms of GVA per employee, the Northern Ireland economy has had relatively slow productivity growth. Conversely, in terms of GDP per capita, the Northern

Ireland economy has shown rapid productivity growth – as have the Swedish, Finnish and Dutch regions.

Figure 9: Productivity growth in selected European Regions, 1996-2006



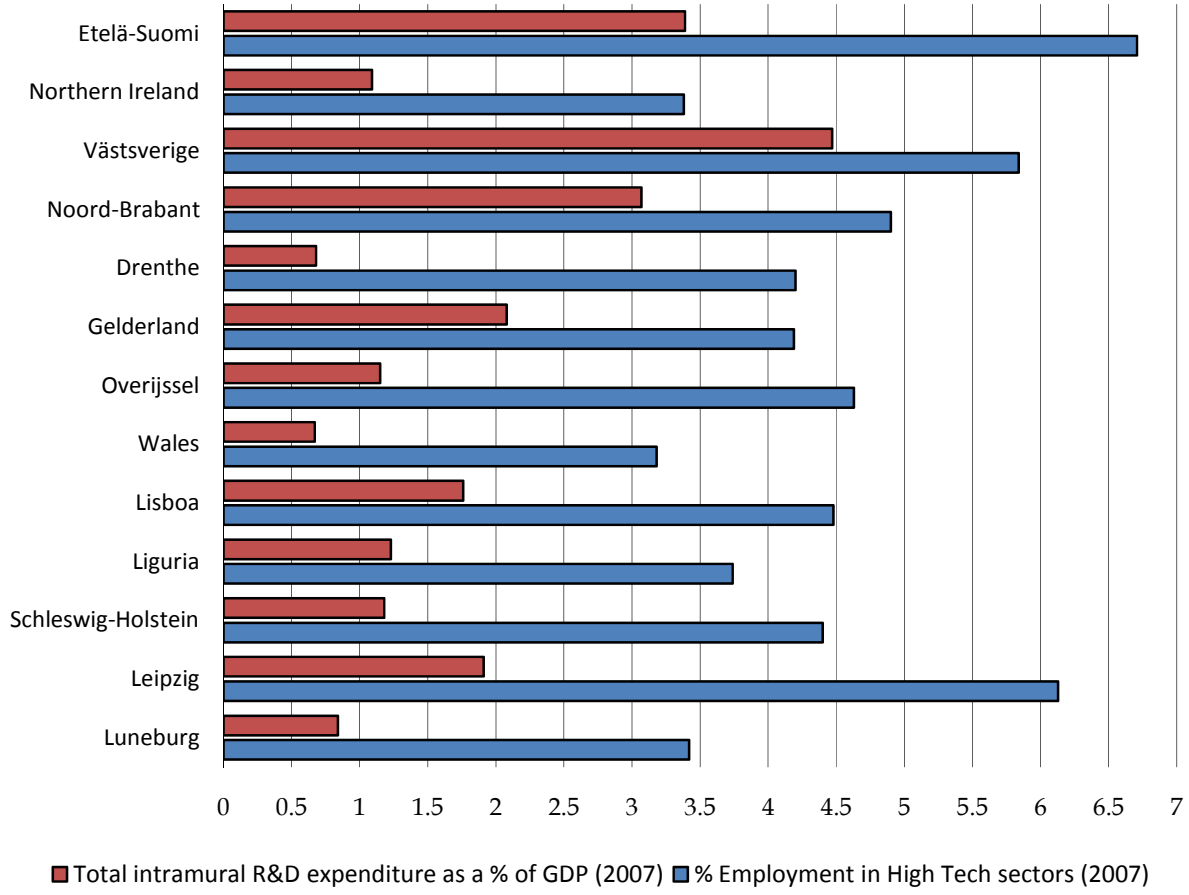
Source: Cambridge Econometrics database

3.2.3 Innovation performance

We analysed the innovation performance across the selected regions using a variety of data sources – including the EUROSTAT Science and Technology indicators data (Figure 10), the Regional Innovation Scoreboard (Figure 11) and the competitiveness indicators provided by the Huggins's Report (Figure 12).

Figure 10 shows the intramural R&D expenditures as a percentage of GDP in 2007 (the latest year for which all data are available, except for Liguria, for which the data refers to 2005) and the percentage of total employment in high-tech sectors. Northern Ireland has one of the lowest shares of employment in high-tech sectors. Most of the benchmark regions – with the exception of Wales – have higher shares of employment in high-tech sectors. A similar picture is apparent in terms of intramural R&D expenditures as a share of GDP: with the Gothenburg and Helsinki regions having high shares. The relative difference in regional innovation performance based on these indicators will reflect, at least partly, that services are an important part of the sectoral structure of these regions, and services traditionally spend less on intramural R&D and relatively more on human capital and employees' training compared to manufacturing.

Figure 10: Intramural R&D expenditures as a % of GDP and total employment in high-tech sectors in selected European regions – 2007

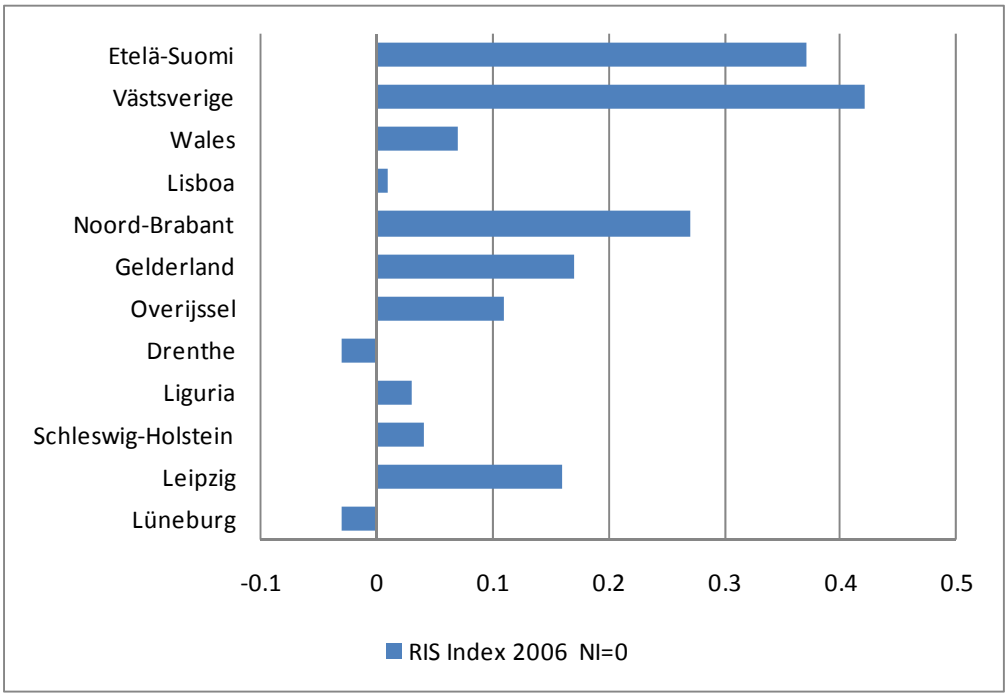


Source: EUROSTAT Science and Technology Indicators

Note: High-tech sectors include high-tech manufacturing and knowledge-intensive services. High-tech manufacturing comprises manufacturers of pharmaceuticals and medicinal products, communication equipment and computers whereas high-tech knowledge-intensive services cover activities relating to post and telecommunications, computer and related activities, as well as research and development.

The composite Regional Innovation Scoreboard indices for the selected regions are shown in Figure 11 (based on Northern Ireland as the reference region).[6] Overall, the data shows the superior innovation outperformance of the two Scandinavian regions of Västsverige. Additionally, the Dutch regions score highly compared to the other selected regions. The relatively poorly performing regions, that have an inferior performance to Northern Irelands, are the regions of Lunenburg and Drenthe.

Figure 11: Regional Innovation Scoreboard Index in selected regions (2006)



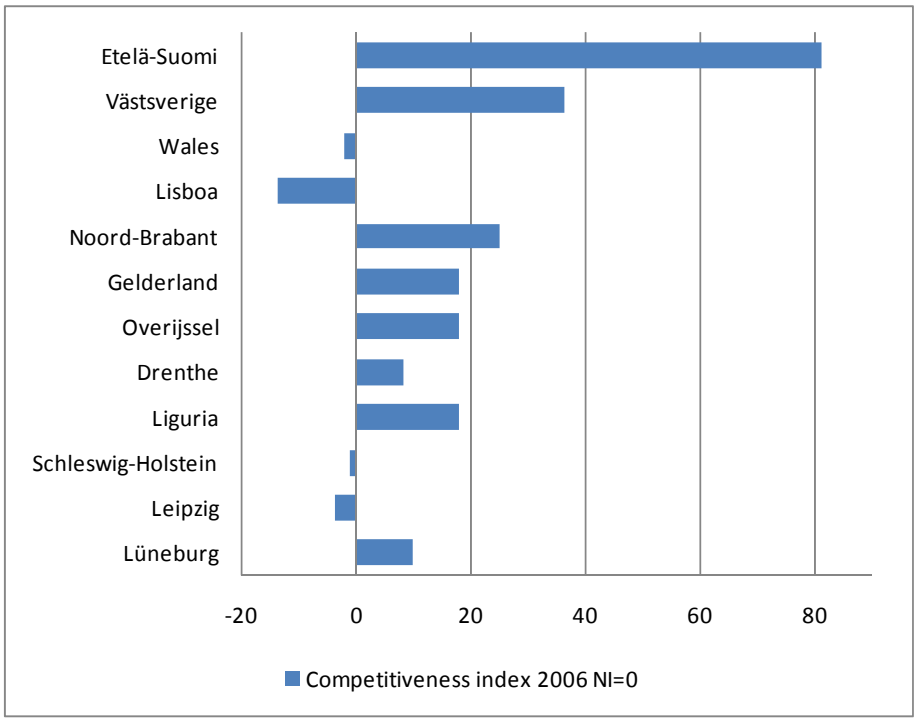
Source: EUROSTAT Science and Technology Indicators

Finally, we also looked at the Regional Competitiveness Index (RCI) compiled by the Centre for International Competitiveness (Figure 12). The composite competitiveness index takes into account several indicators, including:

[6] For a detailed description of the methodology behind the construction of RIS, see Hollander et al. (2009). In the context of this report, the RIS has been rescaled in order to have RIS in NI=0 and to allow regional comparisons so Figure 11 shows the percentage difference from Northern Ireland (e.g. 0.2 indicates a 20% difference).

- Creativity (R&D employees per 1000 inhabitants and R&D expenditure per capita in business services, government and higher education sectors, patent applications per 1000 inhabitants)
- Economic performance (GDP per capita, labour productivity, unemployment rate, gross monthly earnings, economic activity rate)
- Infrastructure and accessibility (motorway and railway length, air freight and air passengers disembarked, number of vehicles)
- Knowledge employment (biotech, chemicals, IT and computer manufacturing, ICT services, R&D, telecoms, machinery and equipment, instrumentation and machinery, auto and mechanical engineering)
- Education (number of students per employed person in general and pre-vocational upper secondary education, in vocational education, in academic and vocational tertiary education)

Figure 12: Regional Competitiveness Index (Huggins Report)



Source: Regional Competitiveness data from the Centre for International Competitiveness

The competitiveness index (with Northern Ireland as the reference) is higher in the two thirds of the regions considered, and lower than NI in the German regions of Leipzig and Schleswig-Holstein as well as in Wales and Lisbon. In the light of the fact that innovation performance is only one of the dimensions of competitiveness, the comparative position of regions might change according to which of the indicators of competitiveness prevails. For instance, the relative position of the regions of Lunenburg and Drenthe changes depending on whether the innovation performance is considered – both regions scored negatively according to the RIS – or if we look at the more comprehensive indicator of competitiveness such as the RCI – on the basis of which the two regions seem to have better performance compared to NI. On the other hand, Wales (and to a lesser extent Lisbon) show a positive innovation performance according to the RIS in Figure 11 and yet both score negatively in terms of RCI as in Figure 12. The relative superior position of the Scandinavian regions is apparent in all indicators.

These indices shed light on the overall performance of Northern Ireland relative to the other regions. While the German and Italian regions are quite similar to NI (medium innovators) the Dutch region of Noord-Brabant is a high innovator as are the Scandinavian regions.

Overall, this suggests that regional differences in competitiveness are due to a variety of factors – including, but not solely confined to, innovation. Sectoral structure, as argued above, together with governance and institutional characteristics, the ability to attract highly skilled human capital and decisions in terms of innovation policy are all playing an important role in shaping productivity growth, employment performance, as well as living standards in these regions.

Among the dimensions of regional competitiveness, the sectoral composition of regions plays an important role in determining their employment and living standard performance. A sector – such as in the case of some services – might be less innovative in terms of traditional innovation indicators (see Abreu et al., 2008) and yet contribute to the overall productivity and employment growth of the region, sparking a positive virtuous circle of high demand and living standards. This explains the apparent paradox of regions scoring low in innovation performance – due to their particular sectoral specialisation – but scoring relatively highly in terms of overall competitiveness.

The next section goes more in depth into different regional innovation policy regimes: using case study analysis it gathers information that public data sources do not provide - such as the governance structure; the different levels of innovation policy; the main innovation activities and examples of successful initiatives. A discussion and implications for innovation policy are provided in the context of each case.

4. In-depth case studies

4.1 Choice of in-depth case study regions

The analysis above provides the sample of regions from which to choose the case studies to analyse in more depth. The first selection criterion was to choose regions with a similar industrial structure to Northern Ireland but which had contrasting innovation performances. As discussed above this would exclude very highly innovative regions, which have a different industrial structure. Following discussions with DETI it was decided to analyse three regions with similar industrial structures and two regions with different industrial structures but with superior innovation performance. Following an analysis of economic, social, demographic and geographic characteristics the final set of selected benchmark regions is as follows:

- Schleswig-Holstein (S Germany) - similar industrial structure to Northern Ireland with a moderately superior innovation performance.
- Liguria (N. Italy) - similar industrial structure to Northern Ireland with a moderately superior innovation performance.
- North Brabant (The Netherland) - similar industrial structure to Northern Ireland with a significantly superior innovation performance.
- Etelä-Suomi (S. Finland) - different industrial structure to Northern Ireland with a significantly superior innovation performance.
- Västsverige (W. Sweden) - different industrial structure to Northern Ireland with a significantly superior innovation performance.

Table 2 below summarises the relative position of NI compared to the case study regions.

Table 2: Summary of economic and innovation performance in the selected case study regions – 2006 (with Northern Ireland as the benchmark location)

	GDP per capita	GVA per employee	Economically active population density	RIS Index 2006
Schleswig-Holstein	104.2	110.7	141.6	0.04
Liguria	110.4	110.2	201.1	0.03
Noord-Brabant	140.6	108.4	432.2	0.27
Västsverige	120.8	133.0	51.1	0.42
Etelä-Suomi	140.6	134.1	54.3	0.37
Northern Ireland	100.0	100.0	100.0	0

Source: Cambridge Econometrics and Regional Innovation Scoreboard
Note: The RIS index is constructed with the benchmark being 0 (zero)

Overall, productivity performance – both in terms of GDP per capita and GVA per employee – is higher in all the selected regions, - although the extent of the gap is lower in those regions with an industrial structure that is similar to that of Northern Ireland. Innovation performance – as discussed above – is only moderately superior in Liguria and Schleswig-Holstein and significantly superior in the Dutch and Scandinavian regions.

The analysis of innovation policy in these regions was initially based on a desk study of the regions followed by in-depth case interviews of key policy makers, members of the business community and regional innovation specialists (the institutions interviewed are shown in Appendix C - individual names have been omitted for reasons of confidentiality).

4.2 Schleswig-Holstein

4.2.1 Background

Schleswig-Holstein is a state in northern Germany, with a population of 2.8 millions - its capital city is Kiel and other major cities include Lübeck, Flensburg and Neumünster. The region is geographically close to Hamburg and this influences the shape and dynamics of the local economy. The regional economy has a relatively low level of productivity compared to the rest of Germany (or more specifically the rest of the former West Germany). It has a traditional economic structure with particular strengths in shipbuilding and agriculture (and related industries, such as food processing).

The Schleswig-Holstein economy has a high share of SMEs and relatively few large companies (similar to the structure in Northern Ireland). Furthermore, it has a history of low levels of innovation and investment in R&D (by comparison with other regions (or states) in Germany). Although Schleswig-Holstein has relatively low unit labour costs by German standards, the region is facing increasing competition from low-cost locations throughout the world – including Asia and Eastern Europe.

Regional policy in Schleswig-Holstein is addressing a range of objectives. First, to support structural change - as in Northern Ireland, the Schleswig-Holstein economy is dependent on traditional sectors, and the objective is to transform the structure by the upgrading of traditional industries (eg from shipbuilding to marine technologies) and the encouragement of new industries. Second, the development of small and medium sized enterprises through support for start-ups and young enterprises. Third, developing infrastructure. Fourth, stimulating education, research, technology transfer and the development of clusters.

4.2.2 Governance structure

Germany consists of sixteen Länder or states. The states are responsible for cultural development, law enforcement and the educational system including universities. It has been argued that the powers of the state governments have been diminished in recent decades due to the power and influence of federal legislation.

In terms of innovation policy both the Länder and the federal government have responsibilities. It has been argued that the combination of autonomous decision structures on both the federal and regional levels can cause inefficiencies and duplications. It has also been argued that there is a lack of transparency, because the policy and instruments are too complex.

Overall, the interviewees in Schleswig-Holstein consider that they have significant autonomy but there is a concern that changes in government at the state level can cause major shifts in policy. This can be particularly problematic as innovation policies take a long time to implement and to have a significant impact.

4.2.3 Innovation policy framework

There is local concern about intensified global competition and Schleswig-Holstein's relatively poor economic performance compared with much of the rest of Germany. To improve the innovative and economic performance of the region a cluster policy was developed based on developing sectors where the region had a competitive strength and which could be developed to increase both regional and national economic growth. The sectors were chosen based on an iterative selection process which included an empirical analysis of regional economic strengths; an analysis of scientific strengths in local universities; and an evaluation of emerging technologies. The sectors include: life sciences, tourism, maritime economics, information and communication technology, dietary industries, renewable energy (in particular wind energy), microsystems and chemical industries.

The region has also adopted the triple helix approach to university-business collaboration. There are three major universities in Schleswig-Holstein. First, the University of Kiel which specialises in a wide range of subjects including agriculture and nutrition. Second, the University of Lübeck which specialises in medicine, biology and information technology. Third the university of Flensburg which specialises in education and social sciences. Additionally, there are the Leibniz institutes for maritime sciences (Kiel) and medicine (Borstel); the Fraunhofer institute for silica technology which has strong connections to Kiel University, and the Helmholtz centre in Geesthacht which specialises in materials. Increasingly, the universities and research institutes

are focusing on the transfer of technology and collaborative behaviour - for instance the latter is facilitated through the encouragement of research in the universities that is based on a consideration of use and the development of outreach companies by many local universities to provide research for the local businesses. Furthermore, the region is developing intermediate organisations that promote collaboration between universities and business – such as 'Innovationsstiftung Schleswig-Holstein' (ISH) (as discussed below) and the Business Development and Technology Transfer Corporation of Schleswig-Holstein (WTSH) also encourages collaboration as part of its role as a one-stop agency for business development and technology transfer in the region. A range of networks have been developed which promote knowledge exchange and create mechanisms to facilitate the transfer of knowledge and expertise.

There is concern, however, that the universities still tend to focus on fundamental research – and that it is difficult to create conditions and incentives to promote research that is applied or that may be used to develop innovative products and processes. In part, this reflects the historical development of the university system and the incentive systems for promotion and peer recognition.

4.2.4 Highlighted initiatives

ISH – Foundation for Innovations

The 'Innovationsstiftung Schleswig-Holstein' (ISH), is a public-private-partnership between the region and E.ON. The ISH aims to foster cooperation between the science base and the regional economy through various knowledge exchange mechanisms including: supporting networks; cooperative projects; and by through supporting applied research at regional universities which can lead to innovative products and processes. The ISH has a €3-4 million annual budget for projects (it aims to fund approximately 20 a year) and 13 staff primarily engaged is boundary spanning support and administration activities. Current projects are focused on the fields of renewable energy and energy efficiency, marine aquaculture, nanotechnology and new materials and ICT, including methods of image processing.

The ISH has three main strategic objectives:

i) Mapping and analysis of selected technology-based innovations and the instruments of innovation policy.
ii) Supporting an innovation-oriented and sustainable social climate and strengthening of the interest in the natural sciences and engineering.
iii) Promoting business-excellence in science, applied R&D with cooperation between industry and research and knowledge transfer to industry.

The ISH is developing six networks in the following areas:

- Image processing;
- Nanomaterials;
- Biological and nutritional products;
- Food for the future;
- Bio- energy; and
- Innovative technologies for damming.

The first network established by the ISH was the 'vision initiative' with an academic coordinator (Prof. Nawrath) which used a range of events to establish a successful network which is now financed exclusively from membership and event contributions. The network has subsequently led to a dozen collaborative projects between science and industry.

The ISH and the region (through the Ministry of Science, Technology and Transport) also collaborate to encourage and facilitate joint research projects through the 'Hochschule-Wirtschaft-Transfer' (HWT - 'University-Economy-Transfer') programme. These are joint projects by academic scientists and businesses; the cost of the projects must not exceed 100,000 Euros, and the company has to fund at least 20 percent - projects are evaluated by a jury which consists of two-thirds from academia and one-third from business. This programme has encouraged the development of innovative products but has also helped to foster a culture and ethos of collaboration between academics and businesses.

An additional area supported by the ISH includes support for innovation and entrepreneurship in the region's universities; this includes infrastructure-building (equipment, endowed chairs etc) and scholarships and training for university graduates.

The ISH adopts a general triple helix framework to encourage university-business collaboration. It intends all its projects to be temporary - they are intended to act as a catalyst for collaboration and for behavioural change – and not to provide a permanent source of support or subsidy. Furthermore, it adopts a range of metrics at the proposal (by committee consisting of business and academics) and impact stages – but appreciates the difficulties of quantifying the impacts of policies that are both uncertain and long-term.

4.2.5 Discussion and implications

There are a number of strengths of the Schleswig-Holstein approach to innovation policy. First, it incorporates a systems approach to the triple helix framework. Second, it recognises the importance of intermediary institutions such as the ISH which promote collaboration. Third, in general, it recognises the importance of encouraging behavioural change and not a policy framework based on subsidies and grants. Fourth, the framework recognises that innovation policies have impact in the long term – and this requires care in using metrics.

There are, however, some limitations of the Schleswig-Holstein approach. First, the policy framework tends to focus on high technology manufacturing despite the economy being now primarily service-based. Second, there is a focus on a narrow notion of innovation – concentrating on technology and R&D – tending to exclude other, and wider, forms of innovation. Third, this tends to result in a concentration on collaboration between businesses and the science base – and not collaboration with other academic disciplines. Fourth, the focus tends to be on local and regional collaborations – an effective collaboration framework also needs to build links with national and international partners. Fifth, long-term innovation policy has been compromised by short-term budgetary constraints - this has been particularly highlighted by the announcement at the end of 2010 that the public funding for the ISH would be terminated at the end of 2011.

4.3 Liguria (Italy)

4.3.1 Background

Liguria is relatively small in physical terms but it is densely populated (1.6m inhabitants) region located between the French Cote d'Azur and the industrial pole of Milan in Lombardia, and includes the popular tourist district of Portofino in the area of 'Le Cinque Terre'. The administrative boundaries of Liguria include the four provinces of Genoa (the capital), Imperia in the west, Savona in the centre-east and La Spezia in the east. Liguria has a very peculiar industrial structure and has gone through a substantial sectoral structural change over the past two decades.

Traditionally, during the early phases of post World War II industrialisation, in the 1960s and 1970s, Liguria specialised in basic metals (such as iron and steel) and machinery primarily for the shipping and aeronautical industries. The market structure linked to these sectors was traditionally characterised by the presence of large mixed private-public firms (such as Ansaldo). These large firms have been concentrated around Genoa (and its harbour) and the province of La Spezia (the port of La Spezia has a large military naval base).

The provinces of Imperia and the west part of the province of Genoa are largely specialised in traditional services like tourism and agriculture, horticulture and the cultivation of flowers. In contrast to the traditional manufacturing sector, these sectors are mainly characterised by the presence of SMEs and micro firms.

Interestingly, since the beginning of the 1980s, the large shipping and aeronautical industries have been going through a process of transformation, which is still ongoing. This has led a diversification of the economy into electronic components and robotics. These industries produce for both high-tech manufacturing – mainly meteorology, security and energy sectors - and high-tech services, mainly for biomedical applications in the health services.

The biomedical sector has developed recently, in response to demographic shift of ageing population in Liguria. Currently, 27% of the population in Liguria are over 64, against a national average of approximately 20%. This has induced an increased demand for care for the elderly, in addition to the traditional Italian family support for elderly people. Many of the latest innovation initiatives (see below) relate to ICT applications and robotics for biomedical sectors linked to the care of the elderly.

Demographic change - as well as new technological developments in the agro food sector - has contributed to changes in the tertiary sector in Liguria. As discussed above, public health services are benefiting from technological progress in biomedical products, medical tools and robotics for care of the elderly. Traditional tertiary activities concentrated in tourism have remained based on SMEs and micro firms. The dual sectoral structure of the region – large mixed public-private firms in traditional manufacturing sectors and micro and small enterprises specialising in tourism and traditional services – does not encourage specialisation in other sectors such as business services. In terms of innovation, the region relies on basic R&D and strong links with the Faculty of Engineering at the University of Genoa, which represents the main source of human capital for basic research in robotics, shipping and aeronautics.

4.3.2 Governance structure

Like all other regions in Italy (with the exception of those with autonomous governments - Valle d'Aosta, Trentino Alto Adige, Sicilia, Sardegna and Friuli Venezia Giulia), Liguria has a limited degree of autonomy in formulating industrial and innovation policies. These policies are centralised at the national level and (of course) have to align to the European guidelines.

Over the last three years, Liguria's regional government has produced a law (Legge Regionale n. 2/2007 published in the Bollettino Ufficiale Regionale 16/01/2007) for the 'Promozione, Sviluppo Valorizzazione della Ricerca, dell'Innovazione, delle Attivita' Universitarie e di Alta Formazione' (Promotion, Development and Valorisation of Research, Innovation, University and Higher Education), which coordinates the complex set of competencies between regional and national government policy and the European guidelines. In general, in Liguria, as in the other Italian regions, the focus of industrial and innovation policies are designed at the national level;

whereas the regional areas of competence relate to the specific implementation of applied research projects and technological transfer to firms. Both these levels are constrained by the amount of resources that the EU devotes to countries and regions. In the case of Liguria, these mainly come from the European Social Fund and the Fund for Regional Development.

4.3.3 Innovation policy framework

Overall, the degree of decisional autonomy in terms of innovation policy at the regional level is increasing, as the region decides the areas where the funds are allocated. The region is adopting a Triple Helix approach – encouraging the cooperation of universities with businesses – with an important role being undertaken by the Faculty of Engineering at the University of Genoa. This latter is a pool of human capital supply, which particularly suits the regional sectoral composition of industries and the dominance of large shipping and mechanical engineering enterprises.

The current financial crisis is having an impact on regional innovation policy: funds for innovation projects are being used to alleviate the problems of struggling firms and industries affected by the crisis. A related issue - which reflects the size structure of firms in Liguria - is that larger firms attract a disproportionate share of public funds compared to those allocated to small highly innovative firms. This imbalance is also reflected in the allocation of the funds for training - which are often linked to, and sometimes constrained by, the needs and the demand for human capital coming from the large mechanical engineering and shipping firms and not from highly innovative small firms specialising in the ICT, robotics and biomedical sectors.

Liguria does not rely on any specific metrics to monitor, evaluate or assess its innovation projects. A traditional way of monitoring innovation activities is to count patents applications originating from projects funded – however, this has a number of limitations, particular regarding wider forms of innovation. In general, Liguria considers revealed preference – as the continuous interests and demand from enterprises – as (according to the interviewees) a good indicator of a project's success.

One of the issues raised – both in terms of governance and of innovation policy more specifically – is the separation between different programmes and budgets. Innovation policy – both at the

regional and national/European level - is still very much a synonymous with public R&D expenditures and support for private R&D (such as through tax credits). Other forms of innovation support, such as non-R&D innovation expenditures (such as training) are often supported through different funding programmes. This creates problems of coordination and efficiency. This lack of coordination could be addressed by further strengthening the triple helix framework: the regional government could coordinate all innovation – orientated programmes within a consistent framework.

4.3.4 Highlighted initiatives

One of the most successful innovation platforms carried out over the last decade in Liguria – within a Triple Helix framework – has been the PRAI Liguria initiative 2001-2007 (Programma Regionale di Azioni Innovative, Regional Programme of Innovative Activities[7]). This initiative is explicitly focussed at enhancing collaborations between research and business and involves the University of Genoa, the National Research Council of Italy (CNR) and the Liguria Region. The project is funded by the EU (€3m), national (€2.1m from the Ministry of Industry and Productive Activities) and regional funds (€990,000) and has successfully developed two of the most innovative initiatives in the region, detailed below. The success of PRAI has resulted in a unique way of matching researchers from the University of Genoa and CNR with small entrepreneurs through the funding of research grants to cooperate with an enterprise.

PRAI applications

PRAI funded in the first instance a total of 26 projects, involving 29 enterprises and 61 researchers from both the University of Genoa and the CNR. These first sets of beneficiaries cooperated to create two technological poles of excellence in the areas of La Spezia and Savona. The La Spezia pole focussed on the implementation of shipping and mechanical engineering technologies. The Savona pole was devoted to energy, environment and sustainable development technologies.

[7] See http://www.prai-liguria.it/eng/index.htm

In La Spezia province, PRAI has funded and implemented numerous projects based on the applications of the Dynamic Numerical Simulation of Complex Systems and System Components.[8] These have resulted in the development of innovative products in the following areas of applications:

- Advanced materials and treatments for shipping components
- Harbour security and protection from superficial underwater and coastal intrusions
- Development of the instruments and technologies for shipping security
- Meteorological new tools to improve navigation security
- Training and technological support activities

In the province of Savona,[9] PRAI has funded projects in the following areas of applications:

- Energy saving and distribution of electricity
- Thermo fluid dynamics and combustion
- ICT technologies for implementing transport efficiency

One of the projects funded by PRAI, in the province of Genoa, is developing a 'district' of virtual intelligence in collaboration with the Faculty of Engineering of Genoa University. This has been coupled with the creation of a complementary PhD programme devoted to artificial intelligence (the EU Erasmus Mundus PhD Programme in Interactive Cognitive Environments Consortium, coordinated by the Department of Biophysical and Electronic Engineering (DIBE). There has not been a formal monitoring process to evaluate the success of these initiatives. Some of these projects led to patent applications, yet these have not been a formal requirement for beneficiaries to get funds nor they have been regarded as an effective measurement of the initiatives' success.

[8] For details on the La Spezia projects funded by PRAI, see http://www.prai-liguria.it/eng/sp_center/projects.php
[9] For details on the Savona projects funded by PRAI, see http://www.prai-liguria.it/eng/sv_center/projects.php

After PRAI

For the period 2007-2013, the EU allocated €530 million for regional development, of which €300m is specifically for the development of new technologies. The follow up of the PRAI, the POR (Programma Operativo Regionale - Operative Regional Programme) – covering the period 2007-2013 – has been funded by the European Social Fund and its focus is more concerned with labour market inclusion and the human capital development rather than allocating funds specifically for innovation projects. In this respect the POR is based on a less marked Triple Helix approach with respect to what had characterised PRAI as well as, in general, a less marked focus on innovation, being more related to the labour market.

With respect to PRAI, the POR logic is more one of funds centralisation. PRAI was smaller in size (see above) and more focused on the links between enterprises, Universities and public research centres (like CNR) and the (sectoral) priorities selected by the regional government.

4.3.5 Discussion and implications

Italy has a number of regions that are average innovation performers compared to the rest of the EU, although there are some firms in specific regions that are high innovative performers, mostly in the case of non-R&D innovation activities (Hollander et al., 2009, p. 13)[10]. In terms of innovation performance (based on the composite indicator reported in the RIS), Liguria is ranked fourth amongst Italian regions, behind Lombardia, Piedmont, Emilia Romagna and Lazio. As discussed above, (section 4.3.1) Liguria is characterised by a very peculiar sectoral structure, including large traditional manufacturing linked to shipping aeronautics and iron which have diversified towards electronics and robotics; as well as a specialisation in tourism and agro-food sectors with a high proportion of SMEs and micro firms.

Innovation policy in Liguria – in line the European funding and policy framework – focuses mainly on (basic) R&D expenditure, and financial support for start-ups and spin-offs in high-tech manufacturing. Furthermore, the increasing concern of the Regional Government with the problem of an ageing population has stimulated demand for innovation linked to the introduction of robotics in the public health.

[10] See also Section 2 of this report for an overall picture of Regional innovation performance across Europe.

Innovation policy in Liguria, therefore, primarily focuses on the manufacturing sector and basic research. Additionally, as the PRAI programme (2001-2007) illustrates, there has been an increasing focus on a triple helix approach to innovation policy. This approach could be strengthened by enhancing the role of the regional government in the coordination of EU-related programmes and the allocation of funds. For instance, typically, non-R&D innovation expenditures linked to the support of human resources and human capital development are managed separately to other aspects of innovation policy.

In terms of the governance structures, Liguria has successfully developed several innovative activities within PRAI, which includes effective coordination between the regional government, the University of Genoa and the National Research Council. The main limitation is that policy has tended to focus on traditional innovation policies such as R&D and high technology manufacturing and has not embraced wider innovation and innovation in other sectors.

PRAI represents the most successful example of Triple Helix inspired policy, being a combination of regional EU and University and public research institute (CNR) funds. The reasons behind its success (as detailed in Section 4.2.3) are mainly because the size of the funds was manageable, the projects were very much focused on the strategic sectors identified at the regional level and this has sparked the demand for specific human capital and therefore has funded a number of graduate and post-graduate training programmes in the main universities in Liguria. Therefore, PRAI specifically aimed – again in line with Triple Helix and Regional Innovation System logic – at enhancing collaboration between firms, Universities and public research institutes, with the overarching strategy of the regional government.

4.4 North Brabant (The Netherlands)

4.4.1 Background

North Brabant is a province located in the South of The Netherlands, roughly at the centre of the triangle formed by Brussels/Antwerp, the Amsterdam/Rotterdam region with its major international business headquarters and transport links, and the Ruhr industrial region of Germany. Its main industrial and business centre is city of Eindhoven, while its administrative

capital is 's-Hertogenbosch. The province is the second largest and third most populous in the Netherlands, with a population of 2.4 million, 725,000 of which live in the greater Eindhoven region.

The province is unique in The Netherlands in its concentration of high-tech manufacturing and knowledge workers, and it is among the most innovative regions in Europe. It has the highest level of R&D spending in the Netherlands, and the highest patent density (number of patents per million inhabitants) in Europe (Hollanders et al., 2009). The main industries are automotive industries, electronics, medical equipment, biotechnology, and information and communications technology (ICT). It is also strong on energy, environmental technologies, transport and materials. In recent years there has been a growth in creative industries, particularly industrial design, software and textiles.

Less than 20 years ago, however, the region was struggling to overcome a deep recession. The two main employers, Philips and DAF Trucks, were forced to lay off thousands of workers. The situation called for a radical new strategy, and the region developed a new governance approach based on a Triple Helix model, that is, on business, government and knowledge institutions working together to design policy initiatives. The model proved to be highly successful, and although Philips relocated its headquarters to Amsterdam in 1997, the company subsequently decided to concentrate all of its R&D activities in Eindhoven. This led to the creation of the Philips High Tech Campus (later changed to Eindhoven High Tech Campus) in 1999.

The region has two large universities, the Eindhoven University of Technology, with a focus on science and engineering, and the University of Tilburg, which focuses on the humanities, economics and social sciences. The region also has the world-renowned Design Academy Eindhoven, originally a training centre run by Philips. The province has made the most of the synergies between the three higher education institutions. For instance, a new professorial chair in entrepreneurship has recently been established, to be shared on a 50-50 basis by the University of Tilburg and the Eindhoven University of Technology. The provincial government has also promoted the theme of entrepreneurship throughout the education system, starting with the primary school level, all the way up to tertiary education.

4.4.2 Governance structure

At the lowest level of governance, the province is composed of 68 municipalities, all with elected governments (municipal councils). Some of the municipalities have organised themselves into larger organisations to look after common interests; one example is the SRE (City Region Eindhoven), which is composed of 21 municipalities, and is the driver behind the Brainport initiative (discussed below).

The next tier of government is the provincial government, which is composed of an elected parliament (or provincial council), and an executive board which is headed by a central-government appointed Queen's Commissioner. Innovation policy is to a large extent delegated to the regional development agency, the Brabantse Ontwikkelings Maatschappij (BOM). This agency is a limited company with two shareholders, the national and provincial governments. It is tasked with implementing national and regional business development strategies, administering innovation grants and providing advice and business support services. The agency also administers the European Regional Development Fund (ERDF), the second largest source of public support for innovation (after the Peaks in the Delta programme, discussed below).

Triple Helix

The Dutch have pioneered the use of a Triple Helix mode of governance for innovation policy, which gives equal weight to business, government and academia, and institutionalised it at different levels of government (Etzkowitz and Leydesdorff, 2000). The Triple Helix model is based on the view that three-way interactions encourage innovation while providing a balance between knowledge, social benefit and profit motivations. While quantitative evidence is hard to come by, anecdotal evidence suggests that this approach can be very successful, particularly to develop new strategies in regions facing industrial decline (Lagendijk and Boekema, 2008; Maldonado and Romein, 2009).

The Triple Helix approach also builds on a long tradition of policymaking by consensus in The Netherlands, known as the Polder model (after polders, or low lying-tracks of land enclosed by dykes). The Polder model is characterised by tri-partite cooperation between employers associations, trade unions and the government, and is credited with helping keep wages low and

allowing the economy to grow, leading to the so-called Dutch miracle growth rates of the late 1990s. This arrangement is institutionalised at the national level in the Social Economic Council, which serves as a forum to discuss labour issues. The origins of the Polder model are said to lie in medieval times, when even warring neighbouring towns had to come together to ensure the maintenance of the dykes that protected common polders.

The use of the Triple Helix model in North Brabant also arose during the crisis period that engulfed the region in the early 1990s, as manufacturing declined and the two main employers in the region, DAF and Philips, announced thousands of job losses. The crisis brought together local policymakers, business leaders (in the form of the Chambers of Commerce) and representatives from universities and further education institutions. The Triple Helix model forms the basis for decision-making for both the national government Peaks in the Delta programme, and the local Brainport initiative.

4.4.3 Innovation policy framework

Innovation policy in The Netherlands is developed and administered at the national, provincial and local levels of government. In terms of national policy, a number of important policy documents published in 2003 shifted the focus from promoting the development of lagging regions, to supporting and building critical mass in a number of key areas, such as genomics, ICT and nanotechnology (Lagendijk and Boekema, 2008). This shift coincided with the establishment of the Innovation Platform, an advisory group comprised of 17 members drawn from the ranks of government, business, academia, and the trade unions, and the publication of a report on the Peaks in the Delta programme (Ministry of Economic Affairs, 2004).

The role of the Innovation Platform (IP) was to advise the government on future innovation policy directions, act as a bridge to between sectors of the economy, commission research on innovation-related topics, and act as an “icebreaker” when current initiatives ran into obstacles. It was headed by the Prime Minister, and included the Minister of Education, Culture and Science, the Minister for Economic Affairs, and representatives from key sectors such as healthcare and the water industry. The most important output of the IP was the Knowledge Investment Agenda (KIA), a ten year plan spanning the period 2006-2016 with the aim of strategically informing

government policy on innovation. The plan included several key areas for action, including a strategy for attracting Fortune 500 companies to establish their global or European headquarters in The Netherlands, improving the quality and availability of international (i.e., taught in English) schools, attracting top PhD students to The Netherlands, developing an international campaign to promote the country, and supporting flagship projects with international appeal, such as the construction of a multi-functional energy island off the coast. Progress on the KIA was reviewed on an annual basis. With a change in government in 2010 the Innovation Platform continued in a different capacity, revolving around the KIA.[11]

The Peaks in the Delta programme, which also came into existence in 2003, is an important new development in innovation policy. It has sought to identify key areas of regional excellence, and recommended that funds be concentrated in those sectors. In the case of the region of North Brabant, the funds available through the programme are administered by the regional development agency, the Brabantse Ontwikkelings Maatschappij (BOM), which is run as a limited company with the national and provincial governments as shareholders. The provincial government also provides matching funds for the programme, and other services such as support for spin-offs and entrepreneurship training.

At the local level, initiatives such as Brainport (in the Eindhoven region) are managed by groups of municipalities, and provide additional support for emerging industries and existing clusters. Support at the local level is mainly in terms of providing infrastructure and physical facilities, and improving the living environment to attract knowledge workers.

4.4.4 Highlighted initiatives

High Tech Campus Eindhoven

In the early 1990s the region of North Brabant and the area around Eindhoven in particular, experienced a severe economic downturn. The two largest employers, DAF Trucks and Philips, both were both struggling, which led to the loss of thousands of jobs. This was a wake-up call for business, policymakers and academics in the region, who agreed to work together in order to turn

[11] More information is available on the Innovation Platform website (http://www.innovatieplatform.nl/en/platform).

things around. The High Tech Campus Eindhoven emerged against the background of these developments, and was originally conceived as a research park to house all the separate R&D departments of Philips, which were scattered across Eindhoven and other European locations. The campus started with the redesign of Philips Research, which was already located on the site. The Municipality of Eindhoven supported the plan as a way of raising the national and international profile of the city, and the programme also receives funds from the national government, to the tune of €184 million over the period 2006-20011.

Initially the campus was known as Philips High Tech Campus, and was comprised only of Philips's R&D divisions. This relocation proved to be highly successful, and the atmosphere of openness and the concentration of high-end knowledge production and facilities produced considerable interaction between researchers. Knowledge sharing and mutual inspiration generated a definite boost for the innovative capacity of the organisation. To further accelerate this process, Philips decided in 2003 to open up the Campus to other technological companies.

The campus is run as a science park, with a strong culture of open innovation. Firms located in the site share office space, and have access to state-of-the-art laboratories, test facilities, clean rooms and specialised equipment, as well as services such as materials analysis and prototyping. The firms also share training and conference facilities, and a social area known as "the strip", which includes restaurants, cafes and shops. From the start all catering facilities were located in the same area, to encourage interaction and promote synergy and collaboration. The campus is managed by a consortium of partners that includes Philips, the Ministry of Economic Affairs, the Brainport Foundation, the Municipality of Eindhoven, the BOM, the government of the city region Eindhoven and the Association Technology Liaison Eindhoven Region (TeLER).

The campus currently houses over 90 companies, including more than 40 start-ups, and a number of specialist service companies. It has around 7,000 workers on campus, originating from over 50 different countries. The campus is actively promoted by the municipal and regional governments, and has expanded to such an extent that a new site is currently being developed. It is also frequently cited as one of the most successful examples of open innovation in practice (Lgendijk and Boekema, 2008).

Brainport

The 21 municipalities of the greater Eindhoven region, in cooperation with local business and academic stakeholders, developed the Brainport programme to encourage public-private initiatives and promote their region within The Netherlands and abroad. It is funded by local government, and supported mainly through European Union Objective 2 funds, with additional funds provided by the Dutch central government and the private sector. The initiative includes a series of local policy drives, the development of critical infrastructure and other resources, and lobbying of the national government to ensure the region is represented in national policy initiatives. The programme is governed through a Triple Helix structure, with business, policymakers and knowledge institutions having equal representation, and deciding on the strategic priorities of the programme. The initiative has three key objectives: to continue to stimulate knowledge-intensive sectors, to create lasting cross-border initiatives with neighbouring regions in Germany and Belgium, and to ensure that in addition to economic development there are also improvements in social indicators such as poverty and inequality.

The policy instruments used by the programme focus on providing infrastructure, improving the living environment and promoting the region abroad and within The Netherlands. In terms of attracting and retaining skilled workers, the initiative stimulates entrepreneurship, for instance by creating the Brabant Entrepreneurial School, and providing training and support; it recently restructured its vocational education system to provide a better match for the jobs needed in the area, and built an international school on the Eindhoven High Tech Campus to cater for the children of foreign knowledge workers. On the business side, it has helped to create and support a number of centres of excellence in relevant high-technology fields, and developed networks to help SMEs innovate. The six centres of excellence developed by the programme are public-private partnerships, involving business and academia, and financed with the help of industry and the central government. They include a Centre for Molecular Medicine (CTMM), the Dutch Polymer Institute (DPI) and the Embedded System Institute (ESI).[12] In terms of infrastructure, it

[12] For further information on these projects see the "Brainport Navigator 2013" report, available at http://archief.brainport.nl/Brainport_C01/default.asp?comid=33&sessionid=73499276044196609621314422817 8&modid=2345&itemid=0&time=82618.

is working on improving transport links, providing green spaces, recreational and sports facilities, and improving business and residential ICT facilities.

Finally, the initiative has also followed an image-building programme for the region, including promoting visual images of local landmarks and cultural attractions, organising events to generate pride in being part of the region, and designating local personalities as ambassadors to promote the region within The Netherlands and abroad.

Peaks in the Delta

The Dutch government published a report in 2004 on the Peaks in the Delta programme, a new initiative to radically alter regional development policies in The Netherlands (Ministry of Economic Affairs, 2004). Up to that point, regional development in the country had focused on helping less developed regions catch up. The new policy sought to identify areas of excellence within six larger regions in The Netherlands, and focus resources on promoting those areas. These regions cover the entire country, but cross existing provincial boundaries, and this has created some tension between the national and provincial governments, although the policy has been successful in aligning regional with national innovation strategies. The programme is also radical in that it has focused on picking "regional winners", in order to avoid wasteful competition between regions to develop initiatives in the same sector.

The Peaks in the Delta funds are administered by independent agencies, and provide grants, training and specialised help to firms in the region, with a focus on supporting SMEs. The budget for the programme varies across regions, and includes matching provincial funds. For instance, the budget for the South East region (which includes Eindhoven) was 100 million Euros over the period 2006-2010. The areas of focus for the Peaks in the Delta programme are proposed by business and regional government representatives in a "bottom-up" approach, and a Programme Committee is tasked with working out the initial agenda. The areas covered by the programme are:

(a) North of the Randstad: creative industries, life sciences, logistics and trade, international services and tourism.

(b) South of the Randstad: harbour and industrial complexes, greenhouse farming, life sciences, and hosting of international institutions in The Hague.
(c) North Netherlands: water, energy and sensor technology.
(d) East Netherlands: food and nutrition, health and technology.
(e) South West Netherlands: Tourism, logistics and processes.
(f) South East Netherlands: High-tech systems and materials, food and nutrition, life sciences and medical technology.

While the eastern part of North Brabant falls into the South East region of the Peaks in the Delta Programme, the western part of the region falls into the South West region of the programme. The funds provided by the central government as part of the programme are matched by the provincial government, and in North Brabant the programme is largely administered by the regional development agency (BOM). The largest proportion of the funds goes towards providing subsidies for collaborative projects, which must be led by an SME, with other SMEs, larger firms and knowledge institutions (universities, polytechnics and research institutes) as partners. The subsidies are intended for innovation activities that are close to market, and are assessed by a panel of in-house experts. Examples of projects funded by the Peaks in the Delta programme are:

- Solar energy: an SME with nine employees based in North Brabant (Alrack) received a grant to develop a more efficient connection between solar panels and the electricity grid. The project also involved Sioux, a software company from Eindhoven, and Scheuten, a producer of solar modules in Venlo. The project received €1 million of public funds.

- Medical Field Lab/Living Lab: a project to encourage the development, testing and marketing of products and services provided by SMEs for the care of elderly and disabled patients in care homes. This project fills the gap between the innovation and creation of new products and services by SMEs, and their uptake by patients and health professionals in care homes. The project involved creating networks to link companies and care homes, building a testing facility, and organising a group of patients to try out new products and services. It received €900,000 of public funds.

4.4.5 Discussion and implications

The success of the North Brabant region, and in particular, of the city region of Eindhoven, is to a large extent due to its system of governance, and the willingness of different sectors of the community to work together to promote the local economy. In particular, the use of a Triple Helix mode of governance, bringing together business, government and knowledge institutions, which is used by both nationally-funded initiatives such as the Peaks in the Delta programme and local initiatives such as Brainport, has proved to be very successful in encouraging growth in the region, and promoting its image nationally and internationally.

Another positive aspect of innovation policy in the region is its focus on open innovation. The open innovation initiative of the High Tech Campus Eindhoven has led to new highly successful collaborations that have resulted in numerous new products, services and spin-off companies. This focus on open innovation is possible because of the links that have long existed between large multinationals, knowledge institutions and local SMEs. Current efforts to build links in sectors other than ICT and the life sciences are designed to set the stage for more open innovation programmes.

The success of the Brainport initiative and the High Tech Campus Eindhoven are both closely intertwined with the location and prominence of Philips in the region. This provides support for the anchor tenant hypothesis, although the success of the Eindhoven region is arguably due to several region-specific factors. An important component is the long history of Philips in the region, both as employer of the local labour force, and client of a large number of independent suppliers and knowledge providers. The long-standing relationships with other firms and knowledge institutions meant it was particularly attractive for Philips to remain in the region. The second important point is that Philips has always had a large R&D presence in the region, which generates substantial knowledge externalities that help to sustain the cluster (Agrawal and Cockburn, 2003).

The focus of the region on promoting itself as an interesting and enjoyable place to live and work have contributed to their success in attracting domestic and foreign knowledge workers. The branding exercise has focused on local landmarks and cultural attractions that can be used

visually in advertising campaigns, the organisation of cultural, sporting and recreational events designed to instil pride in the region, and the use of local personalities to act as national and international ambassadors.

4.5 Etelä-Suomi (S. Finland)

4.5.1 Background

The region of Etelä-Suomi, which includes the capital city Helsinki, is one of the most innovative regions in Europe, particularly in terms of R&D expenditure and enabling factors such as education, training and infrastructure. With a population of 2.7 million, Southern Finland is also one of the most urbanised regions in Finland, and an area of rapid population growth, good public and social services, and a hub of international transport and business links. Although the province covers only 10% of land area, it contains 25% of the Finnish population, and produces close to 50% of country's GNP. Three of the country's largest cities are located in Southern Finland (Helsinki, Espoo and Vantaa).

The economy of the region is based on mainly high-technology sectors, including ICT, biotechnology and environmental technology, knowledge-intensive business services, metals, paper and wood, oil refining, chemicals and the food industry. The region also serves as route for Finnish exports and imports, and has strong links with Russia.

The economic history of the region is closely intertwined with that of Nokia, a telecommunications multinational. Founded in 1871 as a pulp and paper manufacturer, it later diversified into electricity, produced by its mills on the river Nokianvirta close to the city of Tampere. The company grew into a conglomerate, providing telephone, telegraph and electrical cables and laying the foundations for its consumer electronics and communications business, which emerged in the 1980s. Nokia receives a significant amount of public funding in the form of R&D subsidies, but has also had a substantial positive impact on the economy, in particular through its knowledge-sharing activities with local universities and its vast network of suppliers, many of which are SMEs. Nokia's share of R&D spending is close to one third of the Finnish total, or 47% of total private R&D, and at times Nokia has been a substantial contributor to

Finnish GDP growth, in 2000 accounting for almost a third of total GDP growth (Ali-Yrkkö and Hermans, 2002). The focus of recent innovation programmes on SMEs can also be seen as an attempt to counteract the reliance of the innovation system on Nokia.

4.5.2 Governance structure

The two most important layers of government in Finland are the central government and the municipalities, with an intermediate, unelected layer made up of government agencies and associations of municipalities. Until early 2010 there were six provincial governments, which acted as unelected administrative extensions of the central government, but these have recently been phased out. They have been replaced with six Regional Administrative Agencies (AVI) and 15 Centres for Economic Development, Transport and Environment (ELY). The latter provide a single point of access for the services of various ministries and of the Finnish Funding Agency for Technology and Innovation (TEKES).

At the lowest level, the municipal governments are directly elected, and have independent tax raising powers in the form of a flat income tax (which in the range of 16-20% of income), property and corporate taxes (the latter known as "community tax"). There are currently 342 municipalities in Finland, but the central government is encouraging mergers of small municipalities to improve efficiency. The municipalities provide local services and are in charge of schools, health care, local roads and water supply. They also provide information and facilities to stimulate innovation in their local areas.

4.5.3 Innovation policy framework

At the national level, all innovation policy is co-ordinated and evaluated by the Research and Innovation Council (RIC), which is headed by the Prime Minister. It recently commissioned a large-scale review of the national innovation system, carried out by an international panel of experts in collaboration with local academics. The review concluded that innovation policy in Finland is of considerable complexity, and there are substantial overlaps between agencies; the review identified over 1,000 different innovation policy instruments available to businesses. A survey carried out as part of the review found that the most important institutions in the innovation system are the universities and TEKES, which were singled out as important by both

large and small firms, and the public research institute VTT, which was identified as important by large firms. Innovation policy in Finland is the responsibility of the Ministry of Employment and the Economy.

The major intermediary organisations that provide innovation support at the national level are the two funding agencies, TEKES and the Academy of Finland, and SITRA, a financing organisation. The Academy of Finland provides funding for academic research, based on a peer-review application process, while TEKES provides grants and loans for specific projects, on the basis of their business potential (rather than technical content). TEKES operates under the Ministry of Employment and the Economy, and has an annual budget of €600 million, from which it finances around 1,500 projects. Many of its grants and loans (43% in 2009) are used to finance internationally collaborative projects, and around 60% of the funds are allocated to SMEs. In addition to funding, participants also receive support in the form of seminars, training and participation in national and international networks. Around half of the funds are allocated as part of specific programmes, which run over 4-6 years, and focus on strategic areas identified by TEKES, in consultation with business, academia, research organisations and other stakeholders, and in keeping with national innovation strategy goals.

Proposals for projects fall into two areas; roughly half the budget is reserved for research in key sectors, while the other half is used to fund projects proposed by companies or universities in a "bottom-up" approach. The projects are evaluated by an in-house team of experts with knowledge of the sector and technology, generally three years after completion. The evaluations focus on how the project succeeded technically, and the impact on the core business, such as on retaining revenues, creating new business opportunities, maintaining or creating jobs etc. The key areas of priority for TEKES are: wellbeing and health; knowledge society for all; clean energy; scarce resources; built environment; intelligent systems and environments; service business and service innovation; and interactive media.

The Finnish Innovation Fund SITRA was established via an endowment created from the sale of state-owned utilities in 1967, and is an independent organisation operating directly under the supervision of the Finnish parliament. Historically it has provided funding for areas of research

of national importance, including energy, the environment, electronics and telecommunications. Its funding procedures were used as a basis for setting up TEKES, and following a reorganisation in 1997 its operations have focused on venture-capital investments in early-stage enterprises and research and education on the future of Finland. It has also provided funding for the development of social innovations.

In addition, the central government has been keen to improve and extend higher and further education programmes. In the early 1990s there was a great shortage of skilled workers in the telecommunications industry, and Nokia and other companies were forced to invest substantial sums in specialised in-house training programmes, in some cases in collaboration with local universities. In response, the central government invested in an expansion in the higher and further education sector, leading to almost a doubling of the intake of universities between 1993 and 1998, and a tripling of students in polytechnics.

At the local level, municipalities also provide innovation support services; a recent survey found that 86% of municipalities dedicated at least some of their funds to supporting or stimulating local innovation, of which the most common form of support was finance. 70% of the municipalities also provide facilities, and more than half offer information services (Nikulainen and Tahvanainen, 2009).

4.5.4 Highlighted initiatives

VTT

The public research institute VTT is the largest of its kind in Europe and was established in 1942 through the consolidation of existing public research institutes working on technology. It employs 2,700 researchers and provides research and development (R&D) services to companies and other organisations in areas such as applied materials, biological and chemical processes, energy, ICT, industrial systems management, micro-technologies and electronics. It is organised as a not-for-profit research organisation under the Ministry of Employment and the Economy and receives 30% of its income in the form of a government grant, with the additional 70% from services provided to small and large companies, so that 70% of its work is in the form of collaborative

projects, with the government grant being used to maintain equipment and staff and in-house research programmes (it has an annual turnover of €245 million).

The services offered by VTT range from developing technology and business plans, through to strategic research, product and service development, IPR and licensing, testing and prototyping and innovation management. In recent years there has been a drive to better support service sectors, in particular the construction industry, by offering services beyond the traditional technological research and development areas such as management and logistics.

SHOKs

A new innovation policy instrument, the Strategic Centres for Science, Technology and Innovation (SHOKs), were established in Finland in 2006. The centres are organised as public-private partnerships and are intended to speed up the innovation process in a number of key areas. The main goal is to renew industry clusters and create new radical innovations, over a period of 5-10 years. The key areas were identified by the Research and Innovation Council in consultation with business, academic and social organisations and currently include: forestry, metal products and mechanical engineering; built environment innovations; information and communication; energy and environment; and health and well-being. Each centre is set up as a non-profit limited company, which acts as a coordinator for collaborative projects between small and large companies, universities and research organisations. Within each centre, around €40-60 million are invested in research each year. The centres are intended as a demand-driven innovation policy instrument and are incorporated into TEKES.

The SHOKs differ from other TEKES programmes in that they are longer term (5-10 years), are intended to develop a programme of research based on strategic needs in their fields, and aim to institutionalise collaborative partnerships between the public sector, business and academia. Unlike other TEKES grants, which are typically awarded to individual enterprises or academic institutions, they function as consortia with their own strategic areas of focus. There are six centres currently in operation, based on the following themes: forestry (Forestcluster), information and communication industry and services (TIVIT), metal products and mechanical engineering (FIMECC), energy and the environment (CLEEN), built environment innovations

(RYM) and health and well-being (SalWe). They exist both as physical facilities and as coordinators of networks in the field, and provide piloting and testing facilities.

4.5.5 Discussion and implications

One of the main insights from the Finnish innovation system is the important role played by the government, which has a policy of active engagement in the innovation system. The existence of a national Research and Innovation Council, headed by the Prime Minister, to oversee innovation policy across different ministries and agencies, also signals the importance placed on innovation by the central government; the Innovation Platform in The Netherlands was partly inspired by the success of the Finnish approach. The Council follows a Triple Helix model, although this feature is not institutionalised at lower levels of decision-making, as it is, for instance, in the North Brabant region in The Netherlands. A focus on innovation is also evident even at the level of municipalities, many of which offer information and support services for business in their areas, although a recent evaluation of the Finnish innovation system found significant overlaps and complexity in the administration of innovation policies. Unlike in other European countries such as Germany or The Netherlands, in Finland there is more of a focus on centralised decision-making, with little room for regional policy beyond the very local level. This approach may be effective in the Finnish case because of the country's small size (5.4 million residents) and the fact that most of the population is concentrated in the Southern region.

The innovation funding agency TEKES plays a crucial role as an intermediary, not only in funding research projects, but also bringing together businesses, universities and research institutes (through its SHOKs programme), and promoting the flow of ideas and the creation of networks. TEKES acts as a counterpart to the Academy of Finland, which funds academic research. A key element in the success of TEKES is that the project proposals it receives are evaluated by experts on the basis of business merit (rather than the technological or scientific merit).

The existence of the research institute VTT is also a significant asset for the Finnish innovation system, and is of a size and quality not found anywhere in Europe. However, the creation of the institute was based on existing organisations and involved years of substantial investment, so it is

doubtful whether an institution of its size and quality could easily be created from scratch elsewhere. The key to the success of the VTT derives from its focus on applied research, and its success in generating substantial income through services provided to private clients, allowing it to stay at the cutting edge of technology research without competing with blue skies research being conducted at the universities.

4.6 Western Sweden

4.6.1. Background

The NUTS 2 region of West Sweden (*Västsverige)* consists of two counties - Västra Götaland and Halland – accounting for 16.8% and 3.2% of Sweden's population respectively. Västra Götaland, which includes the city of Gothenburg, is the second largest metropolitan city-region in Sweden after Stockholm. It also has the second highest GDP per capita after Stockholm. In terms of employment share, more than 20% of Swedish employees work in Västra Götaland and Halland combined.

The region is mainly specialised in medium-high-technology manufacturing such as automotive industry, trucking and shipbuilding, as well as textiles and energy sector (OECD, 2010). Car manufacturers such as Saab and Volvo both have their facilities here. The region is a major transport and logistics hub, accommodating Scandinavia's biggest port in Gothenburg. Because of its historical dependency on large manufacturing sectors, Västra Götaland has a long and relatively volatile history of structural change.

West Sweden is one of the most innovative regions in Europe, especially in relation to business R&D intensity measured as the ratio of R&D expenditure to GDP. It also scores high in terms of patenting and R&D intensity in the higher education sector (OECD, 2010). The region is a home for the University of Gothenburg which is one of the largest higher education institutions in Northern Europe, carrying out teaching and research in most academic fields. The Gothenburg University is closely linked with another world class university located in Gothenburg, the Chalmers University of Technology, which specialises in engineering, natural sciences and architecture. The two universities have well established links with the industry and public sector

and share a number of research and education facilities. Also, the region's University of Borås is renowned for its breakthrough research in textile technology.

4.6.2 Governance Structure

In the past Sweden's system of governance was often compared to an "hourglass" (McCallion, 2007; OECD, 2010) in which the national government and the municipal level held the majority of powers, while the regional level remained weak. Since the late 1990s, this hourglass governance system has undergone a substantive change, with two pilot regions being given a full set of competences for regional development. One of such pilot regions is Västra Götaland, where a directly elected regional council took over responsibilities for regional development from the county administrative boards, led by the central government. The regional council also took responsibility of former county councils in relation to health and transport. The pilot regions model is now recognised as a success and the Swedish government supports its extension to all regions wishing to follow Västra Götaland and another pilot region of Skåne. Halland's authorities have already validated their application to transform the county to the region with extended governance responsibilities.

The introduction of pilot regions was followed by the creation of fourteen regional co-ordination bodies. Each of these bodies represents a voluntary association of all of a county's municipalities. They are indirectly elected and funded by a member fee as well as the national government in relation to the tasks taken over form the county administrative boards. The areas of responsibility of regional co-ordination bodies is defined by their members and may include regional development co-ordination and infrastructure planning, public transport, culture, tourism and international co-operation.

Overall, the way in which Swedish governance structure evolves reflects bottom-up demands for regionalisation. The national government does not offer one model for all counties. Instead, it supports different governance options with different degrees of devolution of power for different regions.

4.6.3. Innovation Policy Framework

Innovation policy in Sweden is driven by regionalisation of economic development and industrial policy. Before the mid-1990s, innovation policy was primarily a national concern. Then more power was given to pilot regions and regional co-ordination bodies to design and implement innovation policies in their territories. Each of the regions in Sweden is invited to produce Regional Development and Regional Growth Programmes which should provide a holistic picture of long-term and sustainable regional growth as well as funding and implementation modalities, with regional innovation system development being an important component of these programmes.

At the national level, in the last decade there has been a clear shift in both the regional and innovation policy paradigm from targeting lagging regions to promoting opportunities and exploiting unique strengths in all regions. As a result, since the early 2000s the central government has focused on the development of bottom-up regional innovation programmes (such as VINNVÄXT) which concentrate on locally identified regional competitive advantages, provide long-term process support mechanisms rather than one-off cash injections, and enforce triple-helix type collaborations between industry, academia and the public sector. One result of this bottom-up approach is a very heterogeneous pattern of triple-helix arrangements deployed by regional innovation system players. These may well include the open innovation model such as that developed for “interactive innovation platforms” in Västra Götaland (VG, 2009).

The Swedish innovation policy is no longer prejudiced against non-R&D intensive sectors and progressively promotes innovation in a broader sense. After pursuing a technology-based, R&D intensive industrial policy in 1990s, which has resulted in the creation of world class science parks, technology incubators and specialised research institutes, Sweden in its current innovation policy attempts to link the rest of the economy to the existing excellence in science and R&D. There are no specific innovation support programmes targeting non-R&D sectors in Sweden, nor do restrictions exist for these sectors to participate in publicly funded innovation programmes. The “conventional” sectors such as agriculture and forestry, textiles, food industry, tourism, maritime and creative industries are integral part of multi-sectoral innovation programmes currently run in Sweden.

In relation to innovation policy and its implementation, one important institution is the Swedish Governmental Agency for Innovation Systems (VINNOVA). VINNOVA was established in 2001 as part of a comprehensive reform of Swedish research councils and agencies (Eriksson, 2006). The purpose of the reform was to consolidate research funds within fewer and larger research funding councils and agencies. The Swedish Research Council and VINNOVA are now two key pillars of the new research funding system. The former focuses on fundamental research and has a budget of €360 million (SRC, 2008), whereas VINNOVA supports demand-driven research and innovation. VINNOVA has an annual budget of around €213 million and employs around 200 people (VINNOVA, 2010).

VINNOVA's particular focus is on promoting triple helix collaborations between industries, the science base, and the government across the country and in each of the regions. Its main areas of activity include support of commercialisation activities in the university, funding of R&D and radical innovation for SMEs, development of international innovation networks, raising awareness of the importance of research and innovation for economic growth and prosperity. VINNOVA runs a number of programmes in six major fields such as ICT (approximately 20% of the budget), services and IT implementation (10%), biotechnology and life sciences (20%), manufacturing and materials (20%), transport systems and automotive industry (20%) and working life sciences (10%). The programmes are aimed at all main innovation system players such as universities (approximately 40% of the budget), research institutes (30%), and companies (20%). Other recipients include local and regional authorities and individuals (10%).

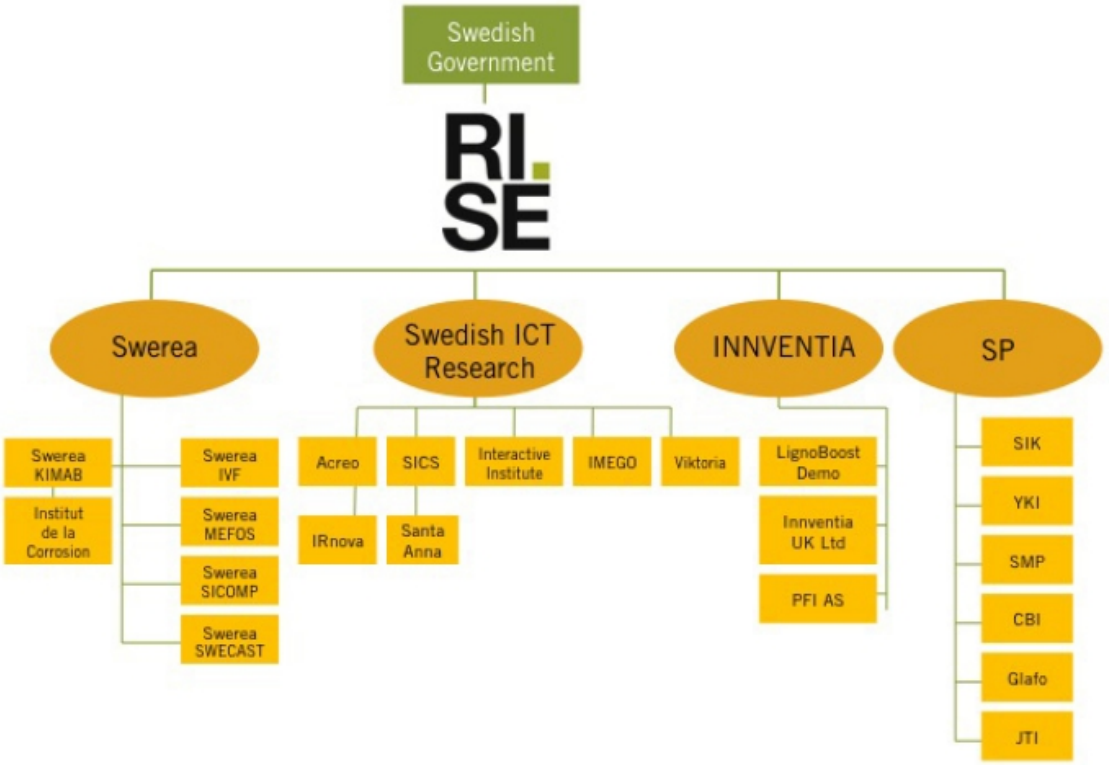
At the regional level, VINNOVA's triple-helix initiatives are complemented and strengthened by regional programmes. In Västra Götaland, the regional authorities have identified five platforms for co-operation between businesses, academia and municipalities (OECD, 2010). The platforms are being developed around five world class science parks in the region. The sectoral and research profile of the platforms is defined by the traditional regional specialisms in industry and research. These include automotive and air transport, health, life sciences and clinical research, ICT and visual technology, energy and environment, shipping and maritime sector, creative industries, new materials and textiles. To successfully develop these key regional sectors and

identify future promising segments within them, the Västra Götaland regional authorities try to link the regional innovation platforms with appropriate EU programmes to form so called “smart partnerships”. Essentially, the smart partnership approach is a way to identify and make maximum use of existing synergies between regional, national, and European innovation support instruments.

One more important player in Sweden’s national and regional innovation system is a well developed and geographically dispersed network of Industrial Research Institutes of Sweden (RISE). RISE is owned by the Government and managed by recently rebranded RISE Holding – the various organisations within the RISE network are shown in Figure 13. About 60% of funding for Industrial Research Institutes comes from industry, 30% is from the government and 10% is from the EU. The government funding is mainly used to strengthen the institutes’ engagement with both industry and the university and to promote international R&D programmes.

Swedish Industrial Research Institutes have been consolidated into four large groups such as Swerea (R&D, training and consulting for manufacturing), Swedish ICT Research, INNVENTIA (R&D in paper, pulp, packaging, graphic media and bio-refining) and SP (R&D and testing along the innovation chain in a number of areas including building and construction, ICT, energy and environment, fire, safety and security, food, pharmaceuticals and biotechnology, materials and chemistry, measurement technologies, mechanics, automotive industry, wood technology). These four institutes employ about 2000 people and generate a turnover of about MSEK 2000 (approximately £190 million), and of this, SP accounts for approximately half (SP, 2009). Appendix E provides further details on Swedish research institutes in terms of funding and staff.

Figure 13: The Swedish Industrial Research Institutes Network



Source: RISE (http://www.ri.se/en/about-rise)

4.6.4 Highlighted Initiatives

VINNVÄXT – Regional Growth through Dynamic Innovation Systems

VINNVÄXT is a programme designed and implemented by VINNOVA. The aim of the programme is to promote sustainable regional growth through developing internationally competitive research and innovation milieus in focus areas (Andersson et al, 2010; OECD, 2010). The focus areas should reflect specific regional comparative advantages and are not limited to high-technology sectors. The programme takes the form of a competition of regions. The notion of a "region" is defined in functional terms as the groups/coalitions/partnerships applying to the programme and the location of their core competencies and supporting (business, technological etc.) activities (VINNVÄXT, 2001).

The programme requires its participants to clearly identify a particular innovation system which should be supported, its capabilities and shortcomings. To develop this innovation system and make it internationally competitive, the participants are required to form and sustain triple helix collaborations between private, public and research sectors. It is the participants who also identify the focus areas based on existing or potential regional strengths.

The prospective participants (applicants) of the programme are any companies, organisations, networks or cooperative groups which are capable of developing a strategic concept and implementation plan for one of the three broad categories of regional innovation systems, such as those: (1) where *existing* regional strengths already represent internationally established competitive environment; (2) where *existing* regional strengths are not yet translated to internationally competitive innovation system but there is a strong potential for that to be achieved, and; (3) where there are *potential* regional strengths to build on internationally competitive environment.

The successful applicants need to rely on local knowledge and initiative to gather support and commitment from all important innovation system players such as the business community, research organisations, policy makers and public administration. Applications are reviewed by a group of INNOVA experts from and outside VINNOVA. Interviews are conducted by the programme management. Final selection is made by a triple helix type steering group.

The programme's focus on regional innovation systems rather than particular sectors encourages intensive cross-sectoral activities of the participants (OECD, 2010). For instance, the programme support for the development of a given innovation system would cover activities which improve process management, develop future-oriented processes and technological scenarios, accumulate expertise in the fields of learning, network organisation and leadership. Once the regional innovation system is developed enough, it is expected that the regions will take the full responsibility for its support, whereas VINNOVA will concentrate on needs-driven R&D.

The programme target is for at least 50% of the funding to go to needs-driven research within the identified focus areas. The winning regions receive funding of up to SEK 10 million per year (approximately £950,000) for a period of 10 years. It is a programme requirement that VINNOVA's funding should be matched by that from regional sources, making it SEK 20 million (approximately £1.9 million) per year in total. The funding is provided for periods of 3.5 years, with the possibility of further extensions based on the assessment of progress reports.

The programme began in 2001 and since then twelve winners have been selected. Of these, GöteborgBIO and Smart textiles came from Western Sweden. The former focuses on converting bio-medical research outputs into practical applications within the health care system. The latter is particularly interesting as it aims to keep and strengthen the long-standing textile identity of the Sjuharad region by lifting it to another level, i.e. smart textiles. Table 3 provides details on the VINNVÄXT programmes and their focus areas.

When it comes to the evaluation of the projects, the programme recognises that the development processes being supported take a long time to implement and that the results, such as increased growth will only be seen after a relatively long period of time. The success of the programme is, therefore, tracked using measurements and indicators which describe the process and the structural and institutional changes considered to be important preconditions for future growth (VINNVÄXT, 2001).

In the short term (after 1 year), it is expected that the approved projects will have established effective management, control and coordination processes, that the most important players in the innovation system are involved and committed and that the necessary resources are available. It is also expected that the projects can influence priority setting in each segment of the triple helix to achieve development objectives. In the medium term (after 3-6 years) the projects should be able to demonstrate clear positive changes in a number of selected project specific indicators of innovative capabilities and international competitiveness. Among such indicators can be the number of new companies attracted to the regions, number of start-ups in the focus area, increase in triple helix cooperation, increase in access to national and international R&D capacity. In the

long term (after 12 years) the programme is expected to make a significant contribution to sustainable growth in the functional regions and the establishment of an internationally competitive and sustainable innovation system.

Overall, what makes VINNVÄXT stand out is its bottom-up approach in identifying focus areas as well as its emphasis on process support rather than one off cash injections. This helps to make locally identified innovation systems sustainable and increasingly competitive in the long-term. The programme requires its participants to develop triple-helix network-based working arrangements which in many instances resemble open innovation approach, with new goods and services being developed through cooperation of multiple economic players. These arrangements are protected from the outset through the respective intellectual property rights agreements (VINNVÄXT, 2010)

Table 3: VINNVÄXT projects

Topic	Region	Description
ProcessIT Innovations (www.processitinnovations.se)	Luleå/Umeå	Developing new services and products in mining,steel, paper and pulp and manufacturing industries based on ICT. Involves processing and manufacturing industries, the universities of Umeå and Luleå, and ICT companies in Västerbotten and Norrbotten.
Biomedical Development (www.goteborgbio.se)	Western Sweden	Converting cutting-edge innovation into practical applications in biomaterials, cellular therapy, and cardiovascular and metabolic diseases.
Triple Steelix (www.triplesteelix.se)	Bergslagen	Increasing expertise in steel materials, steel processing, nanotechnology, industrial IT, the environment and energy efficiency. Involves major companies such as Sandvik, Outokumpu and SSAB.
Fiber Optic Valley (www.fiberopticvalley.com)	Hudiksvall	Developing and testing products and services based on fiber optics. Offering a test bed with contracted test pilots, qualified evaluators, research, training, business models, behavioural analysis, statistical models and an advanced fiber laboratory.
Hälsans Nya Verktyg (New Tools for Health) (www.halsansnyaverktyg.se)	Östergötland	Developing individually adapted solutions in distributed care, personal care and sports.Involves some 60 companies, the municipalities in the county, the county council, the regional association Östsam, NGOs, Linköping University and research companies.
Uppsala BIO (www.uppsalabio.com)	Uppsala	Promoting the growth of diagnostics, tools for biotechnological research and pharmaceuticals.Involves the local biotechnology industry, the university and the public sector.
Robotdalen (Robot Valley) (www.robotdalen.se)	Mälardalen	Fostering research, development and manufacture of industrial, field, and medical robotics. Mobilising major companies such as ABB, Atlas Copco and Volvo.
Food Innovation at Interfaces (www.innovationigransland.se)	Skåne	Increasing the return on investments and value generation in the foodstuffs industry (e.g. food for schools and hospitals), based on interdisciplinary and cross-border research.
Biorefinery of the Future (www.processum.se)	Örnsköldsvik-Umeå	Developing new bio-based green products, chemicals and fuels as well as new energy solutions from industrial process streams based on forest raw materials and energy crops.
Peak of Tech Adventure (www.peakoftechadventure.se)	Åre-Östersund	Promoting R&D in winter sports, tourism and outdoor pursuits. Involves two international competence centres for the tourism industry (ETOUR) and winter sports (Swedish Winter Sports Research Centre).
Smart Textiles (www.smarttextiles.se)	Sjuhärad	Designing, developing and producing nextgeneration textile products (e.g. Greenhouse fabrics, wound care products and soundinsulating textiles) by joining different competences (e.g. textile materials, electronics and medicine).
Printed Electronics Arena (www.printedelectronicsarena.com)	Norrköping/Linköping	Commercialising and exploiting printed electronics (e.g. displays and sensors for packaging and security industries).

Source: OECD (2010)

Innovationbron – Innovationbridge

Innovationbron AB is a public non-profit company formed and owned by the Swedish state. It employs 60 people and has an annual budget of around 300 MSEK (approximately £28 million). The company's role is to complement the market and assist individual projects and start-ups at the very early stage of development. Its target group are researchers, innovators and entrepreneurs facing the challenge of translating ideas to market place.

When it comes to identifying commercially promising ideas, Innovationbron relies on its well established regional and national networks of researchers, businesses, entrepreneurs, local and national policymakers and funding bodies. Innovationbron has a strong regional presence, which makes it possible to meet individual researchers and entrepreneurs locally and offer them early advice and idea verification. Typically, a successful recipient of Innovationbron's support would be an individual who has an innovative research-related business idea, which could be easily grasped and scaled, with a clearly defined target market, which is mature enough to ensure business growth. There should also be clarity about capital needs and intellectual property rights (Blomberg, 2010).

Innovationbron provides support in the form of seed funding combined with advice on business concept, business model development, and technology, market and economic potential of projects. The aim of seed funding is to assist an individual or start-up with advancing potentially promising research-related business ideas at the early stage of development when financing is difficult to obtain. Seed funding is provided in collaboration with other private and public investors at local, national and international level. For instance, one of the collaborators is VINNOVA.

In relation to a particular business idea or start-up, the Innovationbron's goal is to engage investors, customers and partners with the respective business development process. Meanwhile, entrepreneurs should focus on technology and company development rather than looking for investors. Technology and market development support is provided via Innovationbron's

network of experts - researchers, businesses and agencies (Blomberg, 2010).[13] Innovationbron gradually withdraws its support for start-ups as private investors pick it up.

Innovationbron also runs a national programme for incubators, which provides start-ups with operational funding, process development support, business expertise and competence enhancement tools such as business coaching, customer contacts, team training (Blomberg, 2010). In Western Sweden, Innovationbron is engaged with incubators specialising on ICT, biotechnology, management and entrepreneurship. Among the indicators used by Innovationbron to measure success of the incubator programme are: the number of new companies and projects; the proportion of companies with private capital; and the revenue and employment in incubator companies.

Regional Network of Interactive Innovation Platforms (Västra Götaland)

The Västra Götaland regional innovation strategy has identified three broad and inter-related priorities such as entrepreneurship, innovative SMEs and research-based clusters (VG, 2009). To implement this strategy, the regions stakeholders representing industry, academia and municipalities have introduced five "platforms" for interactive research and technology development and open innovation. The platforms have been selected based on traditional regional strengths in industry and research. They have been formed using the existing network of science parks in the region. These science parks, which are partly owned by the regional government, have been transformed to open platforms for the development of dynamic innovation clusters as well providing innovation support to new and existing SMEs.

The five science parks involved are Espira in Boräs which builds on the textile history of this area and close co-operation between the local university and local businesses, Sahlgrenska Science Park specialising in biosciences and medicine and closely connected with the University of Göteborg and the Chalmers University of Technology, Lindholmen Science park co-operating with the Chalmers and automotive and ICT industries, Innovatum Technology Park in

[13] See also www.innovationbron.se

Trollhättan/Vänersborg area which specialises on audiovisual technology, media, energy and eco-technology, and Gothia Science park which is developing ICT and gaming technology and also linked with agricultural industry and the university college in Skövde (OECD, 2010)[14].

These new type science parks are creative environments which bring together SMEs, large companies, universities and research institutes in order to jointly generate innovation, produce new technologies and support business development. The science park innovation platforms are of particular benefit for SMEs, providing high-technology infrastructure (such as labs and testing facilities) and organisational support involving project management, entrepreneurship training, financial and business expertise. The platforms engage SMEs with university research and innovation projects of large companies, regionally, nationally and internationally. Large companies benefit from the resources on platform if they relocate their projects from their closed premises to open co-development platforms. The platforms also develop linkages with equivalents all over the world in order to create critical mass for innovation accessible to its members. To make sure that the open innovation model works smoothly, the platforms operate elaborated models to manage and share intellectual property rights.

The network of open innovation platforms is a strategic regional initiative. However, the specific projects implemented within this initiative rely on multiple funding sources including the region itself, the central government, the EU structural funds and research programmes, as well as interested large companies. For instance, the smart textiles platform is funded by the region, VINNOVA's VINNVÄXT programme, industry and the EU structural Funds. Through the smart textile platform, the Västra Götaland region plays a leading role in CROSSREXNET Textiles, which is a FP7 ERA-NET project involving fifteen regional and two national funding agencies across Europe (VG, 2009). These co-operate to make more funding available to European textile research and industry.

[14] See also www.vgregion.se

Industrial Dynamics (Västra Götaland)

The programme started as an EU funded INTERREG project. The aim of the programme is to support existing SMEs in terms of innovation, technology, market and business development, provide them with access to the research expertise of universities, research institutes and industrial development organisations, and help them navigate within existing EU initiatives and funding schemes (EU, 2010)[15]. The programme is operated by region Västra Götaland and recognised by the 2009 Assembly of European Regions' Innovation Award.

The programme operates as a network of the region's twelve research and science base institutions such as universities, institutes and technical centres. Innovation experts from these institutions approach active companies in the region, hold development discussions with them, conduct analysis of their development needs, provide problem-solving advice, and help initiate business development process.

The target group are the region's industrial companies with no more than 250 employees. Larger companies can be included in the programme as long as they are closely linked with the SMEs concerned, for instance, via supply chain. SMEs that are members of large company groups can be included in the programme if they operate under the same conditions as privately owned SMEs.

The programme finances the outreach activities only. The development work is financed by SMEs themselves. The programme, however, helps SMEs make full use of all available alternative sources of finance at regional, national and European level. The programme has been motivated by the fact that the SMEs sector in Västra Götaland remains disadvantaged in terms of engagement with multi-level research and innovation networks. This is definitely the case with Northern Ireland too. In this regard, the introduction of the scheme similar to Industrial Dynamics could be one of the innovation policy options considered.

[15] Please see also http://www.vgregion.se/en

Innovationvast.se (Västra Götaland)

Innovationvast.se is a gateway to regional innovation system of Västra Götaland, all its key players, funding bodies and programmes. The website is jointly maintained by the Regional Council, Innovationbron AB and private venture capitalist firm ALMI West AB.

4.6.5 Discussion and implications

Excellent innovation performance of West Sweden can be linked to success of the devolution of power experiment which started in the mid-1990s. Sweden has developed an asymmetric approach to the regionalisation processes by offering different options for different regions, depending on aspirations of each region. This bottom-up approach led to the creation of the pilot region of Västra Götaland, with the full responsibility for regional development being transferred to the Regional Council. Correspondingly, innovation policies here are based on local knowledge and shaped by the Regional Council in co-ordination with business representatives, universities and industrial research institutes. They tend to be integrated for co-funding purposes with programmes designed by VINNOVA, other central government agencies and EU structural programmes.

In relation to the regional innovation policy designed by the central government, it is quite striking to see the dominance of a bottom-up approach too. In most cases, it is up to local innovation system players to choose sectoral profile and geographical boundaries for national innovation support programmes. The role of national agencies in such programmes is usually limited to the organisation of selection process, monitoring and assessment.

Another observation from Sweden is that an academic concept of Triple Helix collaborations has been very effectively implemented into practice across sectors and geographies. Every single innovation or development programme on both regional and national level has a requirement for an active involvement of all key innovation system players such as businesses, universities and government. Interestingly, another popular academic model which is the open innovation concept is successfully making its way from academic journal pages to regional innovation practice in Sweden.

Finally, it is a proactive approach which makes regional and national innovation programmes so successful in Sweden. This includes ongoing scanning of the local economy and science base for potentially promising and competitive segments, approaching individual companies to assess and solve their innovation related needs, complementing market failure (if needed) to support early stage start-ups, linking regional and local innovation networks with its national and international equivalents.

4.7 Summary

Regional innovation policies vary across the EU reflecting differences in economic structure, culture, institutional frameworks and growth dynamics. But despite this variety there is evidence that the case study regions have shifted from a Mode1 policy framework to a Mode 2 framework. There is an increasing focus on building collaborative structures – with the development of triple helix initiatives or structures being particularly prominent. Universities are increasingly playing a central role in local innovation systems – although other economic actors can also play an important anchoring role (such as Philips in North Brabant).

The focus on open innovation has also been growing – being a prominent feature in as North Brabant, Etelä-Suomi and Västsverige. Furthermore, the highly innovative regions (Etelä-Suomi and Västsverige) are moving towards wider innovation – embracing traditional sectors and support for multiple forms of innovation. But two points should be stressed. First, the size and extent of interventions also vary – with the initiatives in Finland and Sweden being larger in scale and using greater financial and human resources than many initiatives in the other regions. Second, there is no simple causal process between choice of innovation instruments and subsequent innovation performance. Instruments and policies need to support an evolving innovation ecosystem. As such, the larger scale and more widespread initiatives in Sweden and Finland have, in part, co-evolved with the structural transformation of the economy. But what should also be added is that many initiatives, such as those in North Brabant, has also supported and enabled structural transformation and the upgrading of the regional economic structure.

5. Implications for innovation policy in NI

5.1 Background

Prior to the current recession the Northern Ireland economy had grown rapidly during the previous twenty five years compared to the rest of the UK (IREP, 2009). Despite good overall growth in terms of output and employment, the economy still lags behind most of the rest of the UK in terms of productivity - with Gross Value Added (GVA) per capita remaining around 80% of the UK average since the mid 1990s.

The productivity gap reflects both lower individual sectoral productivity (compared to the UK average) and also the structural composition of the Northern Ireland economy which has a relatively higher share of low productivity sectors compared to the rest of the UK. According to Oxford Economics (2007), two-thirds of the productivity gap in 2004 could be explained by lower productivity in individual sectors with the rest of the gap explained by the industrial structure of the Northern Ireland economy.

The industrial composition of the Northern Ireland (relative to the UK) is shown in Figure 1 above. As this shows, the Northern Ireland economy has a relatively large public sector (education, health and public administration). This is a sector where it is particularly difficult to reliably measure productivity. Other relatively large sectors include health, agriculture, construction, retail and manufacturing. The sectors that are relatively small compared to the rest of the UK include business services, transport and communications, other personal services and finance. Another important industrial characteristic of the Northern Ireland economy is a strong reliance on micro and SME firms and relatively few larger enterprises.

In terms of overall economic performance and productivity in particular, there are a number of key 'drivers'. According to HM Treasury the five main drivers are investment, enterprise, innovation, skills and competition. In terms of the innovation driver, there has been concern that the Northern Ireland economy has been underperforming. According to the Independent Review of Economic Policy (IREP, 2009, p.35) 'it is a matter of some concern that levels of BERD in NI manufacturing have lagged further behind the UK average in recent years…… Leading research

economies, including Finland and Sweden, now have levels of BERD five to six times higher than in NI'.

Although it is important to highlight the low levels of private sector R&D in the Northern Ireland economy, there are important caveats that should be noted. First, private sector R&D is highly concentrated in specific sectors – such as pharmaceuticals and aerospace – thus some of the low level of R&D in the Northern Ireland economy will, at least in part, be a reflection of industrial structure rather than an endemic weakness in terms of innovation. Second, R&D is only one indicator of innovation – it fails to capture many of the wider notions of innovation and is a poor indicator of innovation activity in many sectors such as services (see discussion above). Third, Northern Ireland has a number of advantages that will help it promote innovation and economic growth in the future.

Northern Ireland's innovation advantages have been highlighted by Roper (2009). It is important to highlight two of its most important advantages based on our analysis of the innovation policies in other regions in the EU. First, governance and control over policy is important – often top-down national policies can be inappropriate to the history and needs of local economies. In the Northern Ireland case, devolution means that the Government has significant policy discretion concerning economic policy. This allows the development, and implementation, of a regional innovation policy appropriate to the needs of the Northern Ireland economy. Second, the case studies have highlighted the importance of universities in local innovation systems – with all the case study regions adopting some form of 'triple helix' approach to collaboration and innovation. Northern Ireland has strong universities which not only produce high quality graduates and research – but which are highly connected to other parts of the local, national and international economy. Recent research has shown that Northern Ireland's academics are more highly connected than academics from any other part of the UK (Abreu et al, 2009).

5.2 Current innovation policy framework

There is increasing focus on innovation policy in Northern Ireland. Arguably, Northern Ireland has embarked on a 'regional innovation journey' (Roper, 2009) and policy has moved from rhetoric to action (DETI, 2008). There have been a number of initiatives to support innovation in

the NI economy, many supported through Invest NI (IREP, 2009). Some of the major innovation policy initiatives are outlined below.

5.2.1 Grants for R&D

The R&D Grant scheme administered by Invest NI provides significant financial support for a range of R&D activities. The grant rates vary at the discretion of Invest NI and are determined following an appraisal and an assessment of need for each individual project. The level of funding is also dependent on the type of project and the size of the business. Furthermore, the grants for R&D provide additional assistance for companies wishing to collaborate with others from industry and academia. It is argued that collaboration allows smaller businesses to develop innovative technologies without having to invest in large R&D departments – a development consistent with the open innovation model.

5.2.2 Competence Centre Programme

Competence Centres are collaborative organisations which are led by business to undertake market focused strategic R&D for the benefit of industry. Companies that are members of the Centres are committed to collaborate to engage in high-risk, long-term research. The companies benefit from early access to the intellectual property produced the Centre and from knowledge exchange through the Centre and associated networks. The Centres are supported by individual researchers.

5.2.3 Venture Capital Funds

The Northern Ireland Spin Out (NISPO) initiatives support start-up and early stage businesses in Northern Ireland. The support includes a £5 million venture capital fund, the Invest Growth Fund, which focuses on seed and early stage businesses with high growth potential and a £3 million proof of concept fund, the Invest Growth Proof of Concept Fund, which is funded by Invest NI to provide funding to very early, non-university projects.

5.2.4 Knowledge Transfer Partnerships

Knowledge Transfer Partnerships (KTP) is a UK-wide programme that facilitates and supports the formation of partnerships between business and academic institutions including universities, further education colleges and research organisations. KTPs are focussed on knowledge exchange – through the placement of high calibre graduates – so that expertise within higher education is transferred into the rest of the economy to develop innovative new products, services and processes. KTPs enable new capability to be embedded into a business allowing access to new skills and expertise to improve competitiveness, productivity and performance. They can be used across a wide range of businesses, including micro, small and large businesses, – and organisations from the public and third sectors. KTPs are based on projects undertaken by a recently qualified specialist (the Associate), varying in length from 1 to 3 years (classic KTP) and from 10-40 weeks (shorter KTP), depending on the needs of the business and the objectives of the project. Invest NI commits up to £800,000 per annum to part fund KTP projects in NI.

5.2.5 Small Business Research Initiative (SBRI)

The SBRI aims to use government procurement to drive innovation. It provides business opportunities for innovative companies whilst serving the needs government departments. The SBRI is based on competitions for new technologies and ideas in specific areas which aim to engage a broad range of companies in short-term development contracts. These competitions are supported by the Technology Strategy Board and are made available to businesses on its website[16]. SBRI enables government departments and public sector organisations to procure new technologies through a phased development programme, and also provides paid contracts for business at critical stage of product development.

5.2.6 Innovation Vouchers

Innovation vouchers are designed to enable small Northern Ireland enterprises to access knowledge and expertise to develop innovative solutions to business issues. The programme provides a voucher of up to £4000 to enable small enterprises to engage with one of the

[16] http://www.innovateuk.org/deliveringinnovation/smallbusinessresearchinitiative/competitions.ashx

universities, colleges and other publicly funded research organisations throughout Northern Ireland and the Republic of Ireland. A business may apply for up to three vouchers for different projects.

5.2.7 Matrix

Matrix is the Northern Ireland science and industry panel which has been formed to advise Government on the commercial exploitation of R&D and science and technology. Matrix is a business led organisation which identifies key areas of science, technology and innovation where Northern Ireland has a competitive advantage and advises on the policy required to exploit these strengths and improve economic performance. One of Matrix's major initiatives includes the development of 'Industry-led Innovation Communities' (IICs) to facilitate co-operation and knowledge exchange and to foster innovation - the seedbed of which is the Collaborative Network Programme (see below).

5.2.8 Collaborative Network Programme

Invest NI's Collaborative Network Programme (CNP) supports collaborative behaviour to improve business performance - this can include collaboration with other businesses, academia and training providers. With the programme, a collaborative network must have a minimum of four NI-based private sector companies, but may also have other partners from both within Northern Ireland and beyond.

The programme supports network development at various stages of development: embryonic - early stage of growth with no formal structure in place; established with further growth potential; mature – but with growth possibly stalled; and declining – but with the potential for renewal.

The programme supports a range of activities:

- Lead facilitators - support for individuals to galvanise a network with a key theme
- Support for lead facilitators - administrative, training, information support for Leaders to allow them to develop the collaborative network at a faster rate than otherwise would be possible.

- Training lead facilitators, network members and the wider business community to enable participants to contribute fully to the network.
- Tools for collaborative networks - analytical and developmental tools that can be used by lead facilitators across NI
- Facilitation of networks through activities such as facilitated workshops, study visits etc
- Promotion of networking and clustering - use of targeted workshops market or sector specific events to raise the potential for innovation or risk reduction by participating in a network.

5.2.9 Current Policy: Commentary

There are two general strands to the support for innovation in Northern Ireland. First, support for R&D (or related forms of innovation expenditure); and second, support for collaboration and knowledge exchange. This suggests that although much of innovation policy is based on a Mode 1 framework, there has been some shift towards a Mode 2 framework. This raises a number of issues with respect to whether this shift has yet gone far enough and whether it should be accelerated? First, whether support for innovation is too focused on financial incentives and a grant culture - and whether it may be appropriate to shift the focus to more targeted support for the innovation system rather than support for individual businesses? Second whether the balance between support between R&D and knowledge exchange is appropriate? It may be beneficial to shift the balance further towards better knowledge exchange and increased connectivity in the innovation ecosystem - as R&D tends to be only concentrated in specific parts of the economy (in particular, high-tech manufacturing) and because the shift to open innovation systems indicates the importance of the encouraging knowledge flows and the exchange of ideas.

5.3 A Way Forward: Implications for future policy developments

5.3.1 Guidelines: building a networked economy

The empirical analysis of innovation performance across the EU and the lessons from the case study analysis indicate a number of important guidelines for policy formulation.

Adopt a systems approach

It is important to recognise that innovation evolves from a complex set of relationships among actors within an innovation system – such actors include businesses, universities and the policy community. Innovation policy in the Swedish case shows that policy should develop to support the development of the system with particular focus on addressing 'structural holes' which prevent the system operating effectively.

Importance of local economic structure

Policy development must reflect the key sectors in the local economic structure. Even when these may be traditional sectors they have the potential to be upgraded and transformed into fast growth and innovating sectors. It is a significant policy challenge to develop new industries from scratch rather than exploiting and developing existing competitive advantage. For instance, the innovation policies in both Liguria and Schleswig-Holstein have been based on exploiting current economic strengths to help revitalise the economy. Similarly the policy in North Brabant developed in response to economic crisis and the need to rejuvenate the local economic structure.

Adopt a broad notion of innovation

Traditionally, innovation has focused on product development in high technology manufacturing. This is, however, only part of the innovation spectrum. Innovation not only includes product development but also includes process innovation and innovation in business practices. Furthermore, innovation is not restricted to high technology manufacturing but it is also important in the rest of manufacturing and the service sector. One of the limitations of policy in some of the case study regions is that innovation in services remained on the margins of the policy debate and has not benefitted significantly from policy initiatives. Where policy is tending to encompass broad notions of innovation include the more advanced regions of Västsverige (Sweden) and Etelä-Suomi (Finland).

Foster connectivity and openness

A knowledge-based economy requires the effective movement and exchange of ideas and knowledge. The focus on open innovation illustrates the benefits of knowledge moving in and out of businesses and between other actors in the economy such as universities. Building a

connected and open economy, however, is not easy or costless. In particular, connecting to sources of ideas and expertise is particularly difficult for SMEs – as these firms often lack the information about how to connect and the resources to initiate and manage connections. Furthermore, the evidence from the case studies indicates that many older firms (often in traditional sectors) are resistant to changing their business practices and are also reluctant to become more open. Thus, building a networked economy requires investment - either in individuals who can develop and facilitate networks - or to build intermediary institutions with skilled staff. The importance of building connectivity is apparent in all the case study regions with a variety of initiatives and institutions. But it should be noted that many such institutions require significant resources and investments: for instance TEKES in Finland has an annual budget of €600 million - although other institutions are more modest in scope and resources – the ISH in Schleswig-Holstein has an annual budget of around €3-4 million[17].

Importance of key regional economic anchors

Globalisation and economic volatility have created challenges for regional economies. In particular, these processes have encouraged the mobility of factors of production – as workers and firms move in response to economic shocks and shifts in competitive advantage. This places a premium on the role of local economic 'anchors' – those actors in the production and innovation system that do not move in response to economic change. For instance, the presence and proactive role of Philips is critical to the success of the High Tech Campus in Eindhoven. Many of the most important of these actors include universities and hospitals ('eds and meds') – which can act as important local employers; purchasers of local inputs; suppliers of skilled labour; 'attractors' for other economic actors; and sources of ideas and knowledge. All of the case study regions are building links between their universities and their local economies.

Developing a Triple Helix approach

The Triple Helix approach to innovation policy stresses the importance of interactions between business, government and academia. These interactions encourage knowledge exchange and foster the innovation process to provide social and economic benefits. It is important to develop networks and collaborative institutions that foster the triple helix model. All of the case study

[17] Although due to budgetary constraints, public funding is being terminated at the end of 2011.

regions have adopted some form of triple helix approach – from the less systematic forms in Liguria; to multiple forms, at different levels, in Etelä-Suomi and Västsverige.

Develop bridging networks

When developing networks it is important to ensure that connections are not restricted to the local or regional economy. Instead, networks should be outward looking and seek to build national and global connections. This will ensure access to the best and most appropriate knowledge for economic actors in the local economy. There has been a concern in some of the case study regions that networks tend to be locally focussed – and so there has been a shift to making networks more nationally and internationally connected - as in the case of Schleswig-Holstein and North Brabant.

Governance and policy implementation

The development of an effective regional innovation system requires a local governance system that can shape and implement policy that is appropriate to the characteristics of the local economy. A 'bottom-up approach' is considered to be one of the strengths of the innovation system in the Swedish region of Västsverige; and although it can be argued that Finnish policy is largely centralised it must be taken into account that Finland is small economy, similar in size to many regions in Europe. One of the advantages of the Northern Ireland economy is that devolution allows the development and implementation of a targeted innovation policy – thus policy can be shaped according to the needs of the local economic structure; through local public procurement; and through adjusting the regulatory framework to local needs.

Impact, evaluation and metrics

The case study evidence indicates the challenges of identifying appropriate methods of evaluation – there are a number of different approaches both at the stage of assessing applications and in evaluating the performance of initiatives. This suggests that there are a number of features of the innovation process that need to be factored into when considering impact and evaluation. First, many innovation processes take a long time before they have an impact on standard economic indicators such as GVA or productivity. This suggests care is needed when using metrics in the policy process. Second, many of the important changes in the innovation system are behavioural

or attitudinal – and these are sometimes difficult to capture in conventional metrics. This may suggest the need for a wider range of alternative metrics – which can capture changes in behaviour but also indicate whether policy initiatives are on the appropriate 'trajectory'. Third, some innovation processes are high-risk and may fail – the distribution of success is highly skewed – but those that do succeed can have major social and economic impact. This suggests that some high-risk projects should be considered. The 'fear of failure' is considered as a constraint on innovation in the private sector – but it may also be a constraint on policy initiatives from the public sector.

5.3.2 The Framework and Implementation of Policy

The analysis above provides guidelines for the development of the framework of innovation policy in Northern Ireland. Two points should be emphasised. First, the discussion below is not intended to be prescriptive but to inform the future development of innovation policy. Second, the discussion builds on the 'innovation journey' that is already underway in Northern Ireland. In particular, the lessons from the case studies show the importance of collaboration and connectivity – and these principles underpin the recent development of innovation communities and the collaborative network programme in Northern Ireland. The broad objective should be to continue to build a networked economy that will foster the knowledge exchange process and encourage knowledge-based growth.

Shift from grant support to institutional support

Business support in Northern Ireland has historically been based on grants – and this still applies to many aspects of support for innovation. An alternative is to shift resources to providing institutional support through supporting network development and the creation of collaborative structures. The benefit of structural support is that its objective is to create behavioural change – through encouraging collaboration and the transfer of knowledge. These are benefits that can spread throughout the economy, whereas the impacts of grants are likely to be short-term with the impact diminishing when grants are removed. A number of the case studies show the benefits of building appropriate institutional frameworks that promote innovation. Some of these are large scale with significant funding (such as TEKES with an annual budget of €600 million) – others

are smaller scale such as ISH in Schleswig-Holstein (with an annual budget of €3-4 million). Northern Ireland could consider establishing a boundary spanning institution of a similar scale to the ISH which would help to develop collaborative networks in the local economy (see below).

Development of collaborative structures

Although collaboration is important for the innovation process, there is no automatic mechanism through which the market develops appropriate collaborative networks or structures. A role for policy is to fill this structural hole in the innovation system by creating, or facilitating the development of, appropriate intermediate institutions. Such institutions can be 'industry' or 'market' led but require support and facilitation from the policy domain - and should include all actors in the innovation system including universities. In Northern Ireland, the development of innovation communities and the collaborative network programme are positive steps in the development of a collaborative framework to foster innovation. An important issue is whether such networks or communities should be managed by individual facilitators ('boundary spanners') or a collective institutional framework (a 'boundary spanning' organisation). The benefit of the latter is that in can take a systems perspective (not just the needs of one network); it can promote cross network connections (economy of scope); can deal with peak-load problems (when the needs of one network are high); and can provide a central source of support staff and resources needed by most networks (innovation road mapping, event management etc).

A professional secretariat

Collaborative structures that act as boundary spanners between businesses and other actors in the innovation system require specialist skills – to understand the motives and skills of all parities; to communicate effectively; and to initiate and manage relationships. Thus the establishment of an institutional structure that promotes and facilitates boundary spanning (see above) would require 'T-shaped' individuals – skilled workers who have in-depth sectoral or technological knowledge but also have a wide range of business skills that allow them to connect to other parts of the local innovation system. These skill sets may be in short supply and may require additional initiatives to train specialists (see below).

Training of boundary spanners

There is likely to be increased global demand for such boundary spanning functions and skills - as intermediate institutions grow and develop – and as open innovation spreads throughout the corporate sector. This may provide an opportunity for the Universities in Northern Ireland to develop appropriate programmes to fill the gap in the market. These could take various forms: such as the provision of executive education courses; or the development of a bespoke Masters programme which combines skills in technology and business[18].

Importance of supporting wider innovation

Collaborative structures should not be limited to industries that are perceived to be 'high technology'. All sectors can benefit from improved knowledge exchange and can benefit from lessons from other industries. There should, of course, be prioritisation of those sectors where Northern Ireland has a competitive strength and which are likely to have the largest impact on the economy – but these may include traditional sectors including those in the service sector. This requires two main developments. First, a foresight planning process to establish the areas of: competitive strength, academic excellence and long-term potential - very much along the lines of recent and current Matrix initiatives. Second, policies that are developed should not be narrowly confined to technological innovation or high-technological sectors but should support wider forms of innovation.

Direction, metrics and evaluation

Collaborative structures need to be guided by the needs of the economy – including business, academia and the policy community. Furthermore, such direction should be concerned with long-term developments – and policy should not shift based on short-term changes or temporary shocks to the economy.[19] Moreover, metrics should be embedded into the collaborative frameworks – but they should be used to inform policy and not to direct policy. As the impact of innovation policy is long-term, appropriate metrics include those that capture behavioural change

[18] As an example see the Cambridge MPhil in Technology Policy, see: http://www.jbs.cam.ac.uk/programmes/mphil_techpol/index.html

[19] The cuts in public funding for the ISH in Schleswig Holstein is an example of long term policy being compromised by the short term impact of the recession on public finances.

and those that indicate that the direction of change is on the correct trajectory. Such metrics could be developed based on the data already collected in the Community Innovation Survey – these include behavioural indicators, innovation activities and outputs (at the firm level) such as:

- Growth objectives
- Sources of information
- Collaborative behaviour
- Innovation activities
- Innovation outputs including new products, processes and business practices

The benefits of such indicators is that they more accurately capture changes in innovation practice and they are more appropriate than macroeconomic indicators (such as GVA and GVA per capita) – as the latter can be influenced by external shocks, cyclical changes and other factors - and which may, therefore, distort the innovation picture.

Summary: A Way Forward

Developing an appropriate regional innovation policy depends on economic structure, local culture and institutional structures. As such, there is no one ideal model or perfect exemplars that can be completely replicated in different regional settings. But the lessons from this study of regional innovation in the EU do provide a prospective way forward for the innovation journey in Northern Ireland, which would include the following elements:

- Evaluate whether sufficient foresight planning has been undertaken to establish the areas of competitive strength, academic excellence and long-term potential growth potential in the Northern Ireland economy.
- Develop institutional support for broader innovation and move away from grant support.
- Evaluate the feasibility of establishing a new boundary spanning organisation (or developing existing institutions) that would help to build networks of innovation

communities that would include business, academia and the policy community. Given prevailing budgetary constraints this could at least be partially financed through reducing grant dependency; seeking private sector support; and by providing some services on a fee paying basis.

- Evaluate whether there are sufficient 'boundary spanning' skills in (or that can be attracted to) the Northern Ireland economy that can ensure that intermediary institutions have appropriate skills.

- If there is an existing or potential boundary spanning skills shortage then consider developing specialist educational and training programmes in collaboration with the Universities in Northern Ireland.

- Develop an appropriate system of governance – including a prominent role for business and academia.

- Develop a range of metrics to evaluate projects to support and to understand how initiatives have a long-term impact on innovation, business performance and economic growth.

Appendix A
Table A1 – Euclidean similarity index and Spearman rank correlation index across Regions

Country	NUTS 2	Region	Employment share 2006	GVA share 2006	Employment Spearman 2006	GVA Spearman 2006	RIS Index 2006	Comp index 2006
UK	**UKN0**	**Northern Ireland**	**0**	**0**	**1**	**1**	**0**	**0.0**
UK	UKC1	Tees Valley and Durham	0.06	0.09	0.90	0.89	0.07	0.02
UK	UKC2	Northumberland, Tyne and Wear	0.07	0.07	0.88	0.91	0.07	0.02
UK	UKD1	Cumbria	0.11	0.16	0.94	0.74	0.13	8.8
UK	UKD2	Cheshire	0.15	0.20	0.87	0.80	0.13	8.8
UK	UKD3	Greater Manchester	0.11	0.13	0.83	0.88	0.13	8.8
UK	UKD4	Lancashire	0.06	0.10	0.85	0.81	0.13	8.8
UK	UKD5	Merseyside	0.08	0.08	0.84	0.89	0.13	8.8
UK	UKE1	East Riding and North Lincolnshire	0.07	0.12	0.91	0.86	0.08	8.1
UK	UKE2	North Yorkshire	0.10	0.12	0.95	0.95	0.08	8.1
UK	UKE3	South Yorkshire	0.09	0.07	0.86	0.95	0.08	8.1
UK	UKE4	West Yorkshire	0.10	0.10	0.76	0.91	0.08	8.1
UK	UKF1	Derbyshire and Nottinghamshire	0.08	0.11	0.79	0.90	0.16	11.1
UK	UKF2	Leicestershire, Rutland and Northants	0.12	0.12	0.83	0.94	0.16	11.1
UK	UKF3	Lincolnshire	0.09	0.10	0.92	0.88	0.16	11.1
UK	UKG1	Herefordshire, Worcestershire and Warks	0.14	0.16	0.91	0.89	0.16	2.5
UK	UKG2	Shropshire and Staffordshire	0.09	0.10	0.92	0.93	0.16	2.5
UK	UKG3	West Midlands	0.09	0.11	0.78	0.88	0.16	2.5
UK	UKH1	East Anglia	0.09	0.13	0.95	0.95	0.28	34.2
UK	UKH2	Bedfordshire, Hertfordshire	0.18	0.21	0.85	0.88	0.28	34.2
UK	UKH3	Essex	0.12	0.15	0.89	0.85	0.28	34.2
UK	UKI1	Inner London	0.20	0.29	0.75	0.88	0.18	68.4
UK	UKI2	Outer London	0.20	0.22	0.75	0.91	0.18	68.4
UK	UKJ1	Berkshire, Bucks and Oxfordshire	0.20	0.23	0.86	0.89	0.31	39.9
UK	UKJ2	Surrey, East and West Sussex	0.14	0.21	0.89	0.89	0.31	39.9
UK	UKJ3	Hampshire and Isle of Wight	0.13	0.16	0.87	0.83	0.31	39.9
UK	UKJ4	Kent	0.10	0.12	0.93	0.90	0.31	39.9
UK	UKK1	Gloucestershire, Wiltshire and North Somerset	0.12	0.14	0.86	0.85	0.17	12.3
UK	UKK2	Dorset and Somerset	0.09	0.10	0.95	0.91	0.17	12.3
UK	UKK3	Cornwall and Isles of Scilly	0.08	0.07	0.93	0.92	0.17	12.3
UK	UKK4	Devon	0.07	0.06	0.96	0.91	0.17	12.3
UK	UKL1	West Wales and The Valleys	0.04	0.05	0.95	0.93	0.07	-2.1
UK	UKL2	East Wales	0.07	0.08	0.96	0.89	0.07	-2.1
UK	UKM1	North Eastern Scotland	0.14	0.17	0.76	0.86	0.04	22.5
UK	UKM2	Eastern Scotland	0.07	0.10	0.90	0.87	0.04	22.5
UK	UKM3	South Western Scotland	0.08	0.07	0.87	0.94	0.04	22.5
UK	UKM4	Highlands and Islands	0.10	0.10	0.95	0.78	0.04	22.5
AT	AT11	Burgenland	0.11	0.13	0.93	0.84	-0.12	38.6
AT	AT12	Niederösterreich	0.12	0.17	0.89	0.87	-0.04	38.6
AT	AT13	Wien	0.09	0.21	0.80	0.88	0.27	38.6
AT	AT21	Kärnten	0.09	0.14	0.93	0.88	0.02	11.3
AT	AT22	Steiermark	0.11	0.18	0.94	0.89	0.17	11.3
AT	AT31	Oberösterreich	0.12	0.22	0.90	0.86	0.04	13.3
AT	AT32	Salzburg	0.10	0.19	0.95	0.88	0	13.3
AT	AT33	Tirol	0.14	0.19	0.93	0.83	0.06	13.3
AT	AT34	Vorarlberg	0.15	0.22	0.88	0.86	0.02	13.3
BE	BE10	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest	0.16	0.19	0.73	0.80	0.11	99.3
BE	BE21	Prov. Antwerpen	0.10	0.19	0.81	0.81	0.2	19.8
BE	BE22	Prov. Limburg (B)	0.08	0.14	0.86	0.75	0.2	19.8
BE	BE23	Prov. Oost-Vlaanderen	0.07	0.13	0.76	0.85	0.2	19.8
BE	BE24	Prov. Vlaams Brabant	0.11	0.24	0.88	0.85	0.2	19.8
BE	BE25	Prov. West-Vlaanderen	0.08	0.15	0.77	0.76	0.2	19.8
BE	BE31	Prov. Brabant Wallon	0.09	0.23	0.86	0.85	0.08	-4.2
BE	BE32	Prov. Hainaut	0.12	0.12	0.87	0.85	0.08	-4.2
BE	BE33	Prov. Liège	0.11	0.11	0.88	0.91	0.08	-4.2
BE	BE34	Prov. Luxembourg (B)	0.14	0.11	0.96	0.90	0.08	-4.2
BE	BE35	Prov. Namur	0.16	0.14	0.94	0.89	0.08	-4.2
CZ	CZ01	Praha	0.13	0.18	0.75	0.92	0.29	71.5
CZ	CZ02	Strední Cechy	0.18	0.23	0.80	0.68	0.02	-55.9
CZ	CZ03	Jihozápad	0.18	0.19	0.75	0.72	-0.07	-36.4
CZ	CZ04	Severozápad	0.16	0.20	0.69	0.66	-0.29	-50.0
CZ	CZ05	Severovýchod	0.21	0.21	0.77	0.75	-0.07	-54.5
CZ	CZ06	Jihovýchod	0.17	0.18	0.78	0.73	0.02	-32.8
CZ	CZ07	Strední Morava	0.20	0.20	0.77	0.71	-0.1	-50.1
CZ	CZ08	Moravskoslezko	0.18	0.20	0.61	0.64	-0.17	-32.7

Appendix A (continued)

Country	NUTS 2	Region	Employment share 2006	GVA share 2006	Employment Spearman 2006	GVA Spearman 2006	RIS Index 2006	Comp index 2006
UK	**UKN0**	**Northern Ireland**	**0**	**0**	**1**	**1**	**0**	**0.0**
DE	DE11	Stuttgart	0.14	0.21	0.76	0.72	0.36	44.2
DE	DE12	Karlsruhe	0.10	0.19	0.79	0.71	0.36	44.2
DE	DE13	Freiburg	0.11	0.17	0.79	0.83	0.22	44.2
DE	DE14	Tübingen	0.12	0.17	0.78	0.81	0.31	44.2
DE	DE21	Oberbayern	0.07	0.20	0.82	0.83	0.38	35.5
DE	DE22	Niederbayern	0.11	0.16	0.87	0.81	0	35.5
DE	DE23	Oberpfalz	0.10	0.15	0.89	0.82	0.14	35.5
DE	DE24	Oberfranken	0.12	0.16	0.79	0.81	0.03	35.5
DE	DE25	Mittelfranken	0.09	0.19	0.82	0.73	0.27	35.5
DE	DE26	Unterfranken	0.10	0.16	0.83	0.80	0.14	35.5
DE	DE27	Schwaben	0.10	0.17	0.83	0.82	0.15	35.5
DE	DE30	Berlin	0.10	0.15	0.82	0.82	0.33	22.5
DE	DE41	Brandenburg - Nordost	0.07	0.13	0.93	0.83	0.06	-16.1
DE	DE42	Brandenburg - Südwest	0.07	0.13	0.94	0.83	0.06	-16.1
DE	DE50	Bremen	0.07	0.20	0.76	0.71	0.12	61.6
DE	DE60	Hamburg	0.08	0.25	0.78	0.83	0.14	69.3
DE	DE71	Darmstadt	0.09	0.25	0.82	0.84	0.28	35.5
DE	DE72	Gießen	0.10	0.14	0.80	0.81	0.15	35.5
DE	DE73	Kassel	0.08	0.15	0.85	0.81	0	35.5
DE	DE80	Mecklenburg-Vorpommern	0.08	0.13	0.94	0.83	-0.04	-13.2
DE	DE91	Braunschweig	0.10	0.17	0.79	0.67	0.35	9.7
DE	DE92	Hannover	0.06	0.17	0.84	0.83	0.15	9.7
DE	DE93	Lüneburg	0.06	0.14	0.93	0.82	-0.03	9.7
DE	DE94	Weser-Ems	0.06	0.14	0.92	0.81	-0.09	9.7
DE	DEA1	Düsseldorf	0.07	0.20	0.79	0.84	0.08	14.7
DE	DEA2	Köln	0.07	0.16	0.79	0.85	0.28	14.7
DE	DEA3	Münster	0.07	0.14	0.91	0.84	0	14.7
DE	DEA4	Detmold	0.10	0.16	0.76	0.73	0.02	14.7
DE	DEA5	Arnsberg	0.09	0.15	0.79	0.76	0.02	14.7
DE	DEB1	Koblenz	0.08	0.14	0.85	0.82	-0.03	3.1
DE	DEB2	Trier	0.08	0.13	0.92	0.80	0	3.1
DE	DEB3	Rheinhessen-Pfalz	0.08	0.16	0.85	0.72	0.25	3.1
DE	DEC0	Saarland	0.09	0.16	0.74	0.80	0.03	5.4
DE	DED1	Chemnitz	0.09	0.13	0.83	0.83	0.05	-3.7
DE	DED2	Dresden	0.07	0.13	0.93	0.83	0.28	-3.7
DE	DED3	Leipzig	0.05	0.14	0.93	0.82	0.16	-3.7
DE	DEE1	Dessau	0.08	0.13	0.94	0.81	-0.12	-13.9
DE	DEE2	Halle	0.06	0.12	0.93	0.81	0.01	-13.9
DE	DEE3	Magdeburg	0.08	0.12	0.94	0.83	-0.06	-13.9
DE	DEF0	Schleswig-Holstein	0.06	0.17	0.90	0.83	0.04	-1.1
DE	DEG0	Thüringen	0.09	0.12	0.92	0.81	0.12	-9.0
DK	DK01	Hovedstadsreg	0.12	0.13	0.86	0.91	0.27	39.7
DK	DK02	Øst for Storebælt	0.07	0.10	0.93	0.94	0.27	39.7
DK	DK03	Vest for Storebælt	0.08	0.10	0.93	0.87	0.27	39.7
EE	EE00	ESTONIA	0.13	0.17	0.68	0.87	-0.03	-44.8
ES	ES11	Galicia	0.11	0.12	0.94	0.81	-0.07	-10.0
ES	ES12	Principado de Asturias	0.11	0.13	0.91	0.87	-0.14	-10.0
ES	ES13	Cantabria	0.14	0.16	0.96	0.88	-0.14	-10.0
ES	ES21	Pais Vasco	0.15	0.14	0.83	0.85	0.14	20.7
ES	ES22	Comunidad Foral de Navarra	0.13	0.12	0.88	0.89	0.07	20.7
ES	ES23	La Rioja	0.17	0.15	0.77	0.76	-0.18	20.7
ES	ES24	Aragón	0.12	0.13	0.86	0.78	0.04	20.7
ES	ES30	Comunidad de Madrid	0.07	0.16	0.83	0.91	0.2	38.7
ES	ES41	Castilla y León	0.13	0.13	0.93	0.79	-0.06	-15.7
ES	ES42	Castilla-la Mancha	0.16	0.14	0.81	0.78	-0.24	-15.7
ES	ES43	Extremadura	0.15	0.14	0.91	0.68	-0.24	-15.7
ES	ES51	Cataluña	0.12	0.15	0.85	0.90	0.06	13.5
ES	ES52	Comunidad Valenciana	0.13	0.13	0.83	0.91	-0.05	13.5
ES	ES53	Illes Balears	0.20	0.26	0.86	0.77	-0.25	13.5
ES	ES61	Andalucia	0.11	0.13	0.96	0.82	-0.15	-17.7
ES	ES62	Región de Murcia	0.11	0.10	0.90	0.83	-0.12	-17.7
ES	ES70	Canarias (ES)	0.14	0.18	0.95	0.86	-0.18	-6.6
FI	FI13	Itä-Suomi	0.16	0.15	0.84	0.69	0.08	9.4
FI	FI18	Etelä-Suomi	0.08	0.19	0.90	0.77	0.37	81.2
FI	FI19	Länsi-Suomi	0.13	0.21	0.78	0.65	0.24	38.2
FI	FI1A	Pohjois-Suomi	0.13	0.19	0.85	0.68	0.27	49.4
FI	FI20	Åland	0.27	0.34	0.87	0.84	-0.11	-94.2

Appendix A (continued)

Country	NUTS 2	Region	Employment share 2006	GVA share 2006	Employment Spearman 2006	GVA Spearman 2006	RIS Index 2006	Comp index 2006
UK	**UKN0**	**Northern Ireland**	**0**	**0**	**1**	**1**	**0**	**0.0**
FR	FR10	Île de France	0.11	0.26	0.76	0.86	0.34	91.0
FR	FR21	Champagne-Ardenne	0.10	0.15	0.86	0.71	-0.09	-1.6
FR	FR22	Picardie	0.10	0.14	0.85	0.80	0.05	-1.6
FR	FR23	Haute-Normandie	0.10	0.16	0.82	0.76	0	-1.6
FR	FR24	Centre	0.09	0.16	0.85	0.82	0.05	-1.6
FR	FR25	Basse-Normandie	0.09	0.13	0.89	0.82	0	-1.6
FR	FR26	Bourgogne	0.10	0.14	0.90	0.84	-0.05	-1.6
FR	FR30	Nord - Pas-de-Calais	0.08	0.14	0.84	0.93	-0.07	-11.3
FR	FR41	Lorraine	0.11	0.14	0.84	0.74	-0.01	8.2
FR	FR42	Alsace	0.08	0.19	0.83	0.79	0.14	8.2
FR	FR43	Franche-Comté	0.12	0.17	0.73	0.63	0.1	8.2
FR	FR51	Pays de la Loire	0.08	0.15	0.90	0.89	0.01	1.6
FR	FR52	Bretagne	0.09	0.14	0.93	0.91	0.1	1.6
FR	FR53	Poitou-Charentes	0.10	0.12	0.91	0.91	-0.07	1.6
FR	FR61	Aquitaine	0.07	0.17	0.97	0.85	0.03	13.7
FR	FR62	Midi-Pyrénées	0.07	0.18	0.96	0.85	0.2	13.7
FR	FR63	Limousin	0.12	0.12	0.89	0.92	0.01	13.7
FR	FR71	Rhône-Alpes	0.08	0.19	0.81	0.83	0.19	24.8
FR	FR72	Auvergne	0.11	0.15	0.89	0.80	0.01	24.8
FR	FR81	Languedoc-Roussillon	0.09	0.18	0.93	0.90	0.03	8.2
FR	FR82	Provence-Alpes-Côte d'Azur	0.09	0.19	0.95	0.94	0.08	8.2
FR	FR83	Corse	0.15	0.15	0.88	0.92	-0.15	8.2
GR	GR11	Anatoliki Makedonia, Thraki	0.22	0.20	0.69	0.73	-0.28	-19.9
GR	GR12	Kentriki Makedonia	0.14	0.20	0.78	0.83	-0.14	-19.9
GR	GR13	Dytiki Makedonia	0.18	0.24	0.64	0.64	-0.34	-19.9
GR	GR14	Thessalia	0.21	0.21	0.84	0.71	-0.31	-19.9
GR	GR21	Ipeiros	0.17	0.13	0.89	0.81	-0.22	-18.4
GR	GR23	Dytiki Ellada	0.20	0.18	0.88	0.73	-0.18	-18.4
GR	GR24	Sterea Ellada	0.21	0.26	0.73	0.62	-0.24	-18.4
GR	GR25	Peloponnisos	0.28	0.22	0.75	0.69	-0.31	-18.4
GR	GR30	Attiki	0.09	0.12	0.84	0.85	0.05	3.6
GR	GR41	Voreio Aigaio	0.16	0.28	0.91	0.70	-0.37	-17.3
GR	GR42	Notio Aigaio	0.19	0.28	0.90	0.69	-0.4	-17.3
GR	GR43	Kriti	0.20	0.20	0.85	0.66	-0.15	-17.3
HU	HU10	Közép-Magyarország	0.07	0.16	0.78	0.90	0.19	13.2
HU	HU21	Közép-Dunántúl	0.18	0.19	0.62	0.47	-0.08	-35.9
HU	HU22	Nyugat-Dunántúl	0.19	0.17	0.66	0.49	-0.16	-35.9
HU	HU23	Dél-Dunántúl	0.12	0.12	0.81	0.71	-0.15	-35.9
HU	HU31	Észak-Magyarország	0.14	0.12	0.68	0.60	-0.16	-53.0
HU	HU32	Észak-Alföld	0.13	0.11	0.74	0.64	-0.15	-53.0
HU	HU33	Dél-Alföld	0.13	0.15	0.74	0.65	-0.17	-53.0
IE	IE01	Border, Midlands and Western	0.13	0.14	0.87	0.69	-0.06	-7.3
IE	IE02	Southern and Eastern	0.09	0.22	0.94	0.66	0.07	27.9
IT	ITC1	Piemonte	0.10	0.19	0.77	0.78	0.08	18.0
IT	ITC2	Valle d'Aosta/Vallée d'Aoste	0.13	0.16	0.91	0.86	-0.15	18.0
IT	ITC3	Liguria	0.06	0.19	0.89	0.82	0.03	18.0
IT	ITC4	Lombardia	0.15	0.22	0.62	0.77	0.08	20.2
IT	ITD3	Veneto	0.15	0.21	0.74	0.90	-0.01	14.8
IT	ITD4	Friuli-Venezia Giulia	0.10	0.15	0.81	0.86	0.03	14.8
IT	ITD5	Emilia-Romagna	0.15	0.21	0.72	0.69	0.06	24.6
IT	ITE1	Toscana	0.10	0.18	0.73	0.85	0.02	19.8
IT	ITE2	Umbria	0.10	0.16	0.76	0.76	0.01	19.8
IT	ITE3	Marche	0.15	0.18	0.79	0.80	-0.06	19.8
IT	ITE4	Lazio	0.10	0.19	0.86	0.85	0.16	29.5
IT	ITF1	Abruzzo	0.11	0.15	0.73	0.80	0.01	-3.5
IT	ITF2	Molise	0.10	0.11	0.85	0.81	-0.14	-18.4
IT	ITF3	Campania	0.08	0.13	0.89	0.85	-0.1	-24.5
IT	ITF4	Puglia	0.09	0.13	0.82	0.83	-0.19	-25.3
IT	ITF5	Basilicata	0.12	0.16	0.83	0.63	-0.12	-25.3
IT	ITF6	Calabria	0.10	0.15	0.88	0.86	-0.21	-25.3
IT	ITG1	Sicilia	0.08	0.14	0.91	0.78	-0.16	-25.4
IT	ITG2	Sardegna	0.07	0.13	0.90	0.86	-0.18	-14.0
LT	LT00	LITHUANIA	0.15	0.18	0.73	0.82	-0.08	-48.5
LU	LU00	LUXEMBOURG	0.15	0.24	0.84	0.84	0.07	71.7
LV	LV00	LATVIA	0.13	0.16	0.81	0.93	-0.09	-51.5
MT	MT00	MALTA	0.11	0.09	0.77	0.81	-0.1	-24.6

Appendix A (continued)

Country	NUTS 2	Region	Employment share 2006	GVA share 2006	Employment Spearman 2006	GVA Spearman 2006	RIS Index 2006	Comp index 2006
UK	**UKN0**	**Northern Ireland**	**0**	**0**	**1**	**1**	**0**	**0.0**
NL	NL11	Groningen	0.10	0.32	0.90	0.78	0.11	8.2
NL	NL12	Friesland	0.08	0.10	0.87	0.78	-0.06	8.2
NL	NL13	Drenthe	0.05	0.10	0.93	0.84	-0.03	8.2
NL	NL21	Overijssel	0.05	0.11	0.95	0.79	0.11	17.9
NL	NL22	Gelderland	0.05	0.11	0.94	0.88	0.17	17.9
NL	NL23	Flevoland	0.07	0.17	0.89	0.79	0.18	17.9
NL	NL31	Utrecht	0.10	0.18	0.88	0.94	0.25	39.4
NL	NL32	Noord-Holland	0.10	0.17	0.89	0.91	0.17	39.4
NL	NL33	Zuid-Holland	0.08	0.12	0.91	0.90	0.17	39.4
NL	NL34	Zeeland	0.07	0.13	0.91	0.81	-0.05	39.4
NL	NL41	Noord-Brabant	0.06	0.14	0.91	0.78	0.27	25.1
NL	NL42	Limburg (NL)	0.08	0.12	0.89	0.79	0.12	25.1
PL	PL11	Lódzkie	0.23	0.16	0.57	0.74	-0.12	-13.4
PL	PL12	Mazowieckie	0.15	0.18	0.81	0.88	0.1	-13.4
PL	PL21	Malopolskie	0.21	0.14	0.77	0.90	-0.06	-32.1
PL	PL22	Slaskie	0.16	0.19	0.57	0.79	-0.12	-32.1
PL	PL31	Lubelskie	0.36	0.12	0.66	0.82	-0.14	-56.6
PL	PL32	Podkarpackie	0.29	0.12	0.56	0.87	-0.2	-56.6
PL	PL41	Wielkopolskie	0.20	0.18	0.63	0.78	-0.15	-33.9
PL	PL42	Zachodniopomorskie	0.12	0.14	0.82	0.86	-0.15	-33.9
PL	PL43	Lubuskie	0.14	0.15	0.69	0.79	-0.15	-33.9
PL	PL51	Dolnoslaskie	0.13	0.14	0.73	0.82	-0.1	-32.0
PL	PL52	Opolskie	0.18	0.13	0.66	0.75	-0.1	-32.0
PL	PL61	Kujawsko-Pomorskie	0.19	0.16	0.58	0.79	-0.14	-36.4
PL	PL62	Warminsko-Mazurskie	0.18	0.13	0.67	0.78	-0.14	-36.4
PL	PL63	Pomorskie	0.13	0.13	0.84	0.87	-0.14	-36.4
PT	PT11	Norte	0.23	0.11	0.62	0.74	-0.19	-13.6
PT	PT15	Algarve	0.19	0.16	0.91	0.66	-0.22	-13.6
PT	PT16	Centro (PT)	0.25	0.10	0.71	0.66	-0.1	-13.6
PT	PT17	Lisboa	0.05	0.12	0.91	0.81	0.01	-13.6
PT	PT18	Alentejo	0.15	0.17	0.80	0.52	-0.28	-13.6
SE	SE01	Stockholm	0.11	0.18	0.74	0.85	0.49	83.6
SE	SE02	Östra Mellansverige	0.15	0.14	0.78	0.81	0.33	36.0
SE	SE04	Sydsverige	0.12	0.14	0.83	0.81	0.35	32.2
SE	SE06	Norra Mellansverige	0.17	0.13	0.80	0.73	0.16	-1.5
SE	SE07	Mellersta Norrland	0.17	0.12	0.87	0.79	0.09	-7.8
SE	SE08	Övre Norrland	0.20	0.15	0.70	0.72	0.16	27.2
SE	SE09	Småland med öarna	0.15	0.14	0.72	0.69	0.13	-4.1
SE	SE0A	Västsverige	0.11	0.14	0.73	0.82	0.42	36.2
SI	SI00	SLOVENIA	0.17	0.14	0.80	0.85	0.11	-8.0
SK	SK01	Bratislavský kraj	0.09	0.18	0.76	0.80	0.25	65.4
SK	SK02	Západné Slovensko	0.17	0.29	0.64	0.54	-0.15	-37.7
SK	SK03	Stredné Slovensko	0.13	0.21	0.70	0.71	-0.14	-51.8
SK	SK04	Východné Slovensko	0.12	0.20	0.70	0.72	-0.22	-42.3
NO	NO01	Oslo og Akershus	0.09	0.21	-	-	-	41.4
NO	NO02	Hedmark og Oppland	0.08	0.19	-	-	-	41.4
NO	NO03	Sor-Ostlandet	0.08	0.20	-	-	-	41.4
NO	NO04	Agder og Rogaland	0.10	0.19	-	-	-	41.4
NO	NO05	Vestlandet	0.09	0.21	-	-	-	41.4
NO	NO06	Trondelag	0.09	0.16	-	-	-	41.4
NO	NO07	Nord-Norge	0.11	0.18	-	-	-	41.4
CH	CH01	Région Lémanique	0.09	0.17	-	-	-	41.7
CH	CH02	Espace Mittelland	0.11	0.14	-	-	-	41.7
CH	CH03	Nordwestschweiz	0.14	0.18	-	-	-	41.7
CH	CH04	Zürich	0.14	0.23	-	-	-	41.7
CH	CH05	Ostschweiz	0.15	0.17	-	-	-	41.7
CH	CH06	Zentralschweiz	0.15	0.18	-	-	-	41.7
CH	CH07	Ticino	0.13	0.18	-	-	-	41.7

Appendix B

Figure B1 - Scatter Plot of Euclidean distance in terms of employment shares and innovation

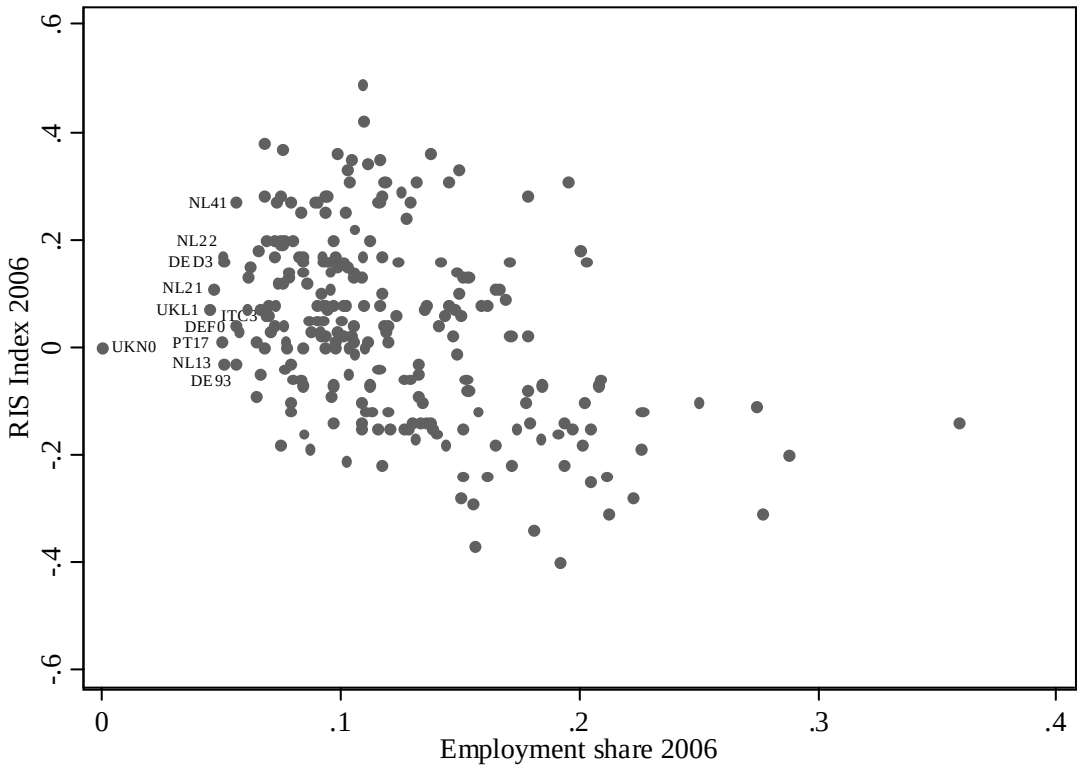


Figure B2 - Scatter Plot of Euclidean distance in terms of GVA shares and innovation

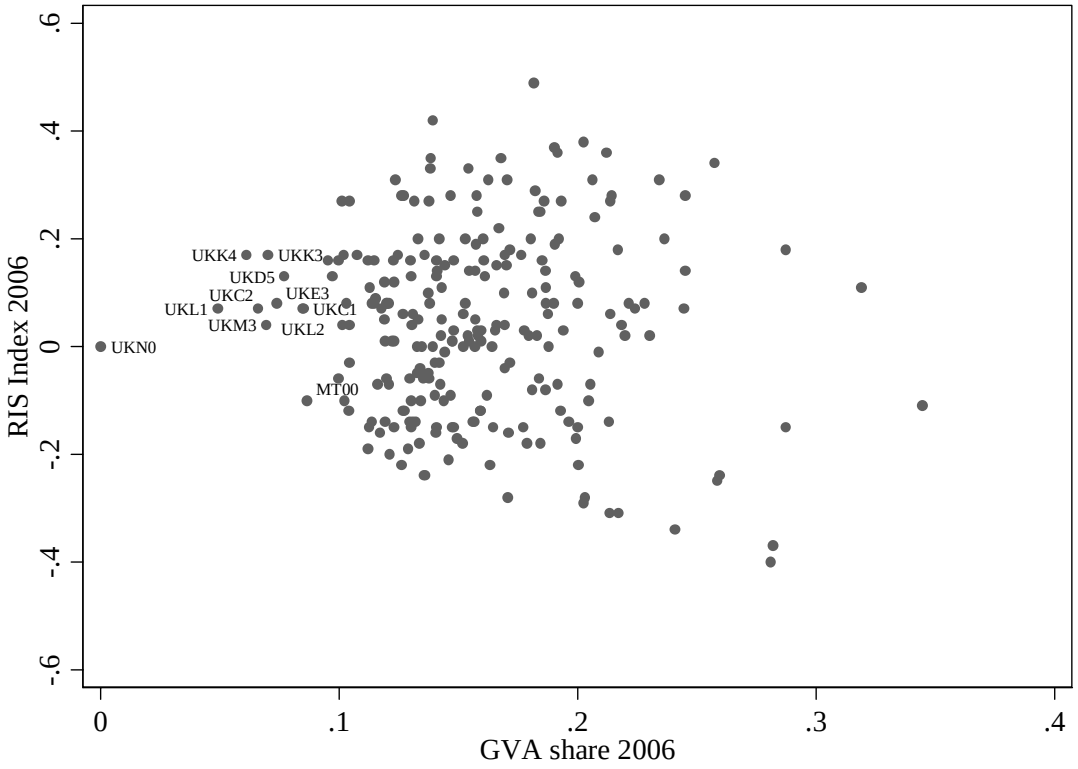


Figure B3 - Scatter Plot of Spearman rank correlation index in terms of employment shares ranks and innovation

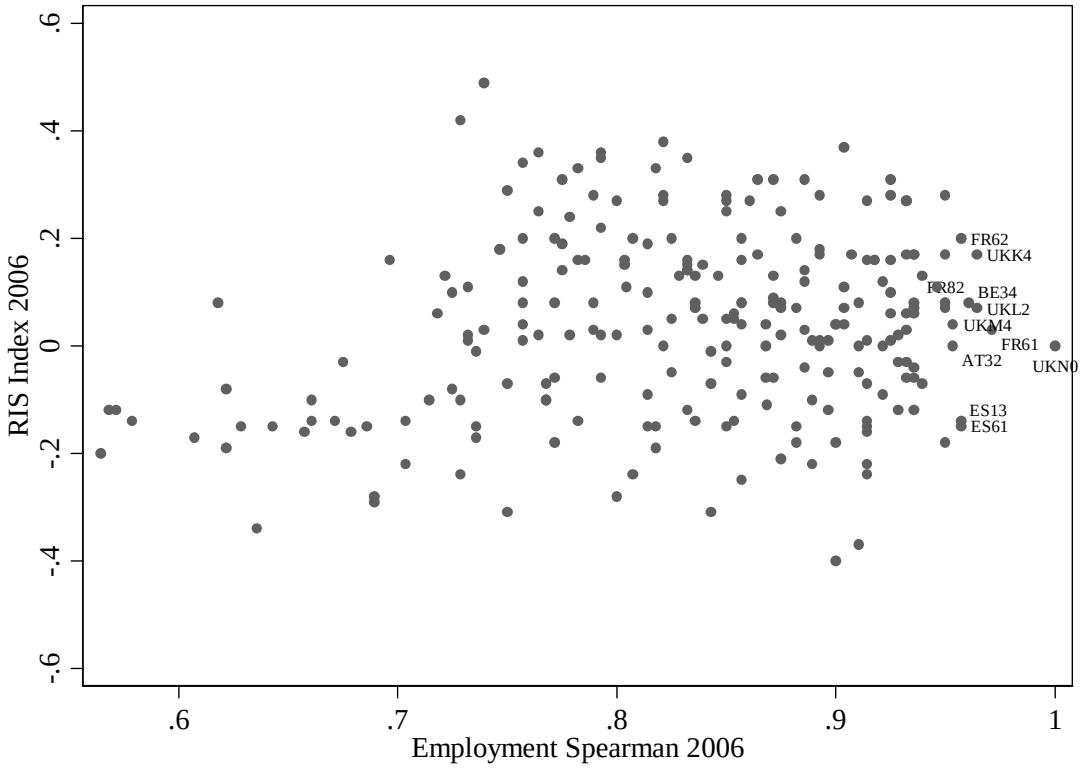
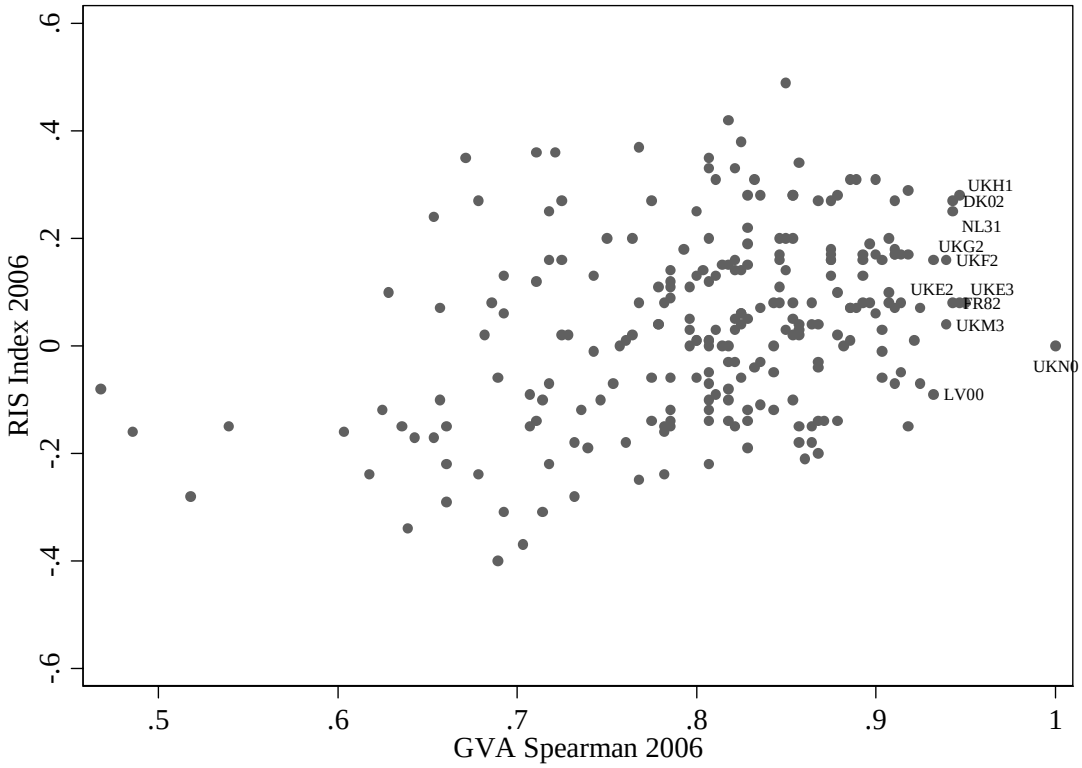


Figure B4 - Scatter Plot of Spearman rank correlation index in terms of GVA shares ranks and innovation



Appendix C

Organisations interviewed

Region 1 – Liguria, Italy

1) Liguria Ricerche

2) Regione Liguria, responsible for the Monitoring of Financial Resources of Enterprise, Region Liguria Government

3) University of Genoa

Region 2 - Kiel, Schleswig – Holstein, Germany

1) Department of Business Development and Technology Transfer, Corporation of Schleswig-Holstein (x2)

2) Ministry of science, economics and transportation of the State of Schleswig-Holstein

3) Innovationsstiftung Schleswig-Holstein (ISH) Foundation

4) The Kiel Institute for the World Economy

Region 3 - Noord-Brabant, Netherlands

1) Province of Noord-Brabant - regional authority.

2) Brabant development agency

3) University of Tilburg

4) World class maintenance

Region 4 - Gothenburg, Sweden

1) Innovationsbron AB (Innovation Bridge), West Sweden

2) Regional Development, Region Västra Götaland

3) Department of Research and Innovation Services, University of Gothenburg

4) Vinnova

Region 5 - Finland

1) TEKES

2) Regional Development, Ministry of Employment

3) Government Institute for Economic Research VATT

4) Academics from University of Tampere

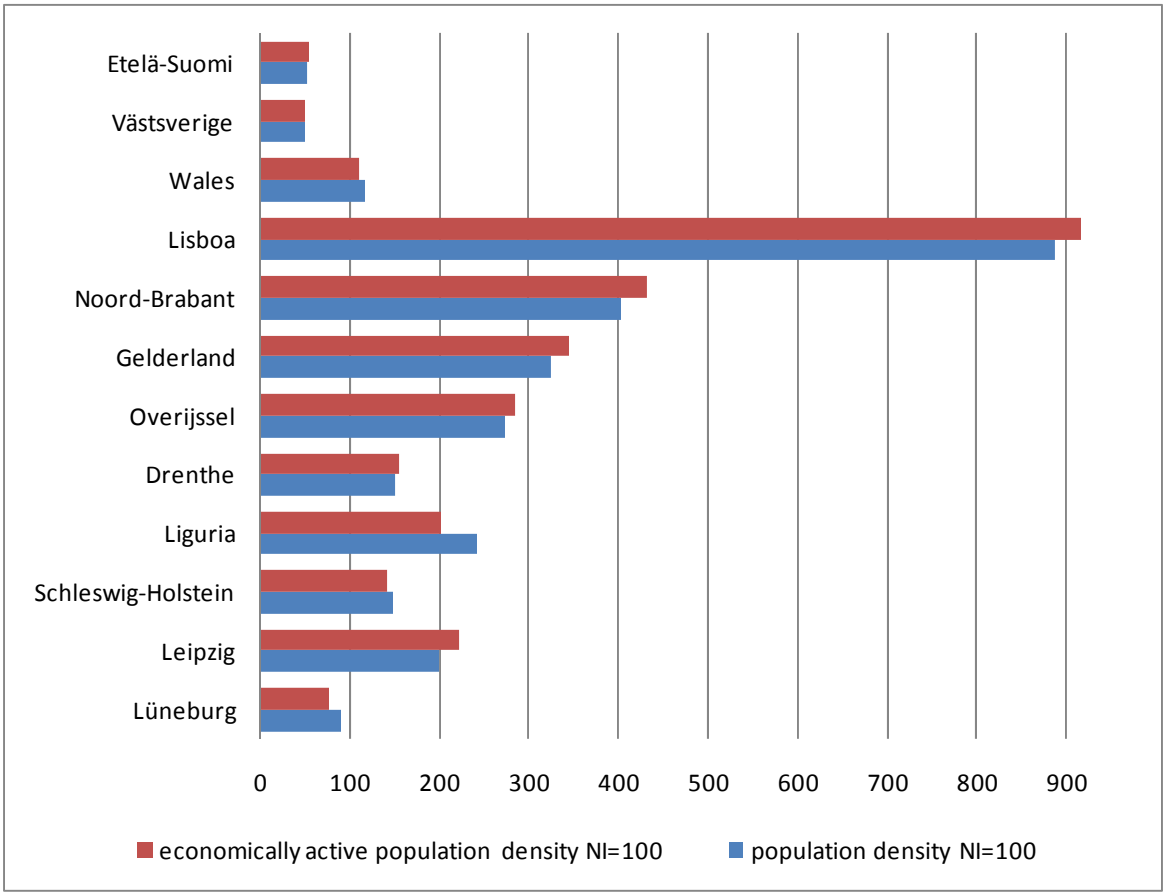
Region 6 - Northern Ireland

1) Queens' College
2) MATRIX
3) DETI Innovation Policy Unit
4) Invest NI
5) NI Science Park
6) University of Ulster
7) Bombardier Aerospace
8) Seagate Technology (Ireland)

Appendix D

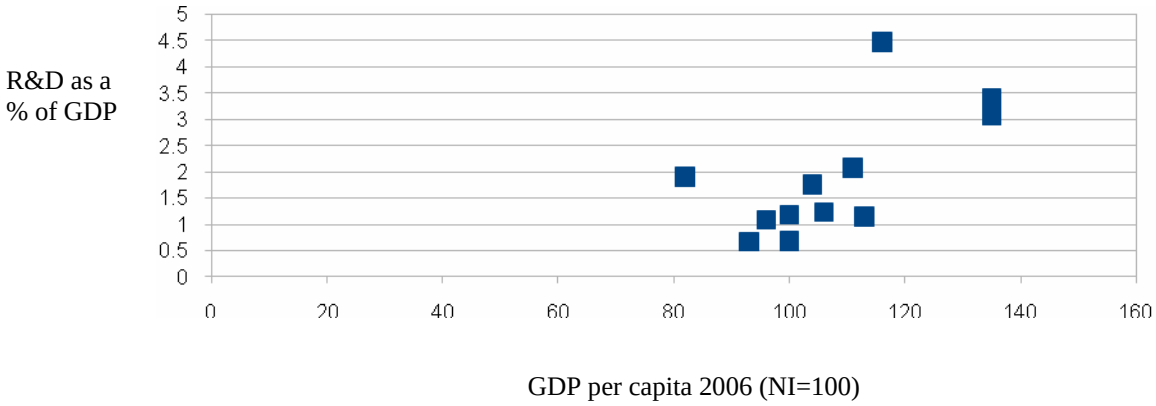
Benchmark regions characteristics

Figure D1 – Total and active population density in the benchmark regions



Source: Cambridge Econometrics Data

Figure D2 - Intramural R&D expenditure as a % of GDP and GDP per capita (selected regions)



Sources: RIS and Cambridge Econometrics database

Appendix E Industrial Research Institutes, Sweden

Institute	Field	Turnover MSEK	Staff
Swerea IVF	Product and production development, manufacturing efficiency and organisation of work – industrial manufacturing processes: Sheet metal working, forging, surface and heat treatment – Working life, environment and energy – Materials development: Textiles, plastics, rubbers and ceramics – Electronic construction methods and reliability– Materials analysis, testing and certification.	181.4	149
Swerea KIMAB	Process and alloy development for steel and other metals. Joining of components, processes and dimensioning. Manufacture of components, processes and optimisation. Mechanical properties, testing and predicting. Materials for demanding environments – including polymers. Corrosion processes, corrosion protection and sea water corrosion. Materials analysis and metallography. Damage analysis and materials selection.	167.5	152
Swerea MEFOS	Research, development and consultancy work within process metallurgy, heating, metal working, environment and energy technology for the mineral, steel and metal industries. Large pilot projects (management, construction, operation), reduction metallurgy, measuring technology and process analysis, computer modelling/simulation with advanced process knowledge, environment and residual product technology, process integration.	117	82
Swerea SICOMP	Polymer composite fibres including: Materials science, mechanical computations and simulations, damage tolerance, process science and production technology, product development, prototype production and testing.	28	30
Swerea SWECAST	Materials technology and metallurgy for iron, steel and other metals. Design, construction and product development. Prototype production. Process development and optimisation supported by simulation. Accident and damage analyses including mechanical testing. Environmental analyses and environment protection technology. Energy efficiency. Customised training courses for companies.	55	44
Acreo	R&D and production resources for new innovative products in electronics, optics and communication technology; activities range from basic research through development and to the final stage of production	196.8	131
SICS	A leading research institute for applied computer science in Sweden	102	100
Interactive Institute	An experimental media research institute that combines expertise in art, design and technology to conduct world-class applied research and innovation; develops new research areas, concepts, products and services, and provides strategic advice to corporations and public organizations.	47.6	50
IMEGO	A leading edge research institute in the field of nano and micro technology	385	375
Viktoria	R&D in applied information technology in collaboration with the industry, the public sector and universities, for automotive, safety and transport industries		25
INNVENTIA	R&D relating to pulp, paper, graphic media, packaging and bio-refining	330	270
SP	Consists of 8 technical departments related to building technology and mechanics, certification, chemistry and materials, electronics, energy, fire technology, measurement, and weights, and 6 subsidiary companies: CBI (cement and concrete), Glafo (glass), JTI (agricultural and environmental engineering), SIK (food and biotechnology), SMP (testing and certification) and YKI (surface chemistry).	936	893

Source: websites of the respective research institutes

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