

### Innovative economy in the Baltic Sea region

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# THE INNOVATIVE DEVELOPMENT OF THE BALTIC REGION: TERRITORIAL DIFFERENTIATION

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## INNOVATIVE ECONOMY IN THE BALTIC SEA REGION

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*Innovative activity is carried out at three levels — those of the state, region and a company or a university. This article considers the level of development of knowledge-based economy in Germany, Denmark, Sweden, Finland, Estonia, Latvia, Lithuania, and Poland at each of the three levels, as well as describes the spatial differentiation of innovative activity within the Baltic region.*

*The analysis is done on the basis of national and international research, as well as statistical data on the intensity of research and development, structure of research expenditure, human capital in the field of advanced technologies, and the methods of institutional support for innovative activity. The authors characterise the role of business, university, and authorities — which constitute the «triple helix» — in national innovative systems.*

*The article also analyses such important factors as the intensity of research and development, the share of employees in the field of advanced technologies, and the methods of public support. Examples of private-public infrastructure for the implementation of innovative projects are offered.*

**Key words:** national innovation system, Baltic Sea region, Triple Helix, R&D

The object of this study is the Baltic Sea region, namely, the countries having direct access to the Baltic Sea: Germany, Poland, Lithuania, Latvia, Estonia, Finland, Sweden and Denmark.

The article aims at studying the Baltic Sea region and the level of innovation economy it enjoys, as well as the integration of business, government and universities in innovation.

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The stated objective necessitates fulfilling the following tasks:

- to characterize the Baltic region as a community of nations and economies based on innovation;
- to determine the role and place of business, universities and the state in the innovation economy;
- to describe the organizational forms of regional innovative businesses;
- to analyse the geographical differentiation of innovation at the national and regional levels.

With varying degrees of effectiveness, NIS (National Innovation System) has been established in the Baltic States, because in the countries striving for economic leadership innovation process requires a comprehensive approach.

In the Russia Competitiveness Report 2011 the notion of NIS is defined as a set of necessary resources, institutions, and policies that can ensure the effectiveness of innovative processes, and their use to enhance future welfare of the states [1].

The most complete definition of the national innovation system can be found in N. Ivanova [2]: NIS is a set of inter-related organizations (agencies) engaged in the production and commercial implementation of science and technology within national borders (small and large companies, universities, state laboratories, technology parks and incubators). The challenge for the state regulation of NIS is to provide a high level of financial, information and legislative support to innovative development.

The concept of NIS rests on J. Schumpeter's theoretical assumptions regarding the driving forces of economic development, based on the ideas of "creative destruction" (resulting from technological breakthroughs), the trajectories of "dependent" development, long waves of economic activity, and evolutionary theory. In the recent decades of the twentieth century Schumpeter's followers — C. Freeman, R. Nelson, and B.A. Lundvall — elaborated on these ideas and used them to explain the intertwining of technological and socio-economic factors, their interior logic in the development, and its impact on society [3]. Later, a need emerged for identifying regional and interstate innovation systems.

Foreign researchers argue that, along with economic (historical and technological) prerequisites of setting up successful NIS, the most important factor to be considered is the quality of state management, the ability of the political leadership of the country to plan and implement large-scale innovative projects [4].

In the Nordic countries the NIS is based on the Triple Helix model [5]. The Triple Helix symbolizes the alliance between the government, businesses and higher education institutions, which are key elements for any state's innovation.

The Triple Helix theory was created in the UK and the Netherlands in early 21st century by the Stanford professor Henry Etzkowitz. The concept of Triple Helix shows the inclusion of certain institutions in the interaction at every phase of the innovative product creation. At the initial stage of knowledge generation, the authorities and the university interact; and then, in the

course of the transfer of technology, the university collaborates with business; finally, the result is put to the market jointly by business and government.

In Russia, the Triple Helix is still being at a very early stage of formation — not yet a system, but mostly pairwise relationships, such as: science — business, the state — science and the state — business. The specificity of the Russian Triple Helix model consists, in the first place, in the supremacy of the state over science and business. Secondly, unlike most countries of the world, Russia does not trust most of the fundamental research to universities, but delegates it to the institutes of the Russian Academy of Sciences [6]. The intensity of research and development (R & D), is measured by the ratio of R & D expenditure to GDP. In Europe, there is a direct dependence between economic growth and the size of national and regional resources allocated to research and development [7]. In 2010, total R & D expenditure in the EU-27 states was an average of 2% of GDP, below the target of 3% set by the 2010 recommendations of the Lisbon Strategy for the EU [8]. Among the EU countries only Finland (3.87%), Sweden (3.42%) and Denmark (3.06%) exceed the 3% of GDP [9]. In per capita terms, these states fall behind Luxembourg. It is important to note that Finland and Denmark still are still showing growth, while Sweden has been in decline for 5 years now. Germany spends 2.82% of GDP on research and development, which is lower than that of the Nordic countries, but higher than the average in the EU and the U.S.

The most aggressive innovation policy in the Baltic Sea region is adopted by the Estonian government. Although their R & D intensity in 2008 was only 1.3%, in the 2004—2010 Estonia was on the rise and leading in the European Union. It was here that in 2009 the Year of Innovation was declared, during which the national project of collaboration was implemented. Latvia and Lithuania come significantly lower: they spend less than 1% of GDP on high-tech development.

Officially, Poland has no comprehensive national policy on innovation, but they are implementing a programme aimed at innovation improvement in the economy for the period of 2007—2013. The programme presented in September 2006 includes an assessment of innovation in the Polish economy, and recommends measures (if implemented) that could contribute to knowledge-based economy and would promote and encourage innovation [10].

The European statistical agency widely uses the GBAORD (Government Budget Appropriations and Outlays for R & D) index to assess the direct government spending on development and implementation of high-tech. It reflects the amount of state budget allocated for research and development by the central bodies of public administration of the OECD and EU member states, and is measured as a percentage of GDP. The average value for the EU in 2009 was 0.76%, in U.S. the value being 1.02%, and in Russia 0.5% [11].

In the Baltic region, the average of the EU's is exceeded by Finland (1.15%), Denmark (0.97%), Germany (0.93%), Sweden (0.89%); the value is rather high in Estonia (0.72%). Denmark has seen an increase of GBAORD by 20% over the last 5 years to the level of 0.97%, which did not

stall even during the global economic crisis. This is a result of the program adopted back in 2005 by the liberal-conservative government. The programme was designed for 5 years with the ambition to reach the level of 3% of GDP for research funding in 2010 [12]. Already by 2009, the goal was achieved.

Innovative activities are carried out at three levels: governmental, regional and business or university ones. The establishment of the Regional Innovation System (RIS) is largely tied to the specificity of the region. According to *Eurostat regional yearbook 2011* [13], 25 of the 260 regions of the EU spend more than 3% of their gross regional product on research and development.

A group of four high-tech areas located in South-Western Germany are: Stuttgart (5.83%), Karlsruhe (3.75%), Tübingen (3.79%), and Darmstadt (3.11%). These regions are very important in absolute terms, as together they account for 8% of total investment in research and development of EC. Other important regions are: Bavaria (4.29%), further to the north is Braunschweig (6.75%), which boasts the highest intensity of research activities in the Baltic Sea; and two more cities — Dresden (4.08%) and Berlin (3.31%). In 2001, only Baden-Württemberg and Berlin had the index of over 3% of GDP.

Germany enjoys a straightforward three-level system of managing the innovation process, consisting of the first, intermediate and industrial levels. Germany's basic law stipulates that R & D funding is part of joint federal and state jurisdiction, and it is distributed by the industry [14]. For example, capital-intensive research in the areas of space, aviation, atomic energy and oceans is fully supported by federal funding. Land and utility organizations in the field of innovation are financed from the budget of federal lands [15].

Eight research-intensive regions are located in the North European states. From south to north, they are as follows: Hovedshtaden (the area around Copenhagen) in Denmark (5.1%), West Suomi (3.66%), South Suomi (3.91%) and Northern Suomi (5.87%) in Finland and Southern Sweden (4.75%), West Sweden (3.72%), Middle-East Sweden (3.74%) and Stockholm (4.03%) in Sweden.

Research strategy has been directly included in the development strategy of the regions in Sweden. Ten years ago, research resources were concentrated in Stockholm, Goteborg and Lund. In addition to the Innovation Policy Council that directed funding to existing centres, the system of distribution was supplemented by two more levels of research funding in which a regional criterion became predominant [16].

Thus, within the Baltic region three clusters can be identified. The first and second ones are located in the South East and West Germany, the western border areas being in close collaboration with the Benelux territories; Southern regions are cooperating with Austria, Switzerland and Northern Italy. All these clusters are densely populated.

In contrast to the first and second ones, the third cluster is fully localized within the Baltic region. It is located in Denmark and southern Sweden, where the regions (except the capital) are sparsely populated. By the volume

of research, the Copenhagen-Malmö region, which also includes universities of Roskilde and Lund, ranks fifth among European research centres after London, Oxford, Paris, Moscow and Randstadt.

Four countries in the region are close to achieving the second goal set by the Lisbon Strategy: 2/3 of R & D costs should be funded by the business enterprise sector. Finland, Germany, Denmark and Sweden have achieved this goal [9].

In 2009, commercial structures' expenditures on R&D in Germany amounted to 1.92% of GDP. It is important to note that the contribution of the twenty largest commercial investors in R & D in Germany is 57% of total investments, with other companies giving a further 15%; the same amount falls on higher education and the state. Support of research in Germany is part and parcel of the common challenge for both the state and society. The policy of state support for innovation is plainly defined in the High-Tech Strategy launched in 2006 [15].

R & D investments in Sweden in 2009 constituted 3.62% of GDP. Most higher schools here are state-run or sponsored by the state, therefore the costs of higher education and the state can be summarized. The largest investor in research is Ericsson, the company's contribution accounting for 31% of the total R&D investment by Swedish business. The vast majority of Swedish innovation is financed by the private sector, mostly by multinational corporations. The publications of Swedish authors [17] reveal close interconnectedness of major Swedish multinational corporations due to the so-called "spinnerets" — closely networked industries related more tightly to each other than to other industries, external to the given association [18]. They also note the relationship between the ability of a single sector to develop thus ensuring progress in other sectors of the economy — the assumption that rests on Dahmen's "development blocks" concept (1950, 1988) [19].

Today, Swedish universities receive budget funding for the following three equally important functions: student teaching, research, and knowledge dissemination. The latter task does not compel the popularization of scientific knowledge as much as it demands commercialization. Therefore, the amount of marketed university developments directly tells on the volume of university funding from the state budget [20]. Large Swedish companies prefer to be based close to universities.

In Finland, business investment accounts for 2.83% of the total cost. It is important to note that of all business investment more than 80% is accounted for by Nokia, which is investing in R & D more than the universities and the state together.

Estonia's R&D has significantly benefited from businesses, which increased their contributions five-fold in 2001—2010. First of all, due to the efforts of business cost structure in Estonia is close to the cost structure of EU leaders [21]. In Latvia, the main investors are institutions of higher education (0.18% of GDP), with business coming next (0.17%) and the state having the lowest proportion (0.11%). Lithuania is noted for the predominance of universities in scientific research even more than Latvia is. In 2009, the investment of higher education institutions amounted to 0.44% of GDP, while business and government's share of only 0.2%.

For new research and development highly qualified and experienced personnel is needed. Researchers are the professionals involved in the creation of new knowledge, products, processes, methods and systems, as well as in the management of innovation projects. Finland has the largest proportion of employees in high-tech development in the total employment. Denmark, Sweden and Germany exceed the average for the EU (1.11%). In Denmark, from 2001 to 2010 the indicator increased by more than 30% (up to 53 thousand people). Estonia is superior to other Baltic states, having shown the fastest growth in the region (33%) from 2001; however, its indicator is below the average.

Finland and Denmark enjoy a steadily large proportion of employees in R & D of total employment — 2.09 and 1.81% respectively; Sweden (1.56%) and Germany (1.32%) are lagging slightly behind. In other states of the region the share is less than 1%. In absolute figures Poland shows higher numbers of researchers than Denmark, Finland and Sweden (98 million versus 52, 55 and 72, respectively).

In Germany, Denmark, Finland and Sweden, researchers account for 75—80% of the total number of employees in R&D. This is due to the fact that the staff includes not only employees working directly in the field of high technology, but also the professionals providing such incidental services as management, administration and office work. In the Baltic States and Poland researchers account for less than half of the total R & D personnel, therefore, investments are used unproductively.

Considering the structure of employment in research and development in the region, one can see that in Germany more than 60% of the workforce is concentrated in business structures; in Denmark the majority is in business, one third in the state and cultural institutions, the most important of which is the Royal Danish Academy of Sciences and Letters. Finland is remarkable for its 40% of the specialists working in R&D in universities, with a little more than half employed in commercial structures. In Sweden, government employees perform most of the managerial function, but due to the fact that all universities are state-run, the proportion can be estimated at 30%. In Latvia and Lithuania, almost 60% of the workforce is higher education employees, and in Poland the share is 50%. In Estonia, the structure has a Nordic tendency: more than 35% are in business, about 50% — in the universities, and 15% — in state institutions.

To ensure stable innovation economy it is essential to educate highly qualified personnel. Under the Triple Helix model, universities involved in research and development are a chief resource for high-tech industries. Evaluating the data on the total number of students, it may be noted that more than a third of Baltic region's 20—29-years-old citizens (i. e., in the typical student age) are students. According to this index, all countries of the region, except in Germany, exceed the average of the EU. In the Baltic States, the proportion of female university graduates working in the field of science and technology is the highest across the EU [22].

An important indicator is the percentage of students studying in the field related to science and development. Finland yields maximum figures —

more than 35%. Over 25% is the share of future professionals in the field of research and development in Germany and Sweden. In Estonia there are a high proportion of students in these fields, too. Critically low indicators in Latvia and Lithuania will be a great problem for the innovation economy in the long term.

Among the methods of state influence used in addition to direct investment are: lending, leasing, stock exchange operations, planning and programming, as well as public entrepreneurship. Senior management of innovation policy in the Nordic countries report directly to the President or the Prime Minister.

In Sweden, the Innovation Policy Council occupies a higher position than the sectoral ministries of education, science and culture or ministers of industry and trade, which play a key role in innovation. The Investment Agency VINNOVA is an important institution engaged in venture financing of innovation, along with that functioning as a source of statistical and analytical information on the governmental and regional activities in the field of innovation [24].

The Science and Technology Policy Council of Finland and the Finnish National Fund for Research and Development are subject only to the Parliament and the Prime Minister — that is, they have the same status as the cabinet, and higher than the line ministries [25].

Productivity of scientific and technological activity can be measured in the number of registered patents, innovative products and organizations involved in innovative activities. The largest number of patents per capita is registered in Finland (215.7), sixth highest in the world. The eighth, ninth and twelfth places are taken by Sweden (154.2), Germany (150.6) and Denmark (110.0) [26]; however, the volume of patents in different industries is different: the more ways industry has to commercialize its products, the more intensive is the development. Thus the focus shifts from fundamental scientific research to the invention of the actual product. In Latvia, Lithuania, Estonia and Poland, the number of registered patents is fewer than one hundred per one million people a year.

Danish investment efficiency is reflected in the region's highest proportion of newly implemented products and services [27]. This can be explained by the fact that most of the Danish companies are small and medium businesses realizing how important it is to update their product lines to be able to compete with the larger players on the market.

In the Baltic region, a crucial component of the NIS is the creation of private-public innovation infrastructure through organizations involved in applied research, such as science parks, cluster projects, and regional centres of commercial implementation of inventions that can implement the relevant marketing procedures.

In the transition to a knowledge-based economy the university is a key element of technology parks, providing intellectual and investment support for entrepreneurship in their regions. They become key elements of the so-called "distributed" control over the new systems, ensuring the generation of innovation and learning of other elements of the cluster. The top ten coun-

tries in terms of research in cooperation within the "company — university" model are: Finland, the U.S., Switzerland, Sweden, Netherlands, Ireland, Germany, Denmark, Belgium and Japan. Moreover, if we compare them with the top ten countries in terms of technological (inter-company) cooperation in research and development (Finland, Japan, the Netherlands, Switzerland, USA, Germany, Sweden, Denmark, Norway, Ireland); we will see the same states only in a different order [28].

The old Swedish technopark Ideon had managed to create 10 thousand jobs in knowledge-intensive business. This was made possible due to the re-orientation of a strong university to market needs and ensuring access of start-up companies to concessional credit terms, venture capital and high quality consulting. The technopark unites companies such as: Avionics, Euro-nics, Eric dream, SaabTech, NNL Technology.

In the Stockholm's suburb Kista, there is a large science and technology park created on the basis of the Triple Helix model. It comprises, first, the IT University founded by the Royal Institute of Technology; the university is engaged in research along with the educational process. Second is the Electrum — the main European centre for information technology. It was established as a result of collaboration between the Swedish government, Stockholm authorities and Swedish computer and electronics industry. Third is the production capacity of some companies, such as the Ericsson [23].

Finland has seven technoparks; they are somewhat different from each other, but carry the same crucial similarity: they are independent in their work. Turku has the largest and fastest growing science park in Europe. The main research areas in Turku Science Park are biotechnology (Bio Turku) and information and communication technologies (ICT) [29].

Technology Parks in Germany are legal entities established for more adequate use of scientific and technological resources with the aim to improve the economic base of the region. Setting up innovation clusters and technology parks in the region can significantly increase the total R&D expenditure at the expense of SME investors. This is especially characteristic of southern Germany. In Germany, science parks and innovation centres have shown rapid development only since November 1983. Now there are more than 350 innovation centres in Germany, with almost two-thirds of them participating in ADT, the German Association of Innovation, Technological and Business. The centres service over 10 thousand small companies with more than 69 thousand employees. Each year adds about 1,200 companies, with three quarters of them state-of-the-art-technology-oriented [30].

According to the Global Competitiveness Index, which is compiled annually by the World Economic Forum [26], Sweden and Finland occupy 3rd and 4th positions out of 142 countries studied, next only to Switzerland and Singapore; Germany (6th) and Denmark (8th) are also ranking high. Other states in the region are also in the first half of the rating list: Estonia (33rd), Poland (41th), Lithuania (44th), Latvia (64th), showing a positive trend too. The same ranking identifies the key drivers of the national economy. Estonia, Latvia and Lithuania refer to the intermediate group between efficiently moving and innovation-driven economies, the rest of the states in the region refer to the innovative group.

Thus, the states of the region fall into two groups. Poland, Estonia, Latvia and Lithuania are lagging far behind in their innovation development and in the results of their innovation activities: it is due to the fact that in the early 90s they had to choose a catch-up strategy of "transfer". It results in a low level of investment in innovation, underfinancing from commercial structures, lack of skilled labour force and underdeveloped institutional spheres.

Estonia's achievements in innovative policy are worth noting. However, although their performance is superior to other Baltic states, at the moment it still does not allow the country to catch up with the leaders of the region.

Germany, Denmark, Sweden and Finland, are typically following an "increase-type" innovation policy; they adhere to a long-term strategy to stimulate innovation at the national and regional levels. R&D investments in these states constitute about 3% of GDP and two thirds of that share comes from business, as recommended by the Lisbon Strategy for the EU. In industrialized countries, the state is the main regulator defining the innovation trend in the economy.

Regions with a high intensity of scientific activity are localized in three clusters: the first and the second ones are in the western and south-eastern states of Germany, while the third one is in Denmark and southern Sweden. For the Baltic region, metropolitan areas are of importance.

A distinctive feature of industrial parks in Sweden, Finland and Denmark is their following the concept of the Triple Helix with due interaction of higher education human resources, financial and investment management business, institutional and infrastructural state support.

The population of the Baltic Sea region lives in a high-tech society, whose development is based on the information and research resources. Maintaining the leading positions by Sweden, Germany, Finland and Denmark is the natural result of the implementation of the socio-economic model, which includes a strong innovative component — the policy they have adhered to for many years.

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