The Geography of Europe's Brain Business Jobs

Dr. Nima Sanandaji
Prof. Stefan Fölster

ECEPR
European Centre for Policy Reform
and Entrepreneurship

Nordic Capital

Supported by NC Advisory AB,
advisor to the Nordic Capital Funds

The Nordics are well known as a dynamic and creative region. As reported by the Telegraph, Stockholm, the Swedish capital, is the world's second most prolific tech hub on a per capita basis, behind only Silicon Valley. This isn't a coincidence. Talented professionals thrive in Scandinavia – a fact that has now received further confirmation through the report you are holding in your hands.

As an active investor in Europe – particularly in the Nordic region – Nordic Capital's continuous goal is to develop understanding of the business environment and ways in which it can be improved. We are therefore pleased to have had the opportunity to support this report. Nordic Capital is one of the longest established and most active private equity investors in the Nordic region, and this report expands understanding of brain business jobs – jobs that are crucial for income and productivity growth.

This report gives the reader an excellent overview of the various sectors where brain business jobs are found, as well as an allocation of these sectors between countries and capital regions in Europe. The report also sheds light on the shifting landscape for knowledge-intensive businesses. On an ever-changing playing field, it is crucial to closely monitor developments to identify ways in which organisations can address changes and work to remain one step ahead.

The Nordics are top-ranked in the study, with Sweden ranked number one in terms of attracting brain business jobs. This confirms our conviction that Nordic Capital is operating in the right region, not least because the Nordic countries offer a good mix of different sectors to invest in.

Our experience also tells us that a high concentration of brain businesses is a breeding ground for creative ideas, R&D inventions, innovative business concepts, business ventures, and start-ups – an all-around dynamic economy. This report adds further proof that the Nordic region is currently a highly interesting arena for investments.

Nordic Capital's deep experience and proven track record strengthen our role as a partner in this region, supporting companies and helping them build strong, sustainable businesses. This allows the Nordic Capital Funds to consistently deliver excellent financial returns to investors across economic cycles.

Brain businesses will continue to be a key driver for growth. This report confirms that there are future opportunities for substantive value creation in Nordic Capital's focus regions and provides definitive support for our focus areas.

Stockholm, October 2017

Kristoffer Melinder, Managing Partner, NC Advisory AB,
advisor to the Nordic Capital Funds

Executive summary

Identifying where talent flocks can be crucial for investors, businesses, as well as people who choose where to live and work. The fruits of many brains stimulating each other lift businesses. Incomes and living standards tend to grow faster in brain business clusters. Start-ups and technological breakthroughs are more likely to succeed in countries that become hotspots for creative engineers, programmers, designers and other innovative, knowledge-intensive specialists. Such innovative hotspots do not arise simply because many people who live there have university degrees, or for that matter, where successful regions have clustered in the past. Instead, hot spots arise where knowledge intensive firms find the best opportunities for future success and growth. This requires the right mix of business environment and supply of talent.

This report is written for those who want to make a strategic choice of where to locate or invest in Europe. Where can they expect to take advantage of the cross-stimulation and growth that takes place in brain business hotspots? In which European countries does brain business abound? Where are knowledge intensive firms likely to grow in the future? We map where the brains - the knowledge workers - of Europe flock to and where investments in their innovative ideas bear fruit. We do this by looking at detailed enterprise employment statistics in 28 different European countries and their respective capital regions, examining how many people work in specialized knowledge intensive companies. We refer to these jobs as brain business jobs. Four different fields of brain business jobs are studied: the tech-sector, ICT, advanced services and creative professions. These in turn fall into eleven subsectors.

Some of our findings might come as a surprise to readers. The geography of brain business jobs in Europe evidently no longer follows a simple division between North and South, West and East. Many countries in Eastern and Central Europe outpace their Southern European fellow EU-members in brain business job intensity. The brain jobs of the former planned economies of Eastern and Central Europe tend to be strongly focused to the capital regions. The Slovakian capital region of Bratislava has the highest share of brain business jobs in all of Europe, despite the fact that Slovakia as a nation has a mediocre concentration of brain business jobs – it ranks 18th amongst 28 European countries.

Overall, the top three countries in terms of brain jobs are Sweden, Denmark and the Netherlands. Yet, the capital regions of these three countries are more dispersed, ranking 2nd, 6th, and 8th respectively in a comparison of European capital regions. The reason is that in Northern and Western Europe, brain business jobs are less centralized in the capital regions. France is the exception in Western Europe, since the brain business jobs of the country are highly centralized: Paris ranks just above London, while France as a country is far behind the UK. These patterns matter for investors, businesses and talents. In Eastern and Central Europe, as well as in France, the obvious choice for brain businesses are the capital regions. In other parts of Europe, it is wise to look also for other regional hubs.

Two distinct groups of successful brain business countries emerge. First, high-income countries with good macroeconomic policies that also invest heavily in their immaterial capital, tend to do well in terms of brain business, and are likely to continue to do so. A second group of countries are ”rookies” that more recently have begun pursuing economic policies conducive to entrepreneurship and provide attractive living conditions. While they often lack established large high-tech firms, they compete with a good supply of knowledge-intensive experts, lower wages and easier access to housing and business facilities. The rookies are mostly Eastern and Central European countries whose capital regions attract many brain business jobs. Bratislava, the overall brain business winner in our capital region ranking, is an example. Another is Prague, the capital of the Czech Republic, which ranks only one step below Stockholm in terms of the share of brain business jobs. Upcoming countries such as the two small states of Estonia and Malta are doing significantly better compared to other European countries with a similar geographical and historical background. By pursuing growth policies and actively attracting international business, the two countries have leapfrogged in terms of knowledge intensive development.

Country Ranking		All brain business sectors, jobs per 1 000 working age population
1	Sweden	87.1
2	Denmark	79.1
3	Netherlands	77.0
4	UK	76.1
5	Luxemburg	70.1
6	Germany	65.8
7	Norway	64.5
8	Finland	59.8
9	Austria	56.7
10	Estonia	55.1
11	Slovenia	54.4
12	Belgium	52.7
13	France	52.5
14	Czech Republic	51.4
15	Hungary	50.6
16	Malta	47.3
17	Latvia	46.1
18	Slovakia	44.0
19	Lithuania	41.6
20	Portugal	36.6
21	Italy	36.4
22	Cyprus	35.6
23	Spain	35.1
24	Croatia	35.0
25	Bulgaria	34.3
26	Greece	34.1
27	Poland	30.2
28	Romania	28.8

Capital Region Ranking		All brain business sectors, jobs per 1 000 working age population
1	Bratislava	179.1
2	Stockholm	167.0
3	Prague	162.9
4	Paris	159.3
5	London	148.1
6	Copenhagen	137.6
7	Oslo	125.3
8	Amsterdam	112.6
9	Bucharest	108.2
10	Helsinki	107.2
11	Wien	105.0
12	Brussels	101.9
13	Budapest	99.6
14	Berlin	95.6
15	Madrid	92.9
16	Sofia	82.6
17	Ljubljana	79.9
18	Lisbon	75.3
19	Warsaw	70.5
20	Luxembourg	70.1
21	Athens	60.6
22	Rome	56.0
23	Estonia	55.1
24	Malta	47.3
25	Latvia	46.1
26	Lithuania	41.6
27	Zagreb	39.4
28	Cyprus	35.6

***** Due to their small size, Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta encompass a single region according to the NUTS 2 division. The capital region and the country are therefore the same.

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The quest for brain business hot spots

All regions aspire to become hotbeds for innovation and creativity. Only few succeed. But which ones succeed best now, how do they do it, and which are likely to move ahead in the future? For investors, businesses and people choosing where to live and work, identifying regions that promise bubbly, innovative growth can be crucial. Start-ups and technological breakthroughs are more likely to succeed in regions that become magnets for entrepreneurs as well as for talented and creative engineers and other specialists. The success of these individuals spills over to wages, housing wealth and quality in public services.

It can be crucial to distinguish between the regions and countries that already are hotbeds for knowledge intensive sectors, and those that are likely to become hotbeds over the coming years. The latter are more promising for investors and entrepreneurs, since the wages and costs of doing business is typically lower in upstart regions. Typically, regulatory regimes and tax systems are also more conductive to investment and businesses in upstart regions. Talents might instead choose regions that are already hotbeds, since the wages tend to be higher there. Some talented workers might also prefer upstart regions, drawn there by lower costs of living and the lower tax levels often found outside of Northern and Western Europe.

The data and analysis provided in this report will help answer questions like: What parts of Europe have the largest concentration of people working in programming? In which countries do jobs in research and development abound? Where are the design centers of Europe? These questions are not only relevant for the business community and those seeking employment abroad, but finding answers offers insights for policy makers who wish to gain a better understanding of the new geography of jobs in Europe.

Our analysis shows that some old structures remain in Europe. It also shows that change is on the way. Overall, the Northern European countries have the highest share of brain business jobs, followed by Western Europe. One would expect Southern Europe to take the third position, followed by Central and Eastern Europe at the bottom. After all, Southern Europe has been open for commerce, enterprise and technological influx from the world market for a long time, while the Central and Eastern Europe region was weighed down by communism until the beginning of the 1990s. Yet, on average, the Central and East European countries now have a higher concentration of brain business jobs than Southern European countries. This is testament of how the former planned economies of Europe have embraced enterprise and fostered growth, while swathes of Southern Europe have stagnated.

Some countries defy gravity. Estonia has a higher concentration of brain business jobs than France and Belgium. […] Another example is Malta. The island nation, which used to be a backwards, albeit pleasant, place, has become the most knowledge intensive center of Southern Europe. By attracting international businesses and talents, the country strives to become a miniature Singapore of the Mediterranean

Some countries defy gravity. Estonia has a higher concentration of brain business jobs than France and Belgium. This is striking, given that the two latter countries have been on the forefront of development since the industrial revolution, while the Estonian economy was in shatters when the planned economy of the Soviet Union collapsed. Since then, Estonia has adopted one of the most business friendly policies and efficient governments in the world. The development in the small Baltic country should be an inspiration for the rest of Europe. Another example is Malta. The island nation, which used to be a backwards, albeit pleasant, place, has become the most knowledge intensive

center of Southern Europe. By attracting international businesses and talents, the country strives to become a miniature Singapore of the Mediterranean.

Sweden is interesting, not only because it has the highest concentration of brain business workers, but also because it has a balanced presence in all four fields of brain business jobs. It might come as a surprise that Sweden is such a well-rounded knowledge capital, since a common view is that Sweden pursues a socialist model. While the Swedish economy is burdened by high taxes, the country has for decades compensated with extensive market-oriented reforms and high R&D spending. During recent decades, significant tax reductions as well as liberalizations have taken place in Sweden. Private businesses have a long tradition of investing in research and development, paving the road for blooming knowledge-intensive. While many large multinational Swedish companies are gradually transitioning their businesses to other parts of the world, notably China, the country fills the gaps by giving birth to new entrepreneurial firms. Sweden benefits from having an advanced private equity sector that invest heavily in new ventures, such as Fintech, computer games and environmental technology.

While brain business jobs are more evenly distributed geographically in Sweden than in some other countries, the capital region Stockholm still manages to be something of a hidden Silicon Valley of Europe, and yet excels also in other knowledge intensive segments, such as high-tech industrial engineering and advanced services. Denmark, which has a record high tax level but still manages to be one of the most market-friendly countries in Europe, scores slightly below Sweden. Its capital region Copenhagen is also fairly well-rounded, although with a shortcoming in advanced services. Denmark and Sweden have compensated for high taxes with other business friendly reforms, and are leaders in research and development investment and other forms of knowledge capital formation. Such advantages matter in times of rapid technological progress, where countries and regions which are early adopters of digitalization, and other disruptive innovations became the focal points of growth in Europe. Yet, the geography of successful enterprise in Europe is complex, as the data in this study shows.

While fintech businesses thrive in Stockholm for example, much of the simpler programming jobs in these businesses are outsourced to places which have many skilled programmers who work at lower salaries, such as Bratislava, Prague and Bucharest. If the innovative regions that sprout in lower-income European countries are nurtured, and combined with a continuous up-skilling of the local workforce, Eastern Europe can soon compete with Northern and Western Europe in terms of innovation. Similarly, if other parts of Southern Europe follow in the footsteps of Malta, this part of Europe can catch-up, with important benefits for job and wealth creation. All four corners of Europe are striving to get ahead in the innovation race.

Why do brain business industries matter?

High and rising standards of living are generated largely through productivity growth that arises due to technological innovations, and through specialization facilitated by trade. Knowledge intensive industries lie at the heart of both processes. As the renowned economists Philippe Aghion and Peter Howitt have stated, "In order to sustain a positive growth rate in output per capita in the long run, there must be continual advances in technological knowledge."[1] This quote is famous, but it is also incomplete. Technological knowledge by itself achieves little, unless it is also used and applied in production. Therefore, the extent to which merely academic knowledge is transformed into knowledge-intensive industries is crucial. According to economic theory, regions can raise their incomes by specializing in production in which they have a comparative advantage, and trade with other regions that may have other advantages. These comparative advantages are often illustrated with examples that have to do with natural advantages such as supplies of raw material or accumulated knowledge in particular industries. The gains from trade are not spread evenly between regions, but depend on the extent of the comparative advantage.

Now, suppose one region manages to hone its comparative advantage as innovator or brain business generator. It thereby acquires a way of raising the region's comparative advantage in many types of production. For example, a region that excels at a generic technology, such as digitalization, will find that local access to these skills help most of its industries to become more productive and more competitive. Thus, there is a turbo effect to brain business. This advantage is further fortified by the gains from a knowledge advantage that stretch beyond exports and trade. In the wake of globalization, a firm that has acquired a knowledge advantage can often quickly expand internationally, implement its cutting edge technology in many daughter companies around the world, and earn large capital gains. Thus, wealth accumulation is added to trade gains. So much for economic theory. Does this theory then hold up to empirical scrutiny? A recent analysis from the OECD provides overwhelming empirical evidence among its member countries. The study shows:

In large parts of Europe even well- educated young people have a hard time finding jobs. Many of these latter regions follow a now obsolete recipe for growth, trying to entice a large share of the young to enroll in higher education, and waiting for growth to come.

- Startups and new entrants create the lion's share of job growth.
- Brain businesses such as "professional, scientific, technical and other business services" are the major job growth segment.
- Knowledge based capital is the fastest growing investment segment.
- Wages are highest and growing fastest in the knowledge intensive firms.[2]

Therefore, it should be come as a surprise that the countries and capital regions that stand out in our mapping of brain business jobs also do well in terms of economic growth and employment. Many brain business hot spots are busily recruiting experts from around the globe. At the same time there are also struggling regions. In large parts of Europe even well-educated young people have a hard time finding jobs. Many of these latter regions follow a now obsolete recipe for growth, trying to entice a large share of the young to enroll in higher education, and waiting for growth to come. The problem with this model is that demand for knowledge workers is changing, becoming more

[1] Philippe Aghion and Peter Howitt (1955).

[2] OECD (2015), http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/oecd-science-technology-and-industry-scoreboard-2015_sti_scoreboard-2015-en#page1

specialized and more oriented toward knowledge or experience with innovative technologies. Technological disruption means that demand for brains rises where the disrupting firms locate, and may fall where the disrupted firms languish.

This also points to a catch to being a brain business hub: If a region loses its edge, brain business employees and investors are more likely to move away than most other groups of employees. More worryingly, a knowledge advantage can evaporate quickly if someone else invents something slightly better. Knowledge-intensive production methods upend firms and industries, but are also themselves prey for those searching for new opportunities for those in the forefront of technological disruption. Nowhere is this more apparent than in digital technologies and services. Digital disruptors have attracted millions of users—and billions of dollars in value. Some of them have grown tremendously over the past three years. In venture capital vernacular, a unicorn is a start-up that has a valuation of at least $1 billion. Unicorns received their name because they have been historically rare, although they are becoming more common as venture funding including private equity funding seeks disruptive companies with the potential to grow large. Entrepreneurs behind disruptive companies are motivated to attract funding, perhaps even dreaming about becoming the next Alibaba, the Chinese e-commerce portal that in 2014 raised $25 billion in capital—the largest IPO in history.

A recent survey of executives of international firms from 12 industries reveals several troubling findings about the potential for disruption. Executives believe an average of roughly four of today's top 10 incumbents (in terms of market share) in each industry will be displaced by digital disruption in the next five years. The threat extends not only to displacement of big companies, but also to the very existence of entire industries. Even beyond digitalization knowledge-intensive newcomers may be disruptive. Tesla, for example, may succeed with a technology-intensive entry into the crowded up-market car segment.

Even knowledge-intensive firms from emerging markets can invade industries in traditionally university-dense countries. For example, in the IT-sector, Huawei encroaches on Nokia and Ericsson. Another example is Embraer, a Brazilian firm that has recently become the largest maker of regional jet aircraft, and is beginning to compete with Airbus. Haier of China has become a power-

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house in household appliances, and it is already the world's largest brand by market share. Other firms to watch are the Indian IT giants, like Infosys and Tata Consultancy Services. These examples show how emerging-market multinationals are learning fast how to compete in a technology-driven world. Depending on where the new rising stars of knowledge firms are located, the geography of successful enterprise is changing rapidly. Many Western firms who used to dominate the global market have fallen behind competitors from new market economies such as China and India.

Some parts of the old world are therefore forced to deal with vast economic and societal frictions that stagnation brings on. Falling behind the rest of the world is not a pleasant experience. For example, relative to other developed countries, Italy, France and Belgium have lost ground in terms of GDP per capita since the early 1990's, and they seem to continue to fall behind. While Italy and France introduced certain growth-oriented reforms in order to qualify for the Euro membership, their policies have mostly been focused on raising taxes and public spending, and even modest market-reforms have provoked fervent, popular opposition. France spends more on public R & D than many countries, and boasts some flagship technological firms, but the overall business conditions have not been very conducive to brain business. By and large the countries that we identify as brain business hubs continue to prosper by moving towards new industries, new technologies and new business models, such as Germany or Sweden. Some even propel themselves ahead in leaps and bounds. Illustrative

[3] See Bradley m.fl. (2015).

examples are Ireland and Estonia, which have made an impressive journey from deep poverty to prosperity during the last three and a half decades, in spite of weathering a deep recession in 2008-2012, and have the mindset and institutional settings for continued growth.

Regions with successful knowledge-intensive business also tend to provide more fertile ground for investments in new start-ups. Different innovative regions have different profiles that may create very different preconditions for investors in innovative firms. Apart from their different focus on types of technological competence, such as digital vs traditional industries, they may also differ in terms of their development stage, cost-profile and future potential. For example, Bratislava is on the up because it has strengths in programming, but also because it is a low cost alternative with good communication through Wien's airport. The current investments, and inflow of programmers and digital competence, suggest that it has potential to be a ground for good tech investment.

There is good research to suggest that firms starting or investing in an innovative region succeed better than those that invest in other areas. For example,

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a meta-analysis of hundreds of studies, conclusively indicates that firms that locate in innovative clusters become more innovative themselves and that choosing matching clusters matters.[4] Another line of research corroborates that firms achieve higher productivity growth in regions with greater start-up activity.[5]

In the age of internet, one might think that location makes less of a difference. At the margin that may also be true. For example, top-ranked universities have lost some of their advantage, with contenders encroaching in terms of publishing in scientific journals and academic careers. Still, in high-tech business, proximity continues to be a strong force shaping regions and technological prowess.

Consider the example set by the move by William Schockley's semiconductor business from the US east coast to San Francisco in 1956. It was the first such firm to settle in the Palo Alto area that today is knows as Silicon Valley. It was not the promise of higher returns that made Schockley relocate, but the fact that his sick mother lived close to San Francisco. Similar motives may explain why entrepreneurs who have established themselves in a region rarely move, an observation which seems to be particularly prevalent in high tech firms. While the beginnings can be shaped by random element, spin-offs can add to the formation of clusters, and later newcomers find it in their interest to establish themselves in the vicinity of a large and creative competence pool. It is almost a convention in the literature that accumulated local knowledge should translate into superior firm performance. Extensive research on local knowledge spillovers describes in great detail why this relationship is expected to hold and provides vast empirical evidence to support this claim.

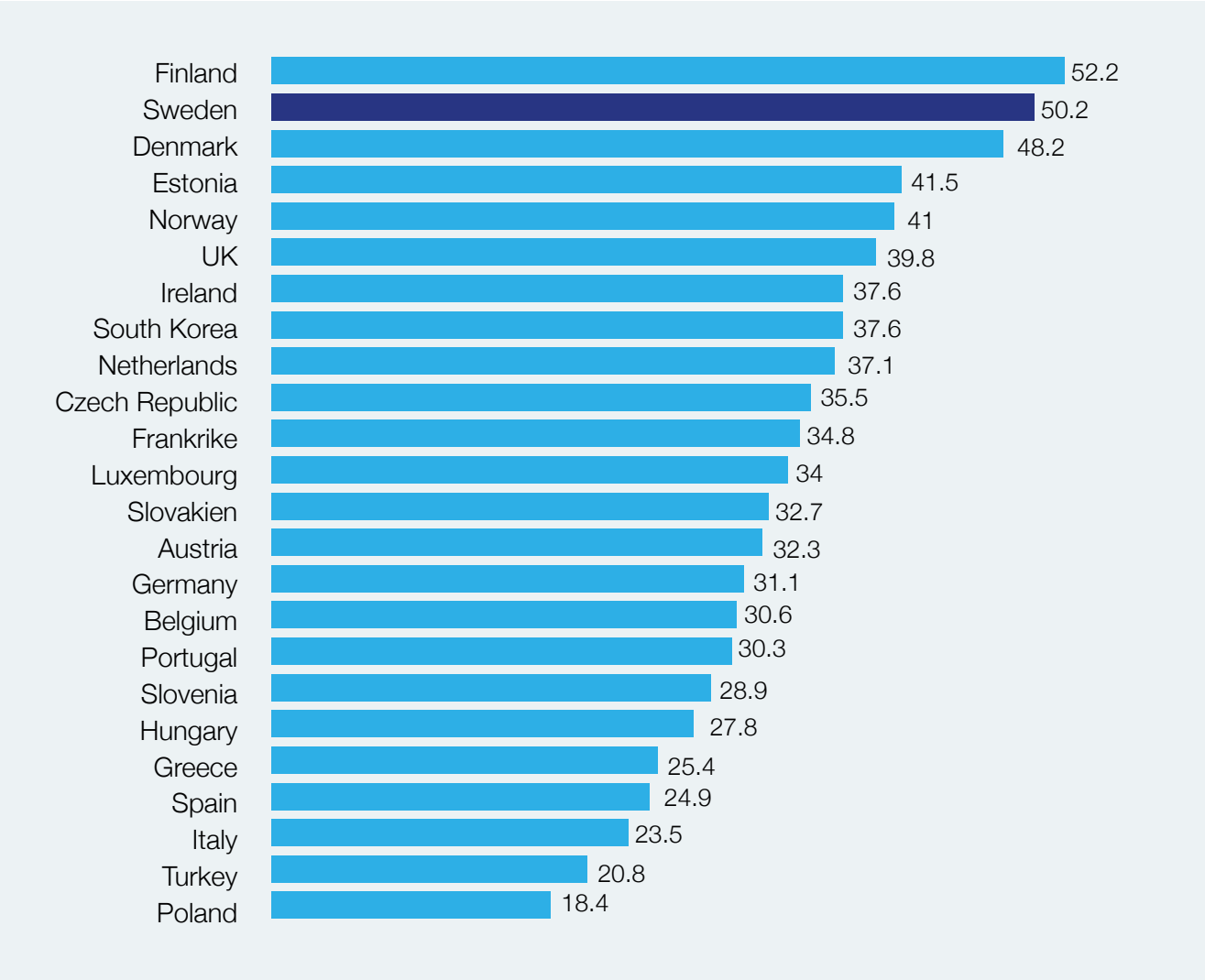
The paradox of brain business hubs

While investing in brain business hotspots on average increases chances of success, there are also risks involed. Local competition is more intense. There is a greater risk that key employees leave to competitors, or find risk capital, and start a competing firm. Or that the older firms that are disrupted are provoked to invest in competing technology. For example, traditional Swedish marketing firms may feel a start-up like Swedish Cint that Nordic Capital has invested in breathing down their neck. Cint's main product is OpinionHUB, a B2B

[4] See Fang (2015).

[5] For example, Holtz-Eakin and Kao (2003) show that variations in the birth rate and the death rate for firms are related to positive changes in productivity. Audretsch and Fritsch (2002) found that regions with a higher startup rate exhibited higher growth rates. See also Fölster (2000) as well as Braunerhjelm and Borgman (2004) established a positive impact of entrepreneurs on regional growth measured as labor productivity.

Percentage of workers who reported structural changes in their workplace during past 3 years



Source: OECD (2013)

exchange for seeking and collecting insights. The platform connects the buy-side - typically a market research firm that needs to access panelists for consumer research - with the sell-side, the companies owning consumer panels. This allows the customer easy access to a specific number of pre-defined, deeply profiled panelists in a specific country, region or local area in the world, through the platform's self-service and real time matching algorithms.

In spite of these risks, as noted above, the dynamism of brain business hot spots helps more than it hinders. At the macroeconomic level, this net advantage also helps to explain an apparent paradox. More employees are replaced by new technology in countries that rank high in terms of brain business presence. Yet this is more than outweighed by the creation of new jobs. For example, according to an OECD survey (shown in diagram above) a large share of employees have experienced major technological change at their work place over the course of the preceding three years. The countries in which many firms adopt new technology also tend to be the ones with innovative, knowledge intensive regions. For example, Sweden which tops the diagram of technologically driven changes in the labor market, and also our ranking of brain business jobs, is also the country with the highest employment rate within the EU. In a time of rapid technological change, countries which succeed in brain business jobs gain a significant advantage.

Mapping Europe's brain business jobs

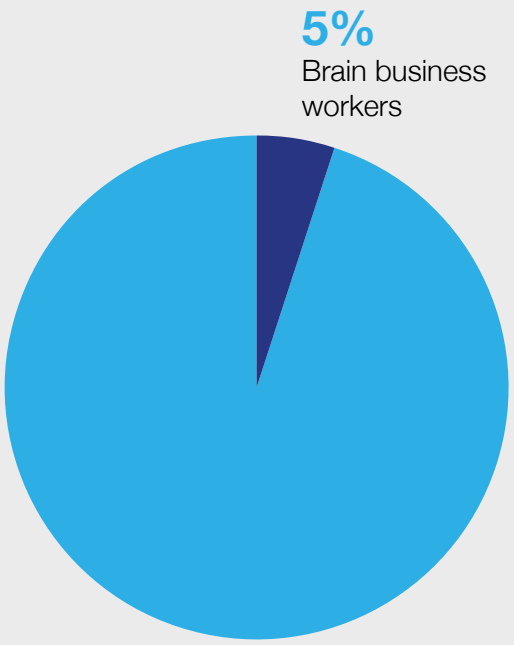
For an investor, a business or employee choosing where to locate, the characteristics of regions and countries matter. Previous studies attempting to identify knowledge intensive industries tend to end up with the following four knowledge intensive types of business, namely the tech-sector, ICT, advanced services and creative professions. These broad fields are in our data analysis divided into eleven subfields, as shown below.

Main categories	Subcategories
Tech-sector	High-tech Manufacturing Engineering/Architecture Research and Development
ICT	Telecom IT Services Computer Programming
Advanced services	Head office Management Advertising and Market Research
Creative professions	Publishing Film/TV/Music Design and other Creative Work

This comprehensive way of defining knowledge business jobs includes not only those who work with novel technological solutions, but also the creators and advanced service providers who play a key role in modern societies. The source of our data is the most detailed structural business statistics data, published by the European statistics agency Eurostat.[6] Statistician have gone through great pains to classify each local unit of each business, measuring how many people work in *highly specialized knowledge-intensive work places or local units of firms*. Thus, employees of local units of larger companies, focused, for example, on high tech manufacturing, are counted as brain business jobs. A potential shortcoming of this approach is that, for example, administrators working in specialized IT-companies are counted as brain business workers, while IT-specialists in sectors such as construction are not. For some purposes, for example determining how many people belong to different professions, this might constitute a measurement error. For the purposes of this report, however, mapping how many people work in advanced knowledge intensive firms is the more interesting metric since it reflects the size of brain business.

Essentially, our measure of work captures the extent to which advanced knowledge intensive firms have been so successful that they have grown large and employ many people. If we had focused on professions we might have been misled by regions where firms e.g. employ many in-house IT-specialists that focused on patching up existing IT-systems, but have few IT-firms that develop and sell innovative IT-solutions. Instead, our measure focuses on employment in the more advanced knowledge firms that also tend to be ones that are growth engines and develop disruptive innovations.

We examine national, and capital regional, statistics for the European Union member states with the exception of Ireland (due to lack of data) but including Norway, a total of 28 countries. Close to 307 million people of working age live in these countries - 15.9 million of whom in the advanced knowledge firms that form the basis of our analysis. Thus, out of each 1 000 working age people in the countries we examine, 51.8 work fit our definition of brain business workers. These approximately 5 percent of Europeans work in advanced knowledge-intensive businesses, such as high-tech manufacturing plants, specialized research and development firms, head offices of large companies and design studios.



307 million working-aged individuals live in the 28 European countries studied in this report, 15.9 million of which fit our definition of brain business workers. This is based on a narrow definition of those working in highly specialized knowledge-intensive companies.

[6]These statistics takes time for the statistical agencies to compile, and therefore the latest high-quality data available when we were writing this report was from 2014. In the rare cases where data was lacking for a particular region for this year, previous year's data has been used. For those who wish to replicate our work, the technical source of data is: Eurostat: SBS data by NUTS 2 regions and NACE Rev. 2. The statistical unit used for regional SBS is generally the local unit, which is an enterprise or part of an enterprise situated in a geographically identified place. Local units are usually classified under NACE according to their main activity.

The definition of brain business jobs

Our definition is purposefully focused. For example, while most of European manufacturing businesses today utilize advanced production methods, only a small share qualify for our definition of high-tech manufacturing. Specifically, we look at firms in the fields: manufacture of computers, electronic components and boards, peripheral and communication equipment, consumer electronics, watches, clocks, magnetic and optical media. These are particularly knowledge-intensive fields of manufacturing, for which data exists both for European nations and regions. The second segment of the **Tech Sector**, Engineering and Architecture, is defined as the firms engaged in architectural and engineering activities, technical testing, technical consultancy and analysis. The tech-sector also includes a third segment, firms specialized in Research and Development. The knowledge intensive part of the **ICT** sector consists first of Telecom, comprising wired as well as wireless telecommunications activities. The second segment, IT Services, encompasses data processing, hosting, web portals, news agency activities and other information service activities. The third segment, Computer Programming, includes firms engaged in computer programming, consultancy, computer facilities management activities and other information technology and computer service activities.

Advanced services include head offices, management consultancy firms as well as public relations and communications activities. This definition captures both the activities of the head offices themselves, and advanced services outsourced from the head offices to specialized firms. Advertising and Market Research includes also media representation, market research and public opinion polling. Finally, the **Creative Professions** consist of publishing of books, newspapers, directories and mailing lists, journals and periodicals, software and computer games. Film/TV/Music includes companies specialized in production and publishing of motion pictures, sound and music as well as programming and broadcasting of the same. Design and other Creative Work includes companies specialized in design, photographic activities, translation and interpretation work and other similar activities.

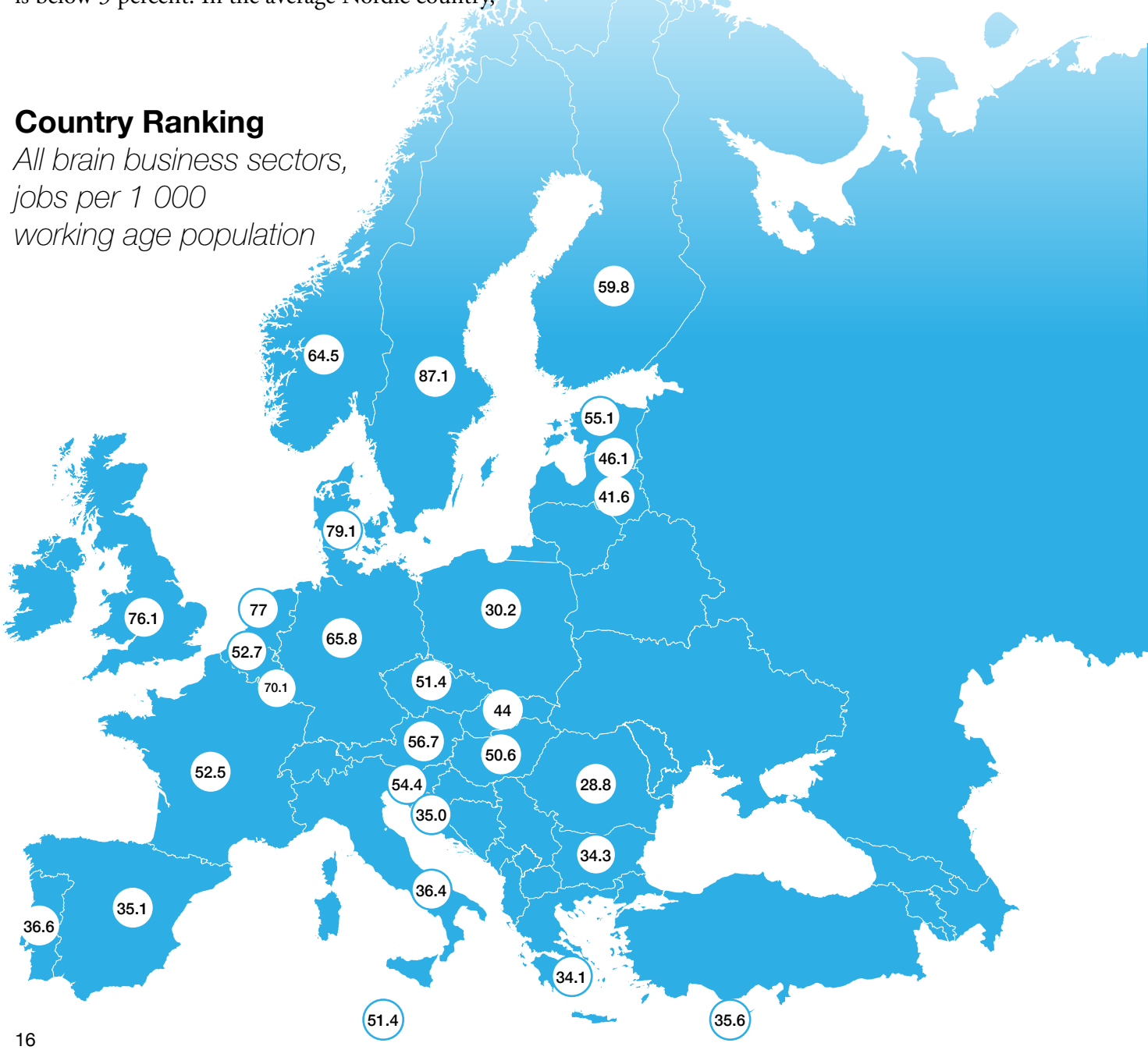
In Sweden, the top ranking country, nearly 9 percent of the workforce are employed in knowledge intensive firms. The corresponding figure for Romania is below 3 percent.

Based on our focused definition of brain business jobs we chart out the innovation hotbeds of Europe. As one might expect, these advanced brain business jobs are not evenly distributed either amongst or between countries. The map on the following page shows notable differences between countries: In Sweden, the top ranking country, nearly 9 percent of the workforce are employed in knowledge intensive firms. The corresponding figure for Romania, at the bottom of the ranking, is below 3 percent. In the average Nordic country, 72.6 out of 1 000 in working age population are brain business workers. This is higher than 64.4 which is the average for the West European countries.

In Southern Europe the average country has 37.5 brain business workers per 1 000 people of working age. In Central and East European countries, the corresponding figure is 42.5, which is interestingly higher than the South European region. In the beginning of the 1990s Central and Eastern Europe were far behind Southern Europe, as the former region was transitioning from the failed communist model towards market economy. Today a number of the countries in the region – such as Estonia, Slovenia, Czech Republic and Hungary – have a high share of brain business jobs, while others – such as Poland and Romania only have a few.

Country Ranking

All brain business sectors, jobs per 1 000 working age population

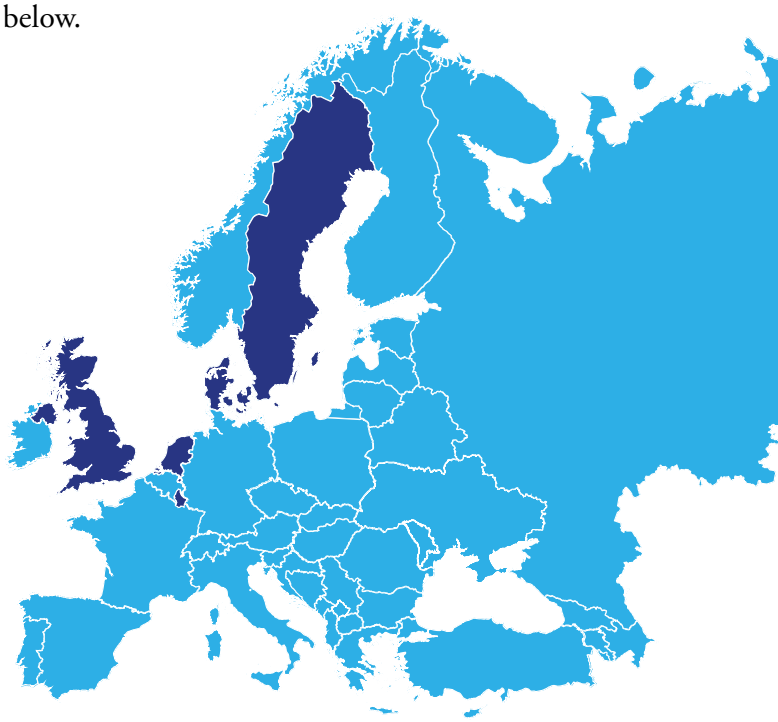


Our analysis shows that the geography of innovation in Europe no longer follows a simple division between North and South, West and East.

Europe can be divided into four regions based on the share of specialized knowledge workers. While these regions do relate to the typical geographical division of Europe, they do not abide by it strictly. Our analysis shows that the geography of innovation in Europe no longer follows a simple division between North and South, West and East. The leading brain business group, is comprised of Sweden, Denmark, the Netherlands, UK and Luxembourg. These five countries have the highest rate of people working in brain business jobs overall. The countries in the group have traditionally established economic models with heavy reliance on knowledge intensive businesses that engage in international trade. These are also countries with a long tradition of openness to international markets that may have sharpened the competitiveness of the advanced knowledge businesses of these countries. It should be noted that two European countries not included in this report due to lack of data are Switzerland and Ireland. These two countries would also have ranked highly.

An interesting observation that is also important for an investor is that most countries are somewhat specialized. While all the top countries are also strong in ICT knowledge intensive jobs per capita, most have some weaker area. Luxembourg, for example, is relatively weak in creative professions.

Four of the countries score highly in the advanced service ranking. Denmark is weaker in advanced services. The UK and Netherlands are strongest in advanced services, but weaker in the tech sector. The only country that is strong in all four areas is Sweden. Several of its leading firms combine digital cutting edge with industrial tradition, such as ABB robotics in the town of Västerås. This firm has been a leading supplier of industrial robots, and has recently developed a collaborative, dual arm, small parts assembly robot solution that includes flexible hands, parts feeding systems, camera-based part location and state-of-the-art robot control. YuMi will change the way we think about assembly automation and may well be used in many areas outside of traditional manufacturing. Sweden also seems to have large scale innovative industrial investments in the pipeline. Two are briefly described in the box below.



Leading knowledge group of countries

	All knowledge intensive sectors	Tech-sector ranking	Tech-sector jobs per 1000 capita	ICT ranking	ICT jobs per 1000 capita	Advanced services ranking	Advanced services jobs per 1000 capita	Creative professions ranking	Creative professions jobs per 1000 capita
Sweden	87.1	1	28.1	2	26.5	4	17.9	2	14.6
Denmark	79.1	2	27.3	3	24.2	10	13.3	3	14.2
Netherlands	77.0	9	18.9	5	21.7	1	24.8	4	11.7
UK	76.1	8	18.8	4	23.3	2	22.8	5	11.2
Luxembourg	70.1	7	19.0	1	28.0	5	17.2	25	5.8

All-round innovative brain businesses in top-ranked Sweden

Several large brain business investments in the pipeline also draw on Sweden's all round strength, not least in environmental technology. For example, the previous head of logistics at Tesla, and one of those closest to Elon Musk at the time, is the force behind Northvolt, a large scale automatic production of high-tech batteries. Prices for electric car batteries are declining faster than most had dared to hope just a few years ago. Car companies like Mercedes or Volkswagen now claim they will build electric cars that are no more expensive than diesels and can go more than 400 km without recharging by 2020. But the supply of batteries is a bottle neck. For one, they need to be produced on a larger scale, second they need to produced more environmentally sound than is the case today. Sweden is now in a good position to host Europe's largest battery factory, and to do it in a way that is environmentally more sustainable than Tesla's new factory in Nevada.

Northvolt has received massive backing from public authorities, risk capitalists, energy companies such as Vattenfall, and most car companies in Europe. In total the project will require some 4 billion US dollars in investment and employ thousands of people. If ten percent of the car sales are electric by 2025, Europe will need three such large battery factories. There is now a good chance that the first such factory will be built over the years 2018-2020. The choice of Sweden is not random. At the moment most battery construction is concentrated in Asia, mainly China, South Korea and Japan. But Sweden actually has cheaper electricity, a major input, and even more importantly, Swedish electricity production is virtually free of greenhouse gas emissions. Also, the raw materials such as lithium, nickel, copper, graphite and cobalt are abundant around the Baltic, even though more mines may need to be opened up.

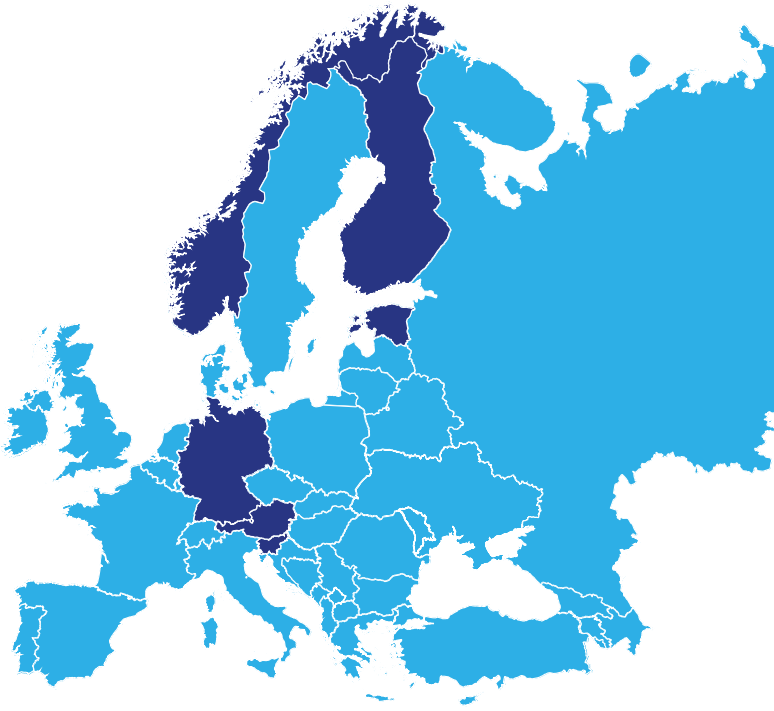
Establishment of Northvolt in Sweden would contribute to a competence pool that will attract other firms in related fields as well. One such example, is the electric car start-up Uniti, that draws heavily on both digital, energy, and industrial competence. It is planned in partnership Siemens PLM, Product Lifecycle Management, which makes it possible to plan the entire production virtually before being physically implemented. Production line construction will begin within 18 months and the first cars will be delivered according Uniti in 2019. Siemens has to date invested equivalent of 3 million in software and support in the company to enable planning of the factory with a fully automated production line able to produce 50,000 electric vehicles in the first year. The fully automated production line can basically have the lights turned off 22 hours a day. In a crowdfunding campaign last autumn Uniti took in just over one million Euros from 570 investors in 45 countries. The money from the campaign is used to build a first prototype of the small city car. But already the company is preparing a larger financing round in which the end of the year plans to bring in 60 million euros, equivalent to more than 570 million from private and institutional investors, ultimately aiming at a listing on the stock exchange.

The cars to be be manufactured at the plant are projected to cost around 20 000 Euros, weigh 400 kg, have a top speed of 90-120 km / h and a range of between 15 and 30 mil depending on the model. Uniti's car is meant to serve as a family's second car or a car for the young commuter who are middle or high incomes.

A completely different example is a start-up whose price rose by 500 percent after it was listed on First North. Its idea is to store electricity in salt. The firm, Saltx, has registered patents worldwide that make it possible to store electricity in the form of thermal energy in salt beds, and then to convert it back to electricity when needed. The special salt it uses is treated with nano-particles and mixed with fluids. When the salt is heated the fluids boils off and the heat is stored chemically in the the salt crystals. When fluids are added the process goes into reverse, allowing temperature spikes of up to 500 degrees Celsius. Saltx already incorporates some of its technology in other firms´ products, such as Alfa Laval, Caterpillar and Rheem. It is now ready to market its own commercial products, first a thermic solar heat collector in China, where a large market is also foreseen for a product that will collect energy during the day and research heat at night. The greatest potential for its technology is the ability to store energy in connection with sun- and wind-power.

A second group of high performing countries includes Germany, Norway, Finland, Austria, Estonia and Slovenia. The four first countries are geographically and culturally close to the leading countries. Interestingly, the other two, Estonia and Slovenia, are former planned economies that have rushed ahead quickly. Germany is particularly strong in the tech-sector, but lags behind in ICT. While Germany has for long been a high-tech powerhouse of Europe, it does not lead digitalization – as evident even by the slow internet speed in the country compared to other parts of Northern Europe. A contributing factor may be that part of the country was a Soviet satellite state for decades. While East Germany was uniquely successful amongst the planned economies of the world, it was way behind West Germany. These differences remain since the two parts of the country were reunited in 1990.

Norway prospers on a foundation of impressive oil-wealth, ranks number one in creative professions and also has a strong tech-sector. However, Norway is weak in advanced services. The same is true of Finland. Norway and Finland are high-performers in terms of innovation jobs, yet lag behind considerably compared to their Nordic cousins Sweden and Denmark. Although Estonia until recently was an impoverished economy, but has managed to develop a knowledge based economy. The country only falls slightly behind the Nordic nations, and is one of the European leaders in creative professions as well as in ICT.



High performing group of countries

	All knowledge intensive sectors	Tech-sector ranking	Tech-sector jobs per 1000 capita	ICT ranking	ICT jobs per 1000 capita	Advanced services ranking	Advanced services jobs per 1000 capita	Creative professions ranking	Creative professions jobs per 1000 capita
Germany	65.8	4	23.2	10	17.7	8	15.5	8	9.3
Norway	64.5	3	23.8	8	19.2	24	6.8	1	14.7
Finland	59.8	5	23.0	6	19.7	21	8.0	9	9.2
Austria	56.7	11	18.1	12	15.4	7	15.9	17	7.3
Estonia	55.1	13	15.9	7	19.4	16	10.2	6	9.6
Slovenia	54.4	6	19.1	17	14.4	11	13.1	14	7.8

Estonia's digital prowess

Three Estonian programmers Ahti Heinla, Jaan Tallinn and Priit Kasesalu developed Skype, in Tallinn in 2003, backed by Danish and Swedish investors Niklas Zennström and Janus Friis. The same team had previously created the successful Kazaa. Skype has in excess of 663 million registered users; this amounts to approximately 8% of the world's entire population. Since 2016 it is owned by Microsoft. Estonia has since become even more tech savvy, innovative and highly connected, partly as a result of the extensive wireless network that exists through the country, which is free in most public places.

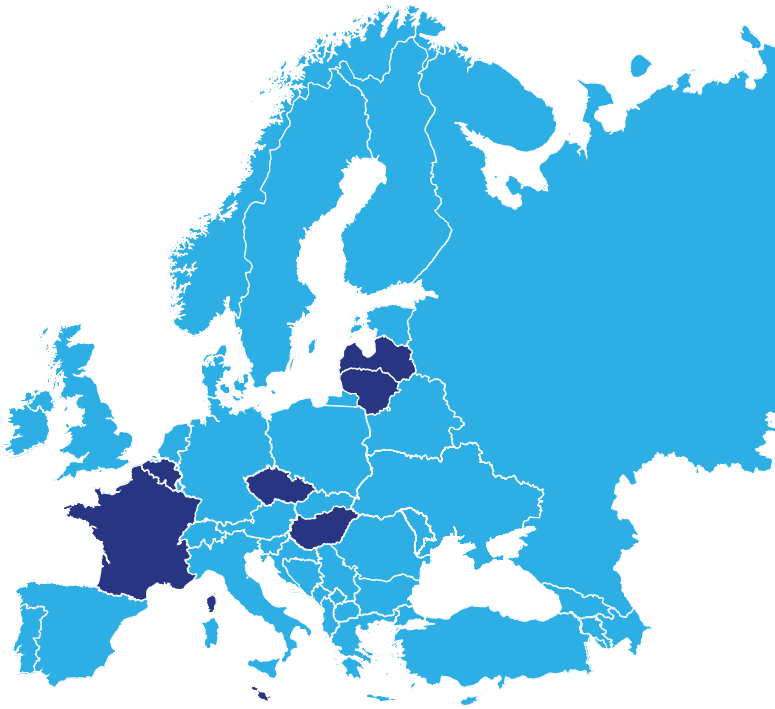
In 2011, Skype's first employee, Taavet Hinrikus, cofounded TransferWise, an online money-transfer company, which now occupies four floors of a Tallinn building and handles about $1 billion a month in exchanges around the world. Investors include Andreessen Horowitz and Peter Thiel's Valar Ventures. Another Estonian-founded startup, Starship Technologies, builds a fleet of autonomous robots designed to deliver goods locally. It has secured USD17.2 million in seed funding. in a partnership with Daimler-owned Mercedes-Benz Vans in 2016 to begin to develop and test the "Robovan", the world's first transportation system integrating specifically adapted vans with autonomous delivery robots to create greater delivery efficiencies.

The third group consists of medium brain business performers. Belgium and France belong to this group. They are the Western European countries with the lowest share of advanced knowledge firm jobs. Belgium is strong in advanced services but very weak in creative professions. France doesn't score particularly well in any field, but has no major weakness either. These two countries have been on the frontline of economic development since the early days of industrialization, and their mediocre ranking is in a historical context therefore somewhat surprising. Both countries have failed to stimulate the entrepreneurship and investments in knowledge and capital that are necessary in order to retain a leading position.

The Czech Republic and Hungary score slightly below Belgium and France. The two countries are similar to Slovenia in that they were in theory forced to introduce a planned economy following a long period of Soviet domination. Yet, the national governments strived to keep a place for private enterprise and trade with the West. Therefore, the countries managed to maintain better functioning and innovative economies even before the fall of the Iron Curtain. The Czech Republic and Hungary are relatively well-rounded in the different knowledge fields.

Malta is the leading country in the South European region – the region which has the lowest share of knowledge workers. Malta is strong in advanced

services and creative professions. It also scores reasonably well in ICT but has a very weak tech-sector. This high level of specialization can be expected due to the countries small size. Malta attracts many European businesses and is also developing a relatively large sector in online-gaming, which in turn fuels the ICT sector. Latvia and Lithuania score below their Baltic neighbor Estonia. Yet, also their progress is impressive given how far behind the three Baltic countries where in the beginning of the 1990s at the collapse of the Soviet model. Latvia is strong in ICT but weak in high-tech, while Lithuania is more well-rounded. Slovakia has a relatively large advanced services sector. The country is otherwise well behind Czech Republic – the other part of Czechoslovakia which was dissolved in the end of 1992.



Medium performing group of countries

	All knowledge intensive sectors	Tech-sector ranking	Tech-sector jobs per 1000 capita	ICT ranking	ICT jobs per 1000 capita	Advanced services ranking	Advanced services jobs per 1000 capita	Creative professions ranking	Creative professions jobs per 1000 capita
Belgium	52.7	17	11.9	14	15.2	3	20.5	26	5.2
France	52.5	14	15.2	11	16.3	13	11.8	11	9.2
Czech Republic	51.4	10	18.7	16	14.6	19	8.7	7	9.5
Hungary	50.6	12	16.9	13	15.3	17	10.1	12	8.2
Malta	47.3	26	7.9	18	13.3	6	17.0	10	9.2
Latvia	46.1	23	9.5	9	18.2	15	10.6	15	7.7
Slovakia	44.0	18	11.7	20	12.4	9	13.9	24	6.0
Lithuania	41.6	19	11.3	22	12.0	14	11.3	18	6.9

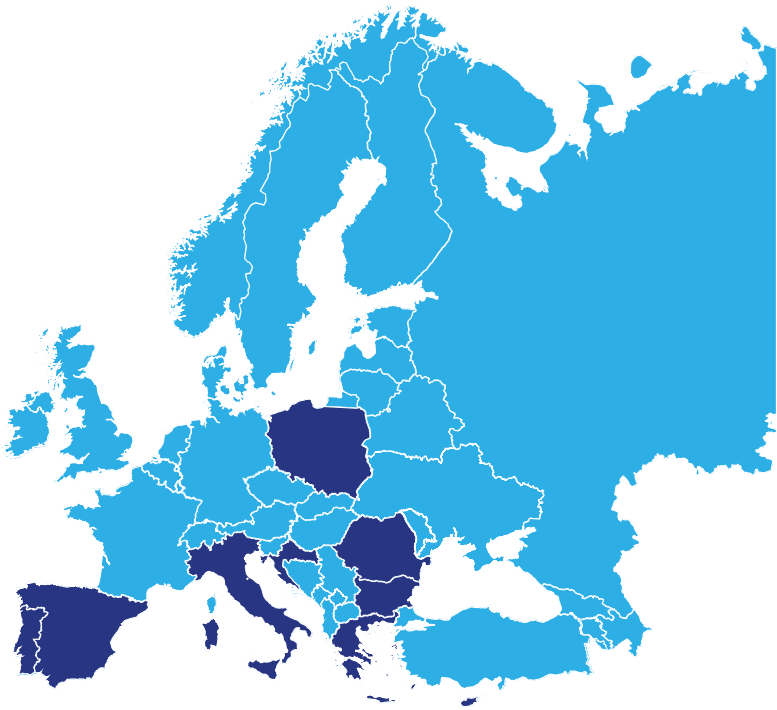
The last group consists of **low ranking countries**. These include most Southern European countries and some of the Central and East European countries. Portugal and Italy have no real strengths, with the possible exception of creative professions in Italy. Given Italy's centuries long tradition of a center for global fashion, one might expect it to be on the top of creative profession workers per capita. But instead, a wider pattern of Italian stagnation emerges than just macroeconomic volatility. Italy was for long knows as a modern and knowledge based country. The lack of business climate reforms, low levels of investment in knowledge, a non-meritocratic university system, a fossilized labor market and problems with corruption and bureaucracy can explain the weakness in brain business.

Cyprus does relatively well in advanced services, since it attracts international businesses by offering low tax deals. Spain has a low ranking and no particular strengths. Croatia is somewhat strong in the tech-sector. Similar to Bulgaria, the coun-

try has a fairly developed ICT sector. Otherwise, both countries have relatively few knowledge firm jobs. Greece has some relative strengths in creative professions and high-tech, but overall ranks as the country with the third lowest share of knowledge workers. While Greece in theory has had a market based model for long, massive regulatory problems exists which hold back the growth of advanced businesses.

Poland has a relatively strong economy, but still scores second lowest in the ranking. The reason is that while Poland has some fairly advanced firms in fields such as manufacturing, it has few highly specialized knowledge workers, which is the measure used in this report. Lastly, Romania ranks at the bottom. While the country is growing, its economy still lags behind other parts of Europe – particularly in knowledge-intensive fields.

In sum, brain business is quite unevenly distributed between countries. During the years to come, the difference in growth trajectory is likely to expand even more. Those parts of the world that manage to shift towards new opportunities are likely to prosper, while others risk falling behind. For European countries, the choice lies between leading the global development, and becoming museums of past success. So, how can one explain these differences between countries? What are the driving forces that promote knowledge intensive business? In our analysis there are two main essential ingredients: A good supply of people capable of working with innovations, and a good business environment conducive to entrepreneurship.



Low ranking group of countries

	All knowledge intensive sectors	Tech-sector ranking	Tech-sector jobs per 1000 capita	ICT ranking	ICT jobs per 1000 capita	Advanced services ranking	Advanced services jobs per 1000 capita	Creative professions ranking	Creative professions jobs per 1000 capita
Portugal	36.6	22	9.9	24	10.6	18	9.9	23	6.2
Italy	36.4	21	11.2	21	12.2	27	5.5	16	7.5
Cyprus	35.6	28	4.6	19	12.7	12	12.0	22	6.3
Spain	35.1	20	11.2	23	10.6	23	6.8	21	6.4
Croatia	35.0	15	13.3	26	9.7	26	5.5	20	6.5
Bulgaria	34.3	27	7.4	15	14.6	28	5.5	19	6.8
Greece	34.1	16	12.0	28	5.9	20	8.0	13	8.2
Poland	30.2	24	8.7	25	9.9	22	6.9	27	4.7
Romania	28.8	25	8.6	27	9.6	25	6.4	28	4.3

Immaterial assets – the foundation of brain business

Brain businesses are built on immaterial assets. These can manifest themselves in the form of patents, registered trademarks or industrial designs. Sometimes such assets are registered, other times they exist in the form of internal company information or knowledge and ideas in the heads of entrepreneurs and employees. Economists sometimes try to value aggregate immaterial assets indirectly, as the accumulated value of previous research and development (R&D) investments after due depreciation. Yet this is obviously a very crude measure. The true value of immaterial assets depends not just on what is classified as R&D in national accounts, but also on wider investments in activity that builds knowledge. Crucially, the value of immaterial assets also depends on how efficiently investments are translated into output, into innovations that can be marketed, that someone is willing to pay for, or that have a social value. Therefore, the measure of brain business prevalence used in this report may provide a better picture of the overall value of immaterial assets in countries and regions than measures that rely on R&D inputs or the number of patents filed. In this section we show how brain business relates to other measures of immaterial investments. This comparison also suggests that many European countries invest much but may not be getting full pay-out.

Too little mileage out of immaterial investment?

In spite of considerable investments in immaterial assets, the European economies' advantage is shrinking. As late as 2004, nearly a third of global economic output was produced in the EU-28 countries. Ten years later, this share had dropped to less than a quarter of global output. Though the shift is partially explained by the catching up of developing economies, it also reflects stagnating growth in the European Union. During this period the EU-28 countries had lower growth rate than all but one of the non-European G20 countries.[7]

> *"'Business as usual' would consign Europe to a gradual decline, to the second rank of the new global order. This is Europe's moment of truth. It is the time to be bold and ambitious"*
>
> *- European Commission*

The European Commission's long-term strategy to boost economic development points out that "business as usual" would consign Europe to a gradual decline, to the second rank of the new global order. This is Europe's moment of truth. It is the time to be bold and ambitious". In order to achieve smart, sustainable and inclusive growth, the Commission points out the importance of "strengthening knowledge and innovation as drivers of our future growth".[8] The Commission's annual growth strategy for 2016 builds upon this theme by stressing the need to promote innovation and entrepreneurship.[9]

Promoting innovation and entrepreneurship, and thereby shifting towards a higher knowledge intensity in the economy, is vital due to changes in the global marketplace. Merely a few decades ago, European firms had strong global positions in manufacturing, information and communication technologies (ICT) and other advanced services. Today a new generation of successful firms, from developing countries such as China and India, have

[7] Eurostat (2015). The pace of growth in EU-28 countries was only marginally stronger than in Japan, which is noteworthy since this country contrary to the European Union has experienced a rapid reduction of the number of working-age adults.

[8] European Commission (2010).

[9] European Commission (2016).

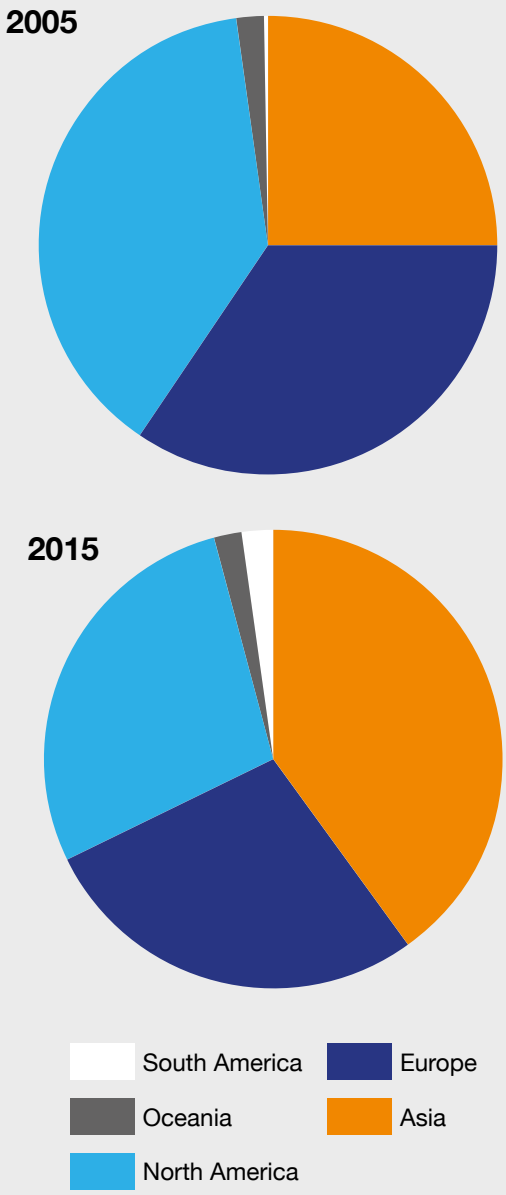
taken up the competition with European businesses. Competition from firms in other developed economies, such as the US, Canada, South Korea and Australia, is also increasing. While Europe in the end benefits greatly from globalization and trade, it is evident that some European enterprises are struggling to succeed in the global marketplace.

Examples are not difficult to find. Nokia, the leading tech company that recently played a key role for overall development in Finland and had a significant share of the world's mobile phone market, has rapidly fallen behind and no longer manufactures phones. Well-known European car brands such as Jaguar, Land Rover, Saab and Volvo have been bought by Chinese and Indian investors. Chinese networking and telecommunications equipment company Huawei has recently reached twice as high global sales as its European competitor Ericsson, and more than four times as high as its other European competitor Nokia. Chinese household appliances manufacturer Midea has recently made a bid for German robot maker Kuka. Forbes describes this move as a way of acquiring the latest technologies for full automation of industries.

These examples are reflected in international enterprise statistics. As shown in the images on the next page, European firms made up 34 per cent of Forbes 500 fortune companies. Ten years later, the number of European firms on this list of globally leading enterprises had shrunk to 28 per cent. The majority of the leading global firms are now found in China and other Asian economies. The old world order, in which the know-how, technologies and capital for competitive businesses to grow was restricted to Europe, the US and a few other developed economies is gone. Competition from China, India, Brazil, Vietnam, Iran and other upstart economies is already strong and will most likely grow in the years to come. The big question is how European businesses can continue to maintain a leading position in this new environment.

Previously, European businesses could stay ahead by having access to physical capital investments that eluded firms in many other parts of the world, and act in a business environment superior to much of the world. To a large extent, these advantages have already spread to competing firms in other parts of the world. Instead, European businesses have to rely on the competitive advantage that is becoming increasingly important in the modern business environment: immaterial values, which create immaterial properties.

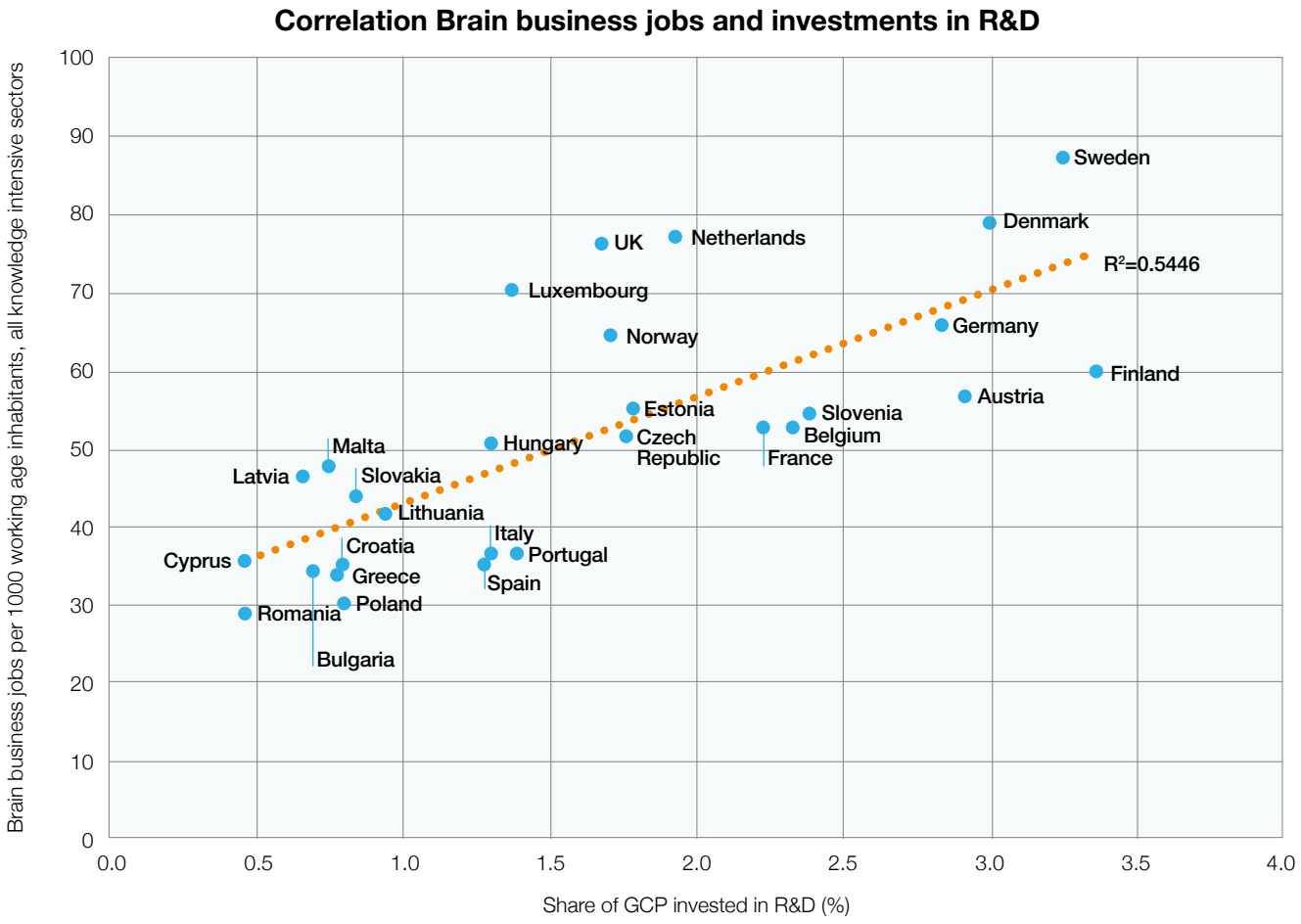
Country´s share of companies on the Forbes 500 list



Source: Forbes Fortune 500 lists, own analysis.

European investments in R & D

For example, overall, European countries have a high degree of R&D investments – not least when compared to the US which invests merely 1 per cent of GDP on R&D. The US makes up for this by attracting global talents, and having a business climate that fosters entrepreneurship. Still, looking at the table and diagram of total R&D investment below, there is a strong correspondence between countries that invest more, and those we showed to be brain business leaders in the previous chapter. But there are quite a number surprises. For example, Belgium and France invest much more in R & D than the UK, but do less well in terms of brain business jobs. Sweden is the top country in terms of brain business jobs, while it is second place in terms of R&D investments. Finland, which is the leading R&D investor ranks on 8th place in terms of brain business jobs.



	Share of GDP invested in R&D	Score, 100 = investments of average country
Finland	3.4	210
Sweden	3.2	203
Denmark	3.0	187
Austria	2.9	182
Germany	2.8	177
Slovenia	2.4	148
Belgium	2.3	145
France	2.2	139
Netherlands	1.9	120
Estonia	1.8	111
Czech Republic	1.8	109
Norway	1.7	106
United Kingdom	1.7	104
Portugal	1.4	86
Luxembourg	1.4	85
Hungary	1.3	81
Italy	1.3	80
Spain	1.3	80
Lithuania	0.9	58
Poland	0.9	54
Slovakia	0.8	52
Croatia	0.8	49
Greece	0.8	48
Malta	0.7	46
Bulgaria	0.7	42
Latvia	0.7	41
Cyprus	0.5	28
Romania	0.4	28

Source: Eurostat and own calculations. Based on average data for the years 2010-2015.

R&D includes investments made by businesses as well as governments and universities. Some of these are also European investments that are placed in some countries. For example, an investment that will be of major importance for the life sciences is The European Spallation Source (ESS) and the large scale microscope Max4 in the city of Lund in the south of Sweden.

The largest share of GDP invested in R&D occurs in Finland, followed by Sweden and Denmark. Norway falls well behind its Nordic neighbors in this regard. While the three other Nordic countries are focused on R&D, Norway's strength lies in industrial designs and trademarks. Austria and Germany also invest considerably in R&D. Northern Europe, and the Western European countries that geographically and culturally are close to Northern Europe – are leading the knowledge investment wave.

Most of Central and Eastern European countries fall well behind the EU average. This is not least true of Romania, which has the bottom position also in this ranking. Slovenia, Estonia and Czech Republic are the countries in the region that have a higher than average investment in R&D. Croatia has a lower than average investment level, but makes up for this by having a high share of industrial designs. Southern European countries have limited investments in R&D – which is particularly true of the small countries Cyprus and Malta. While R&D investments are a metric of input, an albeit imperfect, measure of output might be patents and other immaterial property filings.

European immaterial property assets

As the global economy becomes increasingly knowledge-intensive, much of the development of manufacturing businesses, ICT businesses and modern service businesses occurs through investments in immaterial rather than material assets. These immaterial assets take the form of technologies, patents, know-how, design rights, program code, digital media content and trademarks. The immaterial assets, which are the result of intellectual creation rather than physical creation, are protected by intellectual property rights (IPR). Such immaterial property assets are becoming increasingly important for modern economies due to two long-term factors: firstly, that businesses that work with intellectual creation are becoming an ever larger part of the overall economy and secondly that intellectual value creation is becoming ever more important for firms in general.

The first trend is exemplified by software firms that form a larger part of the overall business sector than in previous decades. The second trend is exemplified by software that is increasingly important not only to software firms, but also a range of other industries, such as manufacturing. This observation is also relevant for other forms of immaterial values, such as arts/graphics, music/film and design. For example, firms today produce film not only for advertisement, but also for communication with stakeholders within and outside the organization (employees, investors, business partners) as well as for expressing long-term commitment to values such as environmental protection and socially sustainable growth.

Data on immaterial property investments and property rights is unfortunately scant, and difficult to come by. Although this form of organized knowledge is driving the world economy – it is not being measured properly. In the table on the next page, we summarize the available information on patents, trademarks and industrial designs. The analysis is based on all applications for patents, trademarks and industrial designs sent to filing offices of the various countries. The number of applications are adjusted for the working age population in each country, and given as a share of the average for the 28 countries.

Investments in immaterial assets is fueling innovative businesses in Europe. It is therefore important to understand which European countries are investing most in these assets.

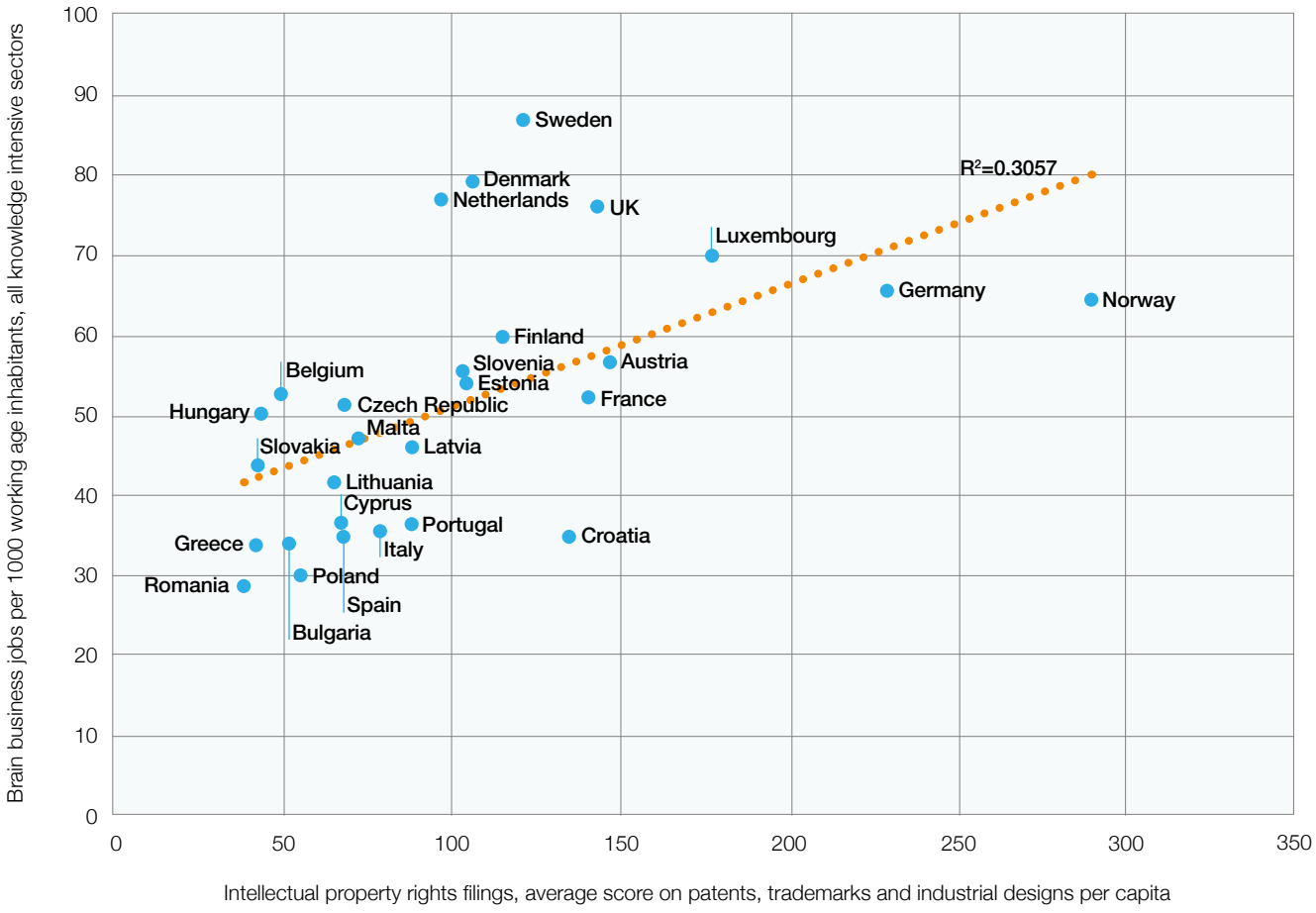
Norway turns out to be the country with the highest share of immaterial property filings overall, and also the highest share of industrial designs and trademarks. Germany tops the list of patents, followed by the UK and Norway. Cyprus and Malta, which attract many foreign businesses, do surpris-

ing well in trademarks. Besides Norway, Croatia and Austria have many industrial designs. Sweden, which has the highest share of knowledge workers, scores highly in patents but only slightly over the average in trademarks and industrial designs. Denmark, which has the second highest share of knowledge workers, also has many patents but surprisingly few trademarks and industrial designs. Romania, which has the lowest share of knowledge workers, ranks in the bottom also in terms of immaterial property filings.

Immaterial property filings constitute an incomplete measure of knowledge business output, as businesses which have IT-based innovations often do not file patents, trademarks and industrial designs in the same way that traditional high-tech businesses do. Sweden and Denmark rely considerably on IT-development, which instead manifests in terms of program code, computer games and solutions for the financial technology sector. Still, there is a broad correlation between countries' immaterial property filings and the share of brain business jobs, as the diagram below shows. The relation is less strong compared to that of brain business jobs and R&D, mainly since Norway and Germany are outliers – countries with a large lead in intellectual property rights filings compared to their European neighbors without a corresponding high rate of brain business jobs.

A crucial question for many European countries is how to increase the efficiency of immaterial investments, that is, ensure that R & D and patents also result in more brain business. Besides knowledge investments, entrepreneurship appears to be a necessary condition for knowledge based growth. Investors, businesses and international talents are attracted to those countries which have a system suited to entrepreneurs. Therefore, it is relevant to gain a better understanding of the entrepreneurial ecosystems of Europe.

Correlation Brain business jobs and intellectual property filings



Immaterial property filings

Standardized data. 100 = average for all countries.

	Average of all three	Patents per capita	Trademarks per capita	Industrial designs per capita
Norway	290	203	243	423
Germany	228	459	72	154
Luxembourg	177	177		
Austria	146	170	89	180
United Kingdom	142	216	64	148
France	140	158	125	138
Croatia	135	33	109	262
Sweden	121	158	101	104
Finland	115	191	80	73
Denmark	106	184	77	58
Slovenia	103	129	85	96
Estonia	103	24	169	115
Netherlands	97	97		
Portugal	88	40	149	74
Latvia	88	51	133	79
Cyprus	78	5	186	42
Malta	72	21	159	36
Czech Republic	68	53	83	68
Spain	67	42	88	72
Italy	67	94	57	49
Lithuania	65	26	114	53
Poland	54	63	36	64
Bulgaria	51	22	71	61
Belgium	49	49		
Hungary	43	40	46	44
Slovakia	42	24	68	34
Greece	42	38	50	37
Romania	38	34	45	36

Own analysis based on data from The World Intellectual Property Organization. Average data for the years 2010-2015 have been calculated. The measures included are: Total patent applications (direct and PCT national phase entries), Total trademark applications (direct and via the Madrid system) and Total design applications (direct and via the Hague system).

The entrepreneurial ecosystems of Europe

Even firms that in our classification are not knowledge intensive can do well with good entrepreneurship. Consider the formerly small Swedish supplier of roof racks to the car industry, the Thule group, today a leading producer of sports and outdoor goods. During the financial crisis in 2007 it went through a difficult patch. But with entrepreneurship and help from its new owner Nordic Capital it intensified its drive to sell directly to consumers. Now it employs 2 200 people, with a very successful product line including everything from roof racks, computer and camera bags, luggage and hiking backpacks to bicycle trailers and strollers. In addition, its portfolio contains several international brands.

A lack of entrepreneurship can sink potential brain business countries.

Entrepreneurship is also an essential ingredient of the technological leaps and brain business that more than ever drives growth. Each wave of invention and progress has been associated with entrepreneurs such as Andrew Carnegie, Henry Ford and Bill Gates. Today, a new wave of entrepreneurs from countries such as China and India, such as Lei Jun ("the Steve Jobs of China", whose company Xiaomi has rapidly become one of the leading smartphone makers of the world) and Azim Premji (Indias outsourcing tech magnate) are the ones driving much of global development. According to the theories of economist Joseph Schumpeter, entrepreneurs are the main motor of growth in capitalism – the foremost drivers of growth and innovation.[13] Apparently, countries that do well in terms of training high-tech experts, and stimulating research and innovation, may still lag behind if too few firms start and grow based on the new technological opportunities that arise. A lack of entrepreneurship can sink potential brain business countries.

It is sometimes argued that Europe suffers from an "entrepreneurship deficit", especially compared to the United States. In a new study two economists use four measures of high-impact Schumpeterian entrepreneurship to compare the entrepreneurial performance of Europe compared to the United States. These measures are: top global firms founded in recent decades, highly valued unicorn start-ups, venture capital investments as a share of GDP, and the number of self-made dollar billionaires per capita who earned their wealth by creating new firms. According to all four measures, it turns out that Europe underperforms compared to the USA. Once Europe's strong performance in technological innovation is accounted for, the gap grows even larger. In fact, the two economists show that Europe also underperforms relative to China and East Asia once the technological innovation level is accounted for.[14]

The authors explain: "Of the 100 largest firms in the United States by market capitalization on the Forbes list in 2009, 34 were firms founded by entrepreneurs in the post-war era. The corresponding number in Western Europe for 2009 was only seven out of the 100 largest firms."[15] Entrepreneurial firms – created with the aim of using a new business model or technology to gain a large market share – are quite rare. The vast majority of firms are small one-person ventures. There are also numerous small- and medium sized businesses that, while they play an integral role in society, have limited ambition to grow by utilizing novel organization forms, inventions or new services.

[13] Schumpeter (1911, 1942).

[14] Henrekson and Sanandaji (2017). "Schumpeterian Entrepreneurship in Europe Compared to Other Industrialized Regions." IFN, Stockholm.

[15] Ibid. p. 9.

Having a knowledge-intensive and profitable entrepreneurial sector also leads to the emergence of new entrepreneurs through two important channels. First, talented entrepreneurs are more inclined to move to regions where there is greater potential for future entrepreneurship. Second, many new entrepreneurial firms are formed as spinoffs by key employees in existing entrepreneurial firms that have already grown large. By working for an established firm, potential entrepreneurs acquire experience, knowledge and cutting-edge ideas of a type needed to start their own venture."

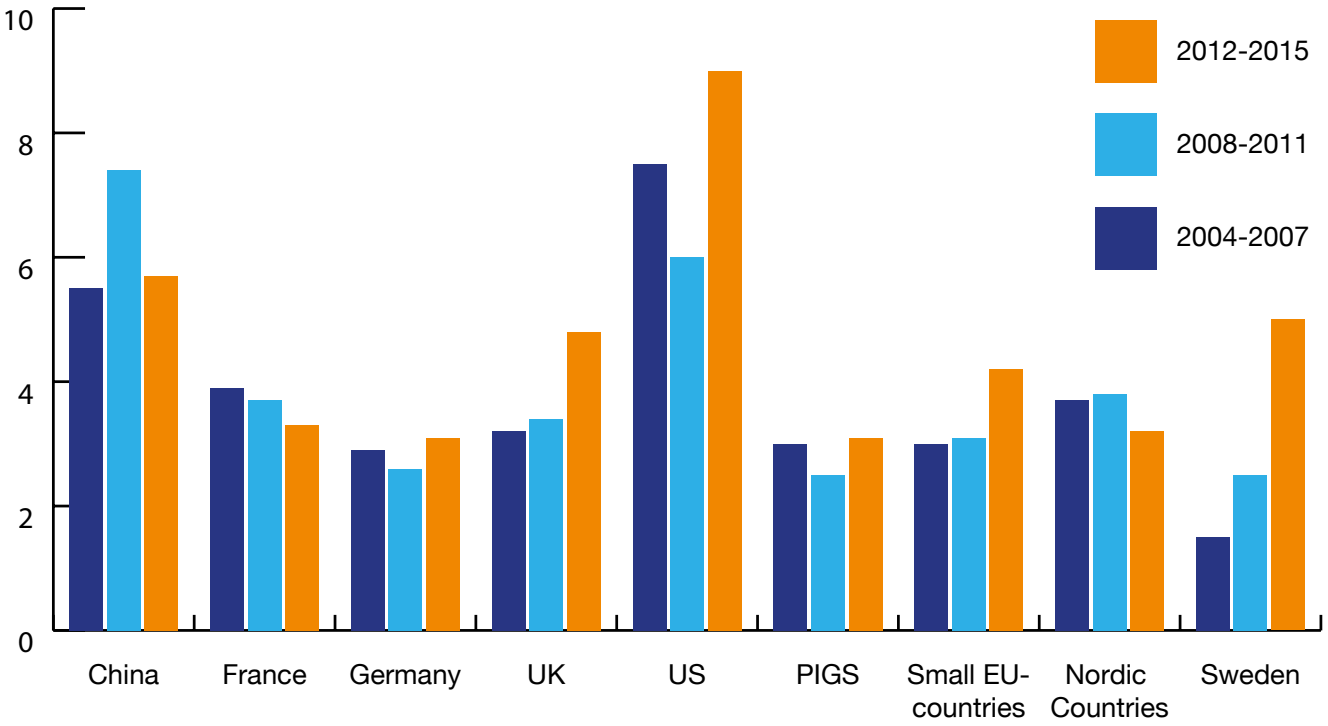
European countries overall have a leading position in knowledge-intensity, have well-educated labor forces, capital supply, modern infrastructure and stable macroeconomic conditions. They are also home to many leading global businesses. Yet, Europe still lags behind in terms of entrepreneurship. Additionally, European countries diverge in their efforts to improve conditions for entrepreneurship.

A recent comparative study of entrepreneurial dynamics shows some stark developments. It measures the share of the population involved in setting up new businesses based on data from the Global Entrepreneurship Monitor (GEM).[16]

As the diagram below shows, the UK which also ranks in the top group in the brain business jobs league has seen a considerable increase in entrepreneurial activity in recent years. The number of people actively involved in starting a business in the UK is growing faster than in Germany and France, which along with Portugal, Italy, Greece and Spain (the PIGS countries), have the lowest levels of entrepreneurial activity in Europe. The most remarkable development, however, can be seen in Sweden, which also tops the brain business jobs league. One might suspect that this reflects an increase in livelihood self-employment. However, in fact, this has at least gone hand in hand with a surge of brain business start-up activity.

Share of population involved in starting a business

Source: Swedish Entrepreneurship Forum, (2016).



[16] Swedish Entrepreneurship Forum, (2016).

In summary, boosting investments in R&D, encouraging other forms of intellectual capital investments, up-skilling the local workforce, attracting international talents and boosting entrepreneurship are all vital ingredients of growth policies. The human capital and the investments needed to become brain business clusters are increasingly mobile across the borders. The regions and countries which hope to attract them must strive be on top of the competition. In a time where rapid technological change is altering the content of jobs, and when previously poor parts of Europe are rapidly catching up, countries and regions that lack an active policy for brain business jobs risk falling behind. Europe as a whole is also meeting increased global competition. The European Union countries, which for long have been leading global development, stand at a crossroad: will they continue to be leaders in technological and business development, or become museums of old achievements?

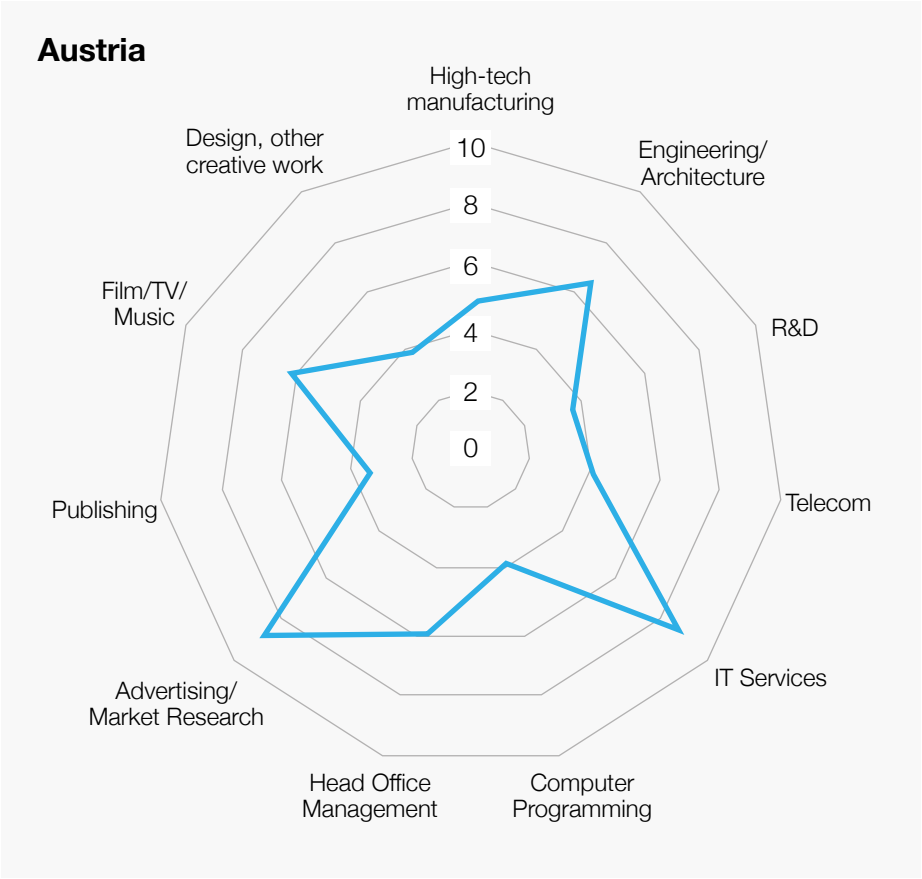
The European Union countries, which for long have been leading global development, stand at a crossroad: will they continue to be leaders in technological and business development, or become museums of old achievements?

Country Analysis: Austria

Austria occupies the 9th place in the country ranking of brain business jobs, with 56,7 such jobs per 1000 working age population. It also invests more than most in R&D, 2.9% of GDP. In combination with a strong tradition of entrepreneurship and family-owned enterprise this has rendered an impressive growth rate over the past decades with the fourth-highest GDP per capita in the EU and one of the lowest rates of unemployment.

In the ranking in this report Austria is grouped in the second tier of high performing brain business countries. Compared to Germany, the leader in this group, Austria lags a little in tech and IT, and even more so in creative professions; but is actually slightly ahead in advanced services. This is also reflected in the diagram below that maps strengths relative to other countries in more detalj. Austria has relatively many brain business jobs in IT-services and advertising/market research, but is a bit weaker in other areas.

This pattern is even more pronounced in Austria's capital region. Wien is on 11th place in comparison with other capital regions in Europe. In common with other capitals, it has more brain business jobs, 105 brain business jobs per 1000 working age population, than the rest of the rest of the country. The strong performance in IT-services is interesting since Wien is also geographically very close to Bratislava which is also strong in IT-services. These two cities strengthen each other and form a cluster.



Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Belgium

Belgium occupies 12th place in the country ranking of brain business jobs, with 52,7 such jobs per 1000 working age population. It is also just slightly above the EU average in terms of investment in R & D as a share of GDP.

Belgium has had periods in which formation of a government has dragged out, and macroeconomic stabilization has suffered. In spite of this it flouts the eighth-highest GDP per capita in the EU. Over the recent decade ballooning public debt has been reigned in, and Belgium has become more competitive. It helps to have a central location in Europe with excellent transport links in all directions.

In the ranking in this report Austria is the leader in the third group, the medium brain business countries. Belgium excels in advanced services, but lags in in tech, IT and creative professions. This is also reflected in the diagram below that maps strengths relative to other countries. Belgium is perhaps the most specialized of all European countries, with many brain business jobs connected to head office management, but rather less in all other areas.

Belgium's capital region Brussels is on 12th place in comparison with other capital regions in Europe, the same as Belgium's relative country ranking. In common with other capitals, it has more brain business jobs, 101.9 brain business jobs per 1000 working age population, than the rest of the rest of the country. As the diagram shows, Brussels also has a good telecom brain business presence.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Bulgaria

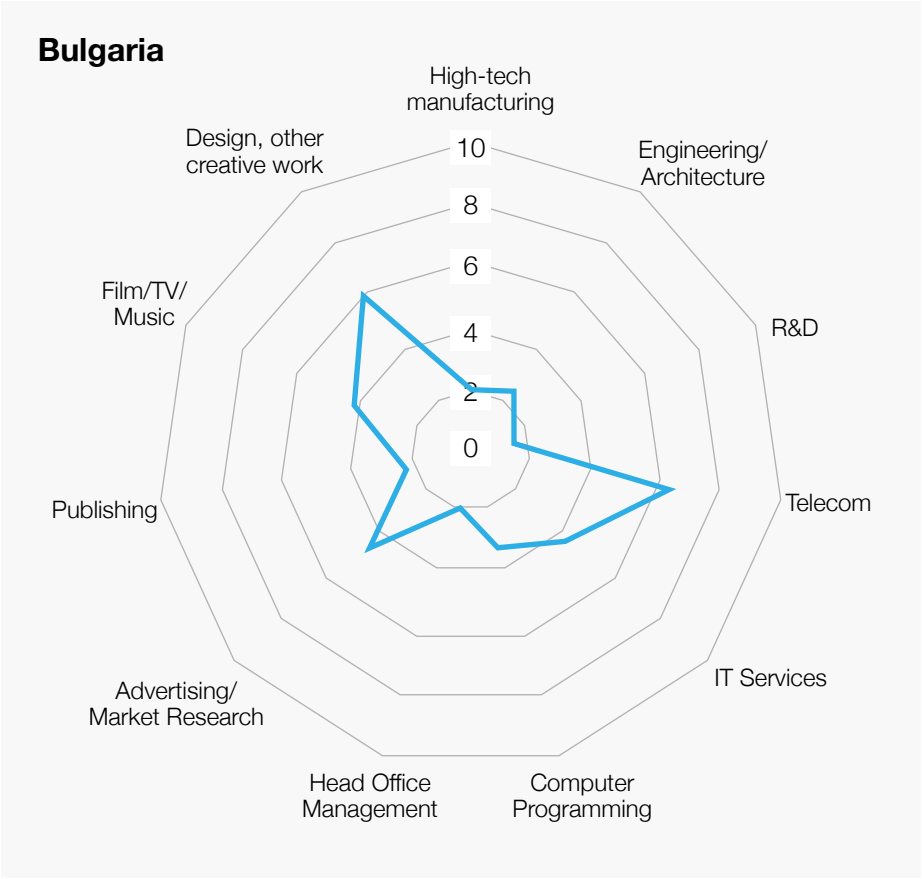
Bulgaria occupies the 25th place in the country ranking of brain business jobs, with 34,3 such jobs per 1000 working age population. It invests a relatively small share of its GDP in R&D.

Bulgaria was poorer than most when it joined the EU. Bulgaria's GDP per capita is still at the lower end within the EU. It has numerous issues with governance and economic policy. Yet it is struggling ahead and making progress, with rapid GDP per capita growth in recent years.

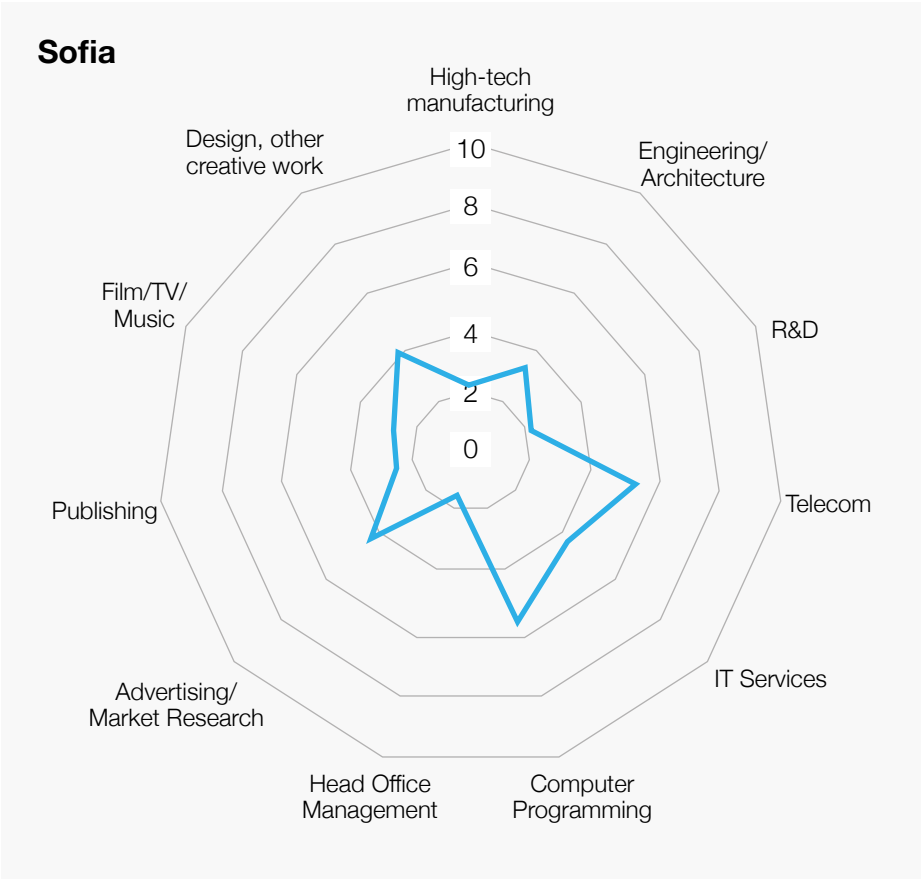
In the ranking in this report Bulgaria is in the lower end of the low ranking brain business countries, but somewhat better in ICT and the creative professions. The more detailed analysis in the diagram below indicates strengths in Design and creative brain business, as well as Telecom.

Much of Bulgaria's brain business is concentrated in the capital region Sofia, which is on 16th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 82.6 brain business jobs per 1000 working age population, than the rest of the rest of the country.

In fact, Sofia is increasingly viewed as an alternative to Bratislava for ICT-localization. As the diagram below shows this has encouraged strong development in computer programming, IT-services and Telecom.



Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

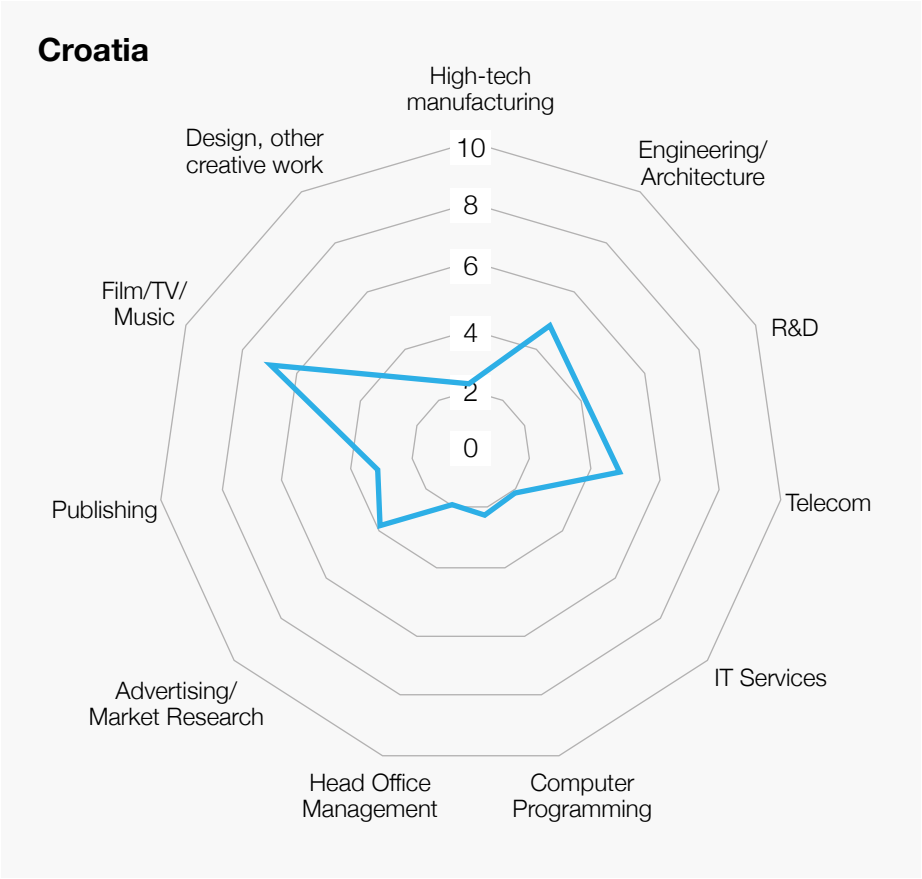
Country Analysis: Croatia

Croatia occupies the 24th place in the country ranking of brain business jobs, with 35 such jobs per 1000 working age population. It invests a relatively small share of its GDP in R&D.

Croatia was affected much more than Slovenia by the Yugoslav war, but is making a comeback. This can partly be ascribed to a strong revival of some industries such as suppliers to European car production as well as tourism, but also to a series of economic policy reforms that have liberalized labor markets and reduced the budget deficit.

Croatia's GDP per capita is still at the lower end within the EU, but will probably surpass some old EU-countries within a number of years. In the ranking in this report Croatia is in the in the middle of the last group, the low ranking brain business countries. It is stronger in the tech area, but lower in the others. But the more detailed analysis in the diagram below also shows an impressively strong result for Film/TV/Music, apart from engineering, R & D and Telecom.

Croatia's capital region Zagreb is on 27th place in comparison with other capital regions in Europe, next to the bottom. In common with other capitals it has more brain business jobs, 39.4 brain business jobs per 1000 working age population, than the rest of the country. Yet Zagreb is the location for much of Croatia's tech brain business jobs.



Score: 1-10, 10 = score of highest ranking country

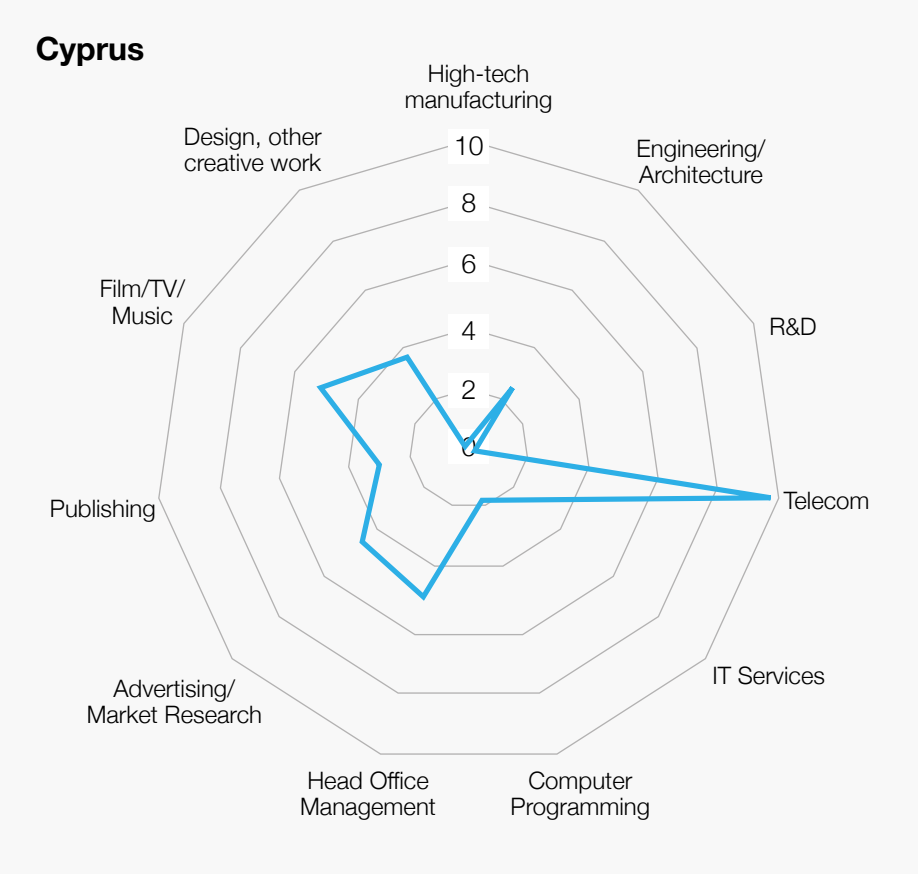
Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Cyprus

Cyprus occupies the 22nd place in the country ranking of brain business jobs, with 35,6 such jobs per 1000 working age population. In the case of Cyprus there is no separate statistic for the capital region.

Cyprus has been hit by many setbacks: The Turkish invasion in 1974 which split the country, an erratic macroeconomic policy in 1990ties, and the financial crisis which in Cyprus culminated in 2012-2013. In recent years, economic policies have been more growth oriented, and Cyprus has achieved a GDP per capita similar to other Mediterranean countries.

In the ranking in this report Cyprus third place in the last group, the low ranking brain business countries. As the diagram shows Cyprus has a spike in Telecom brain business jobs, but is weaker in other areas. It features some interesting startups such as Wargaming and Viber. Setting up and running an office in Cyprus is also close to 1/5 of the costs compared to London. The average salary for a developer with minimum 2 years-experience is €28,000. Cyprus could go in the same growth promoting direction as Malta already has.



Score: 1-10, 10 = score of highest ranking country

Country Analysis:
Czech Republic

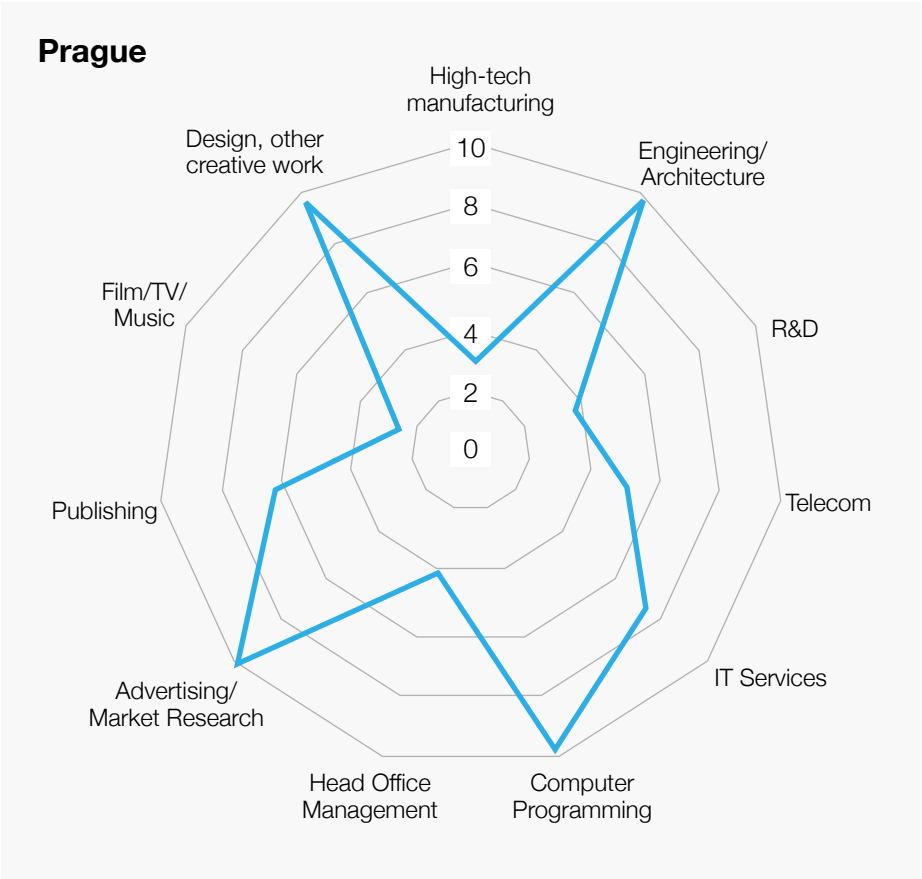
The Czech Republic occupies the 14th place in the country ranking of brain business jobs, with 51,4 such jobs per 1000 working age population. It is average in the EU in terms of R&D as a share of GDP.

The Czech Republic was even during the communist era a relatively developed economy. Some market-features and trade with Western Europe were permitted even then. Since, it has pursued consistently growth-oriented economic policies. In spite of splitting up from Slovakia, this has rendered an impressive growth rate over the past decades. It has the highest GDP of the eastern European countries that are recovering from the communist era. Still, GDP per capita and wages are at about 65 % of Germany's which makes it an attractive location for brain business investment.

In the ranking in this report the Czech Republic is in third place in the third group, the medium brain business countries. It does best in creative professions and the tech sector, and least well in advanced services. This is also reflected in the diagram below that maps strengths relative to other countries. The Czech Republic is excellent in design, film, publishing and advertising. As a result, it has also attracted graphical and printing industry from other parts of Europe.

Many of the The Czech Republic's brain business jobs are located in its capital region Prague, which is on an excellent 3rd place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 162.9 brain business jobs per 1000 working age population, than the rest of the rest of the country. But Prague is in fact one of Europe's leading cities in terms of brain business jobs.

Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Denmark

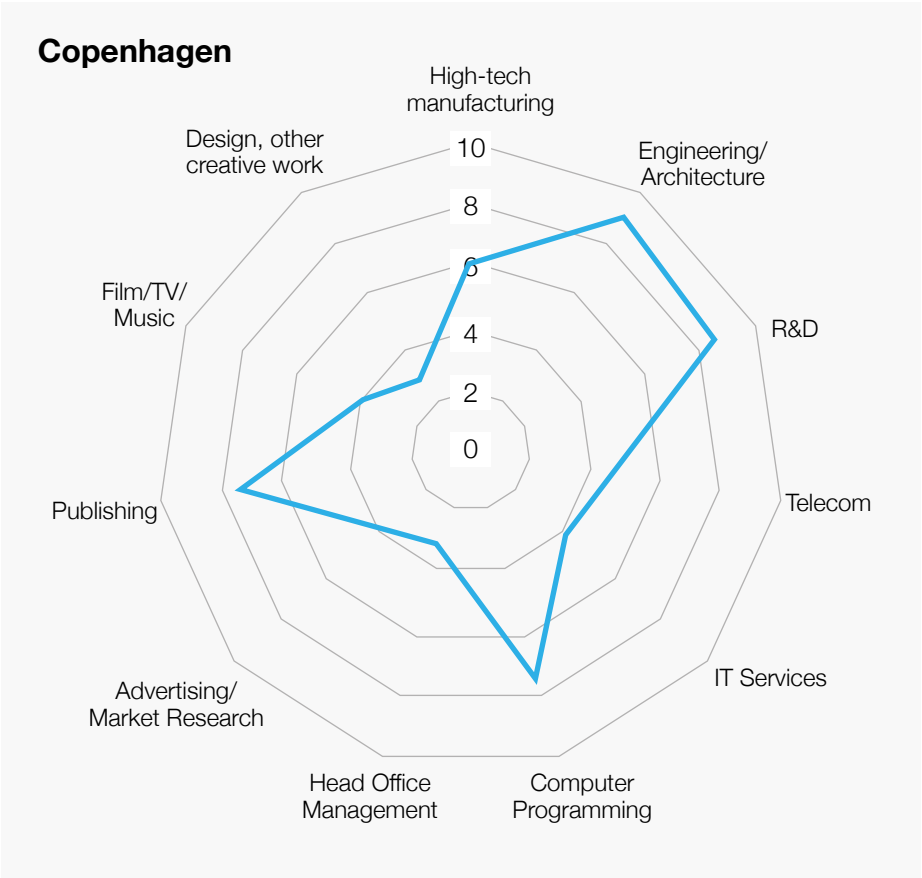
Denmark occupies the 2nd place in the country ranking of brain business jobs, with 79.1 such jobs per 1000 working age population. It also invests more than most in R&D, 3% of GDP.

Denmark has gone through waves of growth-promoting economic policy reforms, most drastically in the mid 1980-ties. In some ways it has become more market-oriented than many other countries, for example with excellent rankings in the OECD's "Ease of Doing Business". This compensates some for a tax-burden that is among the EU's highest. Denmark has been hit by the financial crisis and a housing bubble after 2008, but retains a GDP per capita on 5th place within the EU.

In the ranking in this report Denmark is grouped on second place in the first tier of high performing brain business countries. It ranks highly in tech, IT and creative professions, but is weaker in advanced services. Denmark has fewer large scale industries, which also shows up in terms of fewer high-tech manufacturing brain jobs. Its strength lies in environmental engineering and R & D, for example in firms such as wind turbine firm Vesta.

Denmark's capital region Copenhagen is on 6th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 137.6 brain business jobs per 1000 working age population, than the rest of the rest of the country. It is relatively stronger than the rest of the country in computer programming, but otherwise has a similar profile.

Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Estonia

Estonia occupies the10th place in the country ranking of brain business jobs, with 55.1 such jobs per 1000 working age population. In this case the capital region is not registered separately. Estonia invests in GDP as a share of GDP at a rate similar to Norway or France – 1.8 percent.

Estonia has also pursued consistently growth-oriented economic policies with low taxes, less regulated labor markets and fewer bureaucratic hurdles than most countries. The latter is partly due to the most ambitious program of public sector digitalization in the world.

In spite of being hit hard by the financial crisis in 2008, this has rendered an impressive growth rate over the past decades, and among the eastern European countries that are recovering best from the communist era. Still, GDP per capita and wages are at about 60 % of Germany's which makes it an attractive location for brain business investment.

In the ranking in this report Estonia is grouped in the second tier of high performing brain business countries. Compared to Germany, the leader in this group, Estonia is ahead in IT and the creative professions, but lags in tech and advanced services. This is also reflected in the diagram below that maps strengths relative to other countries. Estonia has relatively many brain business jobs in high-tech manufacturing, but much fewer in engineering and R & D, which explains why it lags a bit in tech overall. In contrast telecom and programming are strong areas.

Score: 1-10, 10 = score of highest ranking country

Country Analysis: Finland

Finland occupies 8th place in the country ranking of brain business jobs, with 59.8 such jobs per 1000 working age population. It also invests more than any other EU country in R&D, 3.4% of GDP. In spite of this Finland trails the other Nordic countries with the tenth highest GDP per capita in the EU. Finland has been hit exceptionally hard several times by dips in trade with Russia. It also suffered as Nokia's fortunes dwindled. But it has also implemented fewer growth-oriented reforms in comparison with, for example, neighboring Sweden.

In the ranking in this report Finland is grouped in the second tier of high performing brain business countries. Compared to Germany, the leader in this group, Finland does well in tech and IT and somewhat less well in creative professions; but it is actually far behind in advanced services. This is also reflected in the diagram below that maps strengths relative to other countries in more detail. Finland has relatively many brain business jobs in high-tech manufacturing but is weaker in other areas.

Finland's capital region Helsinki is on 10th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 107.2 brain business jobs per 1000 working age population, than the rest of the rest of the country. Helsinki mirrors the country as a whole in high-tech manufacturing brain business, but does much better in computer programming. Partly because of the problems experienced by Nokia the labor market for brain business workers is less tight compared to other Nordic countries, which might make Finland an attractive alternative.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: France

France occupies the 13th place in the country ranking of brain business jobs, with 52.5 such jobs per 1000 working age population. It invests just slightly above the EU-average in R&D, 2.2% of GDP.

France has over a longer period pursued economic policies that tend to stifle growth. It now has among the highest tax burden in the EU and a low employment rate. In spite of this it has the 11-highest GDP per capita in the EU, just below the UK. One reason is that France also has advanced industries that do well. After the recent election economic policy may be about to change direction.

In the ranking in this report France is in second place in the third group, the medium brain business countries. France excels in creative professions, does reasonably in advanced services, but lags in tech and IT. This is also reflected in the diagram below that maps strengths relative to other countries. France is well rounded in design, film, publishing and advertising. Telecom also shows a spike. But the important areas of IT, computer programming and even high-tech manufacturing are not well represented.

France is also the most centralized of the larger European countries. The French capital region Paris is on an excellent 4th place in comparison with other capital regions in Europe, doing relatively much better than the country as a whole. In common with other capitals it has more brain business jobs, 159.3 brain business jobs per 1000 working age population, than the rest of the rest of the country. In contrast to the rest of the country, Paris is also strong in computer programming, but less so in film/TV/Music.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Germany

Germany occupies the 6th place in the country ranking of brain business jobs, with 65.8 such jobs per 1000 working age population. It also invests more than most in R&D, 2.8% of GDP. Germany also scores second highest in Europe in terms of intellectual property rights filings such as patents and trademarks.

In combination with a strong tradition of entrepreneurship and family-owned enterprise in southern Germany this has rendered an impressive growth rate of the past decades with the seventh-highest GDP per capita in the EU (in spite of merging with formerly communist eastern Germany) and one of the lowest rates of unemployment.

In the ranking in this report Germany is grouped leading the second tier of high performing brain business countries. It is outstanding in terms of tech brain business jobs, in fourth place. But Germany is a bit weaker in IT brain business jobs - only in 10th place. This is also apparent in the fact that Germany has few so called “unicorns”, digital firms that reach a valuation of one billion dollars, in relation to the size of its population.

This is also reflected in the diagram below that maps strengths relative to other countries. Germany does well in high-tech manufacturing, engineering and R&D, as well as in advertising and market research which cater to industry, but a bit weaker in other areas.

The German capital region Berlin is on 14th place in comparison with other capital regions in Europe. With the exception of R&D, Berlin is weak in most other brain business areas. Berlin is sometimes touted as a digital start-up city. But even in IT-services there are not that many brain business jobs compared to many other cities. In contrast to other European capitals, Berlin does not have more brain business jobs, 95.6 brain business jobs per 1000 working age population, than some other regions of the country. The reason for this relative weakness probably lies partly in its communist history, and partly in poor governance which is reflected in a less advantageous local business climate.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Greece

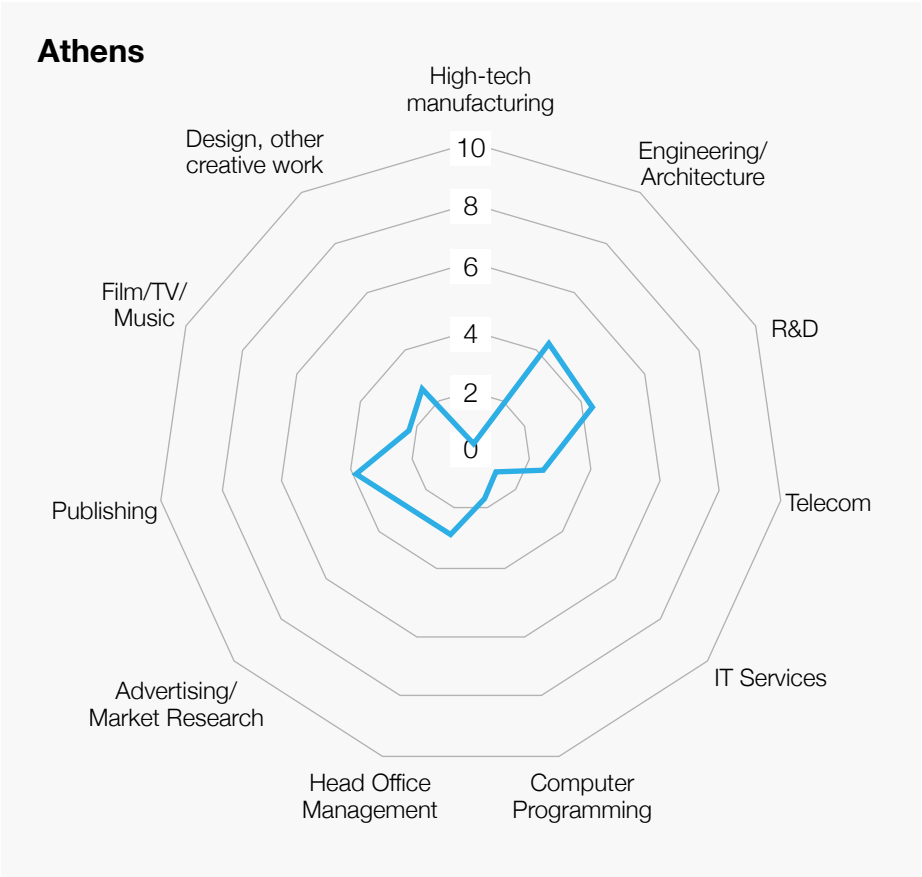
Greece occupies the 26th place in the country ranking of brain business jobs, with 34.1 such jobs per 1000 working age population.

Greece had a boom period after it joined the Euro, but was then hit hard by the financial crisis in 2008 on top of a long spell of growth-inhibiting economic policies. Among them are poorly functioning public authorities and cumbersome regulation that often stifle competition and contribute to high prices. While Greece in theory has a market based model, massive regulatory problems exists which hold back the growth of advanced businesses. As a result, its GDP has stagnated at about half the German level.

In the ranking in this report Greece is near the end of the last group, the low ranking brain business countries. Greece has some relative strengths in creative professions and high-tech, but overall ranks as the country with the third lowest share of knowledge workers. The more detailed analysis in the diagram below reveals that Greece is particularly weak in computer programming, IT-services and Telekom.

The Greek capital region Athens is on 21st place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 60.6 brain business jobs per 1000 working age population, than the rest of the rest of the country. Athens does have some engineering oriented brain business jobs. Some of those are connected to Greece's shipping industry.

Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Hungary

Hungary occupies the 15th place in the country ranking of brain business jobs, with 50.6 such jobs per 1000 working age population. It also invests somewhat less than the European average in R&D, 1.3% of GDP.

Hungary was even during the communist era a relatively developed economy. Some market-features and trade with Western Europe were permitted even then. Since, it has pursued consistently growth-oriented economic policies. This has rendered an impressive growth rate over the past decades. But its GDP per capita falls a bit short of that in some of the eastern European countries that are recovering best from the communist era such as the Czech Republic. With a GDP per capita and wages are at about 55 % of Germany's it is still an attractive location for brain business investment.

In the ranking in this report the Hungary is in fourth place in the third group, the medium brain business countries. It is fairly well rounded, doing slightly better in creative professions, IT and the tech sector, and least well in advanced services. This is also reflected in the more detailed diagram below that maps strengths relative to other countries. Hungary is stronger in high-tech manufacturing than in the other areas.

Hungary's capital region Budapest is on 12th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 99.6 brain business jobs per 1000 working age population, than the rest of the rest of the country. Its profile differs markedly from that of Hungary as a whole, with a greater relative strength in engineering, IT services and computer programming.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

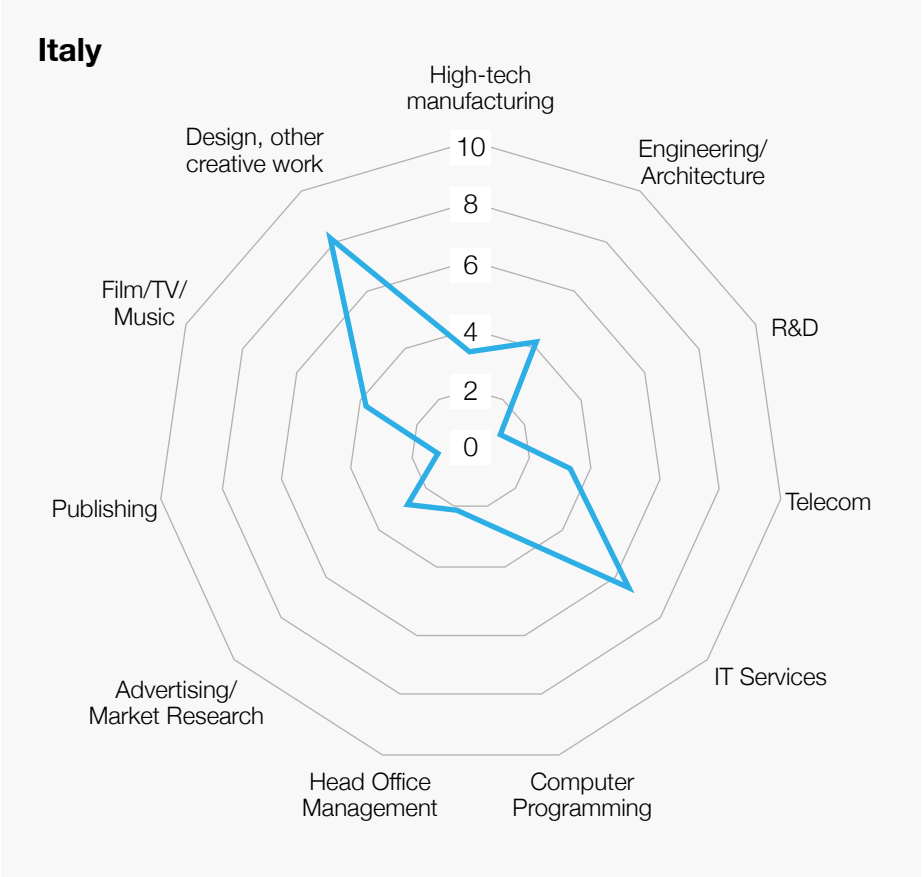
Country Analysis: Italy

Italy occupies the 21st place in the country ranking of brain business jobs, with 36.4 such jobs per 1000 working age population. It invests clearly less than the EU-average in R&D, 1.3% of GDP.

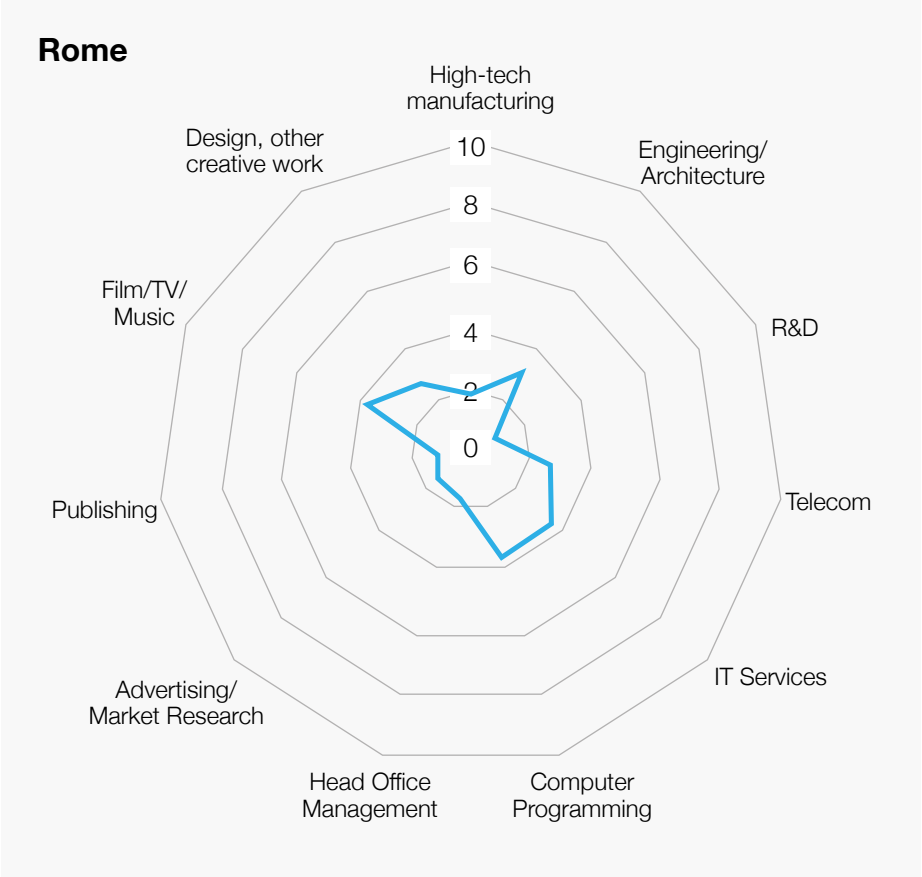
Italy was hit hard by the financial crisis in 2008, but this came on top of a long spell of growth inhibiting economic policies. Among them are cumbersome regulation that often stifle competition and contribute to high prices. As a result, its GDP has stagnated at about 68 percent of the German level.

In the ranking in this report Italy is now second to Portugal in the last group, the low ranking brain business countries. Italy is known for its fashion industry, and this is to some extent reflected in the rankings. It does relatively better in the creative professions than in the three other areas. The more detailed analysis in the diagram below reveals that IT-services are also strong. But particularly surprising is the poor performance in high-tech manufacturing and engineering.

Italy's capital region Rome is on 22nd place and thus fares no better relatively than the country, in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 66 brain business jobs per 1000 working age population, than the rest of the rest of the country. But Rome's profile is more balanced than for the country as a whole, with stronger results for engineering and computer programming.



Score: 1-10, 10 = score of highest ranking country



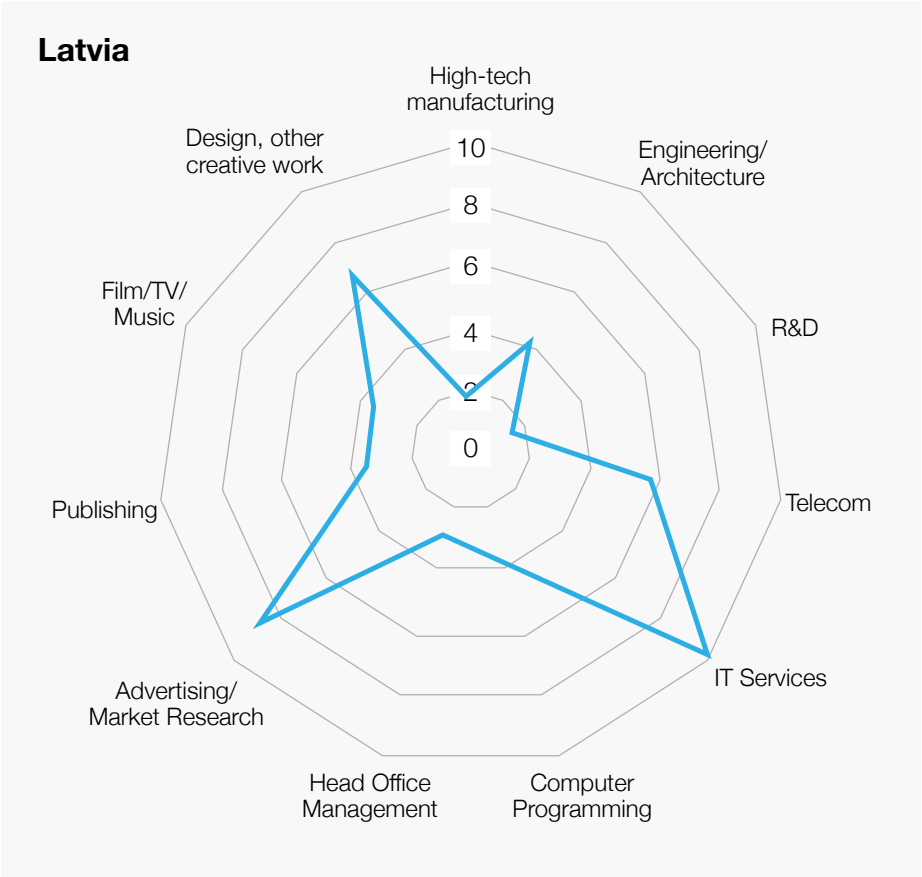
Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Latvia

Latvia occupies the 17th place in the country ranking of brain business jobs, with 46.1 such jobs per 1000 working age population. In this case the capital region is not registered separately. Latvia invests considerably less than Estonia and even Lithuania in R&D as a share of GDP.

Latvia has also pursued growth-oriented economic policies, but not as quite as consistently as Estonia. It was also hit hard by the financial crisis in 2008. Yet, it recovered and is again growing well. Its GDP per capita and wages are at about half those of Germany's.

In the ranking in this report Latvia is grouped 6th in the third group - the medium performing brain business countries. It does well in ICT, but poorly in tech. This is also reflected in the diagram below that maps strengths relative to other countries. Latvia is outstanding in IT-services, and good in advertising, but not very pronounced in the other fields. This reflects the fact that Latvia now has a thriving start-up scene, and low costs of doing business which make it attractive to investors. Communications are also good. For example, Latvia has the busiest airport in the Baltics.



Score: 1-10, 10 = score of highest ranking country

Country Analysis: Lithuania

Lithuania occupies the 19th place in the country ranking of brain business jobs, with 41.6 such jobs per 1000 working age population. In this case the capital region is not registered separately.

Lithuania has pursued growth-oriented economic policies, but not as quite as consistently as Estonia. It was also hit hard by the financial crisis in 2008. Yet, it recovered and is again growing well. Its GDP per capita and wages are at about half those of the EU-average. Yet the share of Lithuanians with higher education is similar to the EU-average. Lithuania seeks to become an innovation hub by 2020. To reach this goal, it is putting its efforts into attracting foreign investment to added-value sectors, especially IT services, software development, consulting, finance, and logistics. Among its efforts to provide an attractive business environment for startups, it has opened two free economic zones, with good infrastructure and tax incentives.

In the ranking in this report Lithuania is grouped on the last, 8th, place in the third group - the medium performing brain business countries. It does better in advanced services, but less well in the other areas. This is also reflected in the diagram below that maps strengths relative to other countries. Lithuania is outstanding in advertising/market research, but not very pronounced in the other fields.

Score: 1-10, 10 = score of highest ranking country

Country Analysis: Luxembourg

Luxembourg occupies the 5th place in the country ranking of brain business jobs, with 70.1 such jobs per 1000 working age population. In this case the capital region is not registered separately. It does not invest very much in R&D, 1.4% of GDP.

Luxembourg has by far the highest GDP per capita within the EU. This is often attributed to a lax tax regime that has attracted banking. But Luxembourg also has both traditional industry such as steel on the border to France, and high-tech industry, such as the world's largest satellite operator SES Global.

In the ranking in this report Luxembourg is grouped on fifth place in the first tier of high performing brain business countries. It ranks highest in IT and fairly well in tech and advanced services, but is relatively weaker in the creative professions.

This profile is even more pronounced in the break-down in the diagram below. There is a spike in engineering brain business jobs and a good presence in computer programming, but fewer jobs in the other areas. High wages and costs of living weigh in to make start-ups relatively expensive, in spite of Luxembourg's many other advantages. But fin-tech start-ups find a sophisticated customer base here.

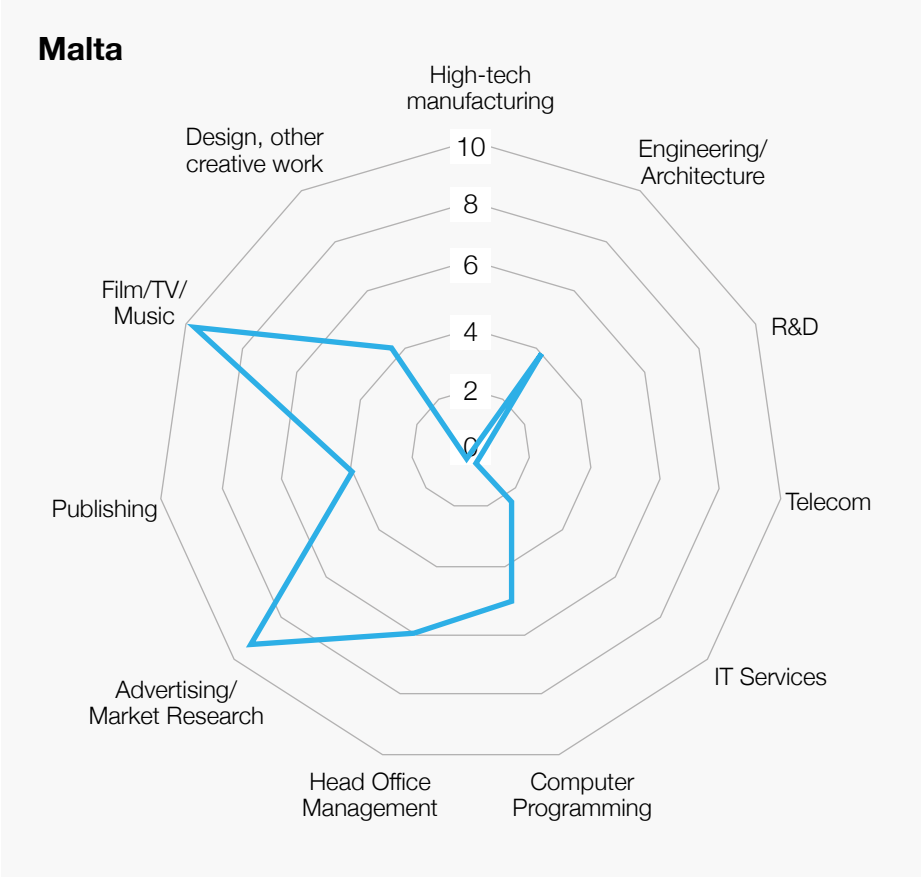
Score: 1-10, 10 = score of highest ranking country

Country Analysis: Malta

Malta occupies the 16th place in the country ranking of brain business jobs, with 47.3 such jobs per 1000 working age population. In this case the capital region is not registered separately. Investments in R&D are not particularly high.

The island nation used to be a pleasant but backwards tourist destination. But thanks to far reaching reforms to abet growth it has become the most knowledge intensive region of southern Europe. By attracting international businesses and talents, the country strives to become a Singapore of the Mediterranean. As a result, its GDP per capita has grown rapidly and is now close to the EU-average.

In the ranking in this report Malta is in fifth place in the third group, the medium brain business countries. Its strengths lie in advanced services and the creative professions, while it remains weak in tech and IT. This is also reflected in the diagram below that maps strengths relative to other countries. Malta is strong Film/TV/Music and Advertising. In particular, there are strong financial services and gaming industry clusters in Malta. In these areas start-ups have also sprung up or flocked to the island.



Score: 1-10, 10 = score of highest ranking country

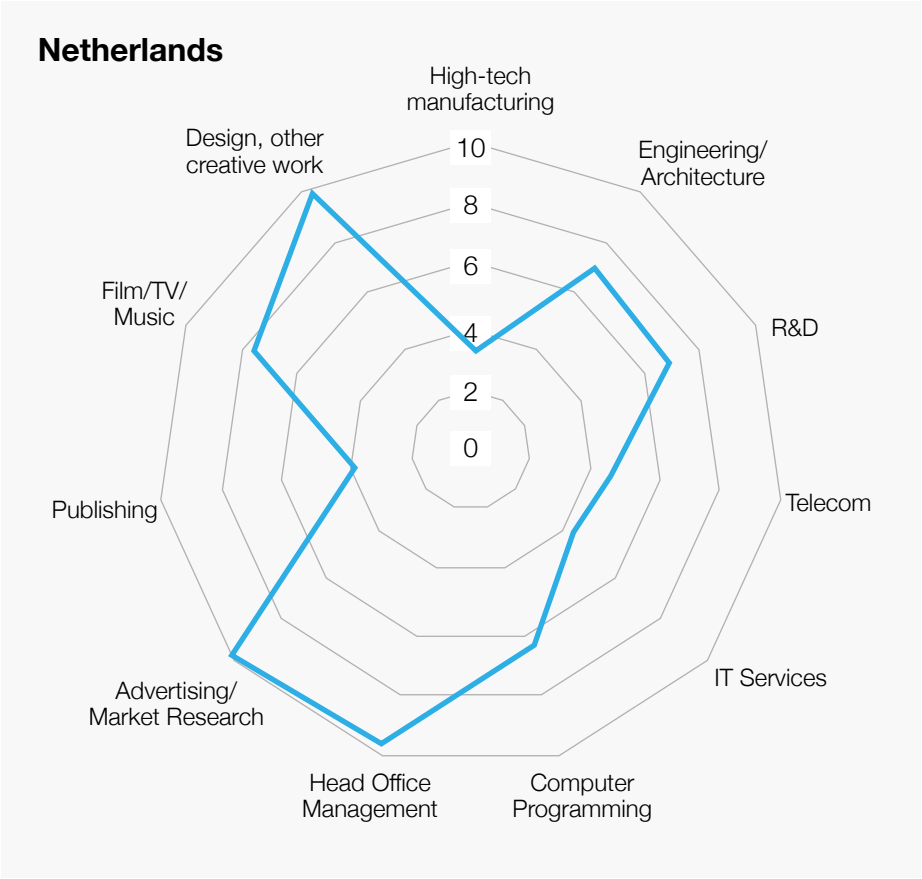
Country Analysis: Netherlands

The Netherlands occupies the 3rd place in the country ranking of brain business jobs, with 77 such jobs per 1000 working age population. This top ranking is achieved even though investment in R&D is hardly higher than the EU-average, 1.9% of GDP.

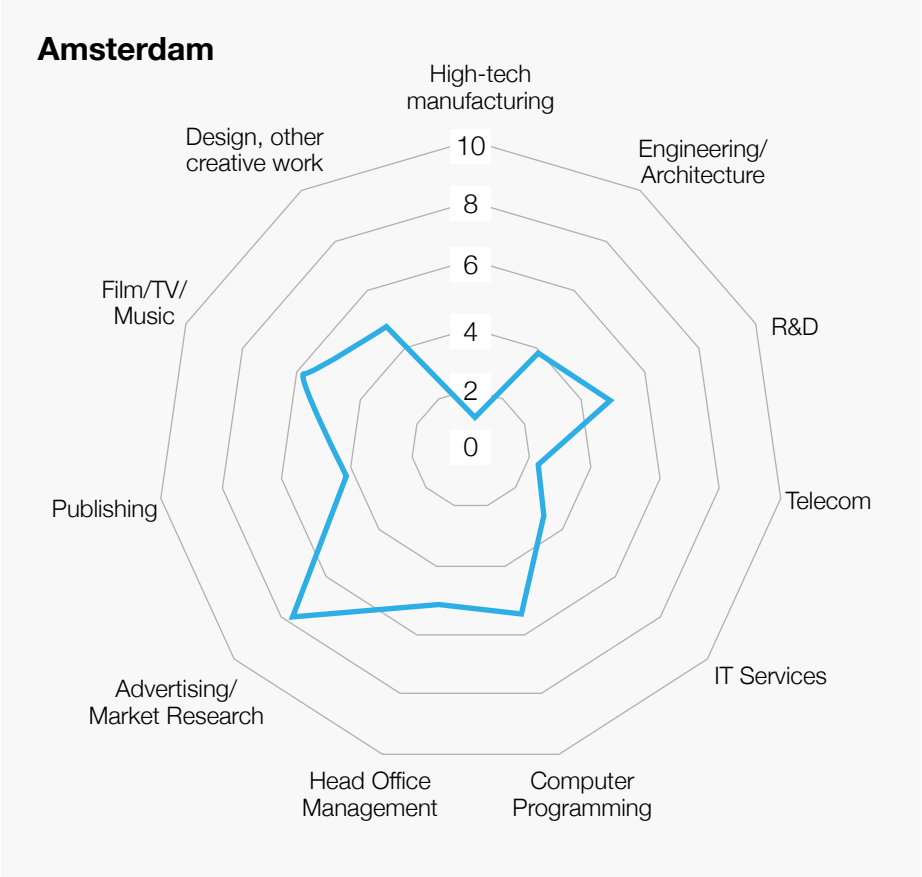
The Netherlands has been among the more ambitious implementers of growth-promoting economic policy reforms among the old EU countries. As a result, it has a high employment rate, and a GDP per capita on 3rd place within the EU.

In the ranking in this report the Netherlands is grouped on third place in the first tier of high performing brain business countries. It ranks highest in advanced services, and quite high in IT and creative professions, but is relatively weaker in the tech area. This profile is even more pronounced in the break-down in the diagram below. The Netherlands is in many ways the "advanced service" leader of Europe, together with London. To some extent these have grown around an exceptional concentration of conglomerate head offices. Fewer in the Netherlands work with high-tech or engineering brain business jobs.

The Netherland's capital region Amsterdam is on 8th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 112.6 brain business jobs per 1000 working age population, than the rest of the rest of the country. But the Netherlands has several very dynamic cities in close proximity of each other, which makes Amsterdam slightly less of a focus point than capitals in many other countries.



Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

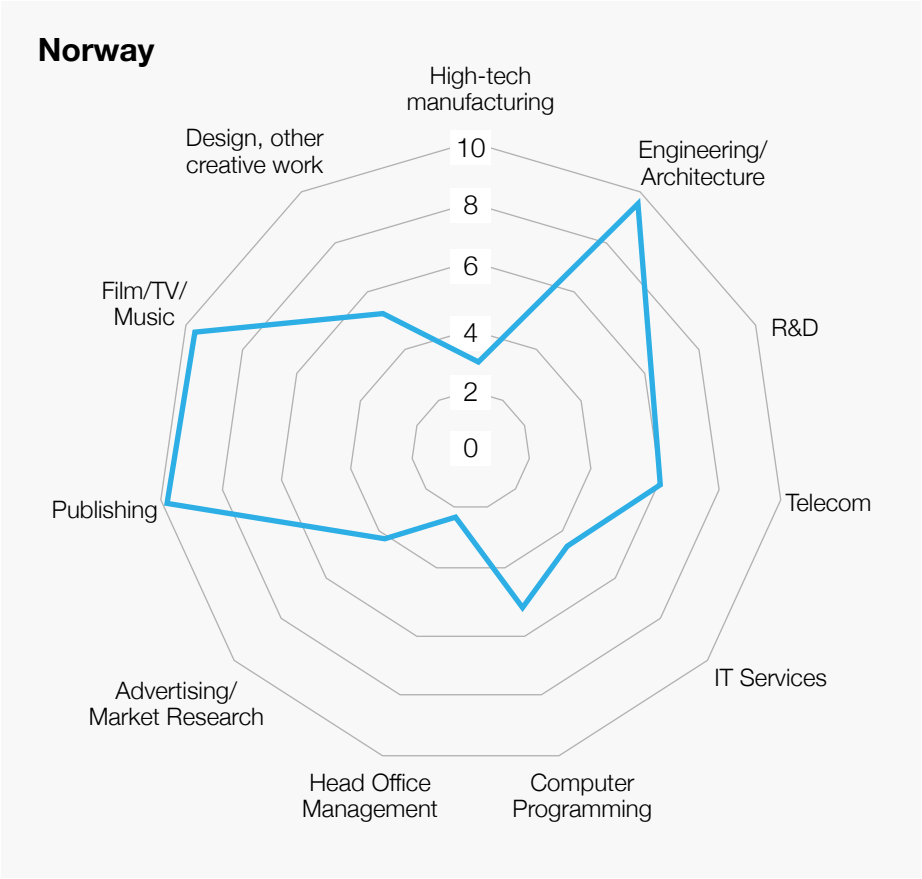
Country Analysis: Norway

Norway occupies the 7th place in the country ranking of brain business jobs, with 64.5 such jobs per 1000 working age population. It invests close to the European average in R&D, 1.7% of GDP. Norway also excels at registering intellectual property rights filings with the highest number in Europe.

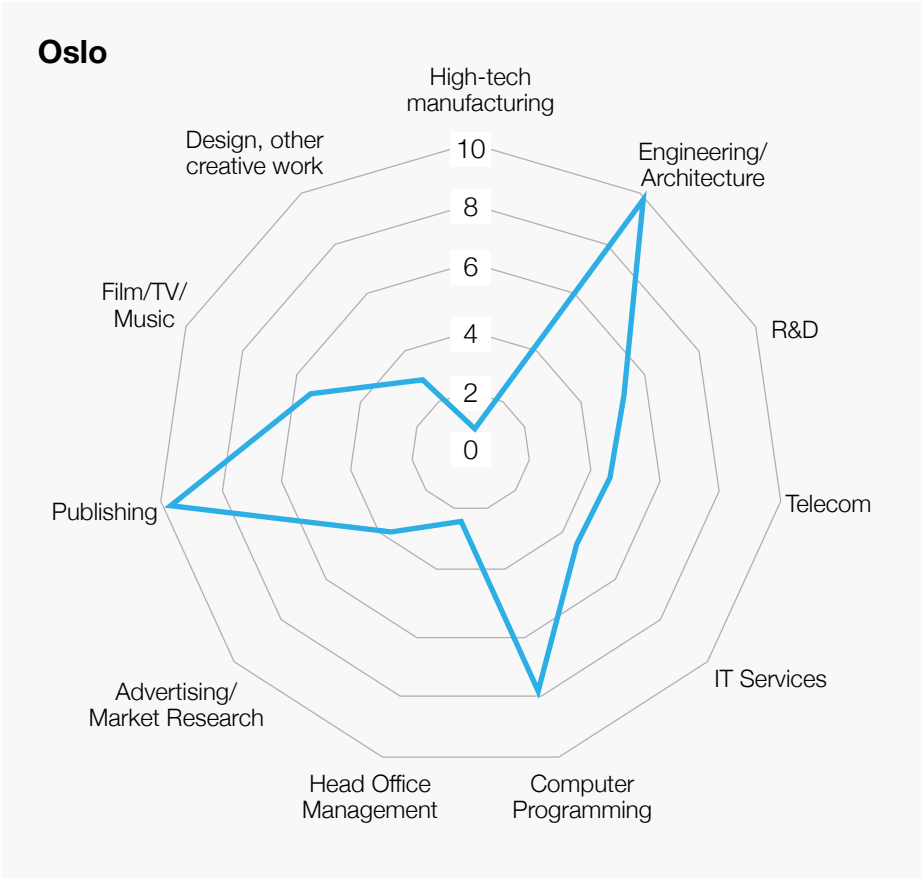
Thanks to this innovative potential and the boom in natural oil and gas Norway has a GDP per capita that would put it at third place if it were a member of the EU. The employment rate is also high, but has gradually been falling in line with falling oil and gas prices.

In the ranking in this report Norway is grouped in the second tier of high performing brain business countries. Compared to Germany, the leader in this group, Norway is equally high in tech, somewhat better in IT, and much better in creative professions. But Norway is also uneven and lags far behind in advanced service brain jobs. This is also reflected in the diagram below that maps strengths relative to other countries. Norway does well in engineering, but not really in high-tech manufacturing.

Norway's capital region Oslo is on 7th place in comparison with other capital regions in Europe, the same rank as the country has as a whole. In common with other capitals it has more brain business jobs, 125.3 brain business jobs per 1000 working age population, than the rest of the rest of the country. Oslo is a bit more pronounced in programming, but otherwise has a similar profile to the country as a whole.



Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Poland

Poland occupies the 27th place in the country ranking of brain business jobs, with 30.2 such jobs per 1000 working age population. In this case the capital region is not registered separately. It invests relatively little in R&D as a share of GDP.

Poland has reformed its economy, and experienced high growth, but from a low level. It has surpassed Greece, but still only has a GDP per capita at about half of the German level. A contributing factor is that Poland has an unusually large migrant population who work and produce abroad but consume in Poland.

In the ranking in this report Poland now the second-lowest country in the last group, the low ranking brain business countries. While Poland has some fairly advanced firms and successful manufacturing firms, few are knowledge intensive by the definition used in this report. The more detailed analysis in the diagram below reveals that there is some presence in IT-services. But the poor performance in high-tech manufacturing and engineering is noteworthy.

Poland's capital region Warsaw is on 19th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 70.5 brain business jobs per 1000 working age population, than the rest of the rest of the country. Thus, Warsaw does a bit better, relatively speaking than the country as a whole, but with a similar profile.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

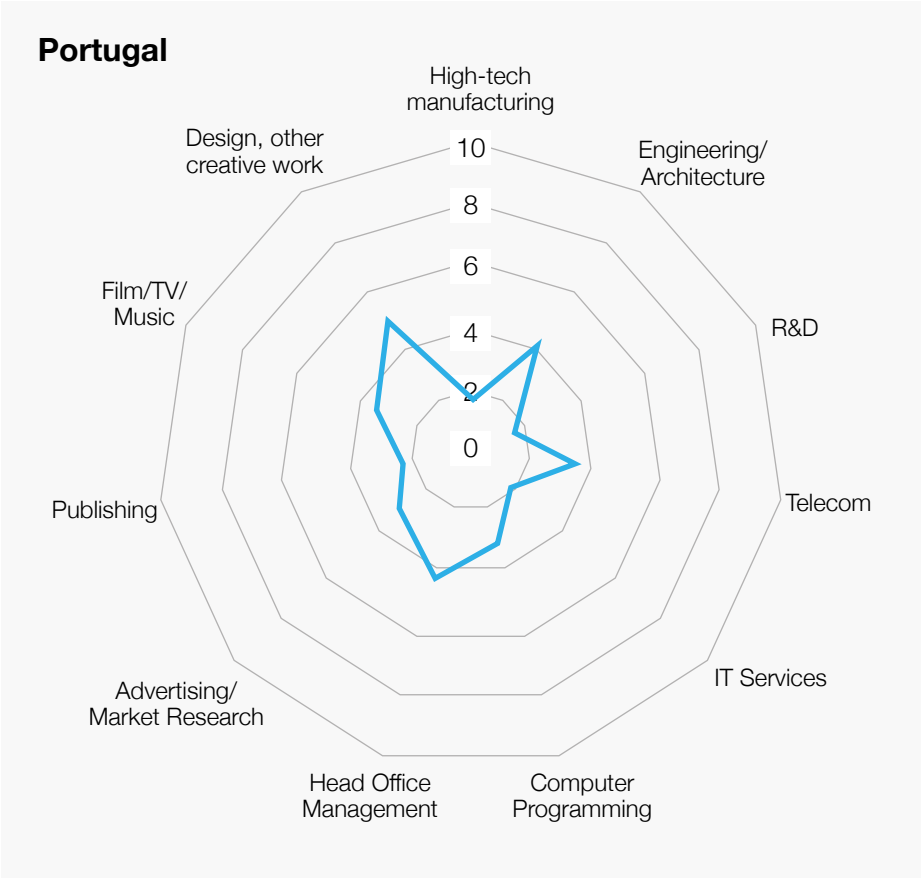
Country Analysis: Portugal

Portugal occupies the 20th place in the country ranking of brain business jobs, with 36.6 such jobs per 1000 working age population. Investment in R&D is also on the low side.

Yet Portugal has inched slightly ahead of Mediterranean countries like Italy and Spain in terms of brain business jobs. It was hit hard by the financial crisis in 2008, but has since engaged on a sensible reform path and is back to growth. Still, Portugal started from a very low level and is still the country with the second-lowest GDP per capita of the old EU countries, at about 60 percent of the German level.

In the ranking in this report Portugal leads the last group, the low ranking brain business countries. It ranks similarly in the four areas. But the more detailed analysis in the diagram below, that maps strengths relative to other countries, shows a more nuanced picture. Portugal is better in design and brain business jobs surrounding head office management, but less strong in most other areas. In particular, high tech manufacturing lags behind.

Portugal's capital region Lisbon is on 18th place in comparison with other capital regions in Europe, similar to its country ranking. In common with other capitals it has more brain business jobs, 75.3 brain business jobs per 1000 working age population, than the rest of the rest of the country. Yet Lisbon has a different profile, and is a bit stronger in in computer programming, in contrast to the country as a whole.



Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Romania

Romania occupies the 28th place in the country ranking of brain business jobs, with 28.8 such jobs per 1000 working age population. Investment in R&D is the lowest in the EU.

While the country is growing, its economy still lags behind other parts of Europe – particularly in knowledge-intensive fields. It has many issues of governance and outdated economic policies, that render its GDP per capita as one of the lowest in the EU.

In the ranking in this report Romania is at the lower end of the last group, the low ranking brain business countries. It ranks similarly in the four areas. But the more detailed analysis in the diagram below, that maps strengths relative to other countries, shows that Romania has some presence in Telekom and Advertising.

Romania's capital region Bucharest, however, does much better than the country as a whole. It is on 9h place in comparison with other capital regions in Europe. It has 108.2 brain business jobs per 1000 working age population. Brain business jobs are thus more concentrated in Romania than in most places.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Slovakia

Slovakia occupies the 18th place in the country ranking of brain business jobs, with 44 such jobs per 1000 working age population. Slovakia as a whole does not invest very much in R&D.

In this sense it trails the The Czech Republic from which it seceded in 1993. But it was even during the communist era a relatively developed economy. Some market-features and trade with Western Europe were permitted even during the communist era. Since then it has pursued consistently growth-oriented economic policies and is now only slightly behind the Czech Republic in terms of GDP. Still, GDP per capita and wages are at about 62 % of Germany's which makes it an attractive location for brain business investment.

In the ranking in this report Slovakia is in seventh place in the third group, the medium brain business countries. It does very well in IT and some advanced services. This is also reflected in the diagram below that maps strengths relative to other countries.

Yet Slovakia is also the country with the greatest contrast between its peripheral regions and the capital region Bratislava, which is on 1st place in comparison with all other capital regions in Europe. In common with other capitals it has far more brain business jobs, 179.1 brain business jobs per 1000 working age population, than the rest of the rest of the country. But Bratislava is also very specialized in IT services, Telecom, computer programming, and to some extent advanced services that often cater to head offices.

Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Slovenia

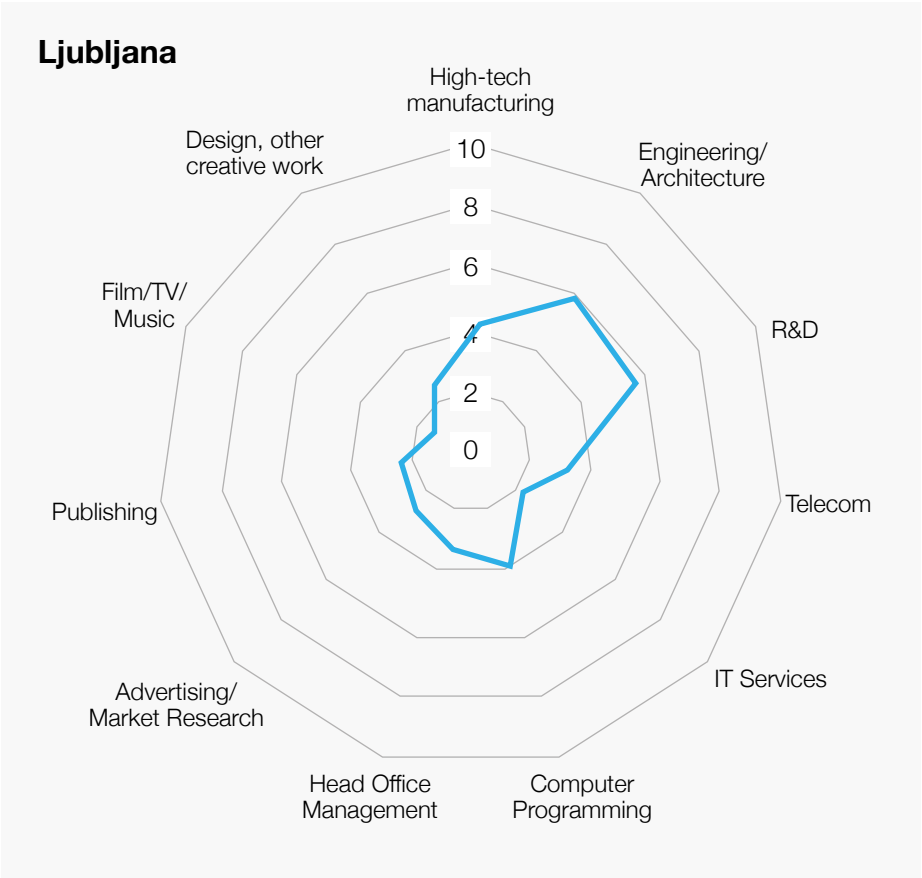
Slovenia occupies the 11th place in the country ranking of brain business jobs, with 54.4 such jobs per 1000 working age population. It also invests more than most in R&D, 2.4% of GDP, and far more than any other east European country. Partly this can be traced to its history. Slovenia was even during the communist era a relatively developed economy. Although Yugoslavia was in theory a planned economy, market-features and trade with Western Europe were permitted, and Slovenia was the economic powerhouse of Yugoslavia. Slovenia was also left relatively undamaged during the war that followed after the collapse of Yugoslavia.

Slovenia has also pursued consistently growth-oriented economic policies. In spite of being hit hard by the financial crisis in 2008, this has rendered an impressive growth rate over the past decades, and among the eastern European countries that are recovering best from the communist era. Still, GDP per capita and wages are at about 60 % of Germany's which makes it an attractive location for brain business investment.

In the ranking in this report Slovenia is grouped in the second tier of high performing brain business countries. Compared to Germany, the leader in this group, Slovenia has a similar overall profile, but lags a bit in all four overall groups, IT, the creative professions, tech and advanced services. This is also reflected in the diagram below that maps strengths relative to other countries. Slovenia is more well-rounded than most countries. It has relatively many brain business jobs in engineering, design, and head-office management.

Slovenia's capital region Ljubljana is on 17th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 79.9 brain business jobs per 1000 working age population, than the rest of the rest of the country. But still, its relative performance compared to other capital cities is a bit weaker than Slovenia's relative country performance. Other cities such as Maribor close to the Austrian border do quite well.

Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Spain

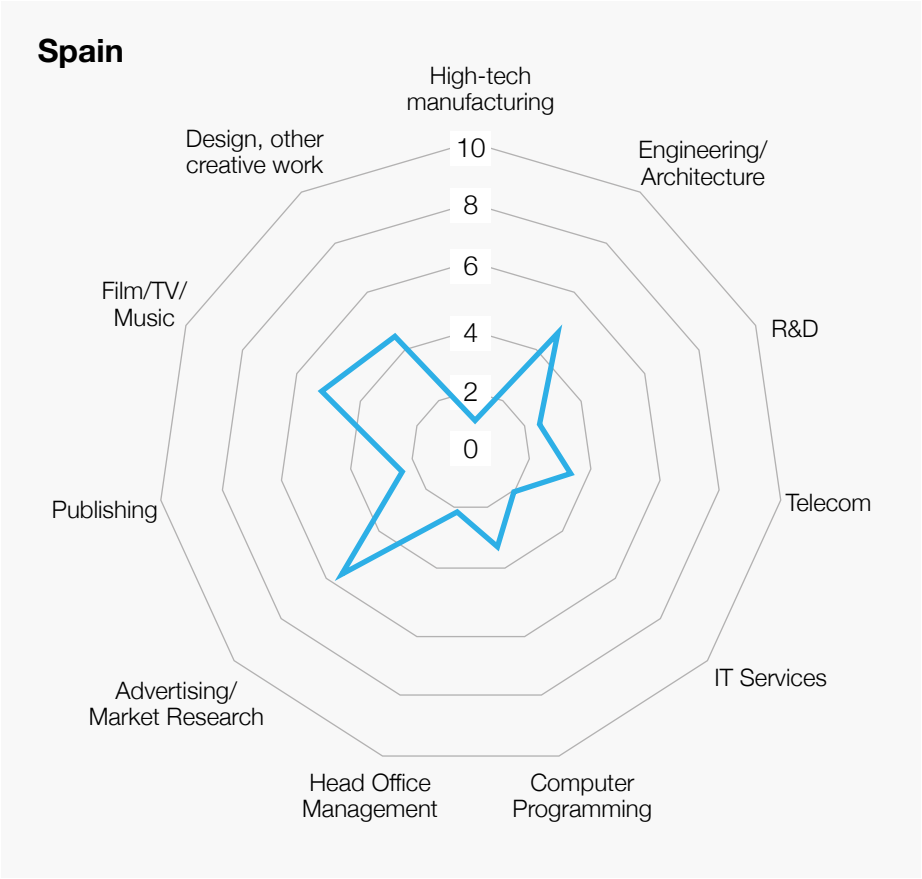
Spain occupies the 23rd place in the country ranking of brain business jobs, with 35.1 such jobs per 1000 working age population. It invests less than the EU-average in R&D, 1.3% of GDP.

Spain was also hit hard by the financial crisis in 2008, but is one of the European countries with the most convincing rebound. This can partly be ascribed to a strong revival of some industries such as car production and tourism, but also to a series of economic policy reforms that have liberalized labor markets and reduced the budget deficit.

Spain's GDP per capita is similar to Italy´s, but only slightly ahead of the best former communist countries like Slovenia that are in fact set to surpass Spain soon.

In the ranking in this report Spain is right in the middle of the last group, the low ranking brain business countries. It ranks similarly even in the four main areas. But the more detailed analysis in the diagram below, that maps strengths relative to other countries, shows a more nuanced picture. Spain has some strength in engineering, Film/TV and Advertising. In particular, high tech manufacturing lags behind.

Spain's capital region Madrid is on 15th place in comparison with other capital regions in Europe, better than the country as a whole. In common with other capitals it has more brain business jobs, 92.9 brain business jobs per 1000 working age population, than the rest of the rest of the country. Its profile is similar to the rest of the country except for a stronger showing in computer programming and a weaker one in film/music.



Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

Country Analysis: Sweden

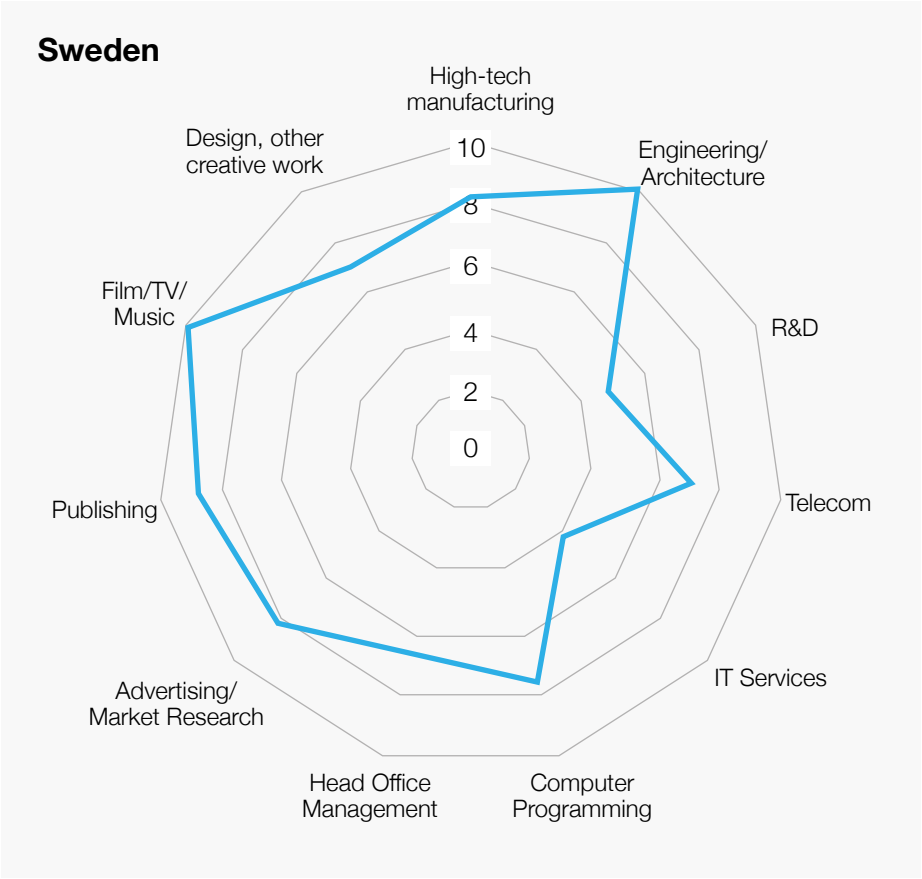
Sweden occupies the 1st place in the country ranking of brain business jobs, with 87.1 such jobs per 1000 working age population. It also invests second most in R&D within the EU, 3.2% of GDP.

Sweden has gone through two waves of growth-promoting economic policy reforms, in the early 1990-ties and 2006-2010. In some ways it has become more market-oriented than many other countries, and even the tax-burden has moved closer in line with other European countries. As a result, Sweden has grown well after being hard hit by recession in 1990, with a GDP per capita on 6th place within the EU and the highest employment rate in the union.

In the ranking in this report Sweden is grouped as the leader in the first tier of high performing brain business countries. Unusually, it has a high rank in all four areas, tech, IT, advanced services and creative professions. In contrast, other countries in the first tier such as the UK or the Netherlands all have some area where they are relatively weaker.

Sweden's all-round character is also reflected in the diagram below that maps strengths relative to other countries. R&D brain business and IT-services are slightly weaker areas.

Sweden's capital region Stockholm is on 2nd place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 167 brain business jobs per 1000 working age population, than the rest of the rest of the country. But many of Sweden's high-tech firms are also spread out over the country, which explains why Stockholm's profile is somewhat less balanced than for the country as a whole. Stockholm is strong in digital start-ups, however, which also shows up as a spike in computer programming.



Score: 1-10, 10 = score of highest ranking country

Score: 1-10, 10 = score of highest ranking capital region

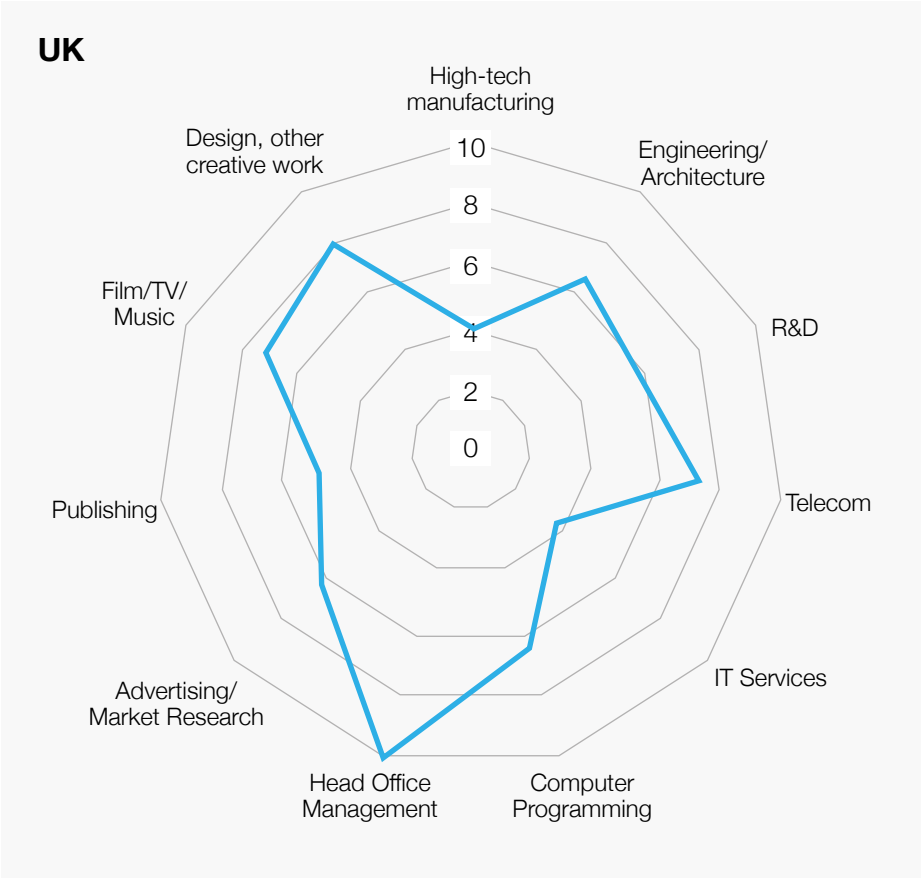
Country Analysis: UK

The UK occupies the 4th place in the country ranking of brain business jobs, with 76.1 such jobs per 1000 working age population. Like the Netherlands, Britain has many brain business jobs, even though it does not stick out in terms of R&D at, 1.7% of GDP.

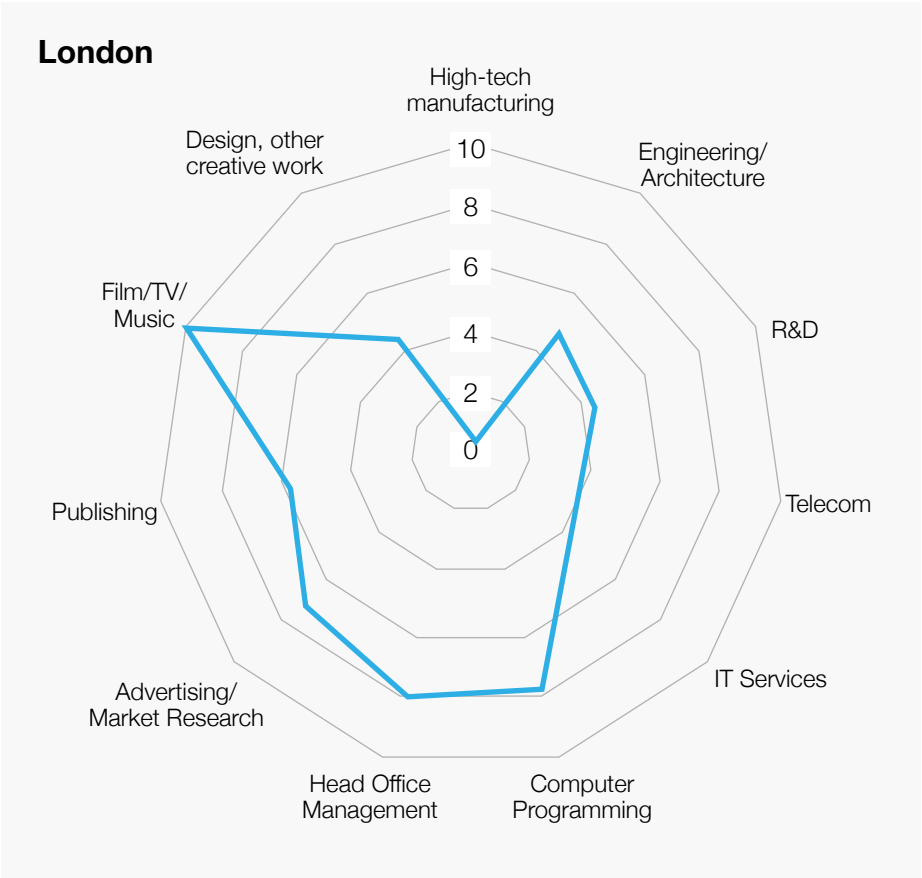
The UK has been among the more ambitious implementers of growth-promoting economic policy reforms during the 1980ties, and an unusually low tax burden for a EU-country. As a result, it has a high employment rate. But productivity growth has lagged and a GDP per capita remains on 10th place within the EU.

In the ranking in this report the UK is grouped on fourth place in the first tier of high performing brain business countries. It ranks high in advanced services, IT and creative professions, but is relatively weaker in the tech area. This profile is even more pronounced in the break-down in the diagram below. The UK is home to an unusual number of head offices that have demand for advanced service. Fewer in the UK work with high-tech or engineering brain business jobs.

Britain's capital region London is on 5th place in comparison with other capital regions in Europe. In common with other capitals it has more brain business jobs, 148.1 brain business jobs per 1000 working age population, than the rest of the rest of the country. London's strength center around brain business firms that cater to the exceptionally well developed financial markets. As a result, however, wage costs for many brain business professionals are also high and housing supply is a brake on growth.



Score: 1-10, 10 = score of highest ranking country



Score: 1-10, 10 = score of highest ranking capital region

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