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### **DEVELOPMENT OF REGIONAL INNOVATION ENVIRONMENT IN THE NORTHERN PART OF CZECHIA**

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### **ROZWÓJ ŚRODOWISKA REGIONALNYCH INNOWACJI W PÓŁNOCNEJ CZĘŚCI CZECH**

DOI: 10.15611/br.2017.1.04  
JEL Classification: O31, O18, R11

**Summary:** The article focuses on the analysis of the innovation environment of the regions in Czechia, focusing on the Ústí Region. Due to the geographical location of the Ústí Region and its economic development and structure, regions which went through similar economic and social development have been selected for research in this article, in particular the Karlovy Vary Region, the Liberec Region, and the Moravia-Silesia Region. The analysis has used the indicators from the field of human resources, employment in R&D, information technologies, as well as education. It is obvious under the comparison of the selected parameters that the Ústí Region lags in the development of the innovation potential behind the Liberec Region and Moravia-Silesia Region, but reports better results and development changes compared to the Karlovy Vary Region.

**Keywords:** innovation environment, region, Czechia.

**Streszczenie:** Artykuł koncentruje się na analizie środowiska innowacyjnego regionów w Czechach, koncentrując się na regionie Ústí. Ze względu na geograficzne położenie regionu Ústí oraz jego rozwój gospodarczy i strukturę, do badań w tym artykule wybrano regiony, które przeszły podobny rozwój gospodarczy i społeczny, w szczególności Region Karlove Vary, Kraj Liberecki i Morawsko-Śląski. W analizie wykorzystano wskaźniki z zakresu zasobów ludzkich, zatrudnienia w B + R, technologii informacyjnych oraz edukacji. Oczywistym jest, że przy porównywaniu wybranych parametrów Region Ústí pozostaje w tyle w rozwoju potencjału innowacyjnego w porównaniu do regionu Liberec i regionu Morawsko-Śląskiego, ale wykazuje lepsze wyniki i zmiany rozwojowe w porównaniu do regionu Karlovy Vary.

**Słowa kluczowe:** środowisko innowacyjne, region, Czechy.

## 1. Introduction

The innovations and innovation processes stand for a pre-condition for improvement of competitiveness [Tödting, Trippl 2005; Hlaváček 2016] in today's globalized world because they are regarded as a source of the economic development and competitiveness. In the global economy, regions and their innovative potential are the growing factor of national economy and, therefore, regional specialization [Asheim, Cooke, Martin (eds.) 2006] is often reinforced to diversify even the branch structure of the national economy. Many factors are reflected in the development of the innovation potential of a region in the regional environment, ranging from structure of companies and their industry specialization or quality of R&D environment, which makes up the special and region-specific properties of the innovation system. Consequently, specific synergies occur in the innovation ecosystem, which generate regional innovation processes. The regional governments may be further stimulated through the support of research and education, and prioritization. The innovation process occurring in different regions leads to the modernization or expansion of the range of products and services, and markets associated thereto, to the creation of new methods of production, supply and distribution and to the implementation of new forms of management. The development of the innovation system is desired although the regions may see different speeds. Hägerstrand [1967] demonstrated different speeds on the example of successive spread of innovations. According to the flexible specialization theory [Dijk 1995; Subesh, Panayiotopoulos 1996], under which the innovations resulted in shortening of the innovation cycle of products and disintegration of big companies, territory attractiveness is increased based on its features for the factors for the said phase of the innovation cycle, and thereby improvement of its image and of external competitiveness. The regional infrastructure has a decisive influence on the generation, adaptation, and diffusion of the innovations, including quality parameters associated e.g. with soft localization factors [Koutský et al. 2009]. Not only highly qualified workforce but also regional universities and R&D institutions [Pinto, Fernandez-Esquinas, Uyarra 2013] including services producer [Bailly 1995] or knowledge intensive based industries [Müller, Zenker 2001; Ženka et al. 2015] determine a real benefit of these factors for the development of the innovation environment. The interaction between the regional stakeholders is substantial, including innovation potential of local companies and their mutual interactions.

Many factors are reflected in the development of the innovation potential of a region in the regional environment, ranging from the structure of companies and their industry specialization or quality of R&D environment, which makes up the special and region-specific properties of the innovation system [Blažek, Csank 2015]. Consequently, specific synergies occur in the innovative eco-system, which generate regional innovation processes and owing to which regional governments

may be further stimulated through the support of research and education, and prioritization. At the theoretical level the spatial differentiated development process may be defined as so-called regional innovation system described by Cooke. His theory is based on the concept of a national innovation system that operates with the regional factors and mechanisms. The concept of the regional innovation system points out that mutual closeness of innovation-oriented stakeholders as well as their mutual cooperation with support of universities and the public are important for the development of the innovative environment and the creation of innovations. Regions produce then endogenous innovation potential based on these parameters that differ in the inter-regional assessment much more than the macro-economic indicators of the regions being compared.

The benefit of the innovation potential analysis consists in the review of the regional assumptions for sustainment or improvement of the regions' competitiveness. There is a business innovation potential on the one hand that represents the ability of the companies to create and implement the innovations. As a result the companies produce the innovation potential of a region from the macro-economic point of view. On the other hand, the innovation policies of the regions aim at supporting the growth of the innovation potential not only through the support of the businesses but also through the creation of suitable innovation conditions in the region. Then, the goal is monitoring and evaluating the development of the regional data with the direct relation to the innovation potential of the region. The regional data from the field of the innovation eco-system pay attention to the assumptions of the region in the development of the innovation environment being important for long-term keeping of the regional competitiveness.

The regional data interpretation should be made within a broader inter-regional context, and would have no reference value without a comparison with other territorial units, if the intensity of changes and dynamics of the development processes correspond to the trends in the Czechia's environment and the situation in other regions.

The aim of the article is a comparison of the indicators from the Ústí Region linked to the innovation of eco-system with selected indicators of some regions. From the Ústí Region's point of view these findings are significant because they show the ability of level of the Ústí Region's to respond and adapt to the development changes compared to other regions.

## 2. Methodology

Selected indicators will be used to monitor the innovation environment. The position of any region compared to other regions within a larger territorial unit is always based on a review of differences between territorial units with respect to other territorial units by the selection criteria.

The reason for difficult establishment of an innovation synthesis and production of a representative indicator of the innovative environment is the fact that there are many factors to be considered in reviewing of a position in relation to other regions. The region's innovation environment consists of phenomena and processes which quantification is difficult. They in particular include behavioural factors, which emphasize the process of learning, mastering of knowledge, and their application in the innovation process.

The selection of the indicators was conditioned upon data availability per regions and their applicability for data comparison with the other regions and the country level. Considering the needs of the comparison of development of the selected data, the basic data on number of persons and expenditures should always be referred to a different value, e.g. workforce or headcount in order to map out the differences in concentration or regional importance of the indicator in question. The conversion of absolute data will also permit to mutually compare the selected regions and also to evaluate the development processes from the time point of view that processes occur at the regional level.

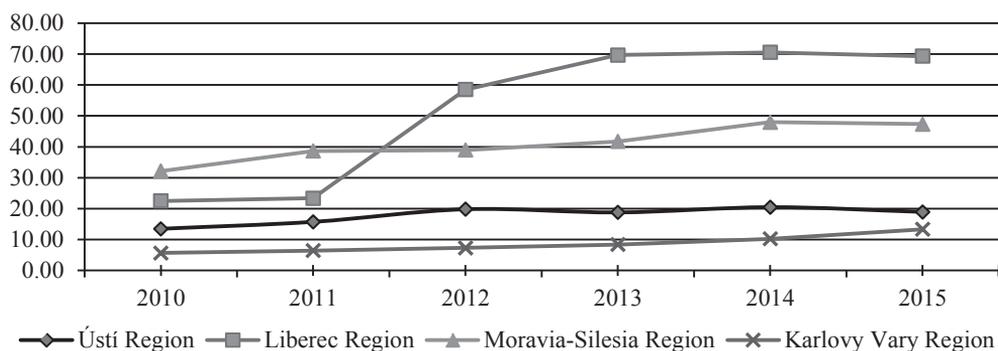
Some regions in the northern part of the country, in particular the Moravia-Silesia Region and two adjacent boundary regions – the Karlovy Vary Region and Liberec Region were selected to compare the innovation potential of the Ústí Region. In addition to geographical location within Czechia, the regions have some similar properties; these are the boundary regions, partially settled up in the post-war period; the regions are characterized also by location of mining industry, which was either fully (uranium mining in the Liberec Region) or partially terminated. The coal mining has been minimized in the Karlovy Vary Region, the Moravia-Silesia Region, and the Ústí Region, but still exists. The data source for the ICT statistics of the experts is published in the Selection Survey of ČSÚ's workforce. The data on patents and utility models have been processed based on the data resources from the Intellectual Property Office that manages the patent protection in the territory of Czechia. Tables include data about patent activities of the entities operating in Czechia only.

### **3. Human resources for increasing innovation and performance of a region**

The first monitored area was the human resources with direct relation to the innovation and technological performance of the region. These indicators were monitored in the human resources: a) headcount in R&D converted to the number of economically active persons, b) share of IT experts per 10 thousand EAs by regions, c) share of students in selected study program (per 100 students).

The indicator of the number of R&D staff in the business sector per 10 thousand EAs has been reporting increased values since 2001. Significant growth was seen in

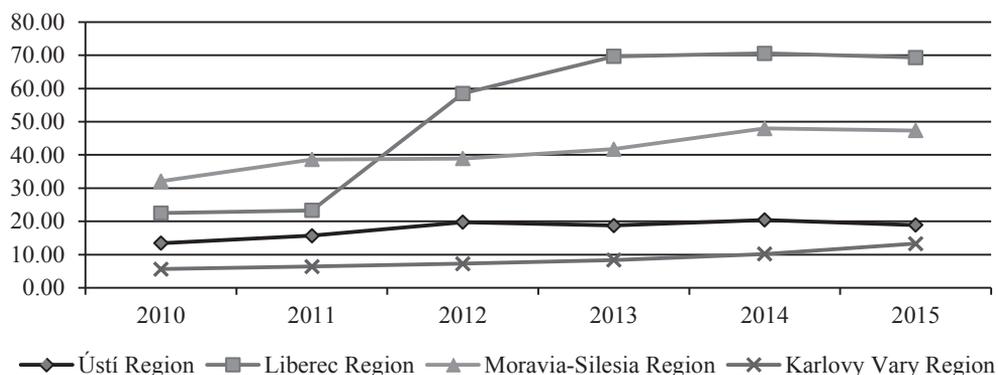
the Liberec Region followed by the Moravia-Silesia Region. The Ústí Region ranked third in the monitored period. The Karlovy Vary Region reported on average higher growth than the Ústí Region, but the level of the latter was not achieved; considering low R&D headcount in absolute values, the individual changes in the businesses are much obvious in total results.



**Figure 1.** R&D staff in the business sector per 10 thousands EA

Source: own research based on data from the Czech Statistical Office.

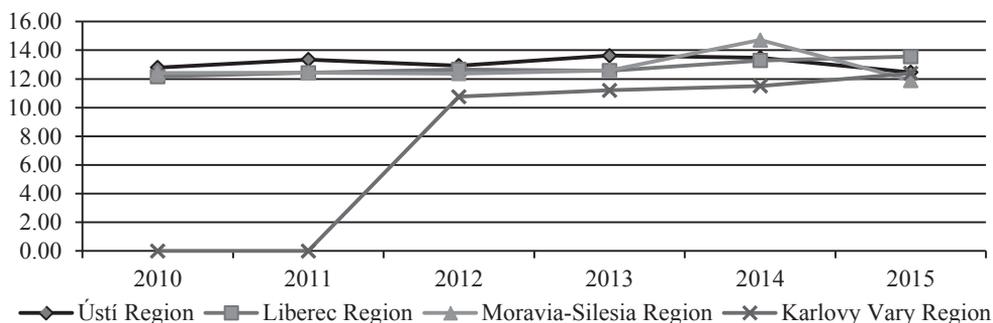
The Liberec Region reported the highest growth in the employment of the IT experts between 2010 and 2015. The share of the IT experts per 10 thousand EAs decreased between 2010 and 2012 and a slightly increased later. On the contrary, the Moravia-Silesia Region showed stagnation in the growth of the relative representation of the IT experts in the region's workforce. This phenomenon is also obvious in the absolute number of IT experts in the Ústí Region where the segment of the IT companies stagnated.



**Figure 2.** Share of IT experts (per 10 thousand EA)

Source: own research based on data from the Czech Statistical Office.

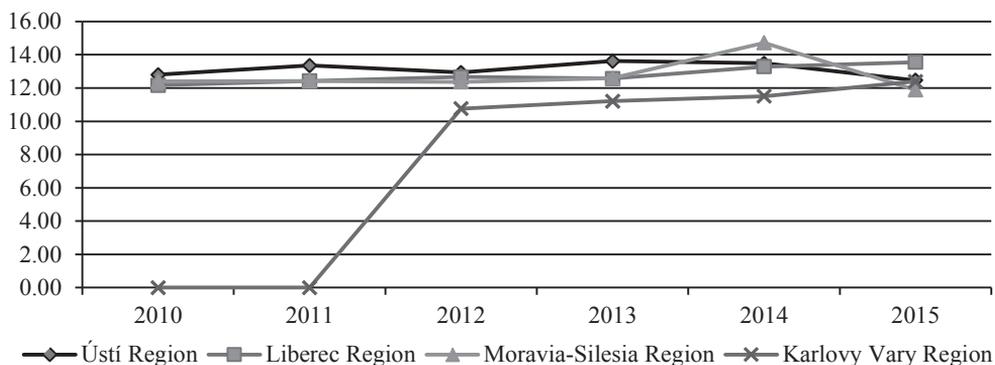
Rather stable differences among the regions exist from the point of view of the share of students in technical, production, and construction branches. Despite the significance of industrial tradition in the Ústí Region and the Moravia-Silesia Region, students from the Ústí Region are not considerably interested in the study of the said branches compared to the Moravia-Silesia Region or the Liberec Region. The reasons may be related to the perspective employment in the branches and the structure of the region's education base.



**Figure 3.** Share of students in technical, industry and construction branches (per 100 students)

Source: own research based on data from the Czech Statistical Office.

Details from the review of the university education and structure of the students by the branch studied are based on the Selection Review of Workforce (ČSÚ) that registers the students by their residential address. Figure 4 shows different trends across the regions. The share of students in the natural sciences, mathematics and information science did not change dramatically in the Ústí Region, it remained stable in the Ústí Region and the Moravia-Silesia Region, and increased in the Karlovy Vary Region. The Liberec Region showed the highest share of this group of students.



**Figure 4.** The share of students in the natural sciences, mathematics and information science (per 100 students)

Source: own research based on data from the Czech Statistical Office.

The second area of innovation activities was monitored through two key categories, expenditure on scientific research activities and patenting at the level of the regions surveyed. The following indicators have been used in the R&D expenditures category: R&D expenditures, and patents granted in Czechia for domestic applicants per 10 thousand EAs. The mapping of science and research expenditure points to the extent of the research activities of the regions, as expenditure *de facto* represents the volume of R&D revenues of organizations in regions. Regionally differentiated flows can also be interpreted as the ability of the R&D organizations to generate quality research that succeeds in the competition of other organizations in Czechia.

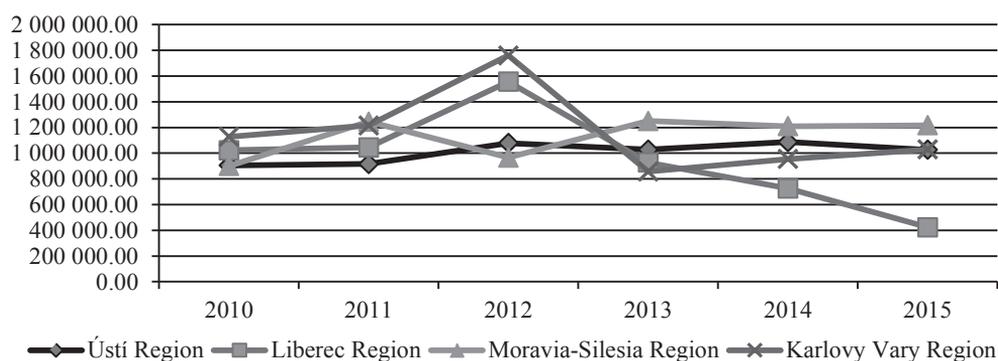


Figure 5. Expenditure for R&D total (in CZK)

Source: own research based on data from the Czech Statistical Office.

The expenditures on R&D personnel show the greatest variability in the Liberec Region and Karlovy Vary Region; the higher level of the changes comes from smaller-sized regions and the lower concentration of the research and development organizations in general. Therefore the changes or limited ascertainment of the data

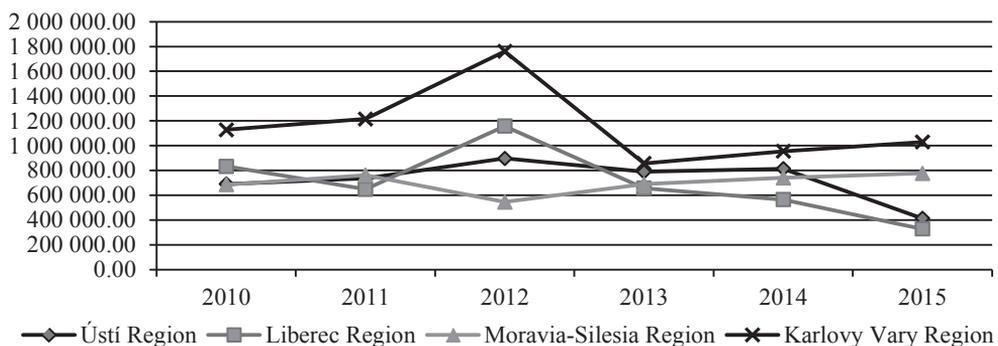
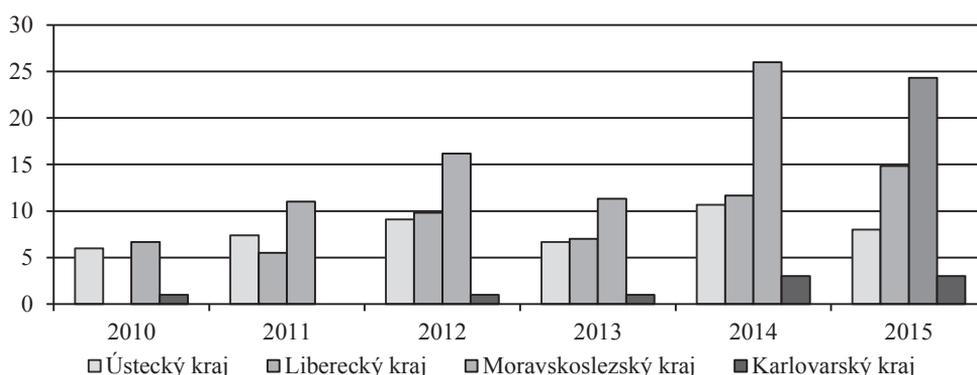


Figure 6. Expenditure for R&D in business sector (in CZK)

Source: own research based on data from the Czech Statistical Office.

at the level of specific workplaces have a greater impact on aggregated results. The Ústí Region as well as the Moravia-Silesia Region show stable each-year development in the field of the funding, and the year-to-year changes remain insignificant.

The problem of regions with lower rates of economic growth and lower competitiveness also consists in lower activity of business subjects in the field of R&D and innovation. The expenditures on R&D in the business sector provide information about the importance of research in business entities, how research is attractive for provision of funds and financing thereof. The development trends show rather reduced support of the R&D activities in the business sector in the Ústí Region and Liberec Region.



**Figure 7.** Patents of domestic applicants (per 10 thousand EAs)

Source: own research based on data from the Czech Statistical Office.

Considering the necessity of reinforcing this aspect of business activities in order to finish the conversion of the industrial and economic base of the region, and to establish new growing branches and segments under the economy of the Ústí Region, the R&D support and the creation of innovations in the commercial sphere are two tools for growing competitiveness of the region.

Another indicator is the number of patents created by private businesses. It can be said that the baseline of the Ústí Region was over the average among the monitored regions in the beginning of the period. In the next years the patent applications of the private companies in the Ústí Region have been growing much slower compared to the other regions; in particular, the Moravia-Silesia Region showed the most intensive growing trend. Although the graph shows the number of patents in absolute values<sup>1</sup>, weaker position of the Ústí Region is evident despite the differing potential and the size of the regions.

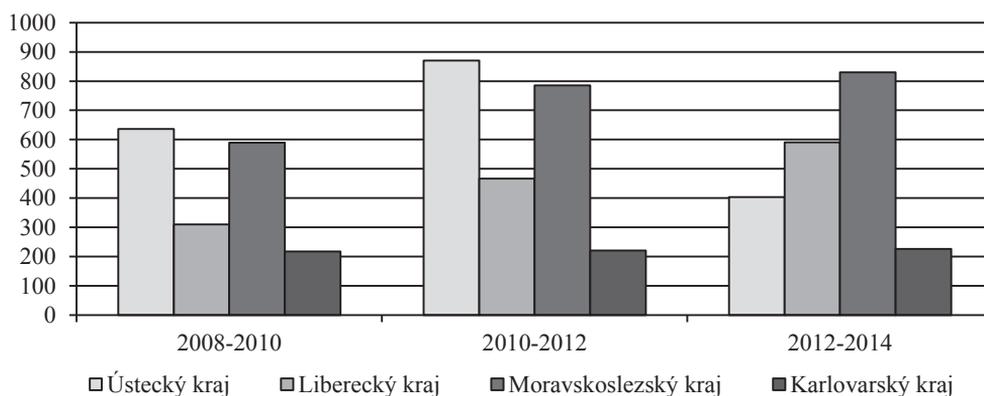
The Ústí Region reports the highest share of the gross added value in processing industry followed by the sum of values from business, transport, accommodation, and catering. The services ranked third (public administration and defense, education,

<sup>1</sup> The results were not converted to another general indicator due to the low patent activity.

health care and social care). Highly above-than-average representations of the mining industry, power engineering, and water management are seen in the Ústí Region as well as the Moravia-Silesia Region.

The numbers of patents granted to local applicants showed a long-term growing trend between 2010 and 2015 even after the conversion of the number of patents granted per 10,000 economically active persons. There are differences among the regions regarding the intensity of the patent activities. The Karlovy Vary Region showed the highest growth with respect to the low number of the patents in the region; even minor changes in absolute numbers result in significant step changes to the resulting values. As far as the Ústí Region is concerned, some increase in the number of granted patents in the last year could be seen, where the values are higher than in the Moravia-Silesia Region, although the increase lags behind the Liberec Region.

In the Ústí Region, the highest share in the added value of the region comes from the processing industry, which confirms higher focus of the region on the industry in long-term compared to other regions of Czechia. From the point of view of the branch structure of the region, the activities in the field of trade, transport, accommodation, catering, as well as information and communication contribute to the production of the gross added value.



**Figure 8.** Sales of the innovated products of innovative companies.

Source: own research based on data from the Czech Statistical Office source, Statistical investigation about innovation activities of businesses TI 2008, 2010, 2014

Data about sales of the businesses for the innovated products come from the Statistical investigation about innovation activities of businesses, which is conducted every other year (2008-2010, 2010-2012, 2012-2014)<sup>2</sup>. Regarding the definition of an innovative business, the updated 2010 methodology of Eurostat has been used

<sup>2</sup> Return rate of the questionnaires in the investigation achieved about 80%.

since 2010, which refers to an innovative business as an entity, which implemented an innovation in the form of a product innovation, process innovation, marketing innovation, and organizational innovation. There has been stable growth of the share of revenues per employee in the Moravia-Silesia Region and the Liberec Region over the two-year period in question. The values achieved in the Ústí Region were above-than-average between 2008 and 2012, and the amount of revenues per employee dropped in the last monitored period between 2012 and 2014. The lowest revenues per employee were reported in the Karlovy Vary Region that indicates stable values without significant growth changes.

## 4. Conclusions

Regional differences are determined by a number of interdependent and regionally conditioned socioeconomic processes and development mechanisms. Attention was focused on monitoring the indicators with a link to and reference value for the innovation environment of the region in the mapping.

To monitor the development of the innovation environment, an appropriate benchmarking should be used to compare the innovative environment of the selected regions, and to monitor the development of the innovation environment of the Ústí Region in a broader regional context. Different values are seen for individual indicators in the nation-wide comparison.

The Ústí Region has been lagging behind the Liberec Region and Moravia-Silesia Region in the monitored indicators, but goes better when compared to the Karlovy Vary Region. The Ústí Region as the old industrial region shows lower innovation potential and weaker growing trend in the innovation indicators. The processing industry has the highest share in the region's added value in the Ústí Region, which confirms long-term focus on industry when compared to the other regions in Czechia. On the other hand, the example of the Moravia-Silesia Region with similar industrial and economic history shows a relative success of the economic transformation and implementation of a range of structural changes, which have brought new R&D activities and jobs in innovation-focused branches.

The economic restructuring of the Ústí Region with increasing innovation potential is important for the growth of the gross added value and therefore, competitiveness of the region. The differences seen among the regions overreach the regional dimension of the innovation environment and point to the attractiveness of the regions for seating of companies or for socioeconomic development of the regions. Therefore, mapping of the indicators requires long-term attention in further research of the innovation potential to assist in an improved view of the regional innovation strategy and the tools for support of the development of the innovation environment.

Tödttling and Trippl [2005] point out to the significance of the public policy, which should develop based on the communication of the regional stakeholders, and the definition of the integrated development priorities based on the endogenous potential of the regions. It is substantial to keep quality human resources for the development of the analyzed regions through the creation of suitable jobs, in particular innovation-focused companies will assist in branch restructuring of the regional economy. The main goal of the politicians should be the establishment of the environment for the dynamic development of the innovative eco-system across the region. From the long-term point of view, the competitiveness of the regions is seen as the decisive assumption for the success of Czechia in the new European and global economic relations.

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