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CHANGES IN THE NATURE OF INNOVATION PROCESSES AND INTERNATIONAL COMPETITIVENESS OF THE REGION AFTER THE COVID-19 CRISIS: THE CASE OF PODLASKIE VOIVODESHIP

Abstract. Technological structure arises as a consequence of innovation processes, encompassing R&D activities, implementations, as well as diffusion. Innovation processes influence technological competitiveness by linking changes in market shares at home and abroad with their technological potential. Increased productivity resulting from higher innovativeness combined with increased technological investments result in changes in relative unit operating costs and higher demand for more technologically advanced products, thus determining the dynamics of economic development.

The aim of this study is to analyse the course of determinants of innovation processes and the level of international competitiveness of regions after the COVID-19 crisis, including especially Podlaskie Voivodeship. Regions are classified into three types of exposure (low, medium, high) and crossed with three degrees of risk sensitivity for the regional economy. Podlaskie Voivodeship has medium exposure and lower sensitivity to pandemic crises. Regions with relatively high sensitivity and exposure to COVID-19 lockdowns were motivated to make greater changes in business processes. Podlaskie Voivodeship relies highly on foreign trade, which is why the COVID-19 crisis, the war in Ukraine and limited contacts with Poland's eastern border have negatively affected the region's innovation. The analysis shows that the establishment of competitive advantages based on the effects of COVID-19 crises should be expanded by regions with medium or high sensitivity to lockdowns.

Keywords: innovation, competitiveness, technology transfer, international trade.

Introduction

Obtaining a competitive position and the ability to maintain or improve it represent a pursuit aimed at higher efficiency in both tangible and human resources. This enables businesses to be more effective in terms of market

competition. Striving for a higher competitive position is characterised by the coherence of component factors and the synergy of effects, which are intended to yield benefits from the applied factors.

The paper focuses on the analysis of the evolution of the factors determining innovation processes in regions (such as policy, technology transfer, share of R&D expenditures, share of innovative firms and their involvement in R&D, etc.) and regional competitiveness. The article attempts to add to the literature on the role of innovation processes in creating competitive advantages at the regional level, during and immediately after economic crises. In contemporary times, regional systems are increasingly reliant on their capacity to generate technological development, resulting in economic entities' competition being fundamentally innovation-based.

Competitive Trends in Innovation Processes

International competitiveness is neither a uniform nor unambiguous economic category. It is the result of various approaches to its assessment and the consideration of a wide spectrum of determining factors. This term has a dual meaning, specifically relating to both the level of residents' prosperity (GDP *per capita*) and the trade activity of a given country. This allows for the delineation of four aspects of competitiveness (see Table 1).

Table 1

Aspects of international competitiveness according to J. Fagerberg, M. Knell and M. Srholec

Term	Meaning
Technological competitiveness	The ability to compete effectively in international markets for new goods and services, which is closely related to the level and dynamics of innovation within a given country.
Capacity and structural competitiveness	The ability to enhance human capital resources, develop information and communication service infrastructure, facilitate their diffusion, and create conducive institutional and social solutions to support it.
Cost competitiveness	The ability to compete in terms of costs and the prices of offered products, measured, among other things, by the levels of unit labour costs.
Competitiveness in terms of effectiveness in adapting to the import demand structure of partners	The ability to adjust production and export structures to the changing demand structure of imports in the global economy.

Source: (Misala, 2011, p. 72).

Gaining competitive advantages is closely linked to innovation capabilities and the efficiency of technology transfer. International technological capabilities are at the core of economic development in an open environment. From a business perspective, internationalisation is a necessary process, although it does not always have to yield only benefits. On the contrary, quite often, it is associated with the emergence of potential threats. This fact constitutes a significant argument in the debate not only on the process of globalisation but also on the possibilities of concentrating or dispersing activities that enhance the level of innovativeness (Freeman, Hagedoorn, 1995, p. 53–56; Howells, 1997, p. 15–17).

Internationalisation of innovation processes and participation in global technological competition are a necessity. This often takes place through transnational corporations, which create opportunities for global technological development, significantly enhancing the developmental prospects of economies and their level of competitiveness.

Currently, the essence of development lies in the efficient utilisation of intellectual capital and knowledge embodied in human capital, as well as in intangible assets. Furthermore, there is a pronounced spatial concentration of various types of economic activity (the 'sticky places' paradox), along with extensive economic openness, increased entrepreneurial cooperation (between companies and within them, between companies and institutions), as well as a growing number of strategic alliances.

Basing economic development on human factors has led to changes in innovation processes, making the scale of corporate spending on R&D activities and the ability to effectively transfer technology a crucial issue.

R&D activities make the development of various industries and businesses more dynamic, but they are not a universal means of enhancing an economy's potential. Sometimes, too much emphasis is placed on education and capital accumulation while overlooking the impact of other components of the innovation process (Mankiw, Phelps, Romer, 1995, p. 290). In the long term, technology transfer is the primary driver of technological development because it leads to increased productivity and enables faster technological convergence. As a result, the return on investment in innovation is more than twice as high as that on investment in physical capital. However, as demonstrated by the examples of certain Asian countries such as Japan and China, technology transfer is most effective in sectors where R&D expenditures are increasing. Furthermore, the synergy between the growth of R&D activities and effective technology transfer triggers diffusion processes, transferring effects to other countries participating in the international division of labour and providing opportunities for enhancing

their competitiveness (Hu, Jefferson 2004, p. 86–90; Jefferson, Hu, Guan, Yu, 2003, p. 89–93).

The level of economic development and the potential for innovation growth in individual economies determine the extent of their participation in global processes. Trade is linked to their level of development but also allows businesses and countries to advance to a higher level of technological sophistication by adapting new production methods, organisational practices, management techniques, products, or market development (the catch-up process).

Factors of Innovative Development in the Context of International Competition

A key element of any analysis concerning the diffusion of innovations and international technology transfer is to explain the ways, possibilities, and nature of knowledge and technology flow between companies from different countries. However, despite general estimates, the scale of technology transfer id difficult to measure and quantify, which creates analytical difficulties. The sensitive nature of such transactions is reflected in transfer pricing and profits, constituting an integral part of the overall economic system, which is often overlooked.

Traditional models of innovation processes depict technology transfer from national companies to their foreign subsidiaries, with the 'parent' companies reaping the greatest benefits from further process and product utilisation of the technology. The essence of such a process lies in the embodiment of technology (licenses, instructions, know-how), which subsequently translates into the outcomes of the entire innovation process.

The mechanism of technology delivery allows for a better understanding and learning of the innovation process, which, in turn, provides the opportunity to create long-term conditions for the operation of the "creating" company and the "receiving" enterprises. It is worth noting that what may be a new technology for a foreign subsidiary is not always new for a company as a whole. Furthermore, companies must be organisationally and technically prepared (in terms of qualifications) for the assimilation and adaptation of new solutions. If not, a situation may arise when mature technologies are more easily adaptable than new ones. Conversely, in companies prepared for technology transfer, the accumulation of experimental knowledge becomes simpler compared to the necessity of adjusting to new technologies.

Technology transfer provides opportunities for increasing innovation, but it requires appropriate preparation and the possession of the potential that allows for its effective adaptation. The most significant barriers to technology transfer include financial constraints, high technology implementation costs, risks that are higher than those in traditional sectors, access to market information, the appropriate level of qualifications and education of human capital, the possibility of achieving economies of scale, and access to intellectual property.

The pace of innovation and the level of competitiveness will accelerate when companies increase the transfer of "soft" technologies, which will positively impact the growth of competitive advantages in terms of utilising intangible technologies. The absorptive capacities of foreign subsidiaries must be strengthened to create opportunities for the development of received technologies. Organisational strategies of companies must shift from the transfer of existing technologies towards knowledge transfer and skill enhancement to increase research potential and reap developmental benefits (Lazonick, 1993, p. 18–19; Reich, 1992, p. 148–152).

Factors that influence the internationalisation of innovative processes are subject to change over time. Statistical data show that the importance of supply-side factors is clearly increasing, which will lead to constraints on the availability of highly skilled personnel in the research and development sector, as well as shortages of technical staff (Cantwell, 1999, p. 162–164). This is synonymous with a decrease in the importance of demand-side factors, which directly results from the "globalisation of product flows" and the reduced ability to adapt new technological products within local markets. It is worth noting that the engaging in innovation activities by large international corporations does not apply to many countries.

The significant increase in the foreign R&D activities of multinational corporations in recent years is an integral part of the changes in their strategies related to global competition. The new strategic approach involves a shift in the role of subsidiaries and their internal interdependencies (Pearce, 1999, p. 159–162). In the traditional approach, the scope of R&D conducted by foreign subsidiaries had to fit within the framework of bilateral relationships between the parent company and its subsidiaries. The modern approach involves various activities occurring within an independent network of mutual support. Entities comprising foreign R&D now provide a significant portion of the resources necessary for innovation, and importantly, their role is growing.

Transnational corporations employ various types of strategies, including ethnocentric, polycentric, global, and transnational ones (Rymarczyk,

1996, p. 75–79), to internationalise their operations and increase their benefits from innovation. Each strategy offers opportunities for more effective diffusion of innovative effects and also provides chances to acquire information and new knowledge regarding the directions of R&D activities. Aligning global market expectations with R&D operations reduces the risk in global expansion efforts.

Since multinational corporations began establishing their branches and subsidiaries abroad to adapt to new products or technological processes, a phenomenon which may be described as a reverse transfer of technology has been occurring. Foreign companies which receive innovations often send them back to the companies that had created them. The primary reason for foreign laboratories transferring such a large number of technologies back to their parent companies is the lack of long-term servicing and adaptation capabilities. Recipients of new technologies expect immediate opportunities to implement new solutions in products and processes, and if this does not happen, the transfer process may reverse direction (Ciborowski, 2003, p. 47).

The technological factor plays a decisive role in the processes of enhancing the competitiveness of economies, significantly influencing the nature and pace of development in highly developed countries by changing the production structure of industries and modernising them. Furthermore, it drives organisational changes in the industry structure, necessitating increased investment concentration in high-risk areas and enabling research and production in new organisational arrangements. It also facilitates the transfer of activities to the small and medium-sized enterprise sector and the creation of new competitive structures.

Such technology-driven impacts on competitiveness point to the increasing significance of microeconomic factors that influence flexibility, innovation, and adaptability to changing competitive conditions. Consequently, countries that create favourable conditions for the development and adaptation of technological progress through significant investments in R&D, the establishment of legal and regulatory infrastructure, and appropriate government policies, simultaneously foster the creation of competitive micro- and macroeconomic structures.

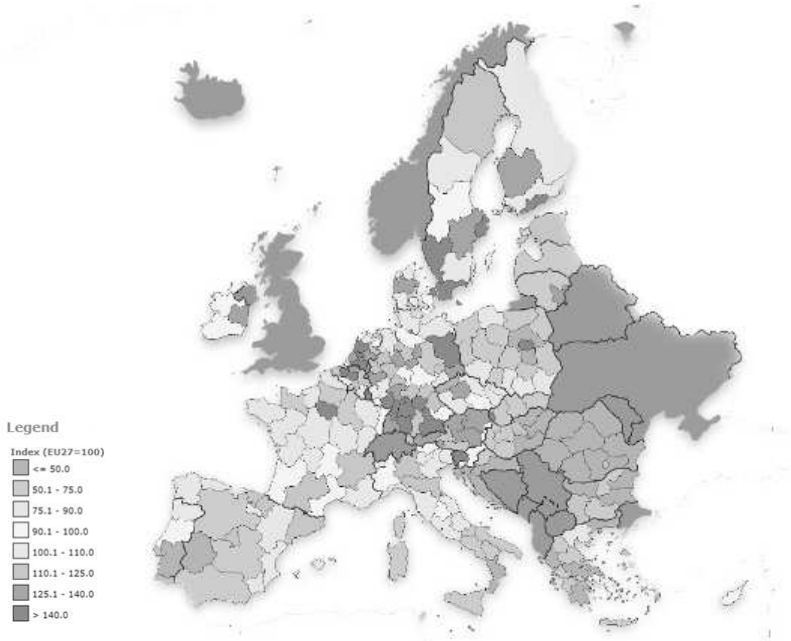
The scope and level of technological activity of multinational enterprises are determined by the economic potential of both the home country and the host countries. If a company originates from a highly developed country and expands its operations into an economy with a lower level of development, it results in the differentiation of innovative activities and specialisation according to local technological capabilities.

Innovative activities expand the realm of applied science. An increasing number of disciplines seem essential for the creation and development of innovations, leading to a growth in the sources of innovation both geographically (new countries) and functionally (greater collaboration with research units and other companies). The consequence of the dynamic development of the innovation environment for companies is stronger competitive pressure and growing demands on the research and development sphere.

Determinant Factors of Innovation and Competitive Potential of Podlaskie Voivodeship

Podlaskie Voivodeship is considered a less developed region with a low level of competitiveness, especially in terms of technology. Taking into account the RCI (European Regional Competitiveness Index) indicator, its position has improved by approximately 11 points between 2016 and 2022. However, the majority of RCI 2.0 components still remain below the average for Poland, Western European countries, and Scandinavian countries (see Map 1).

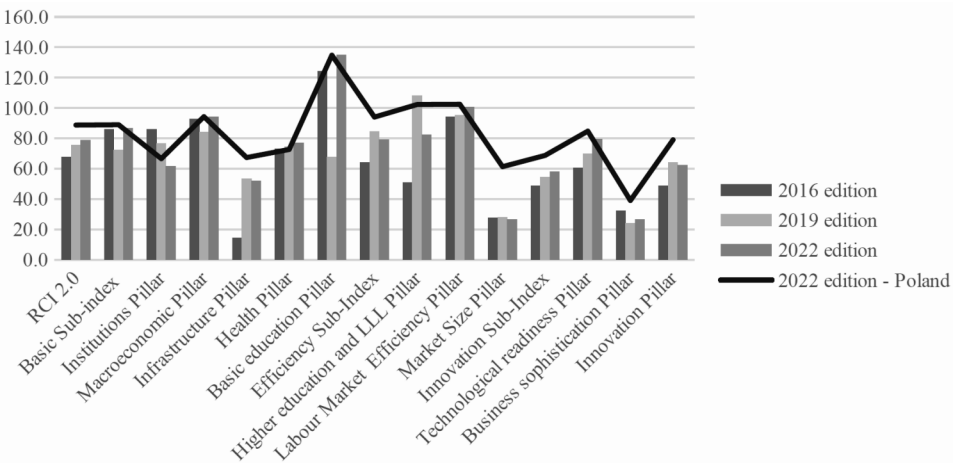
Map 1. EU Regional Competitiveness Index 2.0 (2022)



Source: (Dijkstra at al., 2023, p. 13).

Among the main components of the competitiveness index, the sub-index of efficiency is the lowest in the region, particularly in terms of market size, higher education, training, and lifelong learning. Low values indicate that the markets are relatively small, which reduces the benefits of economies of scale and their potential attractiveness for investment and innovation. In the 2022 edition of RCI 2.0, the position of higher education and lifelong learning had declined, negatively impacting economic growth and productivity. The assessment of infrastructure and innovation growth potential also remains relatively low (see Figure 1).

Figure 1. 2016–2022 RCI 2.0 editions according to sub-indexes and pillars in Podlaskie Voivodeship



Source: own analysis based on data from (European Commission, n.d.).

When evaluating the Regional Innovation Index (RII), Podlaskie Voivodeship, like most Polish regions (with the exception of Małopolskie Voivodeship and the Warsaw Capital Area), falls into the category of modest innovators. Solid institutional foundations that promote the creation and commercialisation of innovations should be the basis for the development of R&D activities. However, the low efficiency of the institutional framework in Poland results in relatively low assessments of both the country and the region's competitiveness and Innovation Input (Global Innovation Index).

The assessment of primary education in all Polish regions is favourable, exceeding the EU average. Podlaskie Voivodeship's strengths lie in the efficiency of its labour market and human capital, considered in terms of its well-being, health, and overall condition, particularly among the workforce.

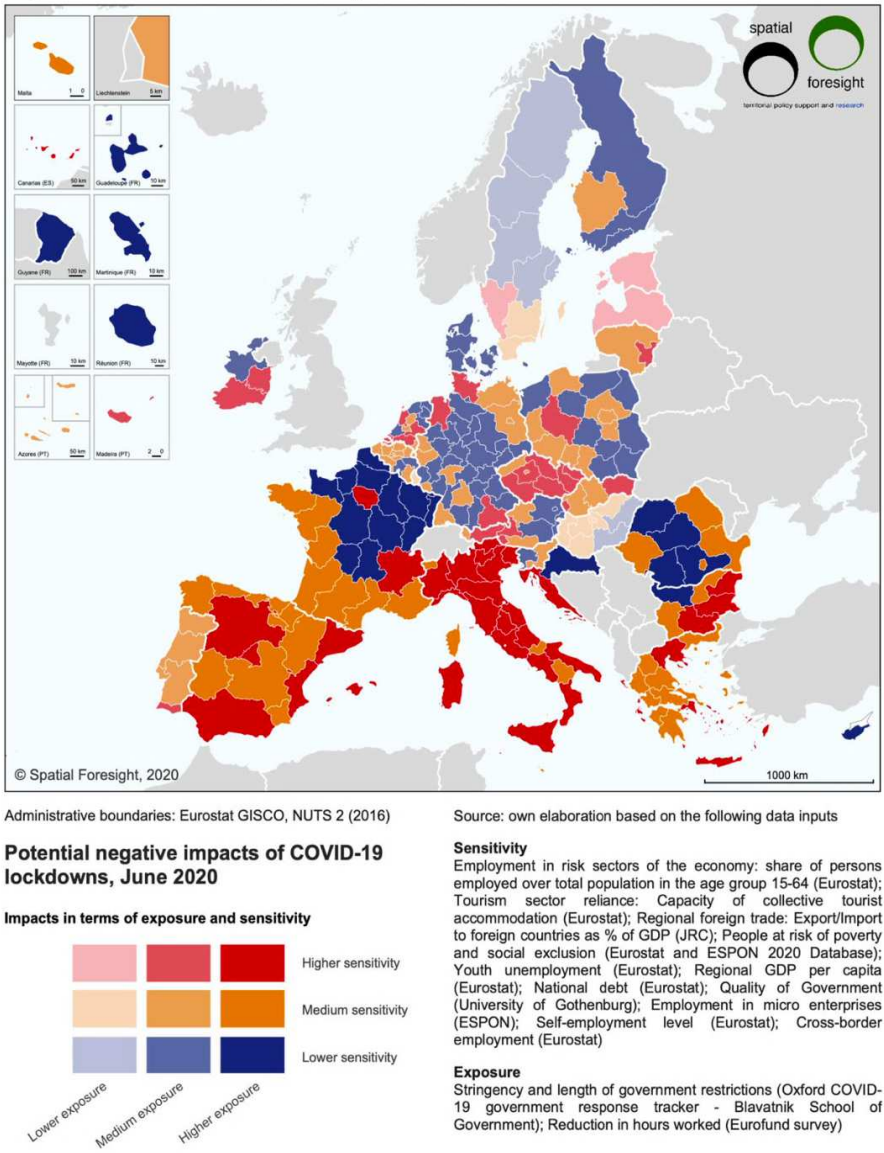
Additionally, it is worth noting that the level of technological readiness has improved in recent years, although the region's position still remains below the average for Poland and the EU.

Podlaskie Voivodeship specializes in agro-food and metal-machinery industries, the medical sector, eco-innovation and ICT (in conjunction with the core industries). Thus, it is important to consider how the industries affected by COVID-19. According to H. Stemmler's research, companies whose services were identified by the government as core (e.g., the food and beverage, coke and chemicals sectors) were less likely to report declines in sales and demand because they remained at least partially open and received preferential treatment. It is worth adding that the regional patterns of individual countries have some limitations, and the differences that occur are due to the different ways in which key companies in the sector are defined. On the other hand, companies that were not considered key in the pandemic (including tourism, accommodation and restaurant sector) needed stronger adaptive and innovative capabilities. Digitalization driven by the pandemic crisis caused companies considered non-key to change their business model and scope of operations. These activities have the potential to provide long-term benefits and be a source of innovative advantages in the future (Stemmler, 2022).

In summary, most of the specializations of the Podlaskie Voivodeship could be classified as key areas, which showed less vulnerability to declines during the crisis (excluding small companies), and at the same time did not have strong impulses for innovation growth.

One of the factors influencing regional innovation processes is the sensitivity of the economy to COVID-19 lockdowns. The analysis of European countries shows that most of them have regions with different sensitivities, creating very diverse regional patterns (see Map 2). Moreover, pandemic outbreaks and the impact of anti-crisis strategies are distinct phenomena with different territorial patterns. The three types of exposure are crossed with the three types of risk sensitivity for the regional economy. This allows for a comprehensive illustration of territorial diversity showing both exposure and risk, without suggesting which exposure influences which region's sensitivity. Map 2 and Map 3 illustrate the territorial diversity of possible impacts of policy responses to the crisis. However, each map is calibrated in terms of indicators and themes, which are recommended to be read separately. COVID-19 and policy responses have a multifaceted and complex impact on regional development. They reflect the high level of regional and local interdependencies in Europe, but cannot be explained by a single indicator. Stronger place-based policy responses should take into account

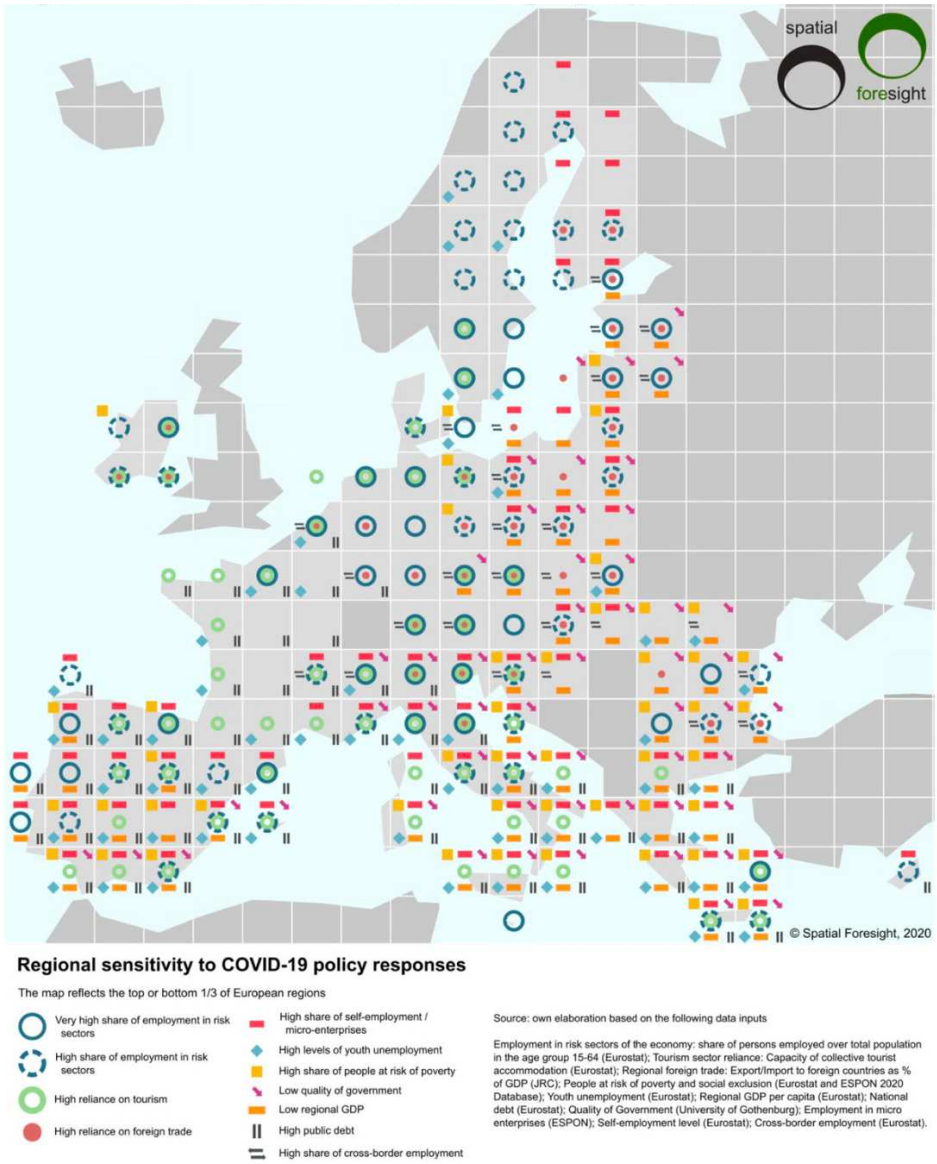
Map 2. Potential negative impacts of COVID-19 lockdowns



Source: (Böhme at al., 2020, p. 14).

the region's economy, structural challenges and social profile. This can affect the conditions for the formation of innovation processes differently. Regions with low innovation potential can have low, medium and high sensitivity to policy responses to the crisis (European Commission, 2020). This is

Map 3. Potential sensitivities to COVID-19 policy responses



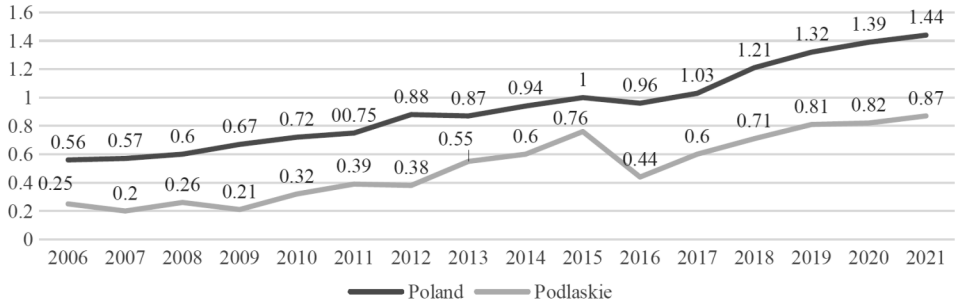
Source: (Böhme at al., 2020, p. 17).

evidenced by regions with high potential in innovation, research and development, which may be highly sensitive to crisis-related policy responses (such as Gothenburg or Oberbayern) or have low sensitivity (such as Copenhagen, Helsinki or Stockholm) (Böhme at al., 2020, p. 14–20).

Podlaskie Voivodeship is a region with medium exposure and lower sensitivity to COVID policies, which suggests that it has less potential to benefit. In a similar situation are other cohesion regions, such as: a large area of Spain, Portugal southern Italy, Bulgaria, Greece, Slovakia, Romania, Lithuania, the Czech Republic, individual regions in Hungary and eastern Germany (Böhme at al., 2020, p. 20). In contrast, the potential sensitivity to policy responses of the crisis in the Podlaskie Voivodeship has high reliance to foreign trade, high share of employment in risk sectors, high share of self-employment, low regional GDP and low quality of government (see Map 3). Due to the low relevance of tourism profile or share of cross border employment, the region was less exposed to the risk of political reactions. This implies that the impact of COVID-19 and consequently the potential sensitivity to addressed policy at the time was not an important determinant of innovation development. However, high reliance to foreign trade was a key factor in slowing down innovation processes, which after the pandemic crisis are sustained by the war in Ukraine and limited contacts with Poland's eastern border.

Investments in R&D activities in the region have consistently shown an upward trend since 2016. The COVID crisis, on one hand, slowed down economic processes, but on the other hand, it intensified demand and the need for research investments. The share of expenditures on R&D activities in regional GDP in 2021 increased by 0.05 percentage points (see Figure 2). According to data from the Central Statistical Office (GUS), the share of current expenditures on applied research and development work in relation to total current expenditures on R&D activities in Podlaskie Voivodeship is more than twice as low as in Poland as a whole. This combines issues of innovation gap and developmental distance, with the primary source of the problem being the region's concentration on basic research rather than the further stages of the innovation process.

Figure 2. R&D expenditures as a % of regional GDP



Source: own analysis based on data from (Statistics Poland, n.d.).

According to the development plan for entrepreneurship based on smart specialisation in Podlaskie Voivodeship for the years 2021–2027+ (RIS3 2027+), the directions for supporting innovation in the region are as follows (in connection with core industries): the medical sector and eco-innovations, agri-food and metal-machinery industries, as well as ICT. The indicated development profile aligns with regional smart specialisations (especially in the fields of medicine, eco-innovations, and given types of industries) and adapts to the new economic reality (VUCA, i.e. volatile, uncertain, complex, and ambiguous), which is based on advanced technologies.

Technology transfer in Podlaskie Voivodeship is supported by the institutional environment that includes, among others, technology and industrial parks (such as the Białystok Science and Technology Park, Podlaskie Industrial Park, Łomża Industrial Park, and the Poland-East Science and Technology Park in Suwałki) as well as higher education institutions (including the Technology Transfer Center for Pharmaceutical Technologies at the Medical University of Białystok Ltd., the Technology Transfer Office for Pharmaceutical Technologies at the Medical University of Białystok, the Institute of Innovation and Technology at Białystok University of Technology, and the Eastern Technology Transfer Centre at the University of Białystok).

Enterprises classified as high and medium-high technology during the first wave of the pandemic in 2020 had lower sales revenue than in the previous year, and in 2021, there was a slight improvement. However, these changes are relatively modest, and the overall share of net revenue in relation to Poland remains over three times lower. The export of innovative products in both Poland and Podlaskie Voivodeship has remained at a low level. In 2021, there was an increase in the regional export of innovative goods, but their level is still below that reported in 2018 or 2019 (see Table 2).

It is worth noting that the average share of innovative enterprises (in the total number of enterprises) in 2020 increased in the region by 137% compared to 2019, and in the following year, it decreased by 6 percentage points. The strongest increase in the number of innovative enterprises in 2020 was observed in the services sector (20.8 percentage points). However, innovative companies in this sector do not have a stable competitive position, as evidenced by fluctuations in previous years, hence one can expect a decline in their number in the post-COVID period (see Figure 3).

Among the percentage of companies significant for Industry 4.0, 34.5% of companies in Podlaskie Voivodeship have a research and development department in their organisational structure, 43.1% have a design and construction department, 77.6% have a distribution department,

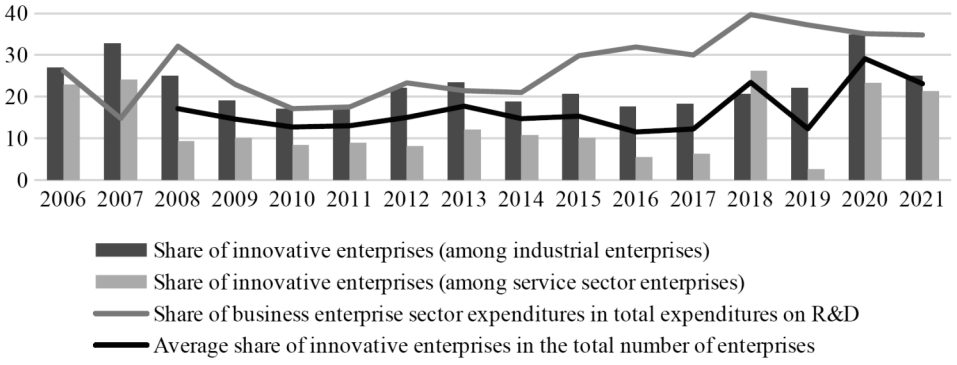
Table 2

Share of revenue from sales obtained by technological companies and from the export of innovative products

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Share of sales revenue from high-tech and medium high-tech enterprises with over 9 employees																
Poland	32.8	32.7	33.2	34.2	34.6	32.9	32.4	32.4	32.7	34.2	34.8	34.1	33.6	34.2	34.4	34.5
Podlaskie	7.2	7.7	9.8	10.3	11.2	13.2	13.9	11.3	10.6	10.9	10.2	9.8	10.3	10.1	9.7	10.3
Share of net revenues from sales of innovative products for export, in net revenues from sales of materials, goods and products in industrial enterprise																
Poland	5.3	5.6	5.2	3.9	4.9	4.2	4.4	4.7	4.4	5.4	4.8	3.7	4.4	4.3	4.8	4.2
Podlaskie	1.2	1.6	1.2	0.7	1.0	1.2	1.3	2.1	1.9	1.7	2.6	2.0	2.8	2.3	1.6	2.0

Source: own analysis based on data from (Statistics Poland, n.d.).

Figure 3. Innovativeness of enterprises in Podlaskie Voivodeship versus their engagement in R&D (%)



Source: own analysis based on data from (Statistics Poland, n.d.).

and 53.5% have a marketing department. In this regard, the region exceeds the national average, except for the category of design and construction departments. Furthermore, companies significant for Industry 4.0 in this voivodeship are among the those in Poland which most intensively use Big Data and Internet of Things analytics. Another major advantage is the high percentage of companies that allow customers to place individually composed orders (the region's result ranges from 18.8% to 22.3% of companies, while the Polish average is 17.5%). On the other hand, companies relevant to Industry 4.0 located in the region are among

those that least frequently use software for automatic information exchange (ERP), make the least use of cloud computing, and represent the smallest percentage of subcontractors for parts/components of machinery/equipment systems from other manufacturers (Statistics Poland, 2020, p. 53, 56, 69, 77).

Based on Central Statistical Office of Poland surveys, about 69.1% of industrial enterprises in the region reported no noticeable impact of the COVID-19 situation on their innovation activities. Negative impact was reported by 30.5% of respondents. The pandemic crisis forced changes in business operations, with 2.6% of companies in the region implementing new or significantly changed products and 4.0% implementing new or significantly changed business processes, which is a slightly stronger response than the national average (Statistics Poland, 2023).

Conclusions

The assessment of the research collaboration model between countries and companies highlights the tremendous importance of international markets for investments in R&D, knowledge, education, and engineering personnel. The contemporary market mechanism, the process of globalisation, and the necessity of using knowledge to enhance competitiveness lead to an increase in foreign direct investments in regions where significant research resources and suitable personnel are available. Hence, transnational corporations select countries such as Israel, China, or India for their operations. Unfortunately, most regions in Poland do not meet these criteria, and Podlaskie Voivodeship ranks at the bottom of the list of regions that create conditions for technological competitiveness.

Transnational corporations are increasingly identifying developing regions that meet the requirements for cost competitiveness, access to innovative factors, and the ability to create a global network of R&D connections. This is particularly evident in technology-related industries within the modern economic and technological model, such as microelectronics, biotechnology, and software. These corporations have also embarked on a significant expansion of their innovation activities beyond the borders of their home countries, often seeking research personnel abroad. Furthermore, there has been a clear increase in R&D costs, which has influenced the shape of the globalisation of technology and the search for better locations for their activities. Unfortunately, Podlaskie Voivodeship does not offer such opportunities, and in the long run, it may find itself en-

tirely excluded from the possibilities of creating conditions for innovative development.

Podlaskie Voivodeship as less developed region with a low level of competitiveness (especially in terms of technology) was characterized by lower sensitivity to both potentially negative and positive effects from COVID-19 lockdowns. R&D expenditures showed an upward trend, but the region's focus on basic research widened the innovation gap, contributing to the low level of competitiveness. In 2020, revenues from exports of innovative products decreased (in contrast to the national average) and, at the same time, there was a significant increase in the share of business expenditure on R&D. The region's technological readiness improved in 2021, but is still rated relatively low.

Podlaskie Voivodeship's specializations have noticed a slight boost in innovation, driven (in part) by greater openness and preferential policies aimed at companies considered as key to the economy. The COVID-19 crisis affected innovation processes with varying degrees of force depending on the specific characteristics of the regions. Regions can be classified into three types of exposure (low, medium, high) and crossed with three degrees of risk sensitivity for the regional economy. Podlaskie Voivodeship is a region with medium exposure and lower sensitivity to COVID crisis. This suggests that the impact of COVID-19, and thus the potential sensitivity to anti-crisis policies, was not an important determinant of innovation development in the region. However, for regions with relatively high sensitivity and exposure to COVID-19 lockdowns and politics, the crisis changed innovation processes (forcing an increase in digitization and changes in business processes), especially in non-key sectors (such as tourism). Podlasie's high dependence on foreign trade has been a key factor in slowing down innovation processes, which are being sustained after the pandemic crisis by the war in Ukraine and limited contacts with Poland's eastern border. In summary, the COVID-19 crisis had a varying impact on innovation processes, depending on territorial patterns and the sensitivity of regions to the effects of lockdown.

To identify changes in the nature of innovation processes, it is recommended to deepen the analysis of regions with medium or high sensitivity to the positive and negative effects of COVID-19 lockdowns. In addition, extending the question of vulnerability to lockdowns with the regions, which experienced an improvement in competitiveness between the 2019 and 2022 editions of the RCI, it would be worth exploring the case of the northern part of Italy, the Scandinavian regions and the peripheral areas of Spain.

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