

WORLD KNOWLEDGE COMPETITIVENESS INDEX 2002

Benchmarking the Globe's High Performing Regions

Robert Huggins, Robert Huggins Associates
Hiro Izushi, Coventry Business School



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A S S O C I A T E S

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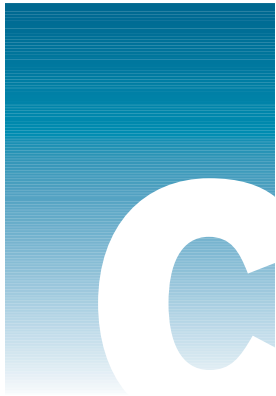


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Executive Summary

The World Knowledge Competitiveness Index 2002 is the first composite and relative measure of the knowledge economies of the globe's best performing regions. It represents an integrated and overall benchmark of the knowledge capacity, capability and sustainability of each region and the extent to which this knowledge is translated into economic value and transferred into the wealth of the citizens of each region.

Knowledge is the ingredient that underlies the competitiveness of regions, nations, sectors or firms. It refers to the cumulative stock of information and skills concerned with connecting new ideas with commercial values, developing new products and processes and, therefore, 'doing business in a new way'. At its most fundamental level, the knowledge-base of an economy can be defined as:

'the capacity and capability to create and innovate new ideas, thoughts, processes and products, and to translate these into economic value and wealth.'

The focus on a global study of regions is highly relevant, since there is an increasing appreciation that it is regions, rather than whole nations, that are competing in the new global economy. In other words, the globalisation and regionalisation of economies are progressing in tandem.

Through the establishment of a knowledge economy model, this study aims to analyse some of the core factors that will underlie the future development of regional knowledge-based economies.

The model we employ to analyse the knowledge-based regional economies is a multi-linked, cycle model representing knowledge creation and utilisation as well as capacity building. The model is made of four key components: (1) Capital Inputs; (2) Knowledge Economy Production; (3) Regional Economy Outputs (including Knowledge Economy Outputs); and (4) the Sustainability Link.

The world's most knowledge competitive region is Minneapolis-St Paul, with a Knowledge Competitiveness Index score of 147.6, followed by San Francisco (including Silicon Valley) - with a score of 146.4 - and Austin (145.1). Minneapolis-St Paul, along with San Francisco and Austin - as well as a number of other high-performing regions - are the world's best examples of knowledge competitive centres.



Minneapolis-St Paul's top ranking indicates that by our criteria it is the region with the most balanced and equitable knowledge-based economy for sustaining overall levels of growth and prosperity. Although it does not dominate in any particular sector of economic activity, it has a strong spread of activity across key knowledge-based economic sectors.

The overall rankings are dominated by US regions, accounting for 49 of the top 90 of the world's most knowledge competitive regions. Furthermore, of the US regions, 45 are featured in the top 50 performers, with only 4 US regions performing below the index mean average of 100.

Europe is represented by 32 regions (with 10 from Germany as well as 3 each from the UK, Italy and the Netherlands). However, only 4 European regions feature in the top 50, led by Stockholm (Sweden) in 22nd position (119.4), and followed by Switzerland in 25th (117.0), Uusimaa (Finland) in 36th (111.7), and London (UK) in 50th (102.0).

Nine non-US or European regions are included in the rankings, led by Ontario (Canada) in 48th position (103.7), followed by Tokyo (Japan) in 54th (97.2), British Columbia (Canada) in 58th (95.5), and New South Wales (Australia) in 61st (89.7).

In general, the development of knowledge competitive centres is a long-term process, dependent on an ever-changing balance in the relative importance of the underlying conditions. In particular, there is a shift away from cost factors, physical infrastructure and regulatory policies, towards the importance of the non-physical knowledge-based infrastructure.

From an underlying assumption that the top-performing regions are developing via a common trajectory, we have identified two core drivers of knowledge-based growth. The first covers a combination of the improvement of ICT infrastructure and the mobilisation of human capital resources in economic production activity. The second is investment in R&D by business, alongside investment in education both at the primary, secondary and higher levels, all of which show a positive association with labour productivity. These drivers of knowledge-based growth are necessarily highly influential in determining the fortune of regions that aspire to reach a higher level of knowledge-based economic activity



Introduction

The World Knowledge Competitiveness Index 2002 is the first composite and relative measure of the knowledge economies of the globe's best performing regions. It represents an integrated and overall benchmark of the knowledge capacity, capability and sustainability of each region, and the extent to which this knowledge is translated into economic value and transferred into the wealth of the citizens of each region. Knowledge is the ingredient that underlies the competitiveness of regions, nations, sectors or firms. Through the establishment of a knowledge economy model, this study seeks to explore those factors driving regional knowledge-based development and productivity.

In almost any nation, there is an unequal distribution of wealth among its regions. In the UK, this is manifested in the 'North-South Divide': while regions in the southern half of the country, in particular London and South East England, are seen as the nation's core economic drivers, northern regions have suffered higher unemployment rates and lower income levels (Robert Huggins Associates, 2000). Many studies relate these divides to the different industries located and functions performed in these regions, and differences in supporting environments. Such supporting environments consist of, for example, universities and research establishments, service providers, and information and communication technologies (ICT) infrastructure. Therefore it appears logical to test whether the distribution of knowledge and the capacity of the knowledge economy are also unequal among regions. Subsequently, we have based our analysis at the regional level within a global framework.

The mode by which knowledge is produced has shifted from traditional linear processes of innovation to more complex incremental and iterative chain-link models based on the interactions between knowledge actors. The most prosaic example of this shift is the demise of large in-house assembly-line production, replaced by networked-based models of production. Within these models networked knowledge and information moves between firms in a non-linear manner, dependent on the development of the range of ever-changing products with which they are involved, i.e. a firm's position in the network will alter as requirements and demand shift.

The characteristics associated with these modes of knowledge production include: (1) a rapid rise in the number and types of sites where innovation occurs; (2) the stock of knowledge is an outcome of the intensity of interaction between knowledge actors; (3) the pattern and dynamics of these



interactions are constantly shifting, reflecting ever changing knowledge contexts; and (4) the density of interactions is increasing rapidly, as is the number of knowledge actors. The links between knowledge creation and diffusion processes, through individuals, organisations and systems, are clearly required to be understood as fully as possible, as knowledge becomes the key value creator in modern economies.

A clear understanding of knowledge-based economic activity has, so far, been limited by the number, type and quality of existing indicators. These indicators fail to capture the new processes by which knowledge is created and diffused. Also, unlike other capital goods, knowledge has no limiting or fixed capacity. For instance, the generation of a new idea may have a massive impact or no impact at all. This means that knowledge cannot be measured in simplistic quantitative terms, but must be evaluated as an overlapping mix of a wide array of variables, some of which are measurable, and some of which are currently not. Indeed, if knowledge is viewed in the same light as any other capital form this will limit the capacity for its understanding. Furthermore, difficulties in establishing new indicators are a reflection of the unique character of the knowledge-based economy.

It is our aim in this report to explore the relative knowledge capacity and capability across the world's best performing regions. The series of benchmarks we establish identify the relative strengths and weaknesses of individual regional economies in terms of their knowledge capacity, capability and utilisation. Furthermore, the features of the knowledge-based economy are far from remaining static but are evolving rapidly. Therefore, we aim to analyse some of the core factors that will underlie the future development of regional knowledge-based economies. The focus on a global study of regions is highly relevant, since there is an increasing appreciation that it is regions, rather than whole nations, that are competing in the new global economy. In other words, the globalisation and regionalisation of economies are progressing in tandem.

The following sections of this report consist of those listed below:

- Section 3 : The Economics of Knowledge Competitiveness
- Section 4 : The Rankings - World Knowledge Competitiveness Index
- Section 5 : Human Capital Components
- Section 6 : Knowledge Capital Components
- Section 7 : Regional Economy Outputs
- Section 8 : Knowledge Sustainability Components
- Section 9 : Conclusions: Driving Knowledge-Based Growth.
- References
- Data Sources



The Economics of Knowledge Competitiveness

The sources of productivity and economic growth are increasingly based on the role that knowledge plays within and across economies. The concept of the knowledge-based economy has emerged from this increasing recognition of the requirement for the production, distribution and use of knowledge within modern economies. New Growth Theory, developed by the economist Paul Romer, proposes that knowledge has become the third factor of production, alongside labour and capital. Romer argues that knowledge is now in fact the basic form of capital and that economic growth is driven by its accumulation. Knowledge-driven economies are those in which knowledge generation and exploitation lead to the creation of wealth. The proposition of the evolution of economies into knowledge-bound entities results in learning and knowledge creation assuming paramount importance in the quest for prosperity.

DEFINING THE KNOWLEDGE-BASED ECONOMY

We need to be very clear from the outset as to what we are referring to when we use the term knowledge-based economy. At its most fundamental level, the knowledge-base of an economy can be defined as:

'the capacity and capability to create and innovate new ideas, thoughts, processes and products, and to translate these into economic value and wealth.'

Knowledge is the ingredient that underlies the competitiveness of regions, nations, sectors or firms. The knowledge economy includes the skills of workers, the experience of firm managers and owners, as well as what the American economic geographer Edward Malecki terms the 'pulse of customers' needs and demands'. However, the question can reasonably be asked: how can we 'see' the knowledge economy? The following are a number of examples of knowledge economy recognition:

- Where the processes of production and their products have become increasingly complex and sophisticated.
- Where increasingly advanced knowledge and skills are required in the production process.



- Where there is an increasing reliance on specialist and idiosyncratic skills.
- Where there is a more extensive use and transfer of information (Malecki, 2000).

The above leads us to the question, what is knowledge? An informative way of answering this question is to break down the knowledge concept into a number of types, as follows:

- Know-what - referring to factual knowledge
- Know-why - referring to knowledge of the principles and laws of nature
- Know-how - referring to skills or capability required to undertake a task
- Know-who - referring to information on who knows what and who knows how to do what.

COMPETITIVENESS, INNOVATION AND KNOWLEDGE

The prosperity of a nation is based upon the productivity gained from the utilisation of its labour force, capital and natural resources (Porter, 1990). The productivity of nations is a function of the interplay of three factors:

- The political, legal and macroeconomic context
- The quality of the microeconomic business environment
- The sophistication of the operations and strategies of its firms.

As illustrated by Figure 1, these three factors determine the capacity of a nation to produce internationally competitive firms and support rising prosperity. The focus of the competitiveness challenge has clearly shifted towards the importance of innovation (Porter, 1999). Furthermore, from the 1990s onwards the competitiveness challenge facing advanced nations has been to adapt to the new environment of the global economy and to build a sound macro and micro-economic foundation. Many countries have moved forcefully towards reducing budget deficits, strengthening financial institutions and streamlining regulation.

At a more micro-level, many firms have made great strides in eliminating non-productive activities and resources (i.e. restructuring), renewing their market focus, and speeding up product and process improvement. There is no end in sight for these changes, and the competitiveness challenge is continually shifting. In the global economy, within which firms have increasingly good access to cheap raw materials and low-wage manual labour around the world, the creation of high value-added rests on innovation, i.e. the ability to create and transform new ideas into commercially valued new products and processes.



MICROECONOMIC FOUNDATIONS



Figure 1 : The Competitiveness Paradigm (Source: Porter, 1990)

Knowledge refers to the cumulative stock of information and skills concerned with connecting new ideas with commercial values, developing new products and processes and, therefore, 'doing business in a new way'. This may be called 'knowledge for innovation' or 'innovative knowledge'. While innovation is a process, knowledge consists of the process recipe and the ingredients to be processed. The knowledge-based economy can be defined as the sphere and nexus of activities and resources centred on and geared towards innovation. Therefore, as illustrated by Figure 2, the relationship between the concepts of knowledge, innovation and competitiveness are strongly associated and inter-linked.

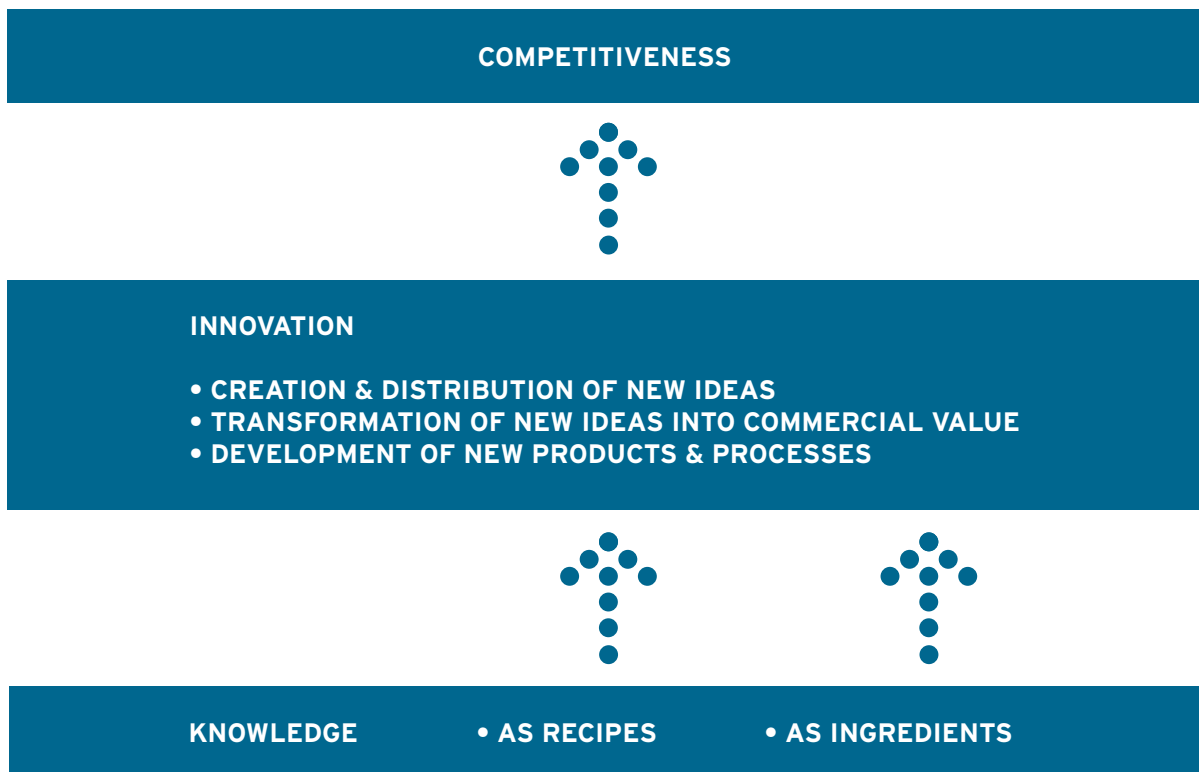


Figure 2 : Competitiveness, Innovation and Knowledge



Knowledge is not - as is sometimes presumed - necessarily confined within 'high technology' industries. Also, although scientific and technical knowledge created by scientists and technologists is a major source of innovation, it is only a part of the value creation process, and must be allied with the conversion of this knowledge into commercial value. Such conversion involves discerning and meeting the needs of customers. Porter (1999) argues that 'there are no "low tech" industries - only low technology companies that fail to incorporate new ideas and methods into their products and processes.'

Hence, the utilisation of a dichotomy between high-technology industries and low-technology industries, based solely on the proportion of employees deemed to be R&D-based, is not a wholly appropriate analytical tool. Instead, we adopt another distinction: 'knowledge-based firms' and 'non-knowledge-based firms'. While 'knowledge-based firms' actively pursue innovation, with a significantly high proportion of their employees involved in producing high value-added, 'non knowledge-based firms' tend to lag behind in the race for the creation, acquisition and transformation of knowledge.

THE KNOWLEDGE ECONOMY MODEL

The model we employ to analyse the knowledge-based regional economies, as illustrated by Figure 3, is a multi-linked cycle model representing knowledge creation and utilisation as well as capacity building. The model reflects the latest thinking on the innovation process, which sees it as a process whereby agents in different domains (e.g. different departments/divisions of private firms, universities, research laboratories, governments) interact with one another through feedback loops (e.g. Klein and Rosenberg, 1986). We extend this thinking to the regional level and add a component that reproduces and sustains the whole system's innovative capacity.

At the heart of the model's extension to the regional level is our understanding that regional clusters of various agents, embodying networks among them, constitute a key to innovative activity. The model is made of four key components: (1) Capital Inputs; (2) Knowledge Economy Production; (3) Regional Economy Outputs (including Knowledge Economy Outputs); and (4) the Sustainability Link. Each of these components, with the exception of Knowledge Economy Production, has representative variables, while Knowledge Economy Production is regarded as a production function that transforms Capital Inputs into Regional Economy Outputs.

Capital Inputs consist of four groups: Knowledge Capital, Human Capital, Financial Capital, and Physical Capital. Until recently, economists used to account for economic outputs (or growth) of regions/nations by 'capital' and 'labour'. 'Capital' refers to physical units of, or fixed investments in, production such as land, plants, machinery and equipment while 'labour' is simply counted by the number of 'heads' in employment (or working population). Under this framework, a residual that cannot be explained by those two factors is often seen as an indicator of technical change.

This traditional accounting model has given way to new models due to two key developments in economic theory: human capital theory and endogenous models of economic growth. Human capital theory recognises skills and expertise gained through education and training as investment made by, and embodied in, individuals. This is a departure from the traditional models of economic growth that do not distinguish any differences between individuals.

Endogenous economic growth theory views the accumulation of knowledge as a key source of



long-run economic growth, and acknowledges the creation of knowledge by private-sector firms, through a Schumpeterian competition (i.e. temporary monopoly of economic gains deriving from new knowledge by its inventor), as an internal (i.e. endogenous) factor.

The four groups of Capital Inputs in our model incorporate these developments in economic theory. While Physical Capital refers to capital in the traditional parlance of economics, Financial Capital emphasises the liquidity of financial resources mobilised into new areas of growth and knowledge (e.g. products, sectors, industries) through sources such as venture capital.

Knowledge Capital is the raw material of the knowledge economy, referring to the region's capacity for, or its resources aimed at, creating new ideas. Ideas in this realm are not necessarily created with consideration for commercial applications, with the sources of such new ideas ranging from universities and research establishments to firms, individuals and other organisations. Included as a form of Knowledge Capital is the intermediary throughput produced during the course of converting knowledge into commercial values. Finally, Human Capital indicates the capacity of individuals in the region to create, understand and utilise knowledge for the creation of commercial values.

The combination of the four types of capital within the region results in the production of knowledge-based goods and services containing high value-added. These knowledge-based goods and services, which we term Knowledge Economy Outputs, form part of the total outputs of the region's economic activity, Regional Economy Outputs. The distinction between Knowledge Economy Outputs and Regional Economy Outputs signifies our assumption that innovative knowledge outputs embodied in goods and services are not always translated evenly into the wealth the region's inhabitants will enjoy.

The cycle is completed by the requirement for Knowledge Sustainability. Unless part of the wealth created is re-invested into Capital Inputs, and particularly Knowledge Capital and Human Capital, to support their reproduction and further development, the medium to long-term prosperity of the regional economy will be undermined.

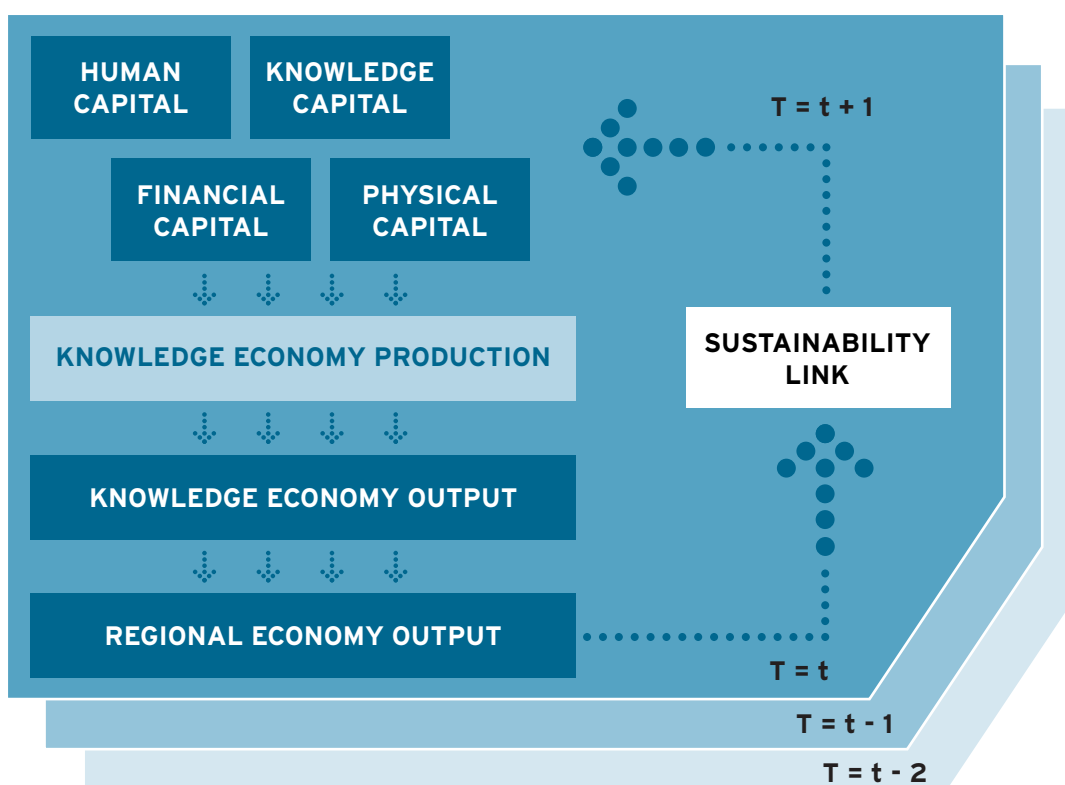


Figure 3 : Knowledge Economy Model

RESEARCH DESIGN

In order to establish the globe's high-performing regions in the first instance, we analysed gross domestic product (GDP) per capita for the majority of regions across the world between 1995-1998. Those included in this study are those who have performed above the mean in terms of GDP per capita during this period.

The majority of European regions are based on European Union's definition of regional units, NUTS-1. Because of the definition, some nations are included as regions (i.e. Denmark, Ireland, Luxembourg). Further, regions in Finland and Sweden are based on NUTS-2, a lower level of units. In addition, two non-EU member countries, Switzerland and Norway are included in the analysis. As with Denmark, Ireland and Luxembourg, these two small nations are treated as regions.

The US regions are based on the units called consolidated metropolitan statistical areas (CMSAs) and metropolitan statistical areas (MSAs). MSAs, defined by the US Census Bureau, consist of a set of counties and represent a single labour market with a one to two-hour commute from edge to edge. CMSAs, consisting of a set of Primary Metropolitan Statistical Areas (PMSAs), include the county hinterlands of two or more large central cities that are adjacent to each other. Also, as the suffix attached to each region suggests, some CMSAs extend over more than one state. Compared with counties, cities and states, both MSAs and CMSAs analysed in this study are better units for economic analysis as they well reflect the boundaries of clusters of firms in related industries.



Those non-US or European regions making the final cut consist of :

- Tokyo, Japan
- Kanagawa, Japan
- Osaka, Japan
- Kyoto, Japan
- Ontario, Canada
- British Columbia, Canada
- New South Wales, Australia
- Singapore
- Hong Kong, China

For a similar region for some small countries in Europe, Singapore is included in the analysis as a region state.

Owing to data availability and compatibility between regions in Europe, the US and the rest of the World, the following variables are selected for the global analysis:

HUMAN CAPITAL COMPONENTS

- Economic Activity Rate
- Number of Managers per 1,000 inhabitants
- Employment in IT and Computer Manufacturing per 1,000 inhabitants
- Employment in Biotechnology and Chemicals per 1,000 inhabitants
- Employment in Automotive and Mechanical Engineering per 1,000 inhabitants
- Employment in Instrumentation and Electrical Machinery per 1,000 inhabitants
- Employment in High-Tech Services per 1,000 inhabitants

KNOWLEDGE CAPITAL COMPONENTS

- Per Capita Expenditures on R&D performed by Government
- Per Capita Expenditures on R&D performed by Business
- Number of Patents Registered per one million inhabitants

REGIONAL ECONOMY OUTPUTS

- Labour Productivity
- Mean Gross Monthly Earnings
- Unemployment Rates

KNOWLEDGE SUSTAINABILITY

- Per Capita Public Expenditures on Primary and Secondary Education
- Per Capita Public Expenditures on Higher Education
- Secure Servers per one million inhabitants
- Internet Hosts per 1,000 inhabitants

METHODOLOGY UNDERLYING THE WORLD KNOWLEDGE COMPETITIVENESS INDEX

All data are first converted so that the mean and variance of each variable are set at zero and one respectively. After the standardisation, a multivariate data reduction technique called factor analysis is applied to the data set. Factor analysis is used to simplify complex and diverse relationships that exist among a set of observed variables by uncovering common dimensions or factors that link together the seemingly unrelated variables, and consequently provide insight into



the underlying structure of the data. In general, those dimensions are uncorrelated with one another.

To extract the common part of variations among the original variables (i.e. commonalities), an extraction method called image factoring is employed. The dimensions obtained are then rotated. A rotation method called varimax is used with Kaiser normalisation. While identifying common dimensions of the underlying structure, factor analysis also shows the location of each case (i.e. region in this study) within the underlying structure, by providing the case's scores for the dimensions identified. We use these scores for the dimensions as sub-composite indices.

Subsequently, we were required to aggregate these sub-composite indices with a view to obtaining a single composite. A quantitative analytical technique called Data Envelopment Analysis (DEA) is used to obtain a single composite index from the above sub-composite indices. DEA is a linear programming technique originally developed for the estimation of the relative efficiency of a set of units (called decision making units, DMUs) producing a set of outputs from common inputs. It neither assigns weights to variables with any dependent variable chosen a priori, nor assigns weights set a priori. Instead, it seeks set of weights for each unit that maximises a weighted sum of variables, with the constraint that no units have a weighted sum larger than one. As a result, each unit receives a score between 0 and 1.

This process is repeated for all units in the data set, giving each unit a score unique to each iteration. Finally a geometric mean of all the scores is taken for each unit, providing a DEA score. In the following analysis all scores are converted into the figures whose average is 100, facilitating an intuitive understanding of the regions' positions in our league table.



World Knowledge Competitiveness Index - The Rankings

The world's most knowledge competitive region is Minneapolis-St Paul, with a Knowledge Competitiveness Index score of 147.6, followed by San Francisco (including Silicon Valley) - with a score of 146.4 - and Austin (145.1). Minneapolis-St Paul's top ranking indicates that by our criteria it is the region with the most balanced and equitable knowledge-based economy for sustaining overall levels of growth and prosperity. As Table 1 illustrates, the rankings are dominated by US regions, accounting for 49 of the top 90 of the world's most knowledge competitive regions. Furthermore, of the US regions, 45 are featured in the top 50 performers, with only 4 US regions performing below the index mean average of 100.

Europe is represented by 32 regions (with 10 from Germany; as well as 3 each from the UK, Italy and the Netherlands). However, only 4 European regions feature in the top 50, led by Stockholm (Sweden) in 22nd position (119.4), and followed by Switzerland in 25th (117.0), Uusimaa (Finland) in 36th (111.7), and London (UK) in 50th (102.0). Nine non-US or European regions are included in the rankings, led by Ontario (Canada) in 48th position (103.7), followed by Tokyo (Japan) in 54th (97.2), British Columbia (Canada) in 58th (95.5), and New South Wales (Australia) in 61st (89.7).

Part of the reason in understanding why Minneapolis-St Paul should head the overall rankings is that although it does not dominate any particular sector of economic activity, it has a strong spread of activity across key knowledge-based economic sectors, in particular: IT and computer-related manufacturing (index score: 162.9); instrumentation and electrical machinery (index score: 245.6); and communication, computer services and R&D (index score: 133.4). Despite recent global repositioning in the ICT sector, San Francisco and Austin possess a similar strength in economic activity across core knowledge-based sectors.

These knowledge competitive centres also perform above average on a range of other measures. In the case of Minneapolis-St Paul these consist of: very high economic activity rates (ranked 1st with a score of 131.2); above average proportion of employees within managerial occupations (ranked 20th with a score 145.2); very high R&D expenditure by businesses (ranked 3rd with a score of 270.3); high proportion of patent registrations (ranked 5th with a score of 268.7); high levels of expenditure on primary and secondary education (ranked 7th with a score of 149.1); and very high levels of expenditure on higher education (ranked 2nd with a score of 175.9). Strength in these factors is at the core for creating and sustaining a high-performing centre of knowledge



competition. Minneapolis-St Paul, along with San Francisco and Austin - as well as a number of other high-performing regions - are the world's best examples of these centres of knowledge competition.

The manner in which knowledge is created, acquired and transformed helps understanding of why such regional knowledge competitive centres are becoming more relevant to the economic activities of industries and firms. At first glance it might be argued that advances in information and telecommunication technologies support the notion that knowledge is geographically ubiquitous, leading to the dissolution of spatial centres as an economic force. However, this proves to be a mistaken belief, particularly if utilising the conceptualisation of knowledge in terms of codified knowledge (explicit and readily transferable) and tacit knowledge (implicit and difficult to codify). Although the latter type is often deeply embedded within individuals, it is a vital component of a firm's competitive performance.

Given the difficulty in transferring tacit knowledge, its movement across firm boundaries is highly reliant on the existence of trust-based interactions between individuals, as well as labour mobility between firms. Trust-based interactions are mobilised and facilitated, or hindered, by a region's socio-economic business culture. As for labour mobility, it tends to operate within local labour markets. Furthermore, labour markets for highly skilled workers are often anchored to universities and research institutes through spin-offs and the employment of graduates, as well as knowledge exchange between industry and universities. These reinforce, rather than weaken, the concentration of knowledge-based economic activities at the regional level. The formation and development, and in some cases decline, of knowledge competitive centres takes place in a complex mix of the local and global environment, which is summarised in Figure 4.

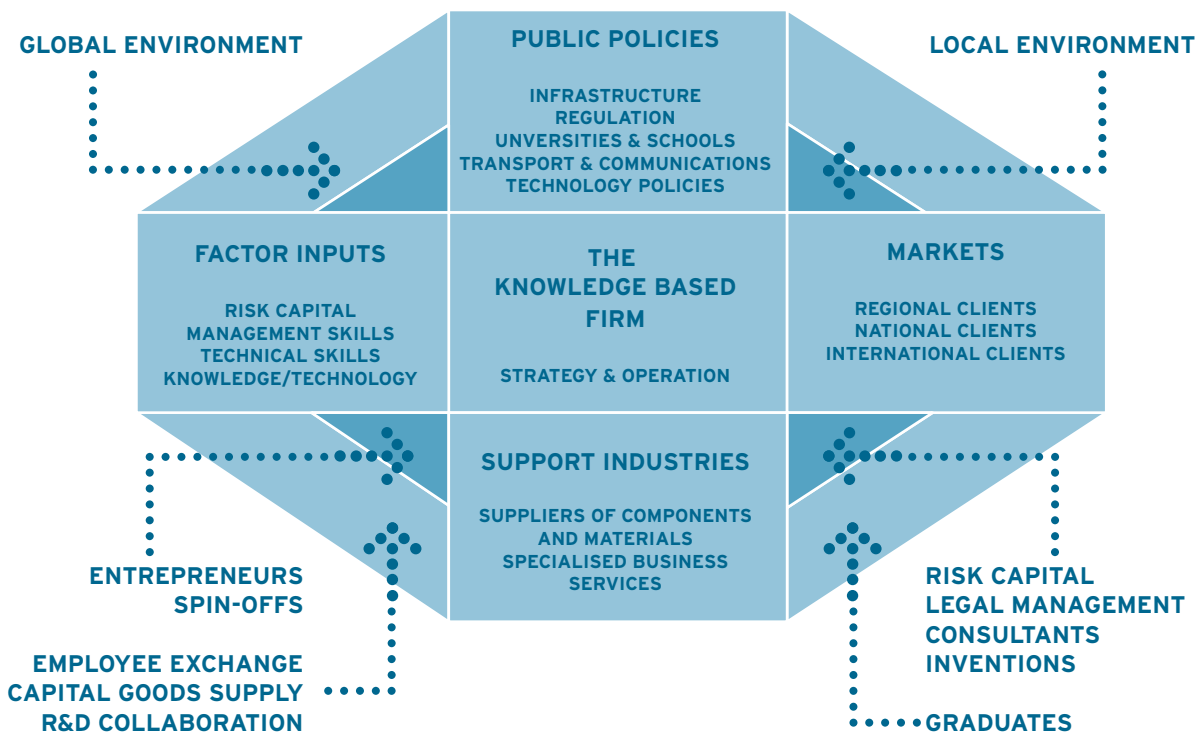


Figure 4 : The Knowledge-based Firm and its Environment



In general, the development of knowledge competitive centres is a long-term process dependent on an ever-changing balance in the relative importance of the underlying conditions. In particular, there is a shift away from cost factors, physical infrastructure and regulatory policies, towards the importance of non-physical knowledge-based infrastructure. This knowledge-based infrastructure is lubricated with a socio-economic business culture that provides feedback loops between knowledge actors. Although this culture cannot be directly measured by any existing data across the regions, it would appear that this culture is strongest within those regions exhibiting a high-level of knowledge competitiveness. To an extent, there is a supporting evidence of this in the form of the large number of studies relating the high-performance of Silicon Valley in the San Francisco region to its integrated business culture.

The following sections of this report unpack the individual elements constituting the World Knowledge Competitiveness Index.



Table 1 : World Knowledge Competitiveness Index

| RANK | REGION | KNOWLEDGE COMPETITIVENESS INDEX | RANK | REGION | KNOWLEDGE COMPETITIVENESS INDEX |
|------|---|---------------------------------------|------|---|---------------------------------------|
| 1 | Minneapolis-St. Paul, US | 147.6 | 46 | Oklahoma City, US | 104.6 |
| 2 | San Francisco, US | 146.4 | 47 | Buffalo-Niagara Falls, US | 104.5 |
| 3 | Austin, US | 145.1 | 48 | Ontario, Canada | 103.7 |
| 4 | Denver-Boulder-Greeley, US | 144.3 | 49 | Pittsburgh, US | 103.6 |
| 5 | Washington, US | 138.1 | 50 | London, UK | 102.0 |
| 6 | Raleigh-Durham, US | 136.9 | 51 | South East, UK | 101.7 |
| 7 | Dallas-Fort Worth, US | 135.4 | 52 | Norfolk-Virginia Beach-Newport News, US | 98.3 |
| 8 | Boston, US | 133.8 | 53 | Miami-Fort Lauderdale, US | 97.5 |
| 9 | Atlanta, US | 132.5 | 54 | Tokyo, Japan | 97.2 |
| 10 | Salt Lake City-Ogden, US | 128.6 | 55 | New Orleans, US | 96.7 |
| 11 | Seattle, US | 127.0 | 56 | Eastern, UK | 96.3 |
| 12 | Kansas City, US | 126.8 | 57 | West Palm Beach-Boca Raton, US | 96.2 |
| 13 | Columbus, US | 124.1 | 58 | British Columbia, Canada | 95.5 |
| 14 | Grand Rapids-Muskegon-Holland, US | 122.1 | 59 | Norway | 95.1 |
| 15 | Louisville, US | 121.7 | 60 | Denmark | 92.4 |
| 16 | Houston-Galveston-Brazoria, US | 121.5 | 61 | New South Wales, Australia | 89.7 |
| 17 | Charlotte-Gastonia-Rock Hill, US | 121.2 | 62 | Hamburg, Germany | 87.9 |
| 18 | Chicago, US | 121.2 | 63 | Île de France, France | 87.1 |
| 19 | Rochester, US | 120.0 | 64 | West-Nederland, Netherlands | 85.1 |
| 20 | Orlando, US | 119.7 | 65 | Singapore | 84.6 |
| 21 | Nashville, US | 119.7 | 66 | Berlin, Germany | 83.8 |
| 22 | Stockholm, Sweden | 119.4 | 67 | Luxembourg | 83.6 |
| 23 | Portland-Salem, US | 119.3 | 68 | Bayern, Germany | 81.5 |
| 24 | Hartford, US | 119.0 | 69 | Baden-Württemberg, Germany | 81.0 |
| 25 | Switzerland | 117.0 | 70 | Hessen, Germany | 81.0 |
| 26 | New York, US | 116.5 | 71 | Ostösterreich, Austria | 80.5 |
| 27 | Richmond-Petersburg, US | 116.3 | 72 | Zuid-Nederland, Netherlands | 79.8 |
| 28 | Indianapolis, US | 116.1 | 73 | Ireland | 79.1 |
| 29 | San Diego, US | 115.3 | 74 | Osaka, Japan | 77.1 |
| 30 | Sacramento-Yolo, US | 115.1 | 75 | Westösterreich, Austria | 76.5 |
| 31 | Cincinnati-Hamilton, US | 114.3 | 76 | Kanagawa, Japan | 75.6 |
| 32 | Philadelphia, US | 114.1 | 77 | Bremen, Germany | 73.6 |
| 33 | Milwaukee-Racine, US | 113.4 | 78 | Schleswig-Holstein, Germany | 73.5 |
| 34 | Jacksonville, US | 113.2 | 79 | Noord-Nederland, Netherlands | 72.4 |
| 35 | Phoenix-Mesa, US | 113.2 | 80 | Brussels, Belgium | 71.6 |
| 36 | Uusimaa, Finland | 111.7 | 81 | Nordrhein-Westfalen, Germany | 71.3 |
| 37 | Los Angeles, US | 111.5 | 82 | Niedersachsen, Germany | 70.0 |
| 38 | Greensboro-Winston-Salem-High Point, US | 110.7 | 83 | Kyoto, Japan | 67.6 |
| 39 | Detroit-Ann Arbor-Flint, US | 110.4 | 84 | Saarland, Germany | 64.6 |
| 40 | Las Vegas, US | 110.0 | 85 | Vlaams Gewest, Belgium | 63.3 |
| 41 | St. Louis, US | 109.8 | 86 | Comunidad de Madrid, Spain | 62.8 |
| 42 | Memphis, US | 109.8 | 87 | Hong Kong | 59.7 |
| 43 | San Antonio, US | 107.8 | 88 | Lazio, Italy | 54.7 |
| 44 | Cleveland-Akron, US | 106.7 | 89 | Lombardia, Italy | 53.3 |
| 45 | Tampa-St. Petersburg-Clearwater, US | 105.9 | 90 | Emilia-Romagna, Italy | 50.7 |



The World Knowledge Competitiveness Index : The North American Dimension



| REGION | KNOWLEDGE COMPETITIVENESS INDEX |
|---|---------------------------------|
| Minneapolis-St Paul, US | 147.6 |
| San Francisco, US | 146.4 |
| Austin, US | 145.1 |
| Denver-Boulder-Greeley, US | 144.3 |
| Washington, US | 138.1 |
| Raleigh-Durham, US | 136.9 |
| Dallas-Fort Worth, US | 135.4 |
| Boston, US | 133.8 |
| Atlanta, US | 132.5 |
| Salt Lake City-Ogden, US | 128.6 |
| Seattle, US | 127.0 |
| Kansas City, US | 126.8 |
| Columbus, US | 124.1 |
| Grand Rapids-Muskegon-Holland, US | 122.1 |
| Louisville, US | 121.7 |
| Houston-Galveston-Brazoria, US | 121.5 |
| Charlotte-Gastonia-Rock Hill, US | 121.2 |
| Chicago, US | 121.2 |
| Rochester, US | 120.0 |
| Orlando, US | 119.7 |
| Nashville, US | 119.3 |
| Portland-Salem, US | 119.3 |
| Hartford, US | 119.0 |
| New York, US | 116.5 |
| Richmond-Petersburg, US | 116.3 |
| Indianapolis, US | 116.1 |
| San Diego, US | 115.3 |
| Sacramento-Yolo, US | 115.1 |
| Cincinnati-Hamilton, US | 114.3 |
| Philadelphia, US | 114.1 |
| Milwaukee-Racine, US | 113.4 |
| Jacksonville, US | 113.2 |
| Phoenix-Mesa, US | 113.2 |
| Los Angeles, US | 111.5 |
| Greenboro-Winston-Salem-High Point, US | 110.7 |
| Detroit-Ann Arbor-Flint, US | 110.4 |
| Las Vegas, US | 110.0 |
| St. Louis, US | 109.8 |
| Memphis, US | 109.8 |
| San Antonio, US | 107.8 |
| Cleveland-Akron, US | 106.7 |
| Tampa-St Petersburg-Clearwater, US | 105.9 |
| Oklahoma City, US | 104.6 |
| Buffalo-Niagara Falls, US | 104.5 |
| Ontario, Canada | 103.7 |
| Pittsburgh, US | 103.6 |
| Norfolk-Virginia Beach-Newport News, US | 98.3 |
| Miami-Fort Lauderdale, US | 97.5 |
| New Orleans, US | 96.7 |
| West Palm Beach-Boca Raton, US | 96.2 |
| British Columbia, Canada | 95.5 |



The World Knowledge Competitiveness Index : The Europe Dimension



| REGION | KNOWLEDGE COMPETITIVENESS INDEX |
|------------------------------|---------------------------------|
| Stockholm, Sweden | 119.4 |
| Switzerland | 117.0 |
| Uusimaa, Finland | 111.7 |
| London, UK | 102.0 |
| South East, UK | 101.7 |
| Eastern, UK | 96.3 |
| Norway | 95.1 |
| Denmark | 92.4 |
| Hamburg, Germany | 87.9 |
| Île de France, France | 87.1 |
| West-Nederland, Netherlands | 85.1 |
| Berlin, Germany | 83.8 |
| Luxembourg | 83.6 |
| Bayern, Germany | 81.5 |
| Baden-Württemberg, Germany | 81.0 |
| Hessen, Germany | 81.0 |
| Ostösterreich, Austria | 80.5 |
| Zuid-Nederland, Netherlands | 79.8 |
| Ireland | 79.1 |
| Westösterreich, Austria | 76.5 |
| Bremen, Germany | 73.6 |
| Schleswig-Holstein, Germany | 73.5 |
| Noord-Nederland, Netherlands | 72.4 |
| Brussels, Belgium | 71.6 |
| Nordrhein-Westfalen, Germany | 71.3 |
| Niedersachsen, Germany | 70.0 |
| Saarland, Germany | 64.6 |
| Vlaams Gewest, Belgium | 63.3 |
| Comunidad de Madrid, Spain | 62.8 |
| Lazio, Italy | 54.7 |
| Lombardia, Italy | 53.3 |
| Emilia-Romagna, Italy | 50.7 |



The World Knowledge Competitiveness Index : The Asia and Australasia Dimension

| REGION | KNOWLEDGE COMPETITIVENESS INDEX |
|----------------------------|---------------------------------|
| Tokyo, Japan | 97.2 |
| New South Wales, Australia | 89.7 |
| Singapore | 84.6 |
| Osaka, Japan | 77.1 |
| Kanagawa, Japan | 75.6 |
| Kyoto, Japan | 67.6 |
| Hong Kong | 59.7 |





Human Capital Components

Human Capital in our model consists of developing a measure of the availability of human inputs for the production of knowledge within each regional economy, including economic activity and knowledge workers. The level of economic participation within a region or nation is a fundamental indicator of its 'vibrancy' and human capital capacity at the macro-level. With sufficient labour market engagement there is little opportunity for long-term and on-going knowledge investment. Indeed, high levels of economic participation are a prerequisite for a socially cohesive living and working environment, as well as an economy that is not over-dependent on its public welfare system. As Table 2 indicates, economic activity rates vary considerably even among the globe's highest performing regions.

The highest levels of economic activity are amongst the regions of the United States, with highest ranking being Minneapolis-St Paul, with a participation rate 31.2% above the high-performing mean. The highest ranked European region, in 10th position, is Sweden's Stockholm (111.7). The lowest ranked region is Lazio in Italy (73.8), followed by Brussels (78.7). This variation is necessarily based on opportunities to enter the labour market, the prevailing system of social security and welfare, age-related demographics, as well as a complex mix of social and cultural variables.



Table 2 : Index of Economic Activity by Region

| RANK | REGION | INDEX OF ECONOMIC ACTIVITY | RANK | REGION | INDEX OF ECONOMIC ACTIVITY |
|------|---|----------------------------|------|---|----------------------------|
| 1 | Minneapolis-St. Paul, US | 131.2 | 46 | Hartford, US | 101.0 |
| 2 | Austin, US | 124.7 | 47 | Philadelphia, US | 101.0 |
| 3 | Grand Rapids-Muskegon-Holland, US | 120.3 | 48 | South East, UK | 100.8 |
| 4 | Salt Lake City-Ogden, US | 117.6 | 49 | Cleveland-Akron, US | 100.0 |
| 5 | Dallas-Fort Worth, US | 116.5 | 50 | British Columbia, Canada | 99.7 |
| 6 | Denver-Boulder-Greeley, US | 116.0 | 51 | Tokyo, Japan | 99.2 |
| 7 | Atlanta, US | 114.4 | 52 | Eastern, UK | 98.7 |
| 8 | Orlando, US | 114.4 | 53 | London, UK | 98.5 |
| 9 | Raleigh-Durham, US | 112.8 | 54 | Kanagawa, Japan | 98.1 |
| 10 | Stockholm, Sweden | 111.7 | 55 | Buffalo-Niagara Falls, US | 97.4 |
| 11 | Nashville, US | 111.7 | 56 | New York, US | 97.2 |
| 12 | Portland-Salem, US | 111.2 | 57 | West-Nederland, Netherlands | 96.5 |
| 13 | Kansas City, US | 111.2 | 58 | San Diego, US | 96.4 |
| 14 | Columbus, US | 110.7 | 59 | Zuid-Nederland, Netherlands | 96.2 |
| 15 | Seattle, US | 109.8 | 60 | Osaka, Japan | 95.8 |
| 16 | Houston-Galveston-Brazoria, US | 109.3 | 61 | Miami-Fort Lauderdale, US | 95.4 |
| 17 | Charlotte-Gastonia-Rock Hill, US | 108.7 | 62 | Norfolk-Virginia Beach-Newport News, US | 95.2 |
| 18 | Louisville, US | 108.5 | 63 | Île de France, France | 95.1 |
| 19 | Indianapolis, US | 108.1 | 64 | Pittsburgh, US | 94.8 |
| 20 | Milwaukee-Racine, US | 107.0 | 65 | Kyoto, Japan | 94.5 |
| 21 | San Francisco, US | 107.0 | 66 | New Orleans, US | 94.4 |
| 22 | Phoenix-Mesa, US | 106.8 | 67 | Hong Kong | 94.4 |
| 23 | Chicago, US | 106.6 | 68 | Bayern, Germany | 93.5 |
| 24 | Washington, US | 106.5 | 69 | Noord-Nederland, Netherlands | 92.7 |
| 25 | Las Vegas, US | 106.3 | 70 | Westösterreich, Austria | 92.7 |
| 26 | Boston, US | 106.1 | 71 | Berlin, Germany | 91.8 |
| 27 | Uusimaa, Finland | 106.1 | 72 | Baden-Württemberg, Germany | 91.6 |
| 28 | Rochester, US | 105.8 | 73 | West Palm Beach-Boca Raton, US | 91.4 |
| 29 | Cincinnati-Hamilton, US | 105.8 | 74 | Ostösterreich, Austria | 91.1 |
| 30 | Singapore | 105.4 | 75 | New South Wales, Australia | 90.8 |
| 31 | Oklahoma City, US | 105.3 | 76 | Hamburg, Germany | 90.2 |
| 32 | Greensboro-Winston-Salem-High Point, US | 105.2 | 77 | Hessen, Germany | 89.1 |
| 33 | Jacksonville, US | 104.9 | 78 | Schleswig-Holstein, Germany | 89.0 |
| 34 | Richmond-Petersburg, US | 103.6 | 79 | Ireland | 89.0 |
| 35 | Switzerland | 103.5 | 80 | Niedersachsen, Germany | 85.6 |
| 36 | Ontario, Canada | 103.2 | 81 | Bremen, Germany | 83.2 |
| 37 | Memphis, US | 102.9 | 82 | Nordrhein-Westfalen, Germany | 83.0 |
| 38 | Detroit-Ann Arbor-Flint, US | 102.3 | 83 | Vlaams Gewest, Belgium | 81.2 |
| 39 | Sacramento-Yolo, US | 102.1 | 84 | Luxembourg | 80.5 |
| 40 | Norway | 102.0 | 85 | Comunidad de Madrid, Spain | 80.2 |
| 41 | St. Louis, US | 102.0 | 86 | Saarland, Germany | 79.9 |
| 42 | San Antonio, US | 101.7 | 87 | Lombardia, Italy | 79.9 |
| 43 | Los Angeles, US | 101.4 | 88 | Emilia-Romagna, Italy | 79.9 |
| 44 | Tampa-St. Petersburg-Clearwater, US | 101.2 | 89 | Brussels, Belgium | 78.7 |
| 45 | Denmark | 101.1 | 90 | Lazio, Italy | 73.8 |



The importance of the number of managers within firms is that innovation - whether it is product, process or organisational - is usually stimulated and co-ordinated through those workers with management responsibilities. The pervasiveness of the global knowledge economy can, to some extent, be equated by the fact employment growth is largely occurring through the expansion of managerial and professional/technical occupations. These non-production employees are now more generally termed knowledge workers.

As shown by Table 3, the proportion of such knowledge workers is highest in Australia's New South Wales region, with an index score of 256.4. This is partly explained by the fact that the region covers the city of Sydney, which is the location of a large proportion of professional and technical businesses in Australia. In second position is the UK's Eastern region, covering the high-tech hub of Cambridge, with a score of 241.2, followed by the US regions of Charlotte-Gastonia-Rock Hill (192.2) and Raleigh-Durham (191.1). The lowest ranked region is Sarland (2.2) in Germany, followed by a cluster of West European regions. The low ranking of the German regions reflects the continuance of an organisational model of work that is still highly hierarchical, with many workers still classed as 'blue-collar'. To some extent, there appears to be an association between the number of managers in a region, and the proportion of small firms within the respective regional economy.



Table 3 : Index of Number of Managers (Managers per 1,000 Inhabitants)

| RANK | REGION | INDEX OF MANAGERS | RANK | REGION | INDEX OF MANAGERS |
|------|---|-------------------|------|---|-------------------|
| 1 | New South Wales, Australia | 256.4 | 46 | Tokyo, Japan | 111.2 |
| 2 | Eastern, UK | 241.2 | 47 | San Antonio, US | 107.6 |
| 3 | Charlotte-Gastonia-Rock Hill, US | 192.2 | 48 | Las Vegas, US | 105.5 |
| 4 | Raleigh-Durham, US | 191.1 | 49 | Los Angeles, US | 100.5 |
| 5 | Ontario, Canada | 182.9 | 50 | New York, US | 98.3 |
| 6 | British Columbia, Canada | 182.7 | 51 | Seattle, US | 98.0 |
| 7 | Austin, US | 182.5 | 52 | San Diego, US | 97.9 |
| 8 | South East, UK | 180.8 | 53 | Sacramento-Yolo, US | 96.1 |
| 9 | Washington, US | 173.1 | 54 | Kanagawa, Japan | 95.2 |
| 10 | Dallas-Fort Worth, US | 164.1 | 55 | Norfolk-Virginia Beach-Newport News, US | 91.6 |
| 11 | Nashville, US | 162.6 | 56 | Detroit-Ann Arbor-Flint, US | 88.5 |
| 12 | Denver-Boulder-Greeley, US | 161.9 | 57 | Rochester, US | 88.3 |
| 13 | Atlanta, US | 161.8 | 58 | Grand Rapids-Muskegon-Holland, US | 84.6 |
| 14 | Norway | 157.4 | 59 | Osaka, Japan | 83.5 |
| 15 | Kansas City, US | 156.9 | 60 | Kyoto, Japan | 78.3 |
| 16 | Boston, US | 153.5 | 61 | Buffalo-Niagara Falls, US | 78.2 |
| 17 | Greensboro-Winston-Salem-High Point, US | 151.8 | 62 | Zuid-Nederland, Netherlands | 73.2 |
| 18 | Columbus, US | 151.7 | 63 | West-Nederland, Netherlands | 72.9 |
| 19 | Milwaukee-Racine, US | 148.7 | 64 | Noord-Nederland, Netherlands | 68.0 |
| 20 | Minneapolis-St. Paul, US | 145.2 | 65 | Singapore | 63.5 |
| 21 | Houston-Galveston-Brazoria, US | 143.1 | 66 | London, UK | 55.9 |
| 22 | Chicago, US | 140.5 | 67 | Stockholm, Sweden | 55.3 |
| 23 | San Francisco, US | 140.4 | 68 | Hong Kong | 40.9 |
| 24 | Oklahoma City, US | 138.1 | 69 | Comunidad de Madrid, Spain | 39.3 |
| 25 | Louisville, US | 136.8 | 70 | Uusimaa, Finland | 36.9 |
| 26 | Hartford, US | 136.5 | 71 | Vlaams Gewest, Belgium | 29.5 |
| 27 | St. Louis, US | 133.0 | 72 | Denmark | 27.7 |
| 28 | Orlando, US | 131.8 | 73 | Luxembourg | 25.1 |
| 29 | Cleveland-Akron, US | 131.5 | 74 | Brussels, Belgium | 25.1 |
| 30 | Memphis, US | 131.0 | 75 | Baden-Württemberg, Germany | 21.3 |
| 31 | Salt Lake City-Ogden, US | 129.9 | 76 | Ireland | 19.9 |
| 32 | Cincinnati-Hamilton, US | 129.8 | 77 | Bayern, Germany | 17.3 |
| 33 | Richmond-Petersburg, US | 129.1 | 78 | Lombardia, Italy | 16.2 |
| 34 | Île de France, France | 128.1 | 79 | Hessen, Germany | 15.4 |
| 35 | Portland-Salem, US | 125.5 | 80 | Hamburg, Germany | 13.9 |
| 36 | Switzerland | 125.1 | 81 | Bremen, Germany | 11.8 |
| 37 | Philadelphia, US | 124.8 | 82 | Berlin, Germany | 11.8 |
| 38 | Indianapolis, US | 124.3 | 83 | Emilia-Romagna, Italy | 9.7 |
| 39 | New Orleans, US | 122.8 | 84 | Lazio, Italy | 8.8 |
| 40 | Tampa-St. Petersburg-Clearwater, US | 122.5 | 85 | Nordrhein-Westfalen, Germany | 7.9 |
| 41 | Pittsburgh, US | 121.1 | 86 | Niedersachsen, Germany | 7.8 |
| 42 | Phoenix-Mesa, US | 118.0 | 87 | Ostösterreich, Austria | 6.5 |
| 43 | Miami-Fort Lauderdale, US | 115.0 | 88 | Westösterreich, Austria | 6.4 |
| 44 | Jacksonville, US | 114.0 | 89 | Schleswig-Holstein, Germany | 4.0 |
| 45 | West Palm Beach-Boca Raton, US | 111.4 | 90 | Saarland, Germany | 2.2 |



KNOWLEDGE-BASED SECTORS AND EMPLOYMENT

The concept of knowledge-based and non-knowledge-based sectors is used to distinguish between industries with higher or lower levels of research and development activity. Knowledge-based sectors, therefore, clearly offer a higher potential for innovation, and subsequently competitive advantage. Within this study we have created five broad groups of knowledge-based sectors, in order to undertake an analysis of employment. It is our hypothesis that some sectors have a higher propensity for developing a knowledge-driven economy. The five sectors consist of:

- IT and computer manufacturing - communication equipment, computer and office equipment, electronic components and accessories.
- Biotechnology and chemical sectors - pharmaceuticals, drugs, chemicals and chemical products.
- Automotive and high-tech mechanical engineering - motor vehicles and transport equipment, machine tools and equipment.
- Instrumentation and electrical machinery - precision and optical instruments, electrical transmission and distribution equipment lighting and wiring equipment.
- High-tech services - software and computer related services, telecommunications, research, development and testing services.

Despite the current global slowdown, high-technology sectors, in particular IT and computer manufacturing, still form an increasingly important component of international trade, and are generally more internationalised than traditional sectors. Throughout the world three regions dominate the field for IT and computer manufacturing (see Table 4) as measured by employment density. The highest ranked is Austin (751.1), with more than seven-fold the high-performing mean, which is the home of Dell Computers and the chip manufacturer Sematech. Second is San Francisco (493.0), which includes the famous Silicon Valley cluster of IT and computer firms such as Apple, Sun Microsystems, Intel, Hewlett-Packard and National Semiconductor. In third position is Portland-Salem (323.2), followed by the Kanagawa (302.5) region of Japan, the headquarters of companies such as NEC, Fujitsu and Toshiba. The lowest ranked regions are Memphis (6.5), New Orleans (7.0) and Las Vegas (14.7).



Table 4 : Index of Regional Employment in the IT and Computer Manufacturing Sectors

| RANK | REGION | INDEX OF IT & COMPUTER MANUFACTURING EMPLOYMENT | RANK | REGION | INDEX OF IT & COMPUTER MANUFACTURING EMPLOYMENT |
|------|---|---|------|---|---|
| 1 | Austin, US | 751.1 | 46 | Philadelphia, US | 59.0 |
| 2 | San Francisco, US | 493.0 | 47 | Hartford, US | 58.9 |
| 3 | Portland-Salem, US | 323.2 | 48 | Vlaams Gewest, Belgium | 58.0 |
| 4 | Kanagawa, Japan | 302.5 | 49 | Niedersachsen, Germany | 55.3 |
| 5 | Phoenix-Mesa, US | 284.6 | 50 | Atlanta, US | 54.0 |
| 6 | Zuid-Nederland, Netherlands | 265.1 | 51 | Houston-Galveston-Brazoria, US | 53.8 |
| 7 | Boston, US | 232.8 | 52 | London, UK | 53.2 |
| 8 | Sacramento-Yolo, US | 203.2 | 53 | Indianapolis, US | 52.8 |
| 9 | Stockholm, Sweden | 201.9 | 54 | Tampa-St. Petersburg-Clearwater, US | 51.7 |
| 10 | Ireland | 199.6 | 55 | Nashville, US | 50.9 |
| 11 | Uusimaa, Finland | 188.5 | 56 | New York, US | 50.4 |
| 12 | South East, UK | 177.0 | 57 | Seattle, US | 50.3 |
| 13 | Dallas-Fort Worth, US | 170.7 | 58 | Norway | 49.0 |
| 14 | Minneapolis-St. Paul, US | 162.9 | 59 | West Palm Beach-Boca Raton, US | 48.8 |
| 15 | Kyoto, Japan | 162.7 | 60 | Bremen, Germany | 46.8 |
| 16 | Baden-Württemberg, Germany | 157.9 | 61 | Grand Rapids-Muskegon-Holland, US | 46.2 |
| 17 | Salt Lake City-Ogden, US | 137.4 | 62 | Pittsburgh, US | 45.4 |
| 18 | Hessen, Germany | 129.7 | 63 | Jacksonville, US | 43.6 |
| 19 | Ostösterreich, Austria | 126.9 | 64 | Buffalo-Niagara Falls, US | 40.2 |
| 20 | Raleigh-Durham, US | 123.9 | 65 | Brussels, Belgium | 38.9 |
| 21 | Eastern, UK | 120.4 | 66 | Cleveland-Akron, US | 38.7 |
| 22 | San Diego, US | 117.8 | 67 | Saarland, Germany | 37.8 |
| 23 | Denver-Boulder-Greeley, US | 114.9 | 68 | Greensboro-Winston-Salem-High Point, US | 37.2 |
| 24 | Osaka, Japan | 106.0 | 69 | Milwaukee-Racine, US | 35.9 |
| 25 | Bayern, Germany | 101.7 | 70 | St. Louis, US | 30.2 |
| 26 | Île de France, France | 101.6 | 71 | San Antonio, US | 29.2 |
| 27 | Schleswig-Holstein, Germany | 95.4 | 72 | Emilia-Romagna, Italy | 29.0 |
| 28 | Berlin, Germany | 95.3 | 73 | Detroit-Ann Arbor-Flint, US | 28.9 |
| 29 | Ontario, Canada | 94.2 | 74 | West-Nederland, Netherlands | 26.0 |
| 30 | Comunidad de Madrid, Spain | 88.9 | 75 | Columbus, US | 24.5 |
| 31 | Charlotte-Gastonia-Rock Hill, US | 88.1 | 76 | Washington, US | 22.8 |
| 32 | Lombardia, Italy | 88.0 | 77 | Westösterreich, Austria | 22.1 |
| 33 | Los Angeles, US | 87.7 | 78 | Louisville, US | 21.1 |
| 34 | Richmond-Petersburg, US | 87.1 | 79 | Kansas City, US | 20.7 |
| 35 | British Columbia, Canada | 85.9 | 80 | Tokyo, Japan | 20.0 |
| 36 | Denmark | 85.4 | 81 | Miami-Fort Lauderdale, US | 19.1 |
| 37 | Noord-Nederland, Netherlands | 81.4 | 82 | Cincinnati-Hamilton, US | 17.2 |
| 38 | Rochester, US | 81.0 | 83 | Las Vegas, US | 14.7 |
| 39 | Oklahoma City, US | 78.5 | 84 | New Orleans, US | 7.0 |
| 40 | Nordrhein-Westfalen, Germany | 78.0 | 85 | Memphis, US | 6.5 |
| 41 | Chicago, US | 72.6 | | Switzerland | N/A |
| 42 | Orlando, US | 71.7 | | Hong Kong | N/A |
| 43 | Hamburg, Germany | 63.6 | | Singapore | N/A |
| 44 | Norfolk-Virginia Beach-Newport News, US | 62.9 | | New South Wales, Australia | N/A |
| 45 | Lazio, Italy | 62.0 | | Luxembourg | N/A |

(Employees per 1,000 inhabitants)



The biotechnology and chemical technology sectors are now widely recognised as having very particular human capital requirements that are often highly, and increasingly, knowledge-intensive. Table 5 indicates employment density in the biotechnology and chemical sectors, with the highest ranked being the German region of Hessen (322.5), followed by the US regions of Cincinnati-Hamilton (248.9) and Philadelphia (242.9). The lowest ranked regions are Norfolk-Virginia Beach-Newsport News (8.9), Las Vegas (10.8) and Orlando (15.6).

Historically, automotive and mechanical engineering has been responsible for capturing a high-degree of the human capital devoted to knowledge-intensive activities, particularly in certain regions. Although these sectors have been somewhat superseded in terms of knowledge intensity, they retain higher than average knowledge inputs. Table 6 is a measure of employment density in the more 'traditional' knowledge-based sectors of automotive and mechanical engineering. Unsurprisingly, the highest ranked region is the motor hotspot of Detroit-Ann Arbor-Flint with a score of 354.3, followed by Germany's Baden-Wurttemberg (295.8), the traditional European powerhouse of engineering and car manufacturing. In third place is another German region, Bayern (234.7), which includes the city of Munich, followed by Seattle (229.3). The lowest ranked region is Las Vegas (6.0), followed by Austin (16.7) and the Brussels (18.4) region of Belgium.

Instrumentation and electrical engineering are key knowledge 'support' sectors, providing high value-added equipment for a very wide range of 'front-line' sectors. Table 7 highlights employment density in the instrumentation and electrical machinery sectors, with by far the leading region being Rochester (753.8), with a score more than seven times higher than the index average. Rochester is followed by Milwaukee-Racine (285.7) and the German regions of Bayern (275.2) and Baden-Wurttemberg (259.0).



Table 5 : Index of Regional Employment in the Biotechnology and Chemicals Sectors

| RANK | REGION | INDEX OF BIOTECHNOLOGY & CHEMICAL SECTOR EMPLOYMENT | RANK | REGION | INDEX OF BIOTECHNOLOGY & CHEMICAL SECTOR EMPLOYMENT |
|------|---|---|------|---|---|
| 1 | Hessen, Germany | 322.5 | 46 | Lazio, Italy | 92.4 |
| 2 | Cincinnati-Hamilton, US | 248.9 | 47 | Minneapolis-St. Paul, US | 91.1 |
| 3 | Philadelphia, US | 242.9 | 48 | Pittsburgh, US | 88.2 |
| 4 | Nordrhein-Westfalen, Germany | 224.3 | 49 | Berlin, Germany | 86.2 |
| 5 | Vlaams Gewest, Belgium | 220.2 | 50 | Bremen, Germany | 83.4 |
| 6 | Lombardia, Italy | 216.5 | 51 | Brussels, Belgium | 81.7 |
| 7 | Raleigh-Durham, US | 204.4 | 52 | Ontario, Canada | 80.4 |
| 8 | Richmond-Petersburg, US | 199.3 | 53 | Kanagawa, Japan | 80.1 |
| 9 | Grand Rapids-Muskegon-Holland, US | 194.8 | 54 | Columbus, US | 78.1 |
| 10 | Indianapolis, US | 176.2 | 55 | British Columbia, Canada | 73.3 |
| 11 | Houston-Galveston-Brazoria, US | 175.6 | 56 | Saarland, Germany | 67.4 |
| 12 | Zuid-Nederland, Netherlands | 173.5 | 57 | Dallas-Fort Worth, US | 62.6 |
| 13 | Hamburg, Germany | 150.6 | 58 | London, UK | 61.6 |
| 14 | South East, UK | 150.6 | 59 | Kyoto, Japan | 60.9 |
| 15 | Cleveland-Akron, US | 150.0 | 60 | Boston, US | 60.1 |
| 16 | Greensboro-Winston-Salem-High Point, US | 143.5 | 61 | Salt Lake City-Ogden, US | 58.2 |
| 17 | Osaka, Japan | 143.1 | 62 | Los Angeles, US | 56.5 |
| 18 | Ireland | 141.4 | 63 | San Francisco, US | 55.7 |
| 19 | Kansas City, US | 140.3 | 64 | Atlanta, US | 54.4 |
| 20 | St. Louis, US | 133.8 | 65 | Nashville, US | 52.1 |
| 21 | Stockholm, Sweden | 131.5 | 66 | Hartford, US | 49.9 |
| 22 | Charlotte-Gastonia-Rock Hill, US | 127.6 | 67 | Detroit-Ann Arbor-Flint, US | 45.4 |
| 23 | Bayern, Germany | 126.5 | 68 | Austin, US | 43.9 |
| 24 | Comunidad de Madrid, Spain | 124.6 | 69 | Rochester, US | 43.2 |
| 25 | Baden-Württemberg, Germany | 124.4 | 70 | San Diego, US | 41.4 |
| 26 | Ostösterreich, Austria | 118.8 | 71 | Washington, US | 37.8 |
| 27 | Île de France, France | 118.7 | 72 | Denver-Boulder-Greeley, US | 36.5 |
| 28 | Niedersachsen, Germany | 118.1 | 73 | Jacksonville, US | 36.0 |
| 29 | New Orleans, US | 117.3 | 74 | Phoenix-Mesa, US | 33.0 |
| 30 | Denmark | 117.1 | 75 | Tampa-St. Petersburg-Clearwater, US | 31.4 |
| 31 | New York, US | 116.7 | 76 | Luxembourg | 30.8 |
| 32 | Uusimaa, Finland | 116.4 | 77 | West Palm Beach-Boca Raton, US | 27.2 |
| 33 | Louisville, US | 115.9 | 78 | Oklahoma City, US | 24.9 |
| 34 | Memphis, US | 115.8 | 79 | San Antonio, US | 22.4 |
| 35 | Chicago, US | 114.1 | 80 | Portland-Salem, US | 19.4 |
| 36 | Buffalo-Niagara Falls, US | 109.9 | 81 | Miami-Fort Lauderdale, US | 17.9 |
| 37 | Emilia-Romagna, Italy | 107.6 | 82 | Seattle, US | 17.1 |
| 38 | Milwaukee-Racine, US | 105.3 | 83 | Sacramento-Yolo, US | 15.9 |
| 39 | West-Nederland, Netherlands | 104.0 | 84 | Orlando, US | 15.6 |
| 40 | Westösterreich, Austria | 100.5 | 85 | Las Vegas, US | 10.8 |
| 41 | Eastern, UK | 98.4 | 86 | Norfolk-Virginia Beach-Newport News, US | 8.9 |
| 42 | New South Wales, Australia | 97.4 | | Switzerland | N/A |
| 43 | Noord-Nederland, Netherlands | 96.1 | | Norway | N/A |
| 44 | Schleswig-Holstein, Germany | 95.9 | | Hong Kong | N/A |
| 45 | Tokyo, Japan | 95.3 | | Singapore | N/A |

(Employees per 1,000 inhabitants)



Table 6 : Index of Regional Employment in the Automotive and Mechanical Engineering Sectors

| RANK | REGION | INDEX OF AUTOMOTIVE & MECHANICAL ENGINEERING SECTOR EMPLOYMENT | RANK | REGION | INDEX OF AUTOMOTIVE & MECHANICAL ENGINEERING SECTOR EMPLOYMENT |
|------|---|--|------|-------------------------------------|--|
| 1 | Detroit-Ann Arbor-Flint, US | 354.3 | 46 | Tokyo, Japan | 78.3 |
| 2 | Baden-Württemberg, Germany | 343.2 | 47 | Phoenix-Mesa, US | 76.5 |
| 3 | Bayern, Germany | 234.7 | 48 | Berlin, Germany | 75.4 |
| 4 | Seattle, US | 229.3 | 49 | Los Angeles, US | 75.0 |
| 5 | Milwaukee-Racine, US | 228.5 | 50 | Portland-Salem, US | 74.6 |
| 6 | Grand Rapids-Muskegon-Holland, US | 220.2 | 51 | Comunidad de Madrid, Spain | 74.3 |
| 7 | Niedersachsen, Germany | 206.1 | 52 | Houston-Galveston-Brazoria, US | 73.4 |
| 8 | Emilia-Romagna, Italy | 183.4 | 53 | Salt Lake City-Ogden, US | 73.3 |
| 9 | Hartford, US | 182.3 | 54 | Ostösterreich, Austria | 69.9 |
| 10 | Saarland, Germany | 181.4 | 55 | Kansas City, US | 69.6 |
| 11 | Hessen, Germany | 173.1 | 56 | Noord-Nederland, Netherlands | 68.6 |
| 12 | Cleveland-Akron, US | 164.4 | 57 | Columbus, US | 66.6 |
| 13 | Indianapolis, US | 162.3 | 58 | Atlanta, US | 63.2 |
| 14 | Lombardia, Italy | 162.0 | 59 | Memphis, US | 62.7 |
| 15 | Bremen, Germany | 161.8 | 60 | San Diego, US | 61.6 |
| 16 | Louisville, US | 159.2 | 61 | Boston, US | 60.7 |
| 17 | Nashville, US | 155.1 | 62 | Pittsburgh, US | 60.4 |
| 18 | Norfolk-Virginia Beach-Newport News, US | 154.8 | 63 | Ireland | 52.7 |
| 19 | St. Louis, US | 146.2 | 64 | Denver-Boulder-Greeley, US | 52.4 |
| 20 | Cincinnati-Hamilton, US | 136.9 | 65 | Philadelphia, US | 52.2 |
| 21 | Kanagawa, Japan | 135.5 | 66 | West-Nederland, Netherlands | 49.8 |
| 22 | Eastern, UK | 131.6 | 67 | Stockholm, Sweden | 49.7 |
| 23 | Nordrhein-Westfalen, Germany | 130.8 | 68 | Orlando, US | 48.4 |
| 24 | Charlotte-Gastonia-Rock Hill, US | 127.2 | 69 | San Francisco, US | 46.0 |
| 25 | Osaka, Japan | 125.2 | 70 | West Palm Beach-Boca Raton, US | 45.6 |
| 26 | Rochester, US | 120.3 | 71 | Jacksonville, US | 42.9 |
| 27 | Schleswig-Holstein, Germany | 112.4 | 72 | Richmond-Petersburg, US | 36.9 |
| 28 | Denmark | 108.7 | 73 | Lazio, Italy | 35.9 |
| 29 | South East, UK | 106.5 | 74 | San Antonio, US | 35.6 |
| 30 | Westösterreich, Austria | 105.6 | 75 | London, UK | 35.0 |
| 31 | Vlaams Gewest, Belgium | 104.7 | 76 | Tampa-St. Petersburg-Clearwater, US | 27.6 |
| 32 | Dallas-Fort Worth, US | 100.3 | 77 | Miami-Fort Lauderdale, US | 27.3 |
| 33 | Minneapolis-St. Paul, US | 99.7 | 78 | New York, US | 25.9 |
| 34 | Oklahoma City, US | 99.2 | 79 | Washington, US | 24.9 |
| 35 | Ontario, Canada | 99.0 | 80 | Raleigh-Durham, US | 23.6 |
| 36 | Hamburg, Germany | 96.0 | 81 | Luxembourg | 23.4 |
| 37 | Buffalo-Niagara Falls, US | 92.8 | 82 | Sacramento-Yolo, US | 20.2 |
| 38 | British Columbia, Canada | 90.3 | 83 | Brussels, Belgium | 18.4 |
| 39 | Uusimaa, Finland | 88.8 | 84 | Austin, US | 16.7 |
| 40 | New Orleans, US | 87.3 | 85 | Las Vegas, US | 6.0 |
| 41 | Île de France, France | 86.0 | | Switzerland | N/A |
| 42 | Kyoto, Japan | 85.6 | | Norway | N/A |
| 43 | Zuid-Nederland, Netherlands | 84.0 | | Hong Kong | N/A |
| 44 | Chicago, US | 81.3 | | Singapore | N/A |
| 45 | Greensboro-Winston-Salem-High Point, US | 80.9 | | New South Wales, Australia | N/A |

(Employees per 1,000 inhabitants)



Table 7 : Index of Regional Employment in the Instrumentation and Electrical Engineering Sectors

| RANK | REGION | INDEX OF INSTRUMENTATION AND ELECTRICAL ENGINEERING SECTOR EMPLOYMENT | RANK | REGION | INDEX OF INSTRUMENTATION AND ELECTRICAL ENGINEERING SECTOR EMPLOYMENT |
|------|---|---|------|---|---|
| 1 | Rochester, US | 753.8 | 46 | Schleswig-Holstein, Germany | 80.2 |
| 2 | Milwaukee-Racine, US | 285.7 | 47 | Stockholm, Sweden | 76.7 |
| 3 | Bayern, Germany | 275.2 | 48 | Cincinnati-Hamilton, US | 76.3 |
| 4 | Baden-Württemberg, Germany | 259.0 | 49 | Orlando, US | 75.8 |
| 5 | Minneapolis-St. Paul, US | 245.6 | 50 | Philadelphia, US | 74.2 |
| 6 | Boston, US | 183.4 | 51 | Bremen, Germany | 71.6 |
| 7 | San Francisco, US | 174.1 | 52 | Seattle, US | 71.1 |
| 8 | Uusimaa, Finland | 167.1 | 53 | Comunidad de Madrid, Spain | 70.7 |
| 9 | Kyoto, Japan | 164.3 | 54 | Atlanta, US | 68.1 |
| 10 | Lombardia, Italy | 149.1 | 55 | Columbus, US | 67.2 |
| 11 | Hessen, Germany | 145.7 | 56 | New York, US | 66.5 |
| 12 | Indianapolis, US | 144.8 | 57 | Niedersachsen, Germany | 65.1 |
| 13 | Tokyo, Japan | 142.2 | 58 | Saarland, Germany | 57.9 |
| 14 | Raleigh-Durham, US | 140.6 | 59 | London, UK | 57.9 |
| 15 | South East, UK | 138.7 | 60 | Zuid-Nederland, Netherlands | 56.4 |
| 16 | Salt Lake City-Ogden, US | 133.8 | 61 | Phoenix-Mesa, US | 55.2 |
| 17 | Emilia-Romagna, Italy | 131.0 | 62 | Miami-Fort Lauderdale, US | 54.1 |
| 18 | Hartford, US | 128.6 | 63 | Jacksonville, US | 51.7 |
| 19 | Osaka, Japan | 128.1 | 64 | Kansas City, US | 51.3 |
| 20 | Cleveland-Akron, US | 124.5 | 65 | Noord-Nederland, Netherlands | 48.6 |
| 21 | Kanagawa, Japan | 123.9 | 66 | Charlotte-Gastonia-Rock Hill, US | 47.4 |
| 22 | Eastern, UK | 123.7 | 67 | Houston-Galveston-Brazoria, US | 46.1 |
| 23 | Berlin, Germany | 120.8 | 68 | Nashville, US | 45.1 |
| 24 | Los Angeles, US | 119.9 | 69 | Detroit-Ann Arbor-Flint, US | 43.4 |
| 25 | Greensboro-Winston-Salem-High Point, US | 116.8 | 70 | Lazio, Italy | 37.8 |
| 26 | Ostösterreich, Austria | 115.4 | 71 | Washington, US | 34.9 |
| 27 | Westösterreich, Austria | 112.8 | 72 | Oklahoma City, US | 34.5 |
| 28 | Buffalo-Niagara Falls, US | 112.1 | 73 | Brussels, Belgium | 33.6 |
| 29 | Chicago, US | 107.6 | 74 | West-Nederland, Netherlands | 33.1 |
| 30 | Ireland | 105.9 | 75 | Sacramento-Yolo, US | 26.1 |
| 31 | Austin, US | 100.0 | 76 | Richmond-Petersburg, US | 25.4 |
| 32 | San Diego, US | 99.0 | 77 | Ontario, Canada | 23.7 |
| 33 | Île de France, France | 98.3 | 78 | Louisville, US | 23.2 |
| 34 | Hamburg, Germany | 97.2 | 79 | British Columbia, Canada | 21.6 |
| 35 | Denver-Boulder-Greeley, US | 97.0 | 80 | San Antonio, US | 20.3 |
| 36 | Denmark | 96.1 | 81 | Norfolk-Virginia Beach-Newport News, US | 19.6 |
| 37 | Tampa-St. Petersburg-Clearwater, US | 95.5 | 82 | West Palm Beach-Boca Raton, US | 19.3 |
| 38 | Nordrhein-Westfalen, Germany | 95.2 | 83 | New Orleans, US | 17.9 |
| 39 | Grand Rapids-Muskegon-Holland, US | 85.8 | 84 | Las Vegas, US | 9.6 |
| 40 | Memphis, US | 85.3 | | Switzerland | N/A |
| 41 | Pittsburgh, US | 84.5 | | Norway | N/A |
| 42 | Dallas-Fort Worth, US | 84.4 | | Hong Kong | N/A |
| 43 | St. Louis, US | 84.0 | | Singapore | N/A |
| 44 | Vlaams Gewest, Belgium | 82.6 | | New South Wales, Australia | N/A |
| 45 | Portland-Salem, US | 81.9 | | Luxembourg | N/A |

(Employees per 1,000 inhabitants)



It is crucial to recognise that high value-added service sectors are increasingly important sites for human capital and innovation. Despite recent criticisms of the new economy concept and the crisis within the associated sector, it is clear that ICT and associated development is at the very heart of knowledge-driven economics. The growth of the Internet and enhanced telecommunications are the keys to creating a global knowledge community. In general, high-tech services provide the base for facilitating global communication, as well as being vitally important for mobilising knowledge-based development within and across sectors.

Table 8 represents an index of employment density in high-tech service sectors. The top ranked regions are Denver-Boulder-Greeley (218.5), Switzerland (207.9), San Francisco (198.1) and Washington DC (191.7). In general, the top ranked regions are predominately in the US, although Sweden's Stockholm is ranked in 7th position. The lowest ranked regions are Kyoto in Japan (27.4), Bremen (31.0) in Germany, and Noord Nederland (39.9).



Table 8 : Index of Regional Employment in the High-Technology Service Sectors

| RANK | REGION | INDEX OF HIGH TECHNOLOGY SERVICE SECTOR EMPLOYMENT | RANK | REGION | INDEX OF HIGH TECHNOLOGY SERVICE SECTOR EMPLOYMENT |
|------|-------------------------------------|--|------|---|--|
| 1 | Denver-Boulder-Greeley, US | 218.5 | 46 | Pittsburgh, US | 89.5 |
| 2 | Switzerland | 207.9 | 47 | Memphis, US | 88.3 |
| 3 | San Francisco, US | 198.1 | 48 | Sacramento-Yolo, US | 88.1 |
| 4 | Washington, US | 191.7 | 49 | Berlin, Germany | 86.3 |
| 5 | Uusimaa, Finland | 186.5 | 50 | Phoenix-Mesa, US | 85.4 |
| 6 | Kansas City, US | 172.2 | 51 | Detroit-Ann Arbor-Flint, US | 85.4 |
| 7 | Stockholm, Sweden | 169.2 | 52 | Richmond-Petersburg, US | 84.8 |
| 8 | Atlanta, US | 169.1 | 53 | Ireland | 83.6 |
| 9 | Raleigh-Durham, US | 168.4 | 54 | Hessen, Germany | 78.6 |
| 10 | Louisville, US | 161.1 | 55 | Buffalo-Niagara Falls, US | 77.6 |
| 11 | Dallas-Fort Worth, US | 160.8 | 56 | Hamburg, Germany | 77.4 |
| 12 | Tokyo, Japan | 155.7 | 57 | Greensboro-Winston-Salem-High Point, US | 76.4 |
| 13 | South East, UK | 150.0 | 58 | Cleveland-Akron, US | 75.7 |
| 14 | Boston, US | 149.8 | 59 | Ostösterreich, Austria | 74.4 |
| 15 | Seattle, US | 139.2 | 60 | Los Angeles, US | 74.1 |
| 16 | Île de France, France | 138.4 | 61 | Bayern, Germany | 73.6 |
| 17 | Minneapolis-St. Paul, US | 133.4 | 62 | Kanagawa, Japan | 73.5 |
| 18 | London, UK | 133.3 | 63 | Oklahoma City, US | 72.6 |
| 19 | Austin, US | 131.1 | 64 | Luxembourg | 72.6 |
| 20 | Columbus, US | 129.8 | 65 | Baden-Württemberg, Germany | 72.3 |
| 21 | Eastern, UK | 122.9 | 66 | Brussels, Belgium | 71.3 |
| 22 | Salt Lake City-Ogden, US | 122.4 | 67 | Miami-Fort Lauderdale, US | 71.2 |
| 23 | San Diego, US | 118.0 | 68 | British Columbia, Canada | 69.3 |
| 24 | Charlotte-Gastonia-Rock Hill, US | 114.6 | 69 | Las Vegas, US | 68.7 |
| 25 | New York, US | 112.8 | 70 | Norfolk-Virginia Beach-Newport News, US | 67.0 |
| 26 | Denmark | 112.0 | 71 | Zuid-Nederland, Netherlands | 64.3 |
| 27 | Nashville, US | 111.9 | 72 | Lombardia, Italy | 64.2 |
| 28 | Chicago, US | 111.4 | 73 | West Palm Beach-Boca Raton, US | 64.0 |
| 29 | Indianapolis, US | 107.2 | 74 | Osaka, Japan | 62.4 |
| 30 | Orlando, US | 105.5 | 75 | Vlaams Gewest, Belgium | 61.1 |
| 31 | West-Nederland, Netherlands | 105.0 | 76 | New Orleans, US | 59.0 |
| 32 | Milwaukee-Racine, US | 101.9 | 77 | Schleswig-Holstein, Germany | 57.2 |
| 33 | St. Louis, US | 101.2 | 78 | Nordrhein-Westfalen, Germany | 55.6 |
| 34 | Houston-Galveston-Brazoria, US | 98.1 | 79 | Grand Rapids-Muskegon-Holland, US | 52.4 |
| 35 | Jacksonville, US | 97.6 | 80 | Niedersachsen, Germany | 49.9 |
| 36 | San Antonio, US | 95.7 | 81 | Emilia-Romagna, Italy | 48.7 |
| 37 | Tampa-St. Petersburg-Clearwater, US | 95.2 | 82 | Saarland, Germany | 46.4 |
| 38 | Lazio, Italy | 93.7 | 83 | Westösterreich, Austria | 44.9 |
| 39 | Philadelphia, US | 92.8 | 84 | Noord-Nederland, Netherlands | 39.9 |
| 40 | Portland-Salem, US | 92.5 | 85 | Bremen, Germany | 31.0 |
| 41 | Comunidad de Madrid, Spain | 92.5 | 86 | Kyoto, Japan | 27.4 |
| 42 | Cincinnati-Hamilton, US | 91.9 | | Norway | N/A |
| 43 | Ontario, Canada | 91.5 | | Hong Kong | N/A |
| 44 | Rochester, US | 91.3 | | Singapore | N/A |
| 45 | Hartford, US | 90.8 | | New South Wales, Australia | N/A |

(Employees per 1,000 inhabitants)



Knowledge Capital Components

Knowledge capital consists of the raw material of the knowledge economy, referring to the region's capacity for creating new ideas and for transforming such new ideas to create commercial value. Research and development expenditure is an indication of attempts to enlarge the knowledge base and inputs to the process of searching for knowledge. In recent years, government expenditure on research and development has decreased with the reduction in defence expenditure. This has prioritised the requirement for increased innovation expenditure by businesses, although public expenditure still represents an important lever for knowledge development.

Table 9 ranks public/government expenditure per head of population. The rankings are dominated by three regions: Washington DC (763.0), Hong Kong (486.4) and Richmond-Petersburg (327.5). As might be expected, there is a degree of association between government R&D expenditure and the location of state and/or federal government administrative centres. At the other end of the index are Louisville (6.3) and the Japanese regions of Tokyo (6.6) and Osaka (8.8), highlighting the dearth of government involvement in innovation in these regions.

Business expenditure on research and development highlights the intensity of efforts to innovate, particularly through technological process development. It is, therefore, an important indicator of innovation capability. At the head of the rankings are (see Table 10) the US high-tech hubs of Boston (322.8) and Seattle (272.7) and Minneapolis-St Paul (270.3). In a reversal of its lofty position in the index of government R&D expenditure, the lowest ranked region is Hong Kong with a score of a mere 2.4, followed by New Orleans (4.9) and Saarland (14.2) in Germany.



Table 9 : Index of Research and Development Expenditure by Government Per Capita

| RANK | REGION | INDEX OF R & D EXPENDITURE BY GOVERNMENT | RANK | REGION | INDEX OF R & D EXPENDITURE BY GOVERNMENT |
|------|---|--|------|---|--|
| 1 | Washington, US | 763.0 | 46 | West Palm Beach-Boca Raton, US | 65.7 |
| 2 | Hong Kong | 486.4 | 47 | Jacksonville, US | 65.7 |
| 3 | Richmond-Petersburg, US | 327.5 | 48 | Brussels, Belgium | 64.4 |
| 4 | Norfolk-Virginia Beach-Newport News, US | 314.9 | 49 | Philadelphia, US | 62.4 |
| 5 | Berlin, Germany | 286.4 | 50 | Raleigh-Durham, US | 57.3 |
| 6 | Lazio, Italy | 276.9 | 51 | Greensboro-Winston-Salem-High Point, US | 57.3 |
| 7 | Boston, US | 255.7 | 52 | Saarland, Germany | 54.9 |
| 8 | Uusimaa, Finland | 249.9 | 53 | Hessen, Germany | 54.0 |
| 9 | Bremen, Germany | 207.9 | 54 | Charlotte-Gastonia-Rock Hill, US | 53.9 |
| 10 | Île de France, France | 201.0 | 55 | New York, US | 53.9 |
| 11 | Los Angeles, US | 196.9 | 56 | Portland-Salem, US | 52.6 |
| 12 | San Francisco, US | 196.9 | 57 | Phoenix-Mesa, US | 50.5 |
| 13 | San Diego, US | 196.9 | 58 | London, UK | 49.5 |
| 14 | Sacramento-Yolo, US | 196.9 | 59 | Buffalo-Niagara Falls, US | 47.2 |
| 15 | South East, UK | 181.6 | 60 | Rochester, US | 47.2 |
| 16 | Hamburg, Germany | 177.5 | 61 | Lombardia, Italy | 46.5 |
| 17 | Denver-Boulder-Greeley, US | 166.1 | 62 | Switzerland | 45.6 |
| 18 | Norway | 148.9 | 63 | Austin, US | 45.1 |
| 19 | Baden-Württemberg, Germany | 143.4 | 64 | Dallas-Fort Worth, US | 45.1 |
| 20 | Singapore | 137.4 | 65 | Houston-Galveston-Brazoria, US | 45.1 |
| 21 | Luxembourg | 133.3 | 66 | San Antonio, US | 45.1 |
| 22 | Comunidad de Madrid, Spain | 119.3 | 67 | Atlanta, US | 42.2 |
| 23 | Zuid-Nederland, Netherlands | 104.6 | 68 | Las Vegas, US | 41.5 |
| 24 | New South Wales, Australia | 104.5 | 69 | Emilia-Romagna, Italy | 40.4 |
| 25 | West-Nederland, Netherlands | 104.4 | 70 | Stockholm, Sweden | 37.8 |
| 26 | Seattle, US | 103.5 | 71 | Pittsburgh, US | 36.7 |
| 27 | Eastern, UK | 99.3 | 72 | St. Louis, US | 35.6 |
| 28 | Noord-Nederland, Netherlands | 97.4 | 73 | Memphis, US | 32.3 |
| 29 | Denmark | 94.3 | 74 | New Orleans, US | 28.9 |
| 30 | Columbus, US | 93.8 | 75 | Nashville, US | 28.9 |
| 31 | Cleveland-Akron, US | 93.8 | 76 | Ireland | 27.1 |
| 32 | Chicago, US | 89.7 | 77 | Oklahoma City, US | 23.3 |
| 33 | Ostösterreich, Austria | 83.8 | 78 | Minneapolis-St. Paul, US | 17.5 |
| 34 | Westösterreich, Austria | 83.2 | 79 | Grand Rapids-Muskegon-Holland, US | 17.0 |
| 35 | Salt Lake City-Ogden, US | 83.1 | 80 | Detroit-Ann Arbor-Flint, US | 17.0 |
| 36 | Niedersachsen, Germany | 82.3 | 81 | Hartford, US | 16.8 |
| 37 | Bayern, Germany | 81.5 | 82 | Kansas City, US | 16.2 |
| 38 | Schleswig-Holstein, Germany | 81.1 | 83 | Vlaams Gewest, Belgium | 14.2 |
| 39 | Ontario, Canada | 79.5 | 84 | Kyoto, Japan | 13.9 |
| 40 | Nordrhein-Westfalen, Germany | 75.7 | 85 | Milwaukee-Racine, US | 13.4 |
| 41 | Cincinnati-Hamilton, US | 75.5 | 86 | Kanagawa, Japan | 11.2 |
| 42 | British Columbia, Canada | 75.0 | 87 | Indianapolis, US | 9.1 |
| 43 | Miami-Fort Lauderdale, US | 65.7 | 88 | Osaka, Japan | 8.8 |
| 44 | Tampa-St. Petersburg-Clearwater, US | 65.7 | 89 | Tokyo, Japan | 6.6 |
| 45 | Orlando, US | 65.7 | 90 | Louisville, US | 6.3 |



Table 10 : Index of Research and Development Expenditure by Business Per Capita

| RANK | REGION | INDEX OF R & D EXPENDITURE BY BUSINESS | RANK | REGION | INDEX OF R & D EXPENDITURE BY BUSINESS |
|------|---|--|------|---|--|
| 1 | Boston, US | 322.8 | 46 | Charlotte-Gastonia-Rock Hill, US | 87.9 |
| 2 | Seattle, US | 272.7 | 47 | Cincinnati-Hamilton, US | 84.5 |
| 3 | Minneapolis-St. Paul, US | 270.3 | 48 | Richmond-Petersburg, US | 82.7 |
| 4 | Grand Rapids-Muskegon-Holland, US | 267.3 | 49 | Norfolk-Virginia Beach-Newport News, US | 80.4 |
| 5 | Detroit-Ann Arbor-Flint, US | 267.3 | 50 | Nashville, US | 77.9 |
| 6 | Stockholm, Sweden | 230.3 | 51 | Phoenix-Mesa, US | 76.8 |
| 7 | Los Angeles, US | 225.8 | 52 | Milwaukee-Racine, US | 76.3 |
| 8 | San Francisco, US | 225.8 | 53 | Berlin, Germany | 70.7 |
| 9 | San Diego, US | 225.8 | 54 | Kansas City, US | 70.1 |
| 10 | Sacramento-Yolo, US | 225.8 | 55 | Memphis, US | 67.5 |
| 11 | Philadelphia, US | 207.9 | 56 | Vlaams Gewest, Belgium | 65.7 |
| 12 | Hartford, US | 197.4 | 57 | St. Louis, US | 65.1 |
| 13 | Denver-Boulder-Greeley, US | 186.4 | 58 | Bremen, Germany | 63.4 |
| 14 | New York, US | 180.5 | 59 | Denmark | 61.2 |
| 15 | Kanagawa, Japan | 156.3 | 60 | Washington, US | 57.9 |
| 16 | Baden-Württemberg, Germany | 152.8 | 61 | Ostösterreich, Austria | 56.9 |
| 17 | Île de France, France | 152.5 | 62 | Westösterreich, Austria | 56.5 |
| 18 | Tokyo, Japan | 141.7 | 63 | Las Vegas, US | 56.3 |
| 19 | Eastern, UK | 139.4 | 64 | British Columbia, Canada | 55.6 |
| 20 | Uusimaa, Finland | 137.2 | 65 | Zuid-Nederland, Netherlands | 53.8 |
| 21 | Buffalo-Niagara Falls, US | 127.7 | 66 | West-Nederland, Netherlands | 53.7 |
| 22 | Rochester, US | 127.7 | 67 | Nordrhein-Westfalen, Germany | 51.1 |
| 23 | Portland-Salem, US | 123.1 | 68 | Noord-Nederland, Netherlands | 50.1 |
| 24 | Pittsburgh, US | 122.5 | 69 | Lombardia, Italy | 49.6 |
| 25 | Chicago, US | 117.0 | 70 | Norway | 46.4 |
| 26 | Bayern, Germany | 110.9 | 71 | Jacksonville, US | 45.9 |
| 27 | Salt Lake City-Ogden, US | 109.6 | 72 | Miami-Fort Lauderdale, US | 45.9 |
| 28 | Brussels, Belgium | 107.0 | 73 | Tampa-St. Petersburg-Clearwater, US | 45.9 |
| 29 | Switzerland | 105.5 | 74 | Orlando, US | 45.9 |
| 30 | Osaka, Japan | 102.4 | 75 | West Palm Beach-Boca Raton, US | 45.9 |
| 31 | Hessen, Germany | 101.1 | 76 | Niedersachsen, Germany | 45.7 |
| 32 | Cleveland-Akron, US | 98.6 | 77 | Ireland | 45.4 |
| 33 | Columbus, US | 98.6 | 78 | Singapore | 44.5 |
| 34 | Hamburg, Germany | 95.0 | 79 | Atlanta, US | 39.2 |
| 35 | South East, UK | 93.4 | 80 | Louisville, US | 37.7 |
| 36 | Raleigh-Durham, US | 92.5 | 81 | Comunidad de Madrid, Spain | 37.0 |
| 37 | Greensboro-Winston-Salem-High Point, US | 92.5 | 82 | New South Wales, Australia | 32.6 |
| 38 | Indianapolis, US | 92.1 | 83 | Lazio, Italy | 31.7 |
| 39 | Luxembourg | 90.6 | 84 | London, UK | 28.2 |
| 40 | Kyoto, Japan | 90.5 | 85 | Emilia-Romagna, Italy | 25.4 |
| 41 | Ontario, Canada | 90.4 | 86 | Schleswig-Holstein, Germany | 19.6 |
| 42 | Dallas-Fort Worth, US | 88.5 | 87 | Oklahoma City, US | 15.2 |
| 43 | Austin, US | 88.5 | 88 | Saarland, Germany | 14.2 |
| 44 | Houston-Galveston-Brazoria, US | 88.5 | 89 | New Orleans, US | 4.9 |
| 45 | San Antonio, US | 88.5 | 90 | Hong Kong | 2.4 |



Patent registrations are a representation of the generation of new ideas and are the nearest proxy to direct indicators of knowledge formation and knowledge capitalisation. A high level of patent activity is often a reflection of high levels of applied research and development activity. Also, patent registrations are a strong indicator of knowledge derived from clustered relationships between both firms and other research institutions.

As Table 11 illustrates, patent registrations are dominated by US regions, which hold the first twelve rankings, led by Rochester (514.2), Austin (485.1), and followed by San Francisco (484.2), Raleigh-Durham (300.5) and Minneapolis-St Paul (268.7). Only three non-US regions are listed in the top twenty - 13th Baden-Wurttemberg (Germany); 14th Stockholm (Sweden); and 16th Uusimaa (Finland). The lowest ranked regions are Madrid (11.8) in Spain, Lazio in Italy (12.9) and Singapore (13.4). The spread of registrations across regions is very wide, and indicates that the top ranked regions in the US are undertaking patent activity at a rate far higher than the majority of regions.



Table 11 : Index of Patent Registrations Per Capita

| RANK | REGION | INDEX OF PATENT REGISTRATIONS | RANK | REGION | INDEX OF PATENT REGISTRATIONS |
|------|---|-------------------------------|------|---|-------------------------------|
| 1 | Rochester, US | 514.2 | 46 | Charlotte-Gastonia-Rock Hill, US | 64.9 |
| 2 | Austin, US | 485.1 | 47 | Hamburg, Germany | 61.1 |
| 3 | San Francisco, US | 484.2 | 48 | Niedersachsen, Germany | 60.9 |
| 4 | Raleigh-Durham, US | 300.5 | 49 | Tampa-St. Petersburg-Clearwater, US | 60.0 |
| 5 | Minneapolis-St. Paul, US | 268.7 | 50 | Eastern, UK | 59.0 |
| 6 | Boston, US | 228.2 | 51 | San Antonio, US | 58.1 |
| 7 | San Diego, US | 219.3 | 52 | Miami-Fort Lauderdale, US | 57.3 |
| 8 | Cincinnati-Hamilton, US | 171.4 | 53 | Louisville, US | 57.0 |
| 9 | Denver-Boulder-Greeley, US | 167.3 | 54 | Kansas City, US | 55.8 |
| 10 | Detroit-Ann Arbor-Flint, US | 164.3 | 55 | Luxembourg | 55.0 |
| 11 | Portland-Salem, US | 156.4 | 56 | Ontario, Canada | 54.4 |
| 12 | Hartford, US | 154.1 | 57 | Westösterreich, Austria | 54.2 |
| 13 | Baden-Württemberg, Germany | 149.2 | 58 | Memphis, US | 53.8 |
| 14 | Stockholm, Sweden | 147.6 | 59 | Richmond-Petersburg, US | 53.7 |
| 15 | Seattle, US | 144.8 | 60 | South East, UK | 53.2 |
| 16 | Uusimaa, Finland | 143.6 | 61 | British Columbia, Canada | 51.6 |
| 17 | Dallas-Fort Worth, US | 139.1 | 62 | Berlin, Germany | 51.1 |
| 18 | New York, US | 138.0 | 63 | Saarland, Germany | 49.6 |
| 19 | Philadelphia, US | 137.3 | 64 | Oklahoma City, US | 49.4 |
| 20 | West Palm Beach-Boca Raton, US | 135.9 | 65 | Denmark | 47.7 |
| 21 | Bayern, Germany | 135.5 | 66 | Vlaams Gewest, Belgium | 46.8 |
| 22 | Phoenix-Mesa, US | 135.3 | 67 | Orlando, US | 46.1 |
| 23 | Houston-Galveston-Brazoria, US | 135.0 | 68 | Emilia-Romagna, Italy | 45.4 |
| 24 | Milwaukee-Racine, US | 134.0 | 69 | Jacksonville, US | 43.9 |
| 25 | Salt Lake City-Ogden, US | 131.5 | 70 | Brussels, Belgium | 43.4 |
| 26 | Cleveland-Akron, US | 130.1 | 71 | Lombardia, Italy | 43.0 |
| 27 | Indianapolis, US | 125.3 | 72 | Nashville, US | 42.3 |
| 28 | Grand Rapids-Muskegon-Holland, US | 125.1 | 73 | Las Vegas, US | 42.3 |
| 29 | Pittsburgh, US | 122.8 | 74 | Schleswig-Holstein, Germany | 42.0 |
| 30 | Zuid-Nederland, Netherlands | 121.7 | 75 | Ostösterreich, Austria | 37.2 |
| 31 | Chicago, US | 121.5 | 76 | New Orleans, US | 36.9 |
| 32 | Hessen, Germany | 109.8 | 77 | West-Nederland, Netherlands | 36.7 |
| 33 | Buffalo-Niagara Falls, US | 107.2 | 78 | Norfolk-Virginia Beach-Newport News, US | 29.9 |
| 34 | Tokyo, Japan | 104.9 | 79 | Kanagawa, Japan | 29.7 |
| 35 | St. Louis, US | 102.3 | 80 | Bremen, Germany | 27.5 |
| 36 | Los Angeles, US | 99.3 | 81 | London, UK | 25.0 |
| 37 | Atlanta, US | 95.9 | 82 | Kyoto, Japan | 22.2 |
| 38 | Washington, US | 94.7 | 83 | Hong Kong | 22.0 |
| 39 | Île de France, France | 89.5 | 84 | Noord-Nederland, Netherlands | 21.7 |
| 40 | Columbus, US | 81.7 | 85 | Ireland | 19.8 |
| 41 | Sacramento-Yolo, US | 80.9 | 86 | Norway | 19.5 |
| 42 | Nordrhein-Westfalen, Germany | 78.5 | 87 | New South Wales, Australia | 15.2 |
| 43 | Switzerland | 68.7 | 88 | Singapore | 13.4 |
| 44 | Osaka, Japan | 68.1 | 89 | Lazio, Italy | 12.9 |
| 45 | Greensboro-Winston-Salem-High Point, US | 67.2 | 90 | Comunidad de Madrid, Spain | 11.8 |



Regional Economy Outputs

Labour productivity is a crucial measure of regional performance, as it is influenced by a wide range of factors such as sector make-up, workforce skills, investment in innovation, and market competition. Productivity varies from GDP per capita and is partly a function of respective economic activity and unemployment rates. Therefore, the prosperity of all economies is highly dependent on their productivity rates.

The highest productivity rates, as illustrated by Table 12, are within the regions of Brussels (160.6), Hartford (155.1) and Luxembourg (144.5). The high ranking of all three regions reflects the significant levels of high value-added service sector employment within their economies. The lowest ranked regions are Kanagawa (67.6), Kyoto (71.7) and the Eastern region of the UK (71.9).

Earning levels are an indicator of the relative wealth and the standards of living within an economy, particularly the value-added generated from economic activity. It is also a strong proxy of the relative quality of jobs within an economy. As shown by Table 13, the regions with the highest average earnings are predominately in the US with their regions occupying 12 of the highest 13 rankings. The top three regions are New York (151.8), San Francisco (142.4) and Hartford (138.9). The three lowest ranked regions are Emilia-Romagna (58.1) in Italy, Singapore (60.5) and Lombardia (61.6) in Italy.

Table 14 illustrates the levels of unemployment within the regions, reverse ranked so that a high score indicates a lower level of unemployment. The majority of the US regions perform well, with them occupying the first six positions of the rankings, led by Raleigh-Durham (103.1), Richmond-Petersburg (103.0) and Austin (102.9). The lowest ranked are the European regions of Brussels (90.3), Berlin (90.6) and Madrid (91.0).



Table 12 : Index of Labour Productivity

| RANK | REGION | INDEX OF LABOUR PRODUCTIVITY | RANK | REGION | INDEX OF LABOUR PRODUCTIVITY |
|------|---|------------------------------|------|---|------------------------------|
| 1 | Brussels, Belgium | 160.6 | 46 | Louisville, US | 97.6 |
| 2 | Hartford, US | 155.1 | 47 | Stockholm, Sweden | 97.3 |
| 3 | Luxembourg | 144.5 | 48 | Detroit-Ann Arbor-Flint, US | 96.9 |
| 4 | Hamburg, Germany | 135.1 | 49 | Nashville, US | 96.9 |
| 5 | Tokyo, Japan | 130.6 | 50 | West Palm Beach-Boca Raton, US | 96.7 |
| 6 | New York, US | 130.5 | 51 | Norfolk-Virginia Beach-Newport News, US | 96.6 |
| 7 | Richmond-Petersburg, US | 122.8 | 52 | Comunidad de Madrid, Spain | 96.6 |
| 8 | San Francisco, US | 121.3 | 53 | Tampa-St. Petersburg-Clearwater, US | 96.5 |
| 9 | Boston, US | 120.8 | 54 | Indianapolis, US | 96.2 |
| 10 | Singapore | 120.0 | 55 | Orlando, US | 95.6 |
| 11 | Bremen, Germany | 119.2 | 56 | Milwaukee-Racine, US | 95.4 |
| 12 | Buffalo-Niagara Falls, US | 117.5 | 57 | San Antonio, US | 95.1 |
| 13 | Sacramento-Yolo, US | 116.1 | 58 | Cincinnati-Hamilton, US | 94.6 |
| 14 | Île de France, France | 114.7 | 59 | Miami-Fort Lauderdale, US | 94.4 |
| 15 | Washington, US | 113.0 | 60 | Kansas City, US | 94.2 |
| 16 | London, UK | 112.9 | 61 | Vlaams Gewest, Belgium | 93.8 |
| 17 | Jacksonville, US | 112.5 | 62 | Salt Lake City-Ogden, US | 92.1 |
| 18 | Rochester, US | 111.2 | 63 | Austin, US | 91.8 |
| 19 | Philadelphia, US | 109.9 | 64 | Ontario, Canada | 91.3 |
| 20 | Chicago, US | 109.5 | 65 | Portland-Salem, US | 91.1 |
| 21 | Charlotte-Gastonia-Rock Hill, US | 108.8 | 66 | Uusimaa, Finland | 90.9 |
| 22 | New Orleans, US | 108.7 | 67 | New South Wales, Australia | 90.1 |
| 23 | Dallas-Fort Worth, US | 108.5 | 68 | Ostösterreich, Austria | 90.0 |
| 24 | Los Angeles, US | 107.7 | 69 | Baden-Württemberg, Germany | 89.5 |
| 25 | Lazio, Italy | 107.4 | 70 | Nordrhein-Westfalen, Germany | 88.7 |
| 26 | Houston-Galveston-Brazoria, US | 106.9 | 71 | Osaka, Japan | 88.5 |
| 27 | Lombardia, Italy | 106.9 | 72 | West-Nederland, Netherlands | 86.5 |
| 28 | San Diego, US | 105.8 | 73 | Bayern, Germany | 86.5 |
| 29 | Seattle, US | 103.8 | 74 | Ireland | 84.8 |
| 30 | Greensboro-Winston-Salem-High Point, US | 103.4 | 75 | Oklahoma City, US | 84.5 |
| 31 | Columbus, US | 102.9 | 76 | Switzerland | 83.3 |
| 32 | Norway | 102.7 | 77 | Saarland, Germany | 82.8 |
| 33 | Las Vegas, US | 102.5 | 78 | British Columbia, Canada | 82.3 |
| 34 | Phoenix-Mesa, US | 102.0 | 79 | Westösterreich, Austria | 81.9 |
| 35 | Atlanta, US | 101.5 | 80 | Berlin, Germany | 80.6 |
| 36 | Denver-Boulder-Greeley, US | 101.3 | 81 | Hong Kong | 80.2 |
| 37 | Pittsburgh, US | 100.8 | 82 | Denmark | 78.5 |
| 38 | Cleveland-Akron, US | 100.4 | 83 | Niedersachsen, Germany | 78.2 |
| 39 | Emilia-Romagna, Italy | 100.2 | 84 | Noord-Nederland, Netherlands | 77.5 |
| 40 | Memphis, US | 100.1 | 85 | Schleswig-Holstein, Germany | 77.5 |
| 41 | Grand Rapids-Muskegon-Holland, US | 99.9 | 86 | South East, UK | 77.1 |
| 42 | Hessen, Germany | 99.6 | 87 | Zuid-Nederland, Netherlands | 73.7 |
| 43 | Minneapolis-St. Paul, US | 98.6 | 88 | Eastern, UK | 71.9 |
| 44 | Raleigh-Durham, US | 98.1 | 89 | Kyoto, Japan | 71.7 |
| 45 | St. Louis, US | 97.9 | 90 | Kanagawa, Japan | 67.6 |



Table 13 : Index of Earnings (Mean Gross Monthly Earnings)

| RANK | REGION | INDEX OF EARNINGS | RANK | REGION | INDEX OF EARNINGS |
|------|---|-------------------|------|-------------------------------------|-------------------|
| 1 | New York, US | 151.8 | 46 | Oklahoma City, US | 101.5 |
| 2 | San Francisco, US | 142.4 | 47 | Kanagawa, Japan | 101.4 |
| 3 | Hartford, US | 138.9 | 48 | Miami-Fort Lauderdale, US | 101.0 |
| 4 | Washington, US | 136.8 | 49 | San Antonio, US | 100.8 |
| 5 | Boston, US | 135.4 | 50 | Baden-Württemberg, Germany | 99.3 |
| 6 | Detroit-Ann Arbor-Flint, US | 132.0 | 51 | Salt Lake City-Ogden, US | 98.7 |
| 7 | Chicago, US | 128.9 | 52 | Hessen, Germany | 97.8 |
| 8 | Atlanta, US | 124.3 | 53 | Orlando, US | 97.2 |
| 9 | Houston-Galveston-Brazoria, US | 124.1 | 54 | Nordrhein-Westfalen, Germany | 96.7 |
| 10 | Philadelphia, US | 123.9 | 55 | Osaka, Japan | 96.2 |
| 11 | Memphis, US | 122.8 | 56 | Austin, US | 95.7 |
| 12 | Seattle, US | 121.2 | 57 | Brussels, Belgium | 94.4 |
| 13 | Tokyo, Japan | 119.4 | 58 | Bayern, Germany | 93.8 |
| 14 | Nashville, US | 118.5 | 59 | Tampa-St. Petersburg-Clearwater, US | 92.9 |
| 15 | Dallas-Fort Worth, US | 118.3 | 60 | Niedersachsen, Germany | 91.9 |
| 16 | Los Angeles, US | 118.3 | 61 | Saarland, Germany | 91.4 |
| 17 | Denver-Boulder-Greeley, US | 117.8 | 62 | Schleswig-Holstein, Germany | 91.0 |
| 18 | Charlotte-Gastonia-Rock Hill, US | 117.4 | 63 | West-Nederland, Netherlands | 89.9 |
| 19 | Raleigh-Durham, US | 116.9 | 64 | Luxembourg | 89.1 |
| 20 | Cleveland-Akron, US | 115.7 | 65 | Denmark | 88.9 |
| 21 | West Palm Beach-Boca Raton, US | 115.2 | 66 | Berlin, Germany | 88.7 |
| 22 | Minneapolis-St. Paul, US | 115.1 | 67 | South East, UK | 87.7 |
| 23 | New Orleans, US | 114.7 | 68 | Kyoto, Japan | 85.8 |
| 24 | San Diego, US | 114.0 | 69 | Phoenix-Mesa, US | 84.2 |
| 25 | Sacramento-Yolo, US | 113.4 | 70 | Vlaams Gewest, Belgium | 82.8 |
| 26 | Pittsburgh, US | 113.3 | 71 | Eastern, UK | 82.5 |
| 27 | Richmond-Petersburg, US | 113.1 | 72 | Zuid-Nederland, Netherlands | 82.2 |
| 28 | Milwaukee-Racine, US | 111.6 | 73 | Ostösterreich, Austria | 78.7 |
| 29 | St. Louis, US | 111.0 | 74 | Noord-Nederland, Netherlands | 76.5 |
| 30 | Indianapolis, US | 110.6 | 75 | Île de France, France | 76.1 |
| 31 | Kansas City, US | 109.8 | 76 | Westösterreich, Austria | 75.8 |
| 32 | Columbus, US | 108.6 | 77 | Ireland | 75.2 |
| 33 | Las Vegas, US | 108.5 | 78 | New South Wales, Australia | 74.4 |
| 34 | Bremen, Germany | 108.4 | 79 | Ontario, Canada | 72.0 |
| 35 | Norfolk-Virginia Beach-Newport News, US | 108.4 | 80 | British Columbia, Canada | 69.3 |
| 36 | London, UK | 108.4 | 81 | Uusimaa, Finland | 68.2 |
| 37 | Hamburg, Germany | 108.4 | 82 | Lazio, Italy | 66.8 |
| 38 | Rochester, US | 108.0 | 83 | Switzerland | 66.4 |
| 39 | Jacksonville, US | 107.0 | 84 | Hong Kong | 66.3 |
| 40 | Cincinnati-Hamilton, US | 106.4 | 85 | Comunidad de Madrid, Spain | 64.8 |
| 41 | Grand Rapids-Muskegon-Holland, US | 105.3 | 86 | Stockholm, Sweden | 64.8 |
| 42 | Louisville, US | 103.9 | 87 | Norway | 64.5 |
| 43 | Greensboro-Winston-Salem-High Point, US | 103.8 | 88 | Lombardia, Italy | 61.6 |
| 44 | Buffalo-Niagara Falls, US | 103.1 | 89 | Singapore | 60.5 |
| 45 | Portland-Salem, US | 101.6 | 90 | Emilia-Romagna, Italy | 58.1 |



Table 14 : Index of Unemployment (Resersed Rankings)

| RANK | REGION | INDEX OF (UN)EMPLOYMENT | RANK | REGION | INDEX OF (UN)EMPLOYMENT |
|------|---|-------------------------|------|--------------------------------|-------------------------|
| 1 | Raleigh-Durham, US | 103.1 | 46 | Seattle, US | 100.7 |
| 2 | Richmond-Petersburg, US | 103.0 | 47 | Pittsburgh, US | 100.7 |
| 3 | Austin, US | 102.9 | 48 | Portland-Salem, US | 100.7 |
| 4 | Hartford, US | 102.4 | 49 | Chicago, US | 100.6 |
| 5 | Denver-Boulder-Greeley, US | 102.4 | 50 | Philadelphia, US | 100.6 |
| 6 | Oklahoma City, US | 102.4 | 51 | Las Vegas, US | 100.6 |
| 7 | Luxembourg | 102.4 | 52 | Houston-Galveston-Brazoria, US | 100.5 |
| 8 | Boston, US | 102.3 | 53 | Cleveland-Akron, US | 100.5 |
| 9 | Indianapolis, US | 102.3 | 54 | West Palm Beach-Boca Raton, US | 100.3 |
| 10 | Columbus, US | 102.3 | 55 | Kyoto, Japan | 100.3 |
| 11 | Singapore | 102.3 | 56 | Ostösterreich, Austria | 100.2 |
| 12 | San Francisco, US | 102.2 | 57 | Kanagawa, Japan | 100.2 |
| 13 | Minneapolis-St. Paul, US | 102.2 | 58 | Miami-Fort Lauderdale, US | 100.1 |
| 14 | Tampa-St. Petersburg-Clearwater, US | 102.2 | 59 | Los Angeles, US | 99.9 |
| 15 | Orlando, US | 102.2 | 60 | Emilia-Romagna, Italy | 99.9 |
| 16 | Norfolk-Virginia Beach-Newport News, US | 102.2 | 61 | Tokyo, Japan | 99.9 |
| 17 | Phoenix-Mesa, US | 102.1 | 62 | Lombardia, Italy | 99.8 |
| 18 | Nashville, US | 102.0 | 63 | Hong Kong | 99.8 |
| 19 | Greensboro-Winston-Salem-High Point, US | 101.9 | 64 | New Orleans, US | 99.7 |
| 20 | Atlanta, US | 101.8 | 65 | Buffalo-Niagara Falls, US | 99.7 |
| 21 | San Diego, US | 101.8 | 66 | Bayern, Germany | 99.7 |
| 22 | Switzerland | 101.7 | 67 | Baden-Württemberg, Germany | 99.6 |
| 23 | Washington, US | 101.7 | 68 | Stockholm, Sweden | 99.5 |
| 24 | Dallas-Fort Worth, US | 101.7 | 69 | Noord-Nederland, Netherlands | 99.4 |
| 25 | Salt Lake City-Ogden, US | 101.7 | 70 | Vlaams Gewest, Belgium | 99.1 |
| 26 | Jacksonville, US | 101.7 | 71 | Denmark | 99.1 |
| 27 | Grand Rapids-Muskegon-Holland, US | 101.7 | 72 | Ontario, Canada | 99.0 |
| 28 | West-Nederland, Netherlands | 101.7 | 73 | Ireland | 98.8 |
| 29 | Zuid-Nederland, Netherlands | 101.7 | 74 | New South Wales, Australia | 98.7 |
| 30 | Detroit-Ann Arbor-Flint, US | 101.6 | 75 | Osaka, Japan | 98.5 |
| 31 | South East, UK | 101.6 | 76 | Hessen, Germany | 97.9 |
| 32 | Kansas City, US | 101.5 | 77 | Uusimaa, Finland | 97.6 |
| 33 | Charlotte-Gastonia-Rock Hill, US | 101.5 | 78 | British Columbia, Canada | 97.4 |
| 34 | Cincinnati-Hamilton, US | 101.4 | 79 | Schleswig-Holstein, Germany | 97.2 |
| 35 | San Antonio, US | 101.4 | 80 | London, UK | 96.8 |
| 36 | Louisville, US | 101.4 | 81 | Hamburg, Germany | 96.7 |
| 37 | Westösterreich, Austria | 101.4 | 82 | Niedersachsen, Germany | 96.4 |
| 38 | Norway | 101.3 | 83 | Nordrhein-Westfalen, Germany | 96.4 |
| 39 | St. Louis, US | 101.1 | 84 | Saarland, Germany | 96.0 |
| 40 | Milwaukee-Racine, US | 100.9 | 85 | Île de France, France | 94.2 |
| 41 | Memphis, US | 100.9 | 86 | Bremen, Germany | 93.0 |
| 42 | Eastern, UK | 100.9 | 87 | Lazio, Italy | 91.1 |
| 43 | Sacramento-Yolo, US | 100.8 | 88 | Comunidad de Madrid, Spain | 91.0 |
| 44 | Rochester, US | 100.8 | 89 | Berlin, Germany | 90.6 |
| 45 | New York, US | 100.7 | 90 | Brussels, Belgium | 90.3 |



Knowledge Sustainability Components

Knowledge sustainability represents each region's capacity for sustaining the long-term health of its knowledge creation and commercial exploitation capacities. In our model, this is represented by investment in future generations of knowledge workers and investment in Information and Telecommunication Technology (ICT) infrastructure. The following four variables are included:

Investment in Future Knowledge

- Per Capita Public Expenditures on Primary and Secondary Education
- Per Capita Public Expenditures on Higher Education

National ICT Infrastructure

- Secure Servers per one million inhabitants
- Internet Hosts per 1,000 inhabitants.

INVESTMENT IN FUTURE KNOWLEDGE

It is clear that future human and knowledge capital is currently embodied within those individuals undertaking education and training. Therefore, the resources dedicated to such education and training are an important source of knowledge investment. Much of the expenditure on education is set by national budgets, particularly for compulsory primary and secondary education in Europe, while higher education expenditure is a reflection of the number and type of institutions within a region. Tables 15 and 16 analyse regional expenditure of primary, secondary and higher education on a per capita basis.

Table 15 highlights primary and secondary expenditure per capita, with the scores for Europe and Japan based on national data. The top ranking is held by Switzerland (208.9) followed by a host of regions from the United States, led by New York (162.9). Luxembourg is placed sixth with a score of 153.3. The lowest ranked is Singapore (23.9) followed by Madrid (59.0) and the included German regions with a score of 64.8.



Table 15 : Index of Investment in Primary and Secondary Education (Per capita expenditure)

| RANK | REGION | INDEX OF INVESTMENT IN PRIMARY & SECONDARY EDUCATION | RANK | REGION | INDEX OF INVESTMENT IN PRIMARY & SECONDARY EDUCATION |
|------|---|--|------|------------------------------|--|
| 1 | Switzerland | 208.9 | 46 | Jacksonville, US | 101.6 |
| 2 | New York, US | 162.1 | 47 | Miami-Fort Lauderdale, US | 101.6 |
| 3 | Buffalo-Niagara Falls, US | 158.6 | 48 | Oklahoma City, US | 100.5 |
| 4 | Rochester, US | 158.6 | 49 | Stockholm, Sweden | 99.9 |
| 5 | Hartford, US | 158.0 | 50 | Louisville, US | 99.2 |
| 6 | Luxembourg | 153.3 | 51 | New Orleans, US | 98.6 |
| 7 | Minneapolis-St. Paul, US | 149.1 | 52 | Ostösterreich, Austria | 97.4 |
| 8 | Detroit-Ann Arbor-Flint, US | 142.8 | 53 | Westösterreich, Austria | 97.4 |
| 9 | Grand Rapids-Muskegon-Holland, US | 142.8 | 54 | Ontario, Canada | 97.2 |
| 10 | Milwaukee-Racine, US | 137.8 | 55 | British Columbia, Canada | 97.2 |
| 11 | Philadelphia, US | 135.7 | 56 | Nashville, US | 89.9 |
| 12 | San Antonio, US | 127.8 | 57 | Memphis, US | 89.4 |
| 13 | Austin, US | 127.8 | 58 | Île de France, France | 86.5 |
| 14 | Dallas-Fort Worth, US | 127.8 | 59 | Uusimaa, Finland | 80.3 |
| 15 | Houston-Galveston-Brazoria, US | 127.8 | 60 | New South Wales, Australia | 80.0 |
| 16 | Pittsburgh, US | 126.0 | 61 | Washington, US | 77.5 |
| 17 | Seattle, US | 124.8 | 62 | Ireland | 77.3 |
| 18 | Indianapolis, US | 124.1 | 63 | Brussels, Belgium | 76.4 |
| 19 | Chicago, US | 121.8 | 64 | Vlaams Gewest, Belgium | 76.4 |
| 20 | Las Vegas, US | 120.6 | 65 | Eastern, UK | 72.6 |
| 21 | Portland-Salem, US | 119.9 | 66 | London, UK | 72.6 |
| 22 | Denver-Boulder-Greeley, US | 116.4 | 67 | South East, UK | 72.6 |
| 23 | Boston, US | 115.9 | 68 | Hong Kong | 71.7 |
| 24 | Atlanta, US | 115.8 | 69 | Lazio, Italy | 71.4 |
| 25 | San Diego, US | 113.5 | 70 | Lombardia, Italy | 71.4 |
| 26 | Sacramento-Yolo, US | 113.5 | 71 | Emilia-Romagna, Italy | 71.4 |
| 27 | Los Angeles, US | 113.5 | 72 | Noord-Nederland, Netherlands | 68.6 |
| 28 | San Francisco, US | 113.5 | 73 | West-Nederland, Netherlands | 68.6 |
| 29 | Columbus, US | 113.0 | 74 | Zuid-Nederland, Netherlands | 68.6 |
| 30 | Cleveland-Akron, US | 113.0 | 75 | Tokyo, Japan | 66.0 |
| 31 | Richmond-Petersburg, US | 112.1 | 76 | Kanagawa, Japan | 66.0 |
| 32 | Salt Lake City-Ogden, US | 111.7 | 77 | Kyoto, Japan | 66.0 |
| 33 | Norway | 110.2 | 78 | Osaka, Japan | 66.0 |
| 34 | Cincinnati-Hamilton, US | 110.2 | 79 | Berlin, Germany | 64.8 |
| 35 | Norfolk-Virginia Beach-Newport News, US | 107.9 | 80 | Hamburg, Germany | 64.8 |
| 36 | Kansas City, US | 106.7 | 81 | Baden-Württemberg, Germany | 64.8 |
| 37 | Denmark | 106.5 | 82 | Bayern, Germany | 64.8 |
| 38 | St. Louis, US | 106.4 | 83 | Bremen, Germany | 64.8 |
| 39 | Charlotte-Gastonia-Rock Hill, US | 105.4 | 84 | Hessen, Germany | 64.8 |
| 40 | Phoenix-Mesa, US | 102.3 | 85 | Niedersachsen, Germany | 64.8 |
| 41 | Raleigh-Durham, US | 101.9 | 86 | Nordrhein-Westfalen, Germany | 64.8 |
| 42 | Greensboro-Winston-Salem-High Point, US | 101.9 | 87 | Saarland, Germany | 64.8 |
| 43 | Tampa-St. Petersburg-Clearwater, US | 101.6 | 88 | Schleswig-Holstein, Germany | 64.8 |
| 44 | Orlando, US | 101.6 | 89 | Comunidad de Madrid, Spain | 59.0 |
| 45 | West Palm Beach-Boca Raton, US | 101.6 | 90 | Singapore | 23.9 |



Table 16 highlights expenditure on higher education by region. The dominance of the United States is once again profound, with the leading regions being Salt Lake City-Ogden (205.3), Minneapolis-St Paul (175.9) and Portland-Salem (169.6). The lowest performing regions are Luxembourg (10.7), the UK's Eastern region (23.5), Singapore (32.2) and Lombardia in Italy (33.9). With a small number of exceptions, investment in higher education is far greater in the United States compared to other regions and nations.



Table 16 : Index of Investment in Higher Education (Per capita expenditure)

| RANK | REGION | INDEX OF INVESTMENT IN HIGHER EDUCATION | RANK | REGION | INDEX OF INVESTMENT IN HIGHER EDUCATION |
|------|---|---|------|-------------------------------------|---|
| 1 | Salt Lake City-Ogden, US | 205.3 | 46 | Rochester, US | 104.6 |
| 2 | Minneapolis-St. Paul, US | 175.9 | 47 | Hartford, US | 101.9 |
| 3 | Portland-Salem, US | 169.6 | 48 | Bremen, Germany | 99.9 |
| 4 | Detroit-Ann Arbor-Flint, US | 168.9 | 49 | Las Vegas, US | 98.2 |
| 5 | Grand Rapids-Muskegon-Holland, US | 168.9 | 50 | Norway | 93.3 |
| 6 | Switzerland | 164.7 | 51 | Zuid-Nederland, Netherlands | 88.8 |
| 7 | Richmond-Petersburg, US | 156.0 | 52 | Ontario, Canada | 88.3 |
| 8 | Seattle, US | 154.1 | 53 | Tokyo, Japan | 88.2 |
| 9 | Norfolk-Virginia Beach-Newport News, US | 150.1 | 54 | Kyoto, Japan | 87.0 |
| 10 | Milwaukee-Racine, US | 150.1 | 55 | Île de France, France | 86.4 |
| 11 | Denver-Boulder-Greeley, US | 147.5 | 56 | Washington, US | 85.8 |
| 12 | Charlotte-Gastonia-Rock Hill, US | 145.4 | 57 | Nordrhein-Westfalen, Germany | 80.2 |
| 13 | Indianapolis, US | 142.1 | 58 | Denmark | 78.1 |
| 14 | Raleigh-Durham, US | 140.9 | 59 | Boston, US | 78.0 |
| 15 | Greensboro-Winston-Salem-High Point, US | 140.9 | 60 | Miami-Fort Lauderdale, US | 74.6 |
| 16 | Louisville, US | 140.8 | 61 | Tampa-St. Petersburg-Clearwater, US | 74.6 |
| 17 | Sacramento-Yolo, US | 134.6 | 62 | Orlando, US | 74.6 |
| 18 | Los Angeles, US | 134.6 | 63 | West Palm Beach-Boca Raton, US | 74.6 |
| 19 | San Diego, US | 134.6 | 64 | Jacksonville, US | 74.6 |
| 20 | San Francisco, US | 134.6 | 65 | West-Nederland, Netherlands | 72.6 |
| 21 | Kansas City, US | 132.4 | 66 | Hessen, Germany | 71.1 |
| 22 | New Orleans, US | 130.7 | 67 | New South Wales, Australia | 69.6 |
| 23 | Brussels, Belgium | 129.8 | 68 | Saarland, Germany | 69.3 |
| 24 | Phoenix-Mesa, US | 125.6 | 69 | Noord-Nederland, Netherlands | 68.6 |
| 25 | Cincinnati-Hamilton, US | 125.3 | 70 | Ireland | 65.2 |
| 26 | Dallas-Fort Worth, US | 124.9 | 71 | Baden-Württemberg, Germany | 63.5 |
| 27 | Austin, US | 124.9 | 72 | Bayern, Germany | 62.9 |
| 28 | Houston-Galveston-Brazoria, US | 124.9 | 73 | Comunidad de Madrid, Spain | 62.7 |
| 29 | San Antonio, US | 124.9 | 74 | British Columbia, Canada | 58.6 |
| 30 | Oklahoma City, US | 121.5 | 75 | Westösterreich, Austria | 58.5 |
| 31 | Ostösterreich, Austria | 120.9 | 76 | Niedersachsen, Germany | 58.1 |
| 32 | Columbus, US | 120.2 | 77 | Lazio, Italy | 57.9 |
| 33 | Cleveland-Akron, US | 120.2 | 78 | Hong Kong | 57.1 |
| 34 | Philadelphia, US | 118.6 | 79 | Schleswig-Holstein, Germany | 51.0 |
| 35 | Berlin, Germany | 117.7 | 80 | Emilia-Romagna, Italy | 48.6 |
| 36 | Memphis, US | 113.7 | 81 | Uusimaa, Finland | 48.3 |
| 37 | Pittsburgh, US | 113.5 | 82 | South East, UK | 47.2 |
| 38 | Atlanta, US | 112.8 | 83 | Singapore | 43.2 |
| 39 | Chicago, US | 112.5 | 84 | Osaka, Japan | 40.7 |
| 40 | Nashville, US | 109.2 | 85 | Vlaams Gewest, Belgium | 40.4 |
| 41 | New York, US | 107.4 | 86 | Kanagawa, Japan | 36.1 |
| 42 | St. Louis, US | 106.4 | 87 | London, UK | 35.5 |
| 43 | Stockholm, Sweden | 106.2 | 88 | Lombardia, Italy | 33.9 |
| 44 | Hamburg, Germany | 104.8 | 89 | Eastern, UK | 23.5 |
| 45 | Buffalo-Niagara Falls, US | 104.6 | 90 | Luxembourg | 10.7 |



NATIONAL ICT INFRASTRUCTURE

A well-developed ICT infrastructure, in particular, access to fast broadband telecommunications services, is a prerequisite for moving knowledge effectively and efficiently within and across regions. Although broadband penetration data is unavailable for all our benchmark regions and nations, the OECD has collected certain data at the national level for its member states. In order to look in more detail at the ICT infrastructure we have analysed the number of secure servers and Internet hosts per capita in the nations covering the benchmarked regions (since regional data is unavailable for the majority of regions). Secure servers utilise encrypted software for e-commerce transactions, and therefore the number of such servers within a nation gives a strong indication of the level of e-business undertaken. The left-hand columns of Table 17 indicate that the highest proportion of secure servers per capita are in the United States (354.7), Australia (220.1) and Canada (188.6). The lowest proportions are within Hong Kong (13.3), Italy (20.5) and Spain (28.5).

The Internet is by far the most rapidly growing feature of ICT infrastructure, as it becomes an ever more important and powerful tool for the movement and diffusion of knowledge. The proportion of Internet hosts within a nation is a representation of the degree to which it is developing its 'wired economy'. The right-hand columns of Table 17 illustrate the number of Internet hosts per capita with the nations. The highest ranked nations are the United States (323.0), Finland (219.4) and Canada (175.4). The lowest ranked are Spain (21.7), France (26.5), and Luxembourg (42.1).

Table 17 : Index of National ICT Infrastructure - Secure Servers and Internet Hosts Per Capita

| RANK | REGION | INDEX OF SECURE SERVERS | RANK | REGION | INDEX OF INTERNET HOSTS |
|------|------------------|-------------------------|------|------------------|-------------------------|
| 1 | United States | 354.7 | 1 | United States | 323.0 |
| 2 | Australia | 220.1 | 2 | Finland | 219.4 |
| 3 | Canada | 188.6 | 3 | Canada | 175.4 |
| 4 | Switzerland | 176.5 | 4 | Norway | 160.7 |
| 5 | Luxembourg | 150.1 | 5 | Sweden | 146.6 |
| 6 | Sweden | 135.2 | 6 | Netherlands | 112.5 |
| 7 | United Kingdom | 109.2 | 7 | Hong Kong, China | 106.6 |
| 8 | Finland | 97.9 | 8 | Australia | 103.4 |
| 9 | Ireland | 96.5 | 9 | Denmark | 100.0 |
| 10 | Norway | 90.3 | 10 | Singapore | 91.8 |
| 11 | Austria | 81.5 | 11 | Switzerland | 87.6 |
| 12 | Denmark | 80.2 | 12 | Austria | 79.4 |
| 13 | Germany | 67.6 | 13 | United Kingdom | 72.4 |
| 14 | Netherlands | 50.5 | 14 | Belgium | 54.7 |
| 15 | Belgium | 38.7 | 15 | Italy | 45.0 |
| 16 | Singapore | 33.9 | 16 | Japan | 44.8 |
| 17 | Japan | 33.8 | 17 | Germany | 43.7 |
| 18 | France | 32.3 | 18 | Ireland | 42.9 |
| 19 | Spain | 28.5 | 19 | Luxembourg | 42.1 |
| 20 | Italy | 20.5 | 20 | France | 26.5 |
| 21 | Hong Kong, China | 13.3 | 21 | Spain | 21.7 |



Conclusions : Driving Knowledge-Based Growth

Our study has sought to identify the key Drivers of Knowledge-Based Growth. The analysis of 90 top-performing regions around the globe provides a snapshot of the regions at one point in time, in this case, in the late 1990s. Underlying the use of late-1990s data is our assumption that the regions under analysis are progressing towards a higher level of the knowledge-based economy through a broad common trajectory. The time of the late 1990s is critical in our analysis, as many academics and policy makers consider that the development of the knowledge-based economy began sometime in the 1980s, and started to show its effects (particularly the long economic boom in the United States) in the 1990s.

In the process of producing the World Knowledge Competitiveness Index, we examined those dimensions that best account for the positions of the top-performing regions. Of the several dimensions identified, two are considered to be of paramount importance. According to our first dimension, the top-performing regions are all building up their ICT infrastructure and mobilising more human capital resources into economic production activity. The second identified dimension indicates an association between investment in knowledge and human capital and growth of labour productivity, through the sustainability link.

Table 18 highlights the GDP per capita of the benchmarked regions indexed to the mean average. It must be made clear that GDP does not equate to the available income within a region and is not a direct or overall measure of relative prosperity between regions. However, GDP is an indicator of a region's output, and therefore, to some extent, its level of economic development.

The highest GDP per capita is found in the regions of Hartford (160.9), Tokyo (144.2) and San Francisco (131.7). The lowest ranked regions are mainly located in Germany. Once again, the significant disparity highlights that even with these high-performing regions there are marked differences in the evolution of their economic development.



Table 18 : Index of Gross Domestic Product Per Capita

| RANK | REGION | INDEX OF GDP PER CAPITA | RANK | REGION | INDEX OF GDP PER CAPITA |
|------|---|-------------------------|------|---|-------------------------|
| 1 | Hartford, US | 160.9 | 46 | Bremen, Germany | 100.1 |
| 2 | Tokyo, Japan | 144.2 | 47 | Memphis, US | 99.9 |
| 3 | San Francisco, US | 131.7 | 48 | St. Louis, US | 99.9 |
| 4 | Richmond-Petersburg, US | 131.3 | 49 | Uusimaa, Finland | 99.2 |
| 5 | Hamburg, Germany | 129.0 | 50 | Salt Lake City-Ogden, US | 99.0 |
| 6 | New York, US | 127.1 | 51 | Cincinnati-Hamilton, US | 98.7 |
| 7 | Boston, US | 125.5 | 52 | Detroit-Ann Arbor-Flint, US | 97.6 |
| 8 | Luxembourg | 124.1 | 53 | Pittsburgh, US | 97.5 |
| 9 | Dallas-Fort Worth, US | 123.9 | 54 | Ontario, Canada | 96.1 |
| 10 | Washington, US | 119.0 | 55 | Stockholm, Sweden | 95.7 |
| 11 | Denver-Boulder-Greeley, US | 118.6 | 56 | Lombardia, Italy | 94.1 |
| 12 | Minneapolis-St. Paul, US | 118.5 | 57 | San Antonio, US | 93.0 |
| 13 | Rochester, US | 118.0 | 58 | Switzerland | 92.7 |
| 14 | Charlotte-Gastonia-Rock Hill, US | 117.8 | 59 | Norfolk-Virginia Beach-Newport News, US | 91.8 |
| 15 | Brussels, Belgium | 117.8 | 60 | Hessen, Germany | 91.6 |
| 16 | Atlanta, US | 116.4 | 61 | Osaka, Japan | 90.8 |
| 17 | Buffalo-Niagara Falls, US | 115.2 | 62 | West Palm Beach-Boca Raton, US | 90.6 |
| 18 | Seattle, US | 115.1 | 63 | Miami-Fort Lauderdale, US | 90.6 |
| 19 | Jacksonville, US | 114.7 | 64 | Emilia-Romagna, Italy | 90.4 |
| 20 | Columbus, US | 114.6 | 65 | West-Nederland, Netherlands | 87.6 |
| 21 | Grand Rapids-Muskegon-Holland, US | 114.5 | 66 | Oklahoma City, US | 86.6 |
| 22 | Austin, US | 113.5 | 67 | New South Wales, Australia | 86.3 |
| 23 | Sacramento-Yolo, US | 113.3 | 68 | Ostösterreich, Austria | 85.8 |
| 24 | Houston-Galveston-Brazoria, US | 113.0 | 69 | Bayern, Germany | 85.7 |
| 25 | Chicago, US | 112.9 | 70 | Baden-Württemberg, Germany | 85.5 |
| 26 | Raleigh-Durham, US | 112.9 | 71 | Denmark | 83.0 |
| 27 | Greensboro-Winston-Salem-High Point, US | 112.0 | 72 | British Columbia, Canada | 82.3 |
| 28 | Philadelphia, US | 109.4 | 73 | Vlaams Gewest, Belgium | 80.3 |
| 29 | Nashville, US | 108.4 | 74 | Hong Kong | 79.2 |
| 30 | Orlando, US | 108.0 | 75 | Lazio, Italy | 79.1 |
| 31 | Las Vegas, US | 107.3 | 76 | Westösterreich, Austria | 77.5 |
| 32 | Norway | 107.3 | 77 | South East, UK | 77.2 |
| 33 | Louisville, US | 107.2 | 78 | Comunidad de Madrid, Spain | 76.8 |
| 34 | London, UK | 107.1 | 79 | Nordrhein-Westfalen, Germany | 76.5 |
| 35 | Indianapolis, US | 106.2 | 80 | Ireland | 75.6 |
| 36 | Île de France, France | 104.8 | 81 | Singapore | 75.0 |
| 37 | Phoenix-Mesa, US | 104.6 | 82 | Zuid-Nederland, Netherlands | 74.8 |
| 38 | Milwaukee-Racine, US | 104.5 | 83 | Kyoto, Japan | 74.1 |
| 39 | Kansas City, US | 104.4 | 84 | Noord-Nederland, Netherlands | 73.3 |
| 40 | Los Angeles, US | 104.3 | 85 | Eastern, UK | 72.6 |
| 41 | Portland-Salem, US | 101.8 | 86 | Kanagawa, Japan | 71.7 |
| 42 | New Orleans, US | 101.3 | 87 | Schleswig-Holstein, Germany | 71.0 |
| 43 | San Diego, US | 100.7 | 88 | Berlin, Germany | 71.0 |
| 44 | Cleveland-Akron, US | 100.3 | 89 | Niedersachsen, Germany | 69.4 |
| 45 | Tampa-St. Petersburg-Clearwater, US | 100.3 | 90 | Saarland, Germany | 69.0 |



Figure 5 shows the association between GDP per capita and the World Knowledge Competitiveness Index. It is clear that there is a close association between them, indicating the importance of knowledge economy factors to the wealth and prosperity of regions.

Three ensuing figures present the relationships between labour productivity and various investments in Knowledge Capital (i.e. R&D expenditures by business in Figure 6) and Human Capital through the Sustainability Link (i.e. expenditure on primary and secondary education in Figure 7, and expenditure on higher education in Figure 8). Again, each of the figures indicates a positive association between the variables

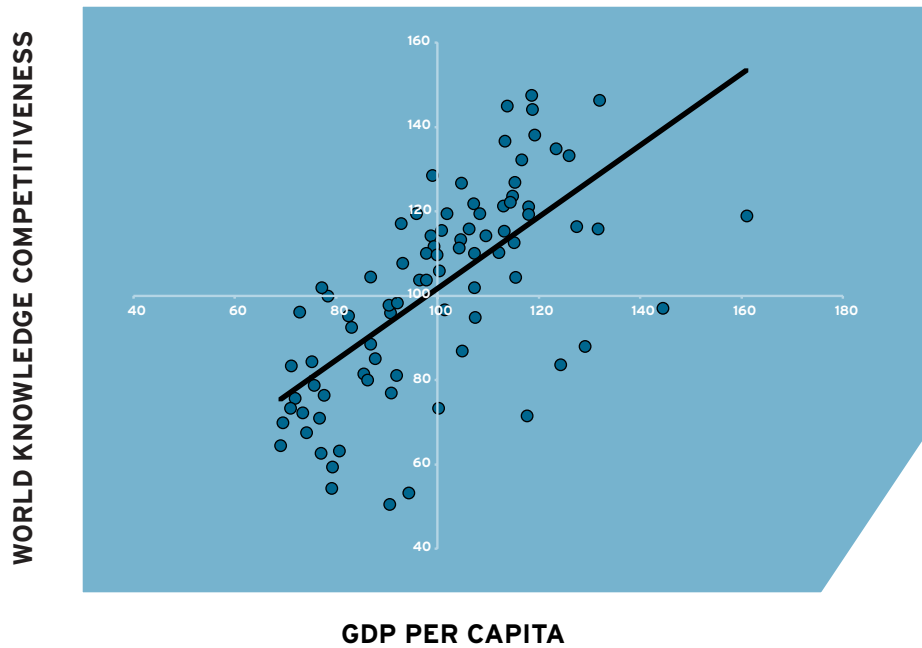


Figure 5 : Relationships between GDP per capita and World Knowledge Competitiveness Index

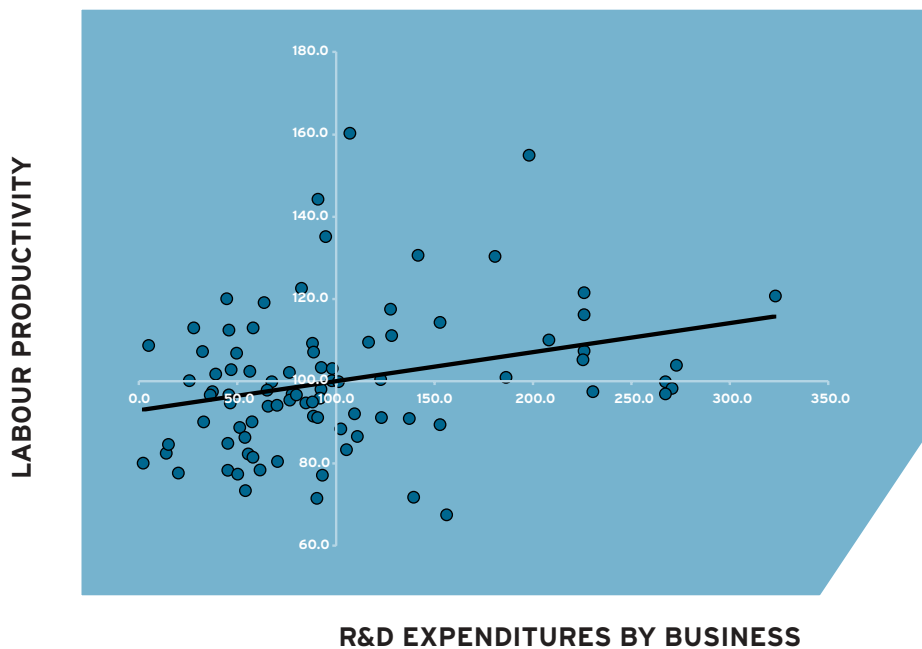


Figure 6 : Relationship between Labour Productivity and R&D expenditure by business

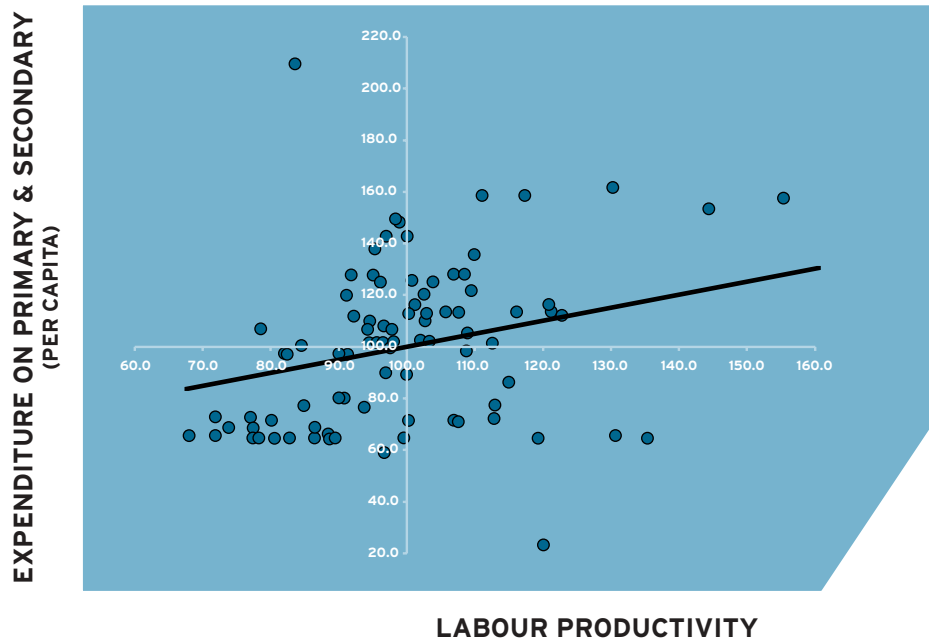


Figure 7 : Relationship between Labour Productivity and Expenditure on Primary and Secondary Education

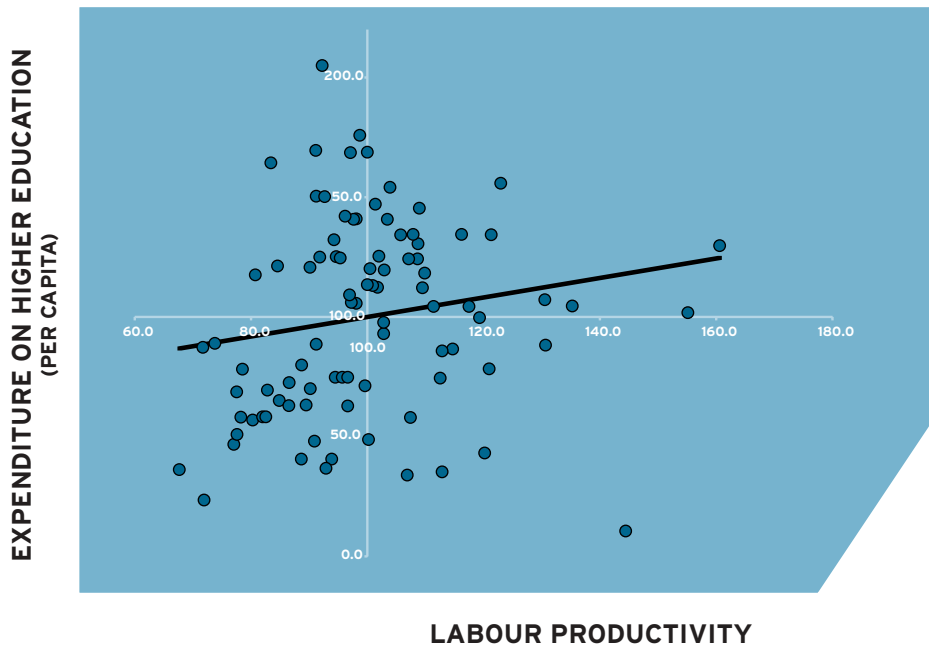


Figure 8 : Relationship between Labour Productivity and Expenditure on Higher Education



Finally, if the growth of GDP per capita is a primary policy goal, our study of top-performing regions, and their development trajectory, finds that these regions are progressing towards this end via two main routes. The first includes a combination of the improvement of ICT infrastructure and the mobilisation of human capital resources in economic production activity. The second is investment in R&D by business, alongside investment in education both at the primary, secondary and higher levels, all of which show a positive association with the growth of production (as illustrated in Figure 9). These drivers of knowledge-based growth are necessarily highly influential in determining the fortune of regions that aspire to reach a higher level of knowledge-based economic activity.

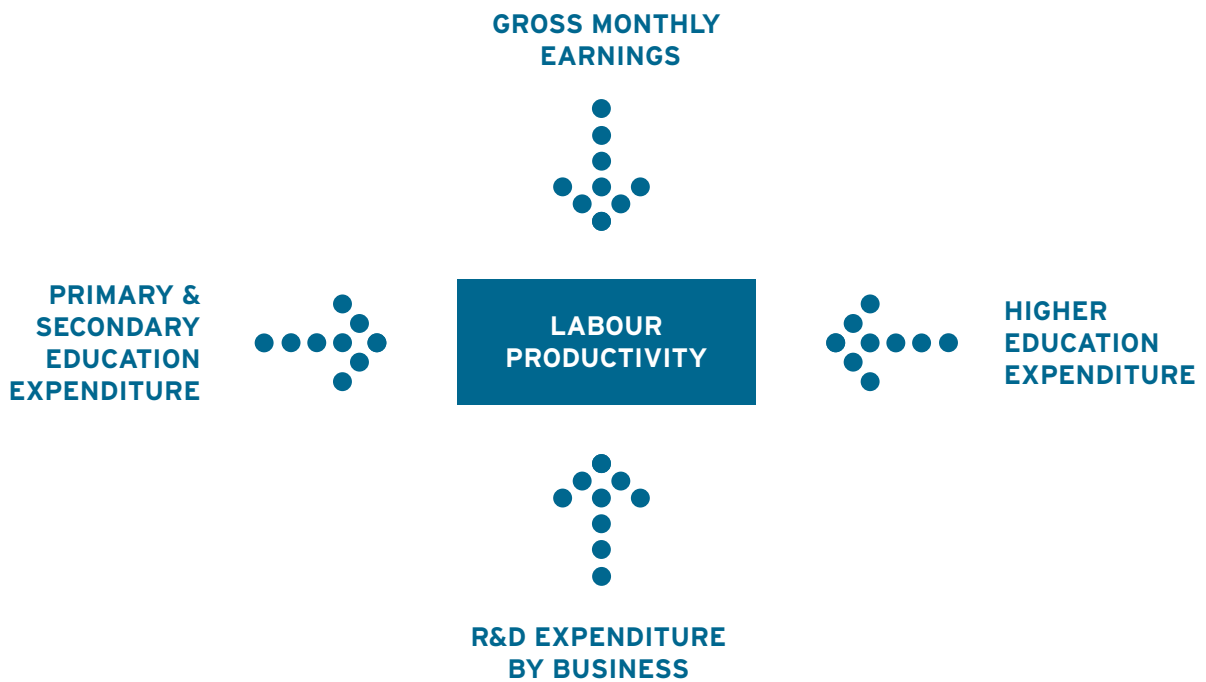


Figure 9 : Knowledge Economy Factors & Productivity



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DATA SOURCES

Data for European regions were assembled in conjunction with Eurostat (<http://europa.eu.int/comm/eurostat/>).

For regions in the US, the sources include:

- US Census Bureau (<http://www.census.gov/>),
- Bureau of Labor Statistics (<http://www.stats.bls.gov/>),
- US Patent and Trademark Office (<http://www.uspto.gov/>),
- US Conference of Mayors (<http://www.usmayors.org/>),
- Bureau of Economic Analysis (<http://www.bea.doc.gov/>),
- and Department of Education (<http://www.ed.gov/>).

As for regions in the rest of the world, the following sources were used:

- Statistics Bureau and Statistics Center, Government of Japan (<http://www.stat.go.jp/>), Japan Patent Office (<http://www.jpo.go.jp/>), Economic and Social Research Institute, and the Cabinet Office of Government of Japan (<http://www.esri.cao.go.jp/>) (for regions in Japan);
- Statistics Canada (<http://www.statcan.ca/>) (for regions in Canada);
- Australian Bureau of Statistics (<http://www.abs.gov.au/>) and New South Wales Department of State and Regional Development (<http://www.business.nsw.gov.au/>) (for New South Wales, Australia);
- Census and Statistics Department, the Government of the Hong Kong (<http://www.info.gov.hk/>) (for Hong Kong);
- Swiss Federal Statistics Office (<http://www.statistik.admin.ch/>) (for Switzerland);
- Statistics Singapore (<http://www.singstat.gov.sg/>) (for Singapore);
- Statistics Norway (<http://www.ssb.no/>) (for Norway).

Data for international comparisons of R&D expenditures are available from the Institute for Statistics, UNESCO (<http://www.unescostat.unesco.org/>).

Figures of purchasing power parities used to harmonise monetary value are available from OECD (<http://www.oecd.org/>).



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We also operate through our own network of global partners - both commercial and academic - with whom we are able to share new thoughts and new solutions, which our clients are then able to action.

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