PL ISSN 1897-2721

OLSZTYN ECONOMIC JOURNAL

20(1/2025)

Wydawnictwo
Uniwersytetu Warmińsko-Mazurskiego
w Olsztynie

Olsztyn Economic Journal is indexed and abstracted in:
BazEcon, BazHum, Central and Eastern European Online Library (CEEOL), EBSCO, Index Copernicus Journal Master List, POL-index, RePEc, The Central European Journal of Social Sciences and Humanities (CEJSH)

The Journal is also available in electronic form on the websites
https://czasopisma.uwm.edu.pl/index.php/oej
http://wydawnictwo.uwm.edu.pl (subpage Czytelnia)
http://www.uwm.edu.pl/wne/olsztyn-economic-journal

The print edition is the primary version of the Journal

PL ISSN 1897-2721
e-ISSN 2083-4675

Wydawnictwo UWM
ul. Jana Heweliusza 14, 10-718 Olsztyn
phone: 89 523 36 61, fax 89 523 34 38
www.uwm.edu.pl/wydawnictwo/
e-mail: wydawca@uwm.edu.pl

Publishing sheets 7,0; printing sheets 6,0; edition copies 22
Print – Zakład Poligraficzny UWM w Olsztynie, order number 549

TABLE OF CONTENTS

SPIS TREŚCI

OLSZTYN ECONOMIC JOURNAL
2025, 20(1), 5–16
ISSN 1897-2721 e-ISSN 2083-4675 DOI: 10.31648/oej.11114

ORIGINAL PAPER

APPLICATION OF ARTIFICIAL INTELLIGENCE IN LOGISTICS PROCESSES – A CASE STUDY OF MICHELIN POLAND LTD.

Dariusz Racz
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
e-mail: dariusz.racz@uwm.edu.pl

Klaudia Kucińska
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
e-mail: klaudia.kucinska@student.uwm.edu.pl

JEL Classification: L91, M11, O33.

K e y w o r d s: logistics management, digital transformation, automation, operational efficiency.

A b s t r a c t

This article focuses on analyzing the use of artificial intelligence (AI) in logistics processes using the example of Michelin Poland Ltd. The purpose of the paper is to assess the degree of application of AI technology in logistics and its impact on operational efficiency. The research includes a literature analysis, a survey of Michelin employees and an evaluation of the effectiveness of the implemented solutions. The results indicate that the implementation of AI has contributed to improving process efficiency, increasing the quality of work and reducing operating costs. Challenges to AI adaptation were also identified, such as high implementation costs and potential employee layoffs. The analysis confirmed that AI is a key component of logistics management strategies in the context of Industry 4.0, contributing to the company's competitiveness. The article underscores the importance of sustainably implementing AI technologies to maximize benefits and minimize risks, offering valuable lessons for logistics managers and researchers.

How to cite: Racz, D., & Kucińska, K. (2025). Application of Artificial Intelligence in Logistics Processes: a Case Study of Michelin Poland Ltd. *Olsztyn Economic Journal*, *20*(1), 5-16. https://doi.org/10.31648/oej.11114

ZASTOSOWANIE SZTUCZNEJ INTELIGENCJI W PROCESACH LOGISTYCZNYCH – STUDIUM PRZYPADKU MICHELIN POLSKA SP. Z O.O.

Dariusz Racz
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Klaudia Kucińska
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: L91, M11, O33.

S ł o w a k l u c z o w e: zarządzanie logistyką, transformacja cyfrowa, automatyzacja, efektywność operacyjna.

A b s t r a k t

W artykule skupiono się na analizie wykorzystania sztucznej inteligencji (AI) w procesach logistycznych na przykładzie przedsiębiorstwa Michelin Polska Sp. z o.o. Celem pracy jest ocena stopnia zastosowania technologii AI w logistyce oraz jej wpływu na efektywność operacyjną. Badania obejmują analizę literatury przedmiotu, badania ankietowe wśród pracowników Michelin oraz ocenę skuteczności wdrożonych rozwiązań. Wyniki wskazują, że wdrożenie AI przyczyniło się do poprawy efektywności procesów, zwiększenia jakości pracy oraz redukcji kosztów operacyjnych. Zidentyfikowano także takie wyzwania związane z adaptacją AI, jak wysokie koszty wdrożenia oraz potencjalne zwolnienia pracowników. Analiza pozyskanych danych potwierdziła, że AI stanowi główny element strategii zarządzania logistyką w kontekście Przemysłu 4.0, przyczyniając się do wzrostu konkurencyjności przedsiębiorstwa. W artykule podkreślono znaczenie zrównoważonego wdrażania technologii AI w celu maksymalizacji korzyści i minimalizacji ryzyk, zaoferowano cenne wskazówki dla menedżerów logistyki oraz badaczy.

Introduction

Logistics constitutes a key element of business operations, particularly in the context of supply chain management. The literature emphasizes that logistics encompasses a wide range of activities, including planning, implementing, and controlling the flow of goods and information. The primary goal of these processes is to meet customer expectations efficiently and sustainably (Setthachotsombut *et al.*, 2024, p. 1, 2; Aslam *et al.*, 2024, p. 1, 2). Modern enterprises utilize logistics not only as a tool for optimizing operational activities but also as a significant source of competitive advantage. Increasing attention is being devoted to integrating logistics with advanced technologies, which enable better coordination of activities and the reduction of operational costs (Wang *et al.*, 2024, p. 1-3).

In the era of dynamic development in information technology, data and information play a crucial role in supporting decision-making in logistics. As noted by Qin & Wan (2024, p. 84-86), precise collection, analysis, and distribution of information form the foundation of effective supply chain management. Artificial intelligence technologies offer new opportunities in this area, enabling more accurate demand forecasting, more efficient inventory management, and distribution process optimization. Consequently, businesses can make better-informed decisions while simultaneously reducing operational risk (Kaup *et al.*, 2024, p. 5506, 5507).

Logistics efficiency, as one of the key indicators of operational performance, plays a significant role in assessing the effectiveness of enterprise management. Measurement tools, such as stimulant, destimulant, and nominative indicators, allow for precise monitoring of changes in logistics processes and identifying value-adding activities (Dmuchowski, 2019, p. 92-94). In particular, the application of AI technology supports cost minimization, quality improvement of services, and increased productivity, which directly translates into better financial results and a stronger competitive position for the company.

Logistics also contributes to building sustainable management strategies, enabling enterprises to quickly adapt to changing market conditions. As Karim *et al.* (2024, p. 1-3) point out, the effective use of logistics not only reduces operational costs but also increases customer satisfaction and strengthens relationships with business partners. The implementation of modern technologies, such as artificial intelligence, further supports decision-making and optimizes operations at both the operational and strategic levels.

As Tjaden & Flämig (2024, p. 2, 3) note, artificial intelligence enables process automation, improving logistics management and eliminating errors. AI supports companies in digital transformation by automating processes related to transport planning, inventory management, and demand forecasting. Research confirms that the application of AI leads to increased efficiency, improved service quality, and reduced operational costs (Geary & Cosgrove, 2023, p. 395, 396). However, the process of implementing AI comes with challenges, such as high costs, the need for organizational restructuring, and concerns related to job losses (Demartini *et al.*, 2019, p. 265-268).

The aim of this study is to assess the degree of application of artificial intelligence technologies in logistics processes and analyze their impact on operational efficiency, using the example of Michelin Poland Ltd. To achieve this objective, the following research questions were formulated:

1. What are the benefits of applying artificial intelligence in logistics?
2. What barriers and challenges do enterprises face during the implementation of AI technologies in logistics?
3. What is the impact of AI implementation on operational efficiency and managerial decision-making in the studied enterprise?

The analysis provides practical insights that may be useful for enterprises considering the implementation of artificial intelligence technologies in logistics.

Research Methodology

The aim of this research is to assess the extent of artificial intelligence utilization in logistics processes at Michelin Poland Ltd. In particular, the study examined the impact of AI technologies on the company's operational processes and logistics management efficiency.

Michelin Poland Ltd. is one of the largest tire manufacturing plants in Europe, employing approximately 5,000 people. The company, located in Olsztyn, includes six production facilities and a Logistics Center, which served as the focus of this research. Established in 1967 as Olsztyńskie Zakłady Opon Samochodowych, the enterprise became part of the Michelin Group in the 1990s. Today, the company implements modern technologies, including AI, to meet global market demands.

The research was conducted using the direct interview method, employing a detailed questionnaire as the primary tool. The questionnaire was developed based on available literature and previous studies in this area (Idrissi *et al.*, 2024, p. 278, 279; Bhowmik *et al.*, 2024, p. 2, 3). It consisted of 22 questions, designed to address both general topics (e.g., types of AI technologies implemented, implementation timelines) and specific issues (e.g., barriers to adoption, outcomes of AI application, benefits, and risks).

The study was conducted between October 20 and November 22, 2022, at Michelin Poland Ltd., located in Olsztyn. The research sample included 25 respondents, all of whom were men. The majority of respondents were employed in managerial positions (68%), and most held higher education degrees (64%). The participants' work experience ranged from one to 15 years, with the largest proportion (56%) having between 5 and 10 years of experience.

Data were collected from individuals directly interacting with AI technologies in Michelin's Logistics Center. Respondents answered questions regarding the types of technologies used, motivations for implementation, barriers, benefits, and potential risks associated with AI use in logistics processes. The collected data were analyzed using Microsoft Excel, employing descriptive statistical methods such as arithmetic means and frequency analysis. Results were presented using bar and pie charts, as well as percentage distributions, providing a clear representation of the findings.

The methodological approach to the research allowed for the collection of comprehensive data on the implementation and use of artificial intelligence in logistics. The analysis results provide practical insights for enterprises planning to implement modern technologies in their operational processes.

Results

Reasons for and barriers to implementing AI

Artificial intelligence was implemented at Michelin Poland Ltd. to improve process efficiency, demand forecasting, and customer service. The primary reason for implementing AI, as identified by respondents, was to enhance workplace safety (76%) (Fig. 1).

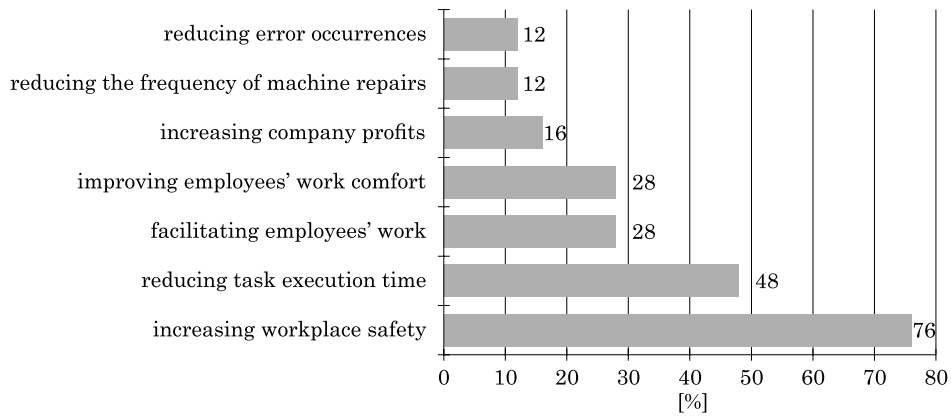


Fig. 1. Reasons for implementing AI in the enterprise (based on the percentage of respondents)
Source: own study based on research findings.

Another significant reason for AI implementation, noted by 48% of respondents, was the desire to optimize the time required for task execution. The least cited reasons for adopting AI were minimizing the frequency of machine repairs and reducing error occurrences, both identified by 12% of respondents.

An important issue associated with the implementation of artificial intelligence is the barriers to its adoption within the company. According to 76% of respondents, the most significant challenge is the insufficient competency of employees (Fig. 2).

The second most critical barrier is the lack of adequate knowledge regarding the implementation and optimization of AI-based technologies in the enterprise, as indicated by 20% of the respondents. The least significant barriers, according to respondents, were insufficient digital infrastructure and limited financial resources, both cited by 4% of respondents. According to Sumarlin & Kusumajaya (2024, p. 207, 208), the main challenges of implementing artificial intelligence in industry include integration with legacy systems, data privacy concerns, employee resistance, lack of training and infrastructure investment. This confirms the validity of the research results obtained.

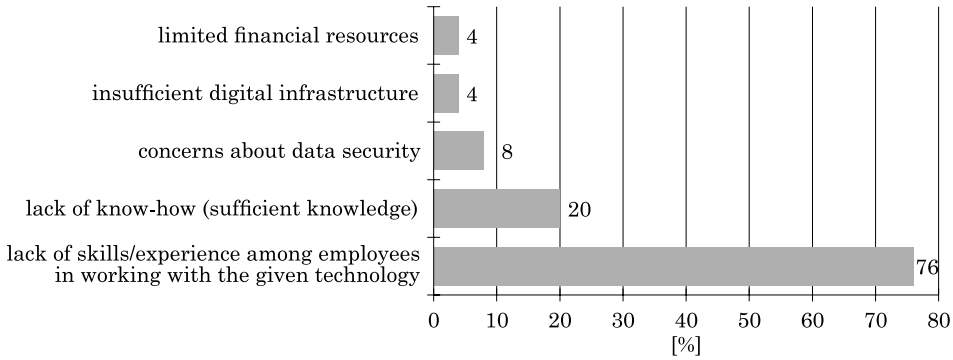


Fig. 2. Barriers in the process of AI implementation in the enterprise (based on the percentage of respondents)

Source: own study based on research findings.

The largest group of respondents (44%) stated that the first benefits of AI implementation became noticeable mainly a year after implementation (Fig. 3).

One in five respondents believed that the initial benefits of AI implementation in the company appeared within six months. Only 16% of respondents noticed benefits as early as one month after implementation, indicating that the adaptation of new technologies is a time-intensive process.

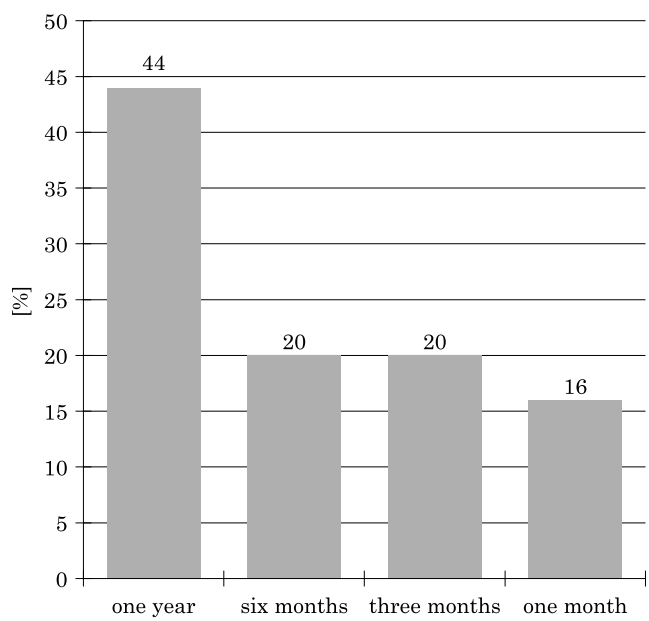


Fig. 3. Time after which the first benefits of AI implementation were observed in the enterprise (based on the percentage of respondents)

Source: own study based on research findings.

Benefits and risks of implementing AI

The research findings indicate that the most frequently reported benefit of AI implementation was the reduction in labor costs, highlighted by 84% of respondents (Fig. 4). This reduction stemmed not only from the automation of many tasks but also from the ability to maintain high work quality with lower costs associated with training and hiring new employees.

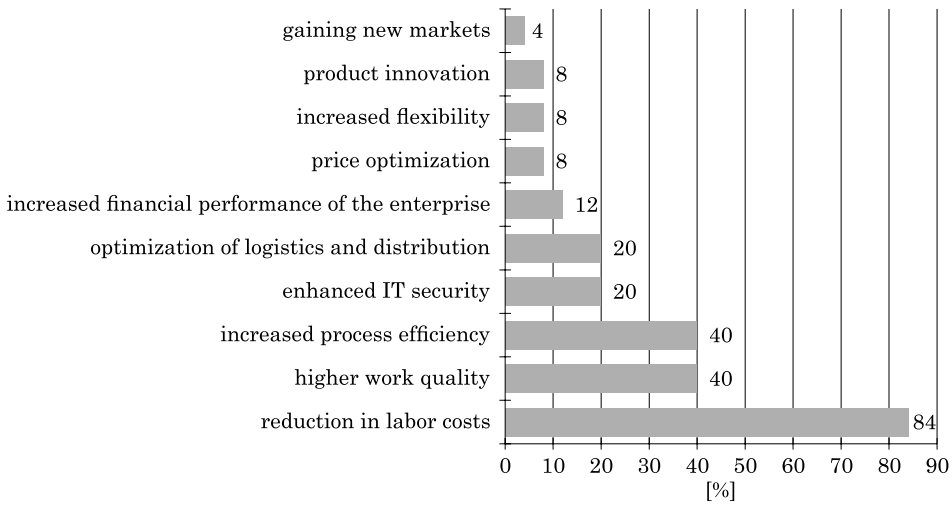


Fig. 4. Benefits resulting from AI implementation in the enterprise (based on the percentage of respondents)

Source: own study based on research findings.

Additionally, 40% of respondents observed increased process efficiency and improved work quality, indicating the positive impact of new technologies on operational activities. However, only 4% of respondents stated that the implementation of AI contributed to entering new markets, likely due to Michelin's already well-established position in the international market. According to Javaid *et al.* (2021, p. 84), artificial intelligence plays a key role in the successful implementation of Industry 4.0, improving product consistency, productivity and reducing operational costs through collaboration between robotics and humans.

The implementation of new technologies in enterprises also involves certain risks. As shown by the research findings (Fig. 5), 44% of respondents identified employee layoffs as the greatest threat.

Although the majority of respondents (44%) reported a low level of concern about job loss, those in lower organizational roles or lacking the necessary qualifications expressed greater anxiety. Other risks included weakened IT system security and reduced system flexibility, each cited by 19% of respondents.

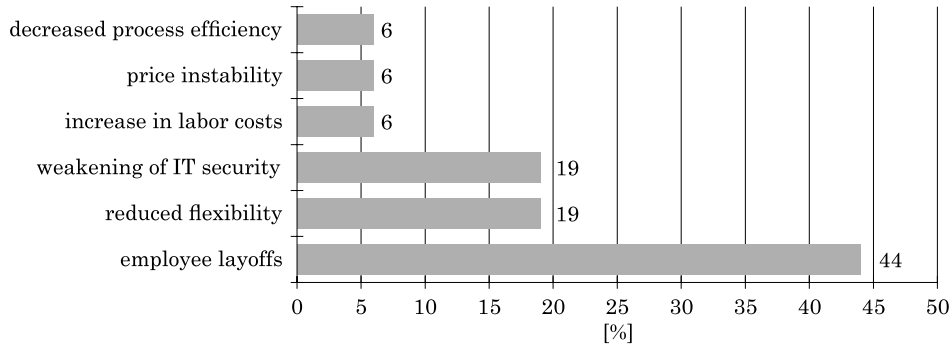


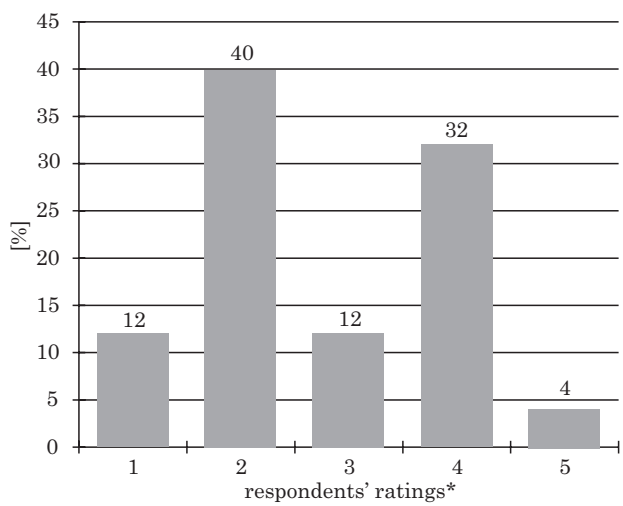
Fig. 5. Risks arising from AI implementation in the enterprise (based on the percentage of respondents)

Source: own study based on research findings.

While smaller groups of respondents noted increased labor costs (6%) or decreased process efficiency (6%), these risks were considered less significant compared to concerns about job stability.

Employees' attitude towards AI implementation

The collected data suggest that employee attitudes toward the implementation of AI were mostly negative. As many as 52% of respondents expressed a skeptical approach to new technologies (Fig. 6).



* the scale used: 1 – very poor, 2 – poor, 3 – moderate, 4 – good, 5 – very good

Fig. 6. Employees' attitudes toward AI implementation in the enterprise (based on the percentage of respondents)

Source: own study based on research findings.

This skepticism may stem from a lack of knowledge about how AI functions and fears of changes in job responsibilities. Only 48% of respondents had a positive attitude (a score of 3 or higher), highlighting the need for greater managerial involvement in educating and preparing employees to work with new systems. Research by Vogel *et al*. (2023, p. 143, 144) confirms that employees without AI experience tend to reject the technology due to fear of consequences and other factors, which calls for retraining and making employees aware of AI's usefulness.

Conclusions

The implementation of artificial intelligence at Michelin Poland Ltd. has brought significant benefits in both operational efficiency and the quality of logistics process management. The main reasons for implementing AI, as indicated by respondents, included improving workplace safety and optimizing task execution time. This highlights the critical role of AI in enhancing operational standards and responding to the needs of a dynamically changing business environment.

One of the most important advantages of AI implementation was the reduction in labor costs, achieved through process automation and increased operational efficiency. AI also positively influenced work quality, underscoring its role as a tool for supporting both productivity and innovation within the company. At the same time, it was observed that AI implementation rarely led to the acquisition of new markets, likely due to the company's stable and established position in the international market.

The process of implementing AI faced significant barriers, such as insufficient employee competencies and a lack of knowledge about new technology implementation. This underscores the need for investments in training and the development of skills related to AI management and utilization. Infrastructure deficiencies and limited financial resources were considered less significant obstacles, suggesting that organizational and educational aspects of AI implementation are critical to the success of the transformation process.

Despite the overall success of AI implementation, certain risks emerged, including employee concerns about job loss. The negative attitude of some team members toward new technologies was primarily driven by a lack of knowledge and uncertainty about how AI would affect their daily responsibilities. Therefore, it is essential to introduce measures to support team adaptation to these changes, such as transparent communication and the implementation of training programs.

In summary, the implementation of AI at Michelin Poland Ltd. has brought many benefits but also posed challenges. The key takeaway is the necessity of a balanced approach to adopting new technologies that considers both technological development and employee needs. Investments in skill development,

education, and transparent change management are essential to maximizing the benefits and minimizing the risks associated with technological transformation.

Limitations and Recommendations for the Future

The primary limitation of this study is the small and homogeneous sample, which consisted of 25 male respondents from one organization, Michelin Poland Ltd. This narrow scope limits the generalizability of the results, as it does not adequately account for the diversity of experiences across industries, regions or demographic groups. In addition, focusing on one company limits the contextual scope, potentially overlooking differences in how artificial intelligence technology is implemented and perceived in different organizational environments.

To address these limitations, future research should include larger and more diverse samples, including respondents from different industries and regions to increase representativeness. Comparative studies across multiple companies or sectors could also provide valuable insights into broader trends in artificial intelligence deployment. Moreover, exploring strategies to overcome barriers, such as insufficient employee skills and high implementation costs, would add practical value. Longitudinal studies to assess the long-term impact of AI and taking into account local contextual references, particularly in Poland, would also enrich the relevance of future research for national stakeholders. By addressing these areas, future research can provide more comprehensive and practical insights into the role of AI in logistics.

Translated by Authors

References

Aslam, J., Lai, K., Kim, Y.B., & Treiblmaier, H. (2024). The Implications of Blockchain for Logistics Operations and Sustainability. *Journal of Innovation & Knowledge*, *9*(4), 100611. https://doi.org/10.1016/j.jik.2024.100611.

Bhowmik, O., Chowdhury, S., Ashik, J.H., Mahmud, G.I., Khan, M. M., & Hossain, N.U.I. (2024). Application of Artificial Intelligence in Reverse Logistics: A Bibliometric and Network Analysis. *Supply Chain Analytics*, *7*, 100076. https://doi.org/10.1016/j.sca.2024.100076.

Demartini, M., Evans, S., & Tonelli, F. (2019). Digitalization Technologies for Industrial Sustainability. *Procedia Manufacturing*, *33*, 264-271. https://doi.org/10.1016/j.promfg.2019.04.032.

Dmuchowski, R. (2019). Pomiar rentowności w zarządzaniu łańcuchem dostaw. *Kwartalnik Naukowy Uczelni Vistula*, *4*(62), 103-104. https://doi.org/10.34765/kn.0419.a08.

Geary, R., & Cosgrove, J. (2023). Manufacturing Reliability and Cost Improvements through Data Analytics: An Industry Case Study. *Procedia Computer Science*, *217*, 395-402. https://doi.org/10.1016/j.procs.2022.12.235.

Idrissi, Z.K., Lachgar, M., & Hrimech, H. (2024). Blockchain, IoT and AI in Logistics and Transportation: A Systematic Review. *Transport Economics and Management*. https://doi.org/10.1016/j.team.2024.09.002.

Javaid, M., Haleem, A., Singh, R.P., & Suman, R. (2021). Artificial Intelligence Applications for Industry 4.0: A Literature-Based Study. *Journal of Industrial Integration and Management*, *7*(1), 83-111. https://doi.org/10.1142/s2424862221300040.

Karim, M.R., Dulal, M., Sakila, F., Aditi, P., Smrity, S.J., & Asha, N.N. (2024). Analyzing the Factors Influencing Sustainable Supply Chain Management in the Textile Sector. *Cleaner Logistics and Supply Chain*, *13*, 100183. https://doi.org/10.1016/j.clscn.2024.100183.

Kaup, M., Wiktorowska-Jasik, A., Smacki, A., & Baszak, K. (2024). Information Systems and Technologies Supporting Decision-Making Processes in Logistics Companies. *Procedia Computer Science*, *246*, 5506-5515. https://doi.org/10.1016/j.procs.2024.09.699.

Qin, L., & Wan, K. (2024). Real-Time Tracking System for Distribution Information of Logistics Enterprises Based on IOT Technology. *Procedia Computer Science*, *243*, 84-91. https://doi.org/10.1016/j.procs.2024.09.012.

Setthachotsombut, N., Sommanawat, K., & Sua-Iam, G. (2024). Logistics Business Management of Provider in Thailand with Smart Logistics. *Journal of Open Innovation Technology Market and Complexity*, *10*(4), 100422. https://doi.org/10.1016/j.joitmc.2024.100422.

Sumarlin, T., & Kusumajaya, R.A. (2024). AI Challenges and Strategies for Business Process Optimization in Industry 4.0: Systematic Literature Review. *Journal of Management and Informatics*, *3*(2), 195-211. https://doi.org/10.51903/jmi.v3i2.25.

Tjaden, S., & Flämig, H. (2024). What May Automation Cost? Activity-Based Costing for Autonomous Transport in Urban Logistics. *Transportation Research Procedia*, *79*, 84-91. https://doi.org/10.1016/j.trpro.2024.03.013.

Vogel, M., Strina, G., Said, C., & Schmallenbach, T. (2023). The Evolution of Artificial Intelligence Adoption in Industry. *AHFE International*. In: T. Ahram, J. Kalra & W. Karwowski (Eds.). Artificial Intelligence and Social Computing. AHFE (2023) International Conference. *AHFE Open Access*, *72*. AHFE International, USA. https://doi.org/10.54941/ahfe1003282.

Wang, Z., Gao, L., & Wang, W. (2024). The Impact of Supply Chain Digitization and Logistics Efficiency on the Competitiveness of Industrial Enterprises: Empirical Data from Chinese Listed Companies. *International Review of Economics & Finance*, *97*, 103759. https://doi.org/10.1016/j.iref.2024.103759.

OLSZTYN ECONOMIC JOURNAL
2025, 20(1), 17–31
ISSN 1897-2721 e-ISSN 2083-4675 DOI: 10.31648/oej.10454

ORIGINAL PAPER

DETERMINANTS OF THE COMPETITIVENESS OF THE WARMIŃSKO-MAZURSKIE VOIVODESHIP

Magdalena Wojarska
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0002-4594-5863
e-mail: magdaw@uwm.edu.pl

Dominika Kopeć
Student of Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
e-mail: dominika.kopec@student.uwm.pl

JEL Classification: R11, C29.

Key words: competitiveness, determinants of competitiveness, Warmińsko-Mazurskie voivodeship, Hellwig metric, multiple regression.

Abstract

The aim of this study has been to identify the factors that have the strongest impact on the competitiveness of regions, with the focus on the Warmińsko-Mazurskie voivodeship. To achieve the aim, the linear ordering method developed by Z. Hellwig (1968) was employed, serving to build competitiveness indices (CI) for each voivodeship in Poland. The analysis included a division into competitive performance (measured with the GDP per capita) and competitive potential (analysed with the use of the Porter's Diamond Model). Competitiveness determinants were identified with the help of multiple regression. The study results indicate that the Warmińsko-Mazurskie voivodeship had the lowest competitive performance and competitive potential in Poland. Although most of the analysed indicators increased in years 2014-2022, and the competitiveness index showed the highest growth dynamics (63.72%), this region persistently remained at the bottom of most ranking lists. As for innovations in production, it occupied the penultimate position, scoring the lowest in terms of demand factors and business environment, and ranking third from the bottom in respect of support and associated branches. Additionally, using the regression model, it was determined that the competitive position of Polish voivodeships was most strongly affected by the level of innovativeness, followed by the business environment.

How to cite: Wojarska, M., & Kopeć, D. (2025). Determinants of the Competitiveness of the Warmińsko-Mazurskie Voivodeship. *Olsztyn Economic Journal*, *20*(1), 17-31. https://doi.org/10.31648/oej.10454

DETERMINANTY KONKURENCYJNOŚCI WOJEWÓDZTWA WARMIŃSKO-MAZURSKIEGO

Magdalena Wojarska
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Dominika Kopeć
Studentka Wydziału Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: R11, C29.

S ł o w a k l u c z o w e: konkurencyjność, determinanty konkurencyjności, województwo warmińsko-mazurskie, miara Hellwiga, regresja wieloczynnikowa.

A b s t r a k t

Celem artykułu była identyfikacja czynników najsilniej oddziałujących na konkurencyjność regionów, ze szczególnym uwzględnieniem woj. warmińsko-mazurskiego. Czynniki identyfikowano metodą porządkowania liniowego autorstwa Z. Hellwiga (1968) – zbudowano indeksy konkurencyjności (CI) poszczególnych województw. W analizie zastosowano podział na konkurencyjność wynikową (ocenioną za pomocą PKB na mieszkańca) i czynnikową (analizowaną modelem rombu Portera). Determinanty konkurencyjności zidentyfikowano za pomocą regresji wieloczynnikowej. Z wyników badania wynika, że woj. warmińsko-mazurskie charakteryzowało się najniższym poziomem konkurencyjności, zarówno wynikowej, jak i czynnikowej. Mimo że w latach 2014-2022 wartości większości wskaźników wzrosły, a dynamika indeksu konkurencyjności była najwyższa (63,72%), region plasował się w końcówce większości rankingów. W obszarze innowacyjności w procesach produkcji zajmował przedostatnią pozycję, w obszarach warunków popytowych oraz środowiska biznesu ostatnią, a w obszarze branż wspierających oraz powiązanych trzecią od końca. Dodatkowo za pomocą modelu regresji ustalono, że na pozycję konkurencyjną województw najsilniej wpływa poziom innowacyjności, a następnie otoczenie biznesu.

Introduction

Contemporary regions operate in a volatile environment, making their ability to respond quickly and adequately to the effects of economic, environmental, and social crises a key determinant of development and competitiveness. A significant challenge also lies in dynamic technological changes that contribute to the devaluation of resource-based and traditional industries – those that, in past centuries, determined the wealth of many regions (Korenik, 2023, p. 33). This is because digital transformation strongly influences changes in socioeconomic development factors, emphasizing specific endogenous resources of a qualitative nature while minimizing the importance of traditional factors.

Under these conditions, improving regional competitiveness requires a unique combination of resources such as innovation and creativity, knowledge, technology, history and culture, tolerance, social networks, trust, responsibility, etc. Investments in efficient and affordable digital infrastructure, as well as in human capital with relevant competencies, are also essential. Consequently, the scientific and technological revolution presents numerous challenges for less developed regions, particularly in strengthening their technological and innovation capacities and improving the quality of institutions. Their low competitiveness in the digital economy is rooted, among other things, in formal and informal ties between actors, historical trajectories that influence the richness of experience and tacit knowledge, and their position in foreign markets (Łaźniewska, 2022, p. 53, 138, 153).

The competitiveness of regions is a widely discussed topic in the literature. Between 1992 and 2024, the Web of Science database contained 280 publications with the keyword 'regional competitiveness' and as many as 685 publications in which this term appeared in the abstract. The importance of the issue is also evidenced by a high number of reported studies and ranking lists. Among the latter, the EU Regional Competitiveness Index (RCI), developed by the European Commission, and the Global Competitiveness Report, published by the World Economic Forum, are best known metrics.

The multidimensional and unequivocal understanding of regional competitiveness means it has been impossible to elaborate a specific set of factors, indicators or variables serving to make an empirical assessment of this phenomenon. Particular regional competitiveness factors can only be described with a set of its characteristics (Gołębiewski & Podlińska, 2015, p. 18). Considering the above, the objective of this article has been to identify factors with the strongest impact on the competitiveness of regions, with the focus on the warmińsko-mazurskie voivodeship. To achieve this aim, the linear ordering method developed by Z. Hellwig (1968) was employed to build competitiveness indices for all Polish voivodeships. An approach based on the Porter's Diamond Method was chosen to select variables. Afterwards, with the help of multiple regression, groups of factors with the strongest impact on competitiveness were identified.

Literature Review

The term 'competitiveness' entered the terminology of economic sciences in the 1980s, mainly owing to the research done by M. Porter (Łaźniewska & Chmielewski, 2012, p. 15), and the principal stimulus to undertaking studies in this area were the discrepancies between the economic theory and market reality (Kuberska *et al.*, 2020, p. 1336). Although competitiveness is now considered one of the paradigms of contemporary scientific thought, we still lack a single,

comprehensive theory comprising all aspects and dimensions of competitiveness (Karman *et al*., 2022, p. 31). The literature dealing with this concept provides a multitude and diversity of interpretations (cf. Bieńkowski *et al*., 2008). At present, competitiveness is analysed on three basic levels, i.e. macro-economic (competition among countries), meso-economic (competition among branches/sections of national economy and/or among regions), and micro-economic level (competition among companies) (Szczech-Pietkiewicz, 2019, p. 70). This division can be further refined by adding successive levels, e.g. meta- (competitiveness of future states), mega- (competitiveness of international economies) and micro-economic ones (competitiveness of commodities and services) (Borowiecki & Siuta-Tokarska, 2015, p. 53).

The ambiguity of interpretations and the varied conceptual scope also apply to regional competitiveness. The analysis of definitions coined by a number of authors which was made by Czyżewska (2012, p. 205-207) suggests that competitiveness is most often assigned such attributes as investment attractiveness, adaptability of changing socio-economic conditions, economic strength, success of regions in competing with other regions, or the ability to create new conditions for development. Definitions of regional competitiveness emphasise the importance of the ability to create conditions based on local resources that favour innovation and development of entrepreneurship. Such conditions should encourage potential investors to locate capital in a given region, thereby contributing to its greater competitiveness (Hyski & Chudy-Hyski, 2023, p. 16, 17). It is in this spirit that Annoni & Dijkstra (2019, p. 3) defined competitiveness, maintaining that this is the capability of a region to offer an attractive and sustainable environment for businesses and inhabitants to live and work in. González Catalán (2021, p. 19) after Storper (1997) viewed regional competitiveness as the ability of a given economy to attract and retain companies with stable or increasing shares in the market, while maintaining or improving the standard of living for those who participate in it. Smart companies, which manage better than others in terms of technological breakthroughs, social and cultural issues, in addition to which competing more successfully and developing in a way that is sustainable to the natural environment, play a special role in strengthening regional competitiveness (Adamik & Sikora-Fernandez, 2021, p. 1572).

To summarise the definitions found in the literature, regional competitiveness can be described as the ability to create high social prosperity owing to the economic development and scientific and technological progress (Ginevičius *et al*., 2023, p. 38). Competitiveness is a dynamic category inextricably linked to economic growth, development, and progress. A new dimension of competitiveness is digital competitiveness, which encompasses various factors of the digital transformation process. This issue is gaining increasing importance as a source of competitive advantage both at the enterprise level and for national economies (Grynia, 2022, p. 19, 22, 23). It means that regional competitiveness

is increasingly based on creativity, knowledge, and environmental conditions rather than accumulated wealth (Łaźniewska, 2022, p. 128). The competitiveness of regions is a product of mutually related factors, acting in different directions and with different intensities (Karman *et al*., 2022, p. 38). These factors can be classified in a number of ways, taking into account different criteria applied to the given economy or its environment (cf. Rubaj, 2019; Szczech-Pietkiewicz, 2019; Kouskoura *et. al*., 2024; Encarnacion *et al*., 2023; Shastitko, 2009; Grassia *et al*., 2024; Huggins *et al*., 2014).

One of the best known and universal sets of competitiveness attributes is the one proposed by M.E. Porter (cf. Ayon Ponce *et al*., 2024; Erboz, 2020; Zeibote & Muravska, 2018; Estevão *et al*., 2018; Zeibote *et al*., 2019; Kot & Kraska, 2018). The so-called Porter Diamond is composed of four interrelated determinants that – on a microeconomic level – decide about a national competitive advantage. These are: factor conditions (refer to a nation's resources necessary for competitiveness in a specific industry, such as skilled labour and infrastructure), demand conditions (involve the characteristics of domestic market demand for the products or services of that industry), related and supporting industries (encompass the existence of competitive supplier industries and other associated sectors within the nation), firm strategy, structure, and rivalry (pertain to the regulations and environment that influence how companies are established, organized, and managed, as well as the nature of competition among domestic firms) (Porter, 1990, p. 77). All these elements of the model are affecting one another (Cetin & Erkisi, 2023, p. 21). In order to enhance this model, it is frequently expanded by adding two other elements, i.e. the government and random events. Through its actions, the government has a positive or negative effect on the other elements. For example, it can affect the quality and availability of production factors by allocating more funds to higher education; it can stimulate the domestic demand by public procurement; or it can influence companies' competitive strategies through laws regulating competition. Likewise, random events (e.g. war, natural disasters, scientific breakthroughs), although difficult to predict, also affect (positively or adversely) the other elements of the model (Radło, 2008, p. 8, 9).

During the identification of competitiveness attributes, a significant role is played by the three stages of economic development, proposed by M.E. Porter. Each stage has different competitiveness determinants assigned to it. In an economy based on production factors, the most important are their costs and availability. In an economy reliant on investments, efficiency is the key determinant of competitiveness. And in the final stage, in an innovation-based economy, the main source of competitiveness are knowledge and innovativeness (Sokołowska-Woźniak, 2005, p. 189).

At present, regional competitiveness is to a large extent dependent on knowledge-based factors. Business activity conducted in this manner creates a basis for 'being attractive in space' and for further development. The key factor is therefore the proximity to the science sector, which stimulates the

flow of knowledge to companies. An example is the impact of the presence of universities on the growth of innovativeness of regions (Łaźniewska, 2013, p. 28, 29). In addition, regional competitiveness largely relies on the rareness and uniqueness of resources. Moreover, in any discussion of competitiveness attributes of regions, it is important to bear in mind that these factors change with time (Czyżewska, 2012, p. 217).

Research Methodology

In the following analysis, the authors included the division into competitive potential and competitive performance. Competitive performance shows the effects of competition, while competitive potential is determined by all broadly understood resources a given country possesses. These resources create the economy's competitive capacity and determine its ability to compete (Grynia, 2018, p. 33, 34). Competitive performance was assessed according to the GDP per capita while competitive potential was evaluated with the use of Porter's Diamond Model. The latter led to a distinction of four groups of determinants of regional competitiveness. Due to the high degree of inertia in regional processes, identifying the factors that may influence regional competitiveness at a given moment or over a specific period is complex and depends on the availability of statistical data necessary for conducting an appropriate analysis (Kot & Kraska, 2018, p. 152). Considering the data resources provided by Statistics Poland, Porter's Diamond Model has been adapted to Polish conditions using the modifications proposed by Strahl (2006, p. 102-104) and Kot & Kraska (2018, p. 153, 154). The final set of variables selected for the analysis is shown in Table 1. All the determinants set in observation matrices were characterised by the variability exceeding 10%.

For the determination of the level of competitiveness of the warmińsko-mazurskie voivodeship, one of the most commonly used linear ordering methods was employed, namely the method proposed by Hellwig (1968), called the economic development metric. This procedure enables the user to order a set a variables according to a synthetic index[1], which is created by the aggregation of normalised[2] input variables. Among others, a detailed discussion of the calculation procedure can be found in the publication by Roszko-Wójtowicz & Grzelak (2019, p. 17, 18).

[1] The aggregate metric was determined from the formula: $CI_i = 1-[c_{i0}/(\bar{c}_0 +2S_0)]$, where: CI_i – Competitiveness Index, c_{i0} – distance of a voivodeship from the model, $\bar{c}_0$ – average distance of voivodeships from the model, S_0 – standard deviation of the distance of voivodeships from the model.

[2] Normalisation of data was achieved through standardisation described with the formula: $z_{ik} = (x_{ik} - \bar{x}_k)/S_k$, where: z_{ik} – standardised value of k-th variable in i-th unit, x_{ik} – value of k-th variable in i-th unit, $\bar{x}_k$ – arithmetic mean of k-th variable, S_k – standard deviation of k-th variable.

Table 1

A set of variables used in the analysis

Competitiveness sub-area	Symbol of the variable	Name of the variable
Innovativeness in production processes	X_1	share of inputs into innovative activity in companies in total national inputs
	X_2	average share of innovative companies in total number of companies
	X_3	inputs into innovative activity in companies relative to the GDP
	X_4	inputs into innovative activity in companies per 1 working person
	X_5	internal inputs into R&D activity in the region
	X_6	higher education graduates and students per 10,000 population in the region
	X_7	share of companies which have collaborated in the field of innovative activity in % of total industrial companies
	X_8	share of sold production of new/improved products in industrial companies in value of total sale of all products
	X_9	investment inputs in the public sector per 1 inhabitant
	X_{10}	investment inputs in the private sector per 1 inhabitant
Demand conditions	X_{11}	average monthly expenses per 1 person in a household (in PLN)
	X_{12}	average monthly spending on education per 1 person in a household (in PLN)
	X_{13}	beneficiary of community social assistance per 10,000 population
	X_{14}	registered unemployment rate
	X_{15}	share of net revenues from sales of innovative products in total net sale revenues (in %)
	X_{16}	gross added value per 1 working person in the region (in PLN)
Supporting and related branches	X_{17}	contribution of the voivodeship in creating the country's gross added value (in %)
	X_{18}	share of net revenues from exporting innovative products in the net revenues from total sale of products (in %)
	X_{19}	number of business entities registsred in the REGON system per 10,000 population
	X_{20}	business environment institutions per 10,000 business entities
	X_{21}	natural persons conducting business activity per 10,000 population
Business environment	X_{22}	share of the national economy entities with the contribution of foreign capital in the total number of business entities registsred in the REGON system
	X_{23}	total length of active sewerage network in km per 100 km^2
	X_{24}	total length of active gas network in km per 100 km^2
	X_{25}	total length of active water supply distribution network in km per 100 km^2
	X_{26}	hard-surfaced roads per 100 km^2
	X_{27}	share of foreign capital located in business entities seated in the voivodeship in the total value of foreign capital located in Poland

Source: developed by the authors, based on Statistics Poland (GUS), https://stat.gov.pl/ (28.02.2024).

In order to make the analytical results more detailed, a multiple regression method was employed, with the aim to determine which group of variables had the strongest impact on the position of the Warmińsko-Mazurskie voivodeship in the competitiveness ranking. First, the variables within the particular areas (*A*-*D*) were submitted to an assessment of mutual correlations using the Pearson's coefficient. Lack of correlation allowed us to proceed to the subsequent step of the analysis. Regression coefficients were estimated with the help of the least squares method.

Having estimated the model, it was then subjected to an evaluation with respect to fit. To this aim, we employed a corrected R^2 coefficient, which unlike R^2 takes into account the degree of complexity of the model and is more often used in multiple regression analysis. The significance of variables was also evaluated, using the *F* statistics and the related *p* values. The explanatory variables were considered statistically significant at $p<0.05$ (Osojca-Kozłowska 2021, s. 125-127). The analysis was made on the basis of averaged values of the variables from years 2014-2022.

Results

Comparison of the values of the Competitiveness Index (CI) obtained in the particular areas shows that the Warmińsko-Mazurskie voivodeship occupied the penultimate place in the area of innovativeness in production processes, while the Świętokrzyskie voivodeship fell to the last place. In two other areas, demand conditions and business environment, the Warmińsko-Mazurskie voivdeship scored the lowest among all Polish voivodeships. Its position was somewhat better in the area of business support and related branches. There, the Warmińsko-Mazurskie had the third lowest position. In each of these four areas, the highest CI value was scored by the Mazowieckie voivodeship (Tab. 2). The research results reflect the characteristics of the voivodeship. Warmia and Masuria is one of the most agricultural voivodeships in Poland, with a large area of agricultural land and forests. For this reason, there are few large industrial enterprises that focus on innovation.

The data collated in Table 2 served to determine the linear regression model from the following formula:

$$y = -0.037 + 0.325A + 0.199B + 0.205C + 0.285D$$

The parameter related to the business environment area achieved the highest value (0.325). This means that the strongest impact on regional competitiveness was exerted by this area. On the other hand, the lowest value was achieved in the area of demand conditions (0.199), which confirms its smallest impact on the final

Table 2

Values of the Competitive Index (CI) of Polish voivodeships in the distinguished areas

Voivodeship	Overall	Innovativeness in production processes	Demand conditions	Support and related branches	Business environment
	Y	*A*	*B*	*C*	*D*
Dolnośląskie	0.43	0.50	0.63	0.53	0.23
Kujawsko-Pomorskie	0.20	0.26	0.27	0.22	0.16
Lubelskie	0.20	0.27	0.20	0.12	0.34
Lubuskie	0.20	0.17	0.45	0.38	0.10
Łódzkie	0.26	0.31	0.44	0.28	0.18
Małopolskie	0.41	0.53	0.39	0.39	0.36
Mazowieckie	0.61	0.87	0.75	0.64	0.34
Opolskie	0.24	0.27	0.45	0.31	0.15
Podkarpackie	0.22	0.41	0.15	0.17	0.20
Podlaskie	0.14	0.28	0.18	0.11	0.05
Pomorskie	0.38	0.46	0.60	0.44	0.19
Śląskie	0.43	0.46	0.55	0.44	0.39
Świętokrzyskie	0.10	0.13	0.14	0.09	0.19
Warmińsko-Mazurskie	0.08	0.17	0.09	0.15	0.05
Wielkopolskie	0.34	0.39	0.46	0.42	0.25
Zachodniopomorskie	0.21	0.24	0.30	0.33	0.13

Source: developed by the authors, based on the Local Data Bank.

level of competitiveness. The problem of low innovation in the voivodeship has been noticed, and its improvement has become one of the four goals of the Strategy for the socio-economic development of the Warmińsko-Mazurskie voivodeship until 2030. The essence of the strategic goal 'Smart productivity' is actions aimed at strengthening enterprises' competitiveness by developing their innovation. The goal also focuses on intensively engaging high-quality human resources in response to technological changes (robotization) and population ageing. A similar analysis was carried out in each of the four areas. Within the group of indicators comprised in the production innovativeness areas, the regression model looked as follows:

$$A = -0.3034 + 0.014X_1 + 0.005X_2 + 0.029X_3 + 0.000002X_4 - 0.009X_5$$
$$+0.001X_6 + 0.015X_7 + 0.006X_8 + 0.000038X_9 + 0.000017X_{10}$$

The indicators X_1, X_3 and X_7 had the strongest whereas the indicator X_4 had the weakest impact on the CI values. However, indicator X_3, same as X_2, X_4, X_5,

was not statistically significant, which was evidenced by the *p*-value. For this reason, the indicator that had the strongest impact on the area of innovation was the Share of enterprises that cooperated in the field of innovative activity in % of all industrial enterprises, This means that an increase in the share of enterprises that cooperated in the field of innovative activity in % of all industrial enterprises by one percentage point will contribute to an increase in the indicator in the area of innovation by 0.015.

The fact that the warmińsko-mazurskie voivodeship scored higher than the Świętokrzyskie voivodeship position in this competitiveness ranking was a consequence of its higher scores in nearly all indicators. It was only the percentage of companies collaborating in the field of innovation in the total number of industrial companies and the share of sold production of new/improved in the total sale of products that the scores obtained by the Warmińsko-Mazurskie voivodeship were the lowest among all Polish voivodeships (both 4.83%).

Another area submitted to a regression analysis covered the demand conditions, and the model constructed on the basis of collected data looked as follows:

$$B = -0.42 + 0.0005X_{11} + 0.007X_{12} - 0.0001X_{13} - 0.02X_{14} + 0.02X_{15} + 0.000002X_{16}$$

According to this model, the strongest effect on the CI value in the demand conditions area was produced by indicator X_{15}, i.e. share of net revenue from the sale of innovative products in net revenue from total sale (in %), which in the Warmińsko-Mazurskie voivodeship was the lowest in Poland and amounted to 4.31%. The highest value of this indicator was achieved in the Pomorskie voivodeship (13.02%).

The high negative effect was exerted by indicator X_{14}, i.e. the registered unemployment rate. Its value in the Warmińsko-Mazurskie voivodeship was the highest among all voivodeships – the average of the years examined (2014-2022) was 12.02%. The average unemployment rate in the country was 7.92%. The values of these two indicators were mostly responsible for the low level of CI in this area in the Warmińsko-Mazurskie voivodeship.

The next area submitted to our analysis was the one of supporting and related branches. In this case, the model looked as follows:

$$C = -0.35 + 0.011X_{17} + 0.019X_{18} + 0.00026X_{19} + 0.00014X_{20} + 0.098X_{21}$$

The CI value in this area was most strongly affected by indicator X_{21} (number of natural persons conducting economic activity), while it was least impacted by indicator X_{20} (business environment institutions per 10,000 business entities).

These indicators in the Warmińsko-Mazurskie voivodeship were 0.17 and 1,185.83 respectively. For this reason, this voivodeship, despite one of the highest values of indicator X_{20} in Poland, was found on a low place in the ranking as regards the CI value in this area.

The last area that underwent a regression analysis was the business environment area. Competitiveness in this area was determined by six indicators. The strongest effect on the CI value in this area was produced by indicators X_{22} and X_{25}, which is demonstrated by the equation below:

$$D = -0.21 + 0.001X_{22} + 0.00014X_{23} - 0.00003X_{24} + 0.001X_{25}$$
$$+0.0002X_{26} + 0.0028X_{27}$$

The indicators mentioned above are the percentage of the national economy entities with foreign capital share in the total number of companies registered in the REGON system, and the total length of water distribution systems in km per 100 km^2.

Both these indicators in the Warmińsko-Mazurskie voivodeship scored the lowest in the whole country and they amounted to sequentially 30.22% and 57.31 km. On the other hand, the indicator X_{24}, which according to the model had the lowest impact on the final value of the CI, achieved a relatively high value in the Warmińsko-Mazurskie voivodeship (67.61 km). This resulted in a very low CI value in this area achieved by the Warmia and Mazury region. Not only was it the lowest in the country, but also it was twice as low as in the voivodeship that was on the penultimate place in the ranking (the Świętokrzyskie voivodeship).

The five regression models enabled us to identify the factors with the strongest impact on competitiveness. They were the indicators from the areas of business environment and innovativeness in production processes. In these areas, the following had the greatest importance: X_1 (percentage of inputs into innovative activity in companies in total national inputs), X_3 (inputs into innovative activity in companies relative to the GDP), X_7 (share of companies which have collaborated with others in the field of innovative activity in % of the total number of industrial companies), and X_{21} (natural persons conducting business activity per 10,000 inhabitants). Their low values in the Warmińsko-Mazurskie voivodeship had the largest contribution to the overall low values of the competitiveness index in this region in years 2014-2022.

Summary and Conclusions

Competitiveness as a research question is now gaining importance. Articles dedicated to this problem are increasingly often referred to not just by economists but also by government and local government officials, politicians, and entrepreneurs. Interest in all kinds of reports dealing with competitiveness has been growing. Many of them address the topic of competitiveness, looking at examples of rich, competitive regions. This article, using the example of the Warmińsko-Mazurskie voivodeship, presents the most important factors shaping the level of regional competitiveness and focuses attention on an underdeveloped and uncompetitive region. A direction for further research may be to re-examine the situation after the next EU programming period (2021-2027). By comparing these two periods, it would be possible to examine changes in individual areas and the impact of EU funds on these changes.

Regional competitiveness has a considerable impact on the state's economic condition. For this reason, balanced development of all voivodeships should be in the interest of local, regional and central governments. The state's regional policy should envisage such actions that would level off the emerging discrepancies among the country's regions. To this aim, it is necessary to develop a comprehensive approach and a long-term action plan. Unique values of regions should be taken into consideration, and rare resources ought to be used while building a region's competitive advantage. In the case of the Warmińsko-Mazurskie voivodeship, important factors are its peripheral location, the ongoing war in Ukraine, and new aspects of specialization.

Investments into infrastructure, the R&D sector and business environment should also be included in efforts aiming to improve competitiveness. Competitiveness is increasingly often equated with innovativeness. Hence, it is also important to purchase and employ cutting edge technologies in companies operating in a given region. The key aspect in the development of regional competitiveness is the access to qualified human resources. In the knowledge-based economy, it is essential to invest in education, higher education, and in upgrading courses for employees.

The analysis presented in this paper shows that the Warmińsko-Mazurskie voivodeship consistently scored the worst in competitiveness rankings among all Polish voivodeships. This was observed in terms of both competitiveness performance and potential. When analysing the GDP per capita in years 2014-2021, the said region had one of the lowest growths of this parameter in whole Poland, which equalled just 53.6%. The GDP per capita in the Warmińsko-Mazurskie voivodeship increased from PLN 31,973 in 2014 to 49,098 in 2021. The observations appeared the same when considering competitiveness potential. Although values of most indicators increased over the years, and the dynamics of the competitiveness index (CI) was the highest in Poland (63.72%), this did not affect significantly the competitive position of the region. In the area

of innovativeness in production processes, the Warmińsko-Mazurskie voivodeship had the penultimate place among all voivodeships in Poland, while being the last in the areas defining demand conditions and business environment, and being the third from the bottom for the area of support and related branches. It can be assumed that the gap between the Warmińsko-Mazurskie voivodeship and the other Polish voivodeships was so large in many of the studied areas because of historical circumstances. Hence, despite efforts to improve the region's competitiveness, such discrepancies have not been levelled off.

Moreover, using the regression model, it has been determined that the level of innovativeness has a strong impact on the competitive position of any voivodeship. Another important area was the business environment. These results are reflected in reports dealing with this research subject, where innovativeness is nowadays identified as a crucial factor in the development of competitiveness. An example is *Innovation and Entrepreneurship: Practice and Principles* by Peter F. Drucker (1992), in which the author often emphasizes that innovation is a fundamental element of entrepreneurship and a key factor in gaining a competitive advantage. In *The Geography of Innovation: Regional Innovation Systems*' by Asheim & Gertler (2005) the authors present the concept of regional innovation systems (RIS), which emphasize the importance of innovation as a key factor in the competitiveness of regions.

It is important to regularly examine the competitiveness of regions to see where development funds should be allocated and to counteract disproportions. Similar research in the coming years will allow us to see the direction of changes taking place in individual voivodeships as well as changes in the values of individual indicators.

Translated by Jolanta Idźkowska

References

Adamik, A., & Sikora-Fernandez, D. (2021). Smart Organizations as a Source of Competitiveness and Sustainable Development in the Age of Industry 4.0: Integration of Micro and Macro Perspective. *Energies*, *14*(6), 1572. https://doi.org/10.3390/en14061572.

Annoni, P., & Dijkstra, L. (2019). *The Eu Regional Competitiveness Index 2019*. Luxembourg: Publications Office of the European Union. Retrieved from https://ec.europa.eu/regional_policy/sources/work/2019_03_rci2019.pdf (17.07.2024).

Asheim, B., & Gertler, M.S. (2005). The Geography of Innovation: Regional Innovation Systems. In J. Fagerberg, D.C. Mowery, & R.R. Nelson (Eds.). *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Ayon Ponce, G.I., Álvarez Indacochea, A.A., Salazar Moran, A.L., Baque Sánchez, E.R., Hernández-Ramírez, J., Arboleda Puerta, J.E., Camero Ortiz, E.L., Corredor-Torres, J.E., Tovar-Quintero, J., & Rincón-Guio, C. (2024). Enhancing Competitiveness in Cocoa Associations: An Integral Project Management Approach Based on Porter's Diamond Model. *Journal of Infrastructure, Policy and Development*, *8*(2), 2872. https://doi.org/10.24294/jipd.v8i2.2872.

Bieńkowski, W., Czajkowski, Z. Gomułka, M., Brocka-Palacz, B., Latoszek, E., Misala, J., Radło, M.J., & Weresa, M. (2008). *Czynniki i miary międzynarodowej konkurencyjności gospodarek w kontekście globalizacji – wstępne wyniki badań*. Warszawa: Szkoła Główna Handlowa.

Borowiecki, R., & Siuta-Tokarska, B. (2015). Konkurencyjność przedsiębiorstw i konkurencyjność gospodarki Polski – zarys problemu. *Nierówności Społeczne a Wzrost Gospodarczy*, *41*(1), 52-66. Retrieved from https://www.ur.edu.pl/files/ur/import/Import/2015/6/3-Borowiecki-R.-Siuta-Tokarska-B..pdf (17.07.2024).

Cetin, M., & Erkisi, K. (2023). An Innovative Perspective on the Impact of Innovation on Global Competitiveness: Comparative Analysis of EU13 and EU15 Countries. *Journal of Competitiveness*, *15*(4), 19-35. https://doi.org/10.7441/joc.2023.04.02.

Czyżewska, D. (2012). Istota konkurencyjności regionów. *Ruch Prawniczy, Ekonomiczny i Socjologiczny*, *74*(4), 203-217. https://doi.org/10.14746/rpeis.2012.74.4.14.

Drucker, P.F. (1992). *Innowacja i przedsiębiorczość. Praktyka i zasady.* Warszawa: PWE.

Encarnacion, R.H., Magnaye, D.C., & Castro, A.G.M. (2023). Spatial Analysis of Local Competitiveness: Relationship of Economic Dynamism of Cities and Municipalities in Major Regional Metropolitan Areas in the Philippines. *Sustainability*, *15*, 950. https://doi.org/10.3390/su15020950.

Erboz, G. (2020). A Qualitative Study on Industry 4.0 Competitiveness in Turkey Using Porter Diamond Model. *Journal of Industrial Engineering and Management*, *13*(2), 266-282. https://doi.org/10.3926/jiem.2915.

Estevão, C., Nunes, S., Ferreira, J., & Fernandes, C. (2018). Tourism Sector Competitiveness in Portugal: Applying Porter's Diamond. *Tourism & Management Studies*, *14*(1), 30-44. https://doi.org/10.18089/tms.2018.14103.

Ginevičius, R., Žemaitis, E., Šuhajda, K., & Schieg, M. (2023). Assessing the Global Ccompetitiveness of European Countries. *Journal of Competitiveness*, *15*(4), 36-52. https://doi.org/10.7441/joc.2023.04.03.

Gołębiewski, J., & Podlińska, O. (2015). Determinanty konkurencyjności polskich regionów w Unii Europejskiej. *Przegląd Zachodniopomorski*, *2*, 7-20. https://doi.org/10.18276/pz.2015.2-01.

González Catalán, S.A. (2021). Regional Competitiveness in Latin America: A Comparative Study of the Key Elements for Regional Performance. *Investigaciones Regionales – Journal of Regional Research*, *2*(50), 125-146. https://doi.org/10.38191/iirr-jorr.21.014.

Grassia, M.G., Marino, M., Mazza, R., Misuraca, M., Zavarrone, E., & Friel, M. (2024). Regional Competitiveness: A Structural-Based Topic Analysis on Recent Literature. *Social Indicators Research*, *173*, 83-108. https://doi.org/10.1007/s11205-022-02951-4.

Grynia, A. (2018). *Międzynarodowa konkurencyjność gospodarki Litwy po przystąpieniu do Unii Europejskiej. Osiągnięcia i postulowane kierunki zmian*. Gdańsk: Wydawnictwo UG.

Grynia, A. (2022). Cyfryzacja jako determinanta międzynarodowej konkurencyjności gospodarki. Przypadek krajów Europy Środkowo-Wschodniej. *Optimum. Economic Studies*, *4*(110), 17-31. https://doi.org/10.15290/oes.2022.04.110.02.

Hellwig, Z. (1968). Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę wykwalifikowanych kadr. *Przegląd Statystyczny*, *4*, 307-327.

Huggins, R., Izushi, H., Prokop, D., & Thompson, P. (2014). Regional Competitiveness, Economic Growth and Stages of Development. *Journal of Economics & Business*, *32*(2), 255-283. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2554326 (17.07.2024).

Hyski, M., & Chudy-Hyski, D. (2022). Marka gminy jako determinanta konkurencyjności obszaru. *Studia Politicae Universitatis Silesiensis*, *35*, 11-32. https://doi.org/10.31261/spus.14716.

Karman, A., Banaś, J., Bronisz, U., & Miszczuk, A. (2022). *Zmiany klimatu a konkurencyjność regionów*. Warszawa: Polska Akademia Nauk, Komitet Przestrzennego Zagospodarowania Kraju.

Korenik, S. (2023). Nowa gospodarka a rozwój regionalny. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *67*(3), 30-37. https://doi.org/10.15611 /pn.2023.3.04.

Kot, J., & Kraska, E. (2018). Ocena konkurencyjności polskich regionów oparta na metodzie M.E. Portera. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *527*, 148-159. http://dx.doi.org/10.15611/pn.2018.527.13.

Kouskoura, A., Kalliontzi, E., Skalkos, D., & Bakouros, I. (2024). Assessing the Key Factors Measuring Regional Competitiveness. *Sustainability*, *16*, 2574. https://doi.org/10.3390/su16062574.

Kuberska, D., Grzybowska-Brzezińska, M., & Brelik, A. (2020). Shaping Competitiveness Through Policy: The Case of the Organic Food Market. *European Research Studies Journal*, *XXIII*(4), 1334-1354. https://doi.org/10.35808/ersj/1913.

Łaźniewska, E. (2013). *Konkurencyjność regionalna w czasie i przestrzeni na przykładzie polskich regionów*. Poznań: Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu.

Łaźniewska, E. (2022). *Gospodarka cyfrowa – rozwój regionalny – odporność*. Poznań: Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu.

Łaźniewska, E., & Chmielewski, R. (2012). Konkurencyjność regionalna jako termin w ekonomii. In E. Łaźniewska, M. Gorynia (Ed). *Konkurencyjność regionalna. Koncepcje – strategie – przykłady*. Warszawa: Wydawnictwo Naukowe PWN.

Porter, M. (1990). The Competitive Advantage of Nations. *Harvard Business Review*, *68*(2), 73-93.

Radło, M.J. (2008). Międzynarodowa konkurencyjność gospodarki. Uwagi na temat definicji, czynników i miar. *Prace i Materiały*, *284*, 1-33. https://doi.org/10.13140/RG.2.2.26561.35684.

Roszko-Wójtowicz, E., & Grzelak, M.M. (2019). The Use of Selected Methods of Linear Ordering to Assess the Innovation Performance of the European Union Member States. *Economic and Environmental Studies*, *19*(1), 9-30. https://doi.org/10.25167/ees.2019.49.1.

Rubaj, P. (2019). Teoretyczny i praktyczny wymiar międzynarodowej konkurencyjności gospodarki. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, *6*(984), 7-24. https://doi.org/10.15678/ZNUEK.2019.0984.0601.

Shastitko, A. (2009). Competitiveness of the Region: Content, Factors, Policies. Baltic Region, *1*, 10-25. https://doi.org/10.5922/2079-8555-2009-1-2.

Sokołowska-Woźniak, J. (2005). Determinanty konkurencyjności regionu. In A. Nalepka (Ed.). *Organizacje komercyjne i niekomercyjne wobec wzmożonej konkurencji i rosnących wymagań konsumenta*. Nowy Sącz: Wyższa Szkoła Biznesu – National-Louis University.

Strahl, D. (2006). Klasyczne metody pomiaru i oceny rozwoju regionalnego. In D. Strahl (Ed.). *Metody oceny rozwoju regionalnego*. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego.

Szczech-Pietkiewicz, E. (2019). *Konkurencyjność miasta w kontekście współczesnych koncepcji teoretycznych i zjawisk gospodarczych*. Warszawa: Oficyna Wydawnicza SGH.

Zeibote, Z., & Muravska, T. (2018). Promoting the Regional Competitiveness Through Clusters' Approach: Case of the Latvian Information Technology Cluster. *European Integration Studies (Kaunas University of Technology)*, *12*, 77-91. https://doi.org/10.5755/j01.eis.0.12.20846.

Zeibote, Z., Volkova T., & Todorov, K. (2019). The Impact of Globalization on Regional Development and Competitiveness: Cases of Selected Regions. *Insights into Regional Development*, *1*(1), 33-47. https://doi.org/10.9770/ird.2019.1.1(3).

OLSZTYN ECONOMIC JOURNAL
2025, 20(1), 33–54
ISSN 1897-2721 e-ISSN 2083-4675 DOI: 10.31648/oej.10663

ORIGINAL PAPER

COMPARATIVE ADVANTAGES IN INTERNATIONAL TRADE OF SERVICES – A FOCUS ON THE EUROPEAN UNION AND POLAND

Piotr Malinowski
Faculty of Economics Sciences
University of Warsaw
ORCID: https://orcid.org/0009-0002-9835-6621
e-mail: piotrmalinowski13@gmail.com

JEL Classification: F14, F62.

Key words: comparative advantage, international trade, services sector, economic specialization, European Union.

Abstract

This study examines comparative advantages in the context of international trade in services. Using the Revealed Comparative Advantage (RCA) index, countries with comparative advantages in specific service groups across 28 EU countries were identified. The results are illustrated for each service category using gradient maps, allowing for the determination of sectoral specialization in individual countries. Subsequently, a detailed case study of Poland was conducted, additionally utilizing the Corrected Revealed Comparative Advantage (CRCA) index to assess the stability of its comparative advantages between 2010 and 2018. The study identifies labor-intensive sectors, such as production services, transport, construction, and repair and maintenance services, as key areas of Poland's comparative advantage, stemming from lower labor costs compared to Western Europe.

PRZEWAGI KOMPARATYWNE W MIĘDZYNARODOWYM HANDLU USŁUGAMI – ANALIZA PRZYPADKU UNII EUROPEJSKIEJ I POLSKI

Piotr Malinowski
Wydział Nauk Ekonomicznych
Uniwersytet Warszawski

Kody JEL: F14, F62.

Słowa kluczowe: przewaga komparatywna, handel międzynarodowy, sektor usług, specjalizacja ekonomiczna, Unia Europejska.

How to cite: Malinowski, P. (2025). Comparative Advantages in International Trade of Services – a Focus on the European Union and Poland. *Olsztyn Economic Journal*, *20*(1), 33-54. https://doi.org/10.31648/oej.10663

Abstrakt

W pracy opisano przewagi komparatywne w kontekście międzynarodowego handlu usługami. Wykorzystując wskaźnik ujawnionej przewagi komparatywnej (RCA), zidentyfikowano kraje mające przewagi komparatywne w poszczególnych grupach usług w 28 krajach UE. Wyniki zobrazowano dla każdej kategorii usług z wykorzystaniem map gradientowych, co pozwoliło na określenie specjalizacji sektorowej poszczególnych państw. Następnie szczegółowo przeanalizowano przypadek Polski, z zastosowaniem dodatkowo skorygowanego wskaźnika ujawnionej przewagi komparatywnej (CRCA), w celu oceny stabilności jej przewag komparatywnych w latach 2010-2018. W wyniku badania zidentyfikowano pracochłonne sektory, jak usługi produkcyjne, transportowe, budowlane oraz naprawy i utrzymania, jako kluczowe obszary przewagi komparatywnej Polski, wynikające z niższych kosztów pracy w porównaniu z Europą Zachodnią.

Introduction

In today's world, we are witnessing increasingly strong globalization processes and the dynamic integration of the global economy. These processes have significantly accelerated since the 1990s, as confirmed by Krugman *et al.* (1995) and Baldwin (2016). This leads to an increase in trade flows between countries in both goods and services. At the beginning of the current millennium, services accounted for one-quarter of international trade (Hoekman & Matoo, 2000), and at that time, a significant increase in this share was expected due to the intensifying internationalization of services. While most of the literature still focuses on comparative advantages in goods trade, Lejour and de Paiva Verheijden (2004) and Balassa (1965) proposed key theories and methodologies that can be successfully adapted to the analysis of services trade.

Although the Revealed Comparative Advantage (RCA) index was originally designed for assessing competitiveness in the export of industrial goods (Balassa, 1965), subsequent research has demonstrated its applicability to international trade in services. Hindley and Smith (1984), Nusbaumer (1987), and Peterson and Barras (1987) were among the first to discuss how RCA can be employed in service sector analysis, emphasizing the growing role of services in international trade. Deardorff (1985, 2005) further explored the theoretical foundations of RCA in the context of services, highlighting the differences between goods and services in terms of trade patterns and specialization. More recently, Wyszkowska-Kuna (2016) reviewed these contributions, providing evidence of RCA's relevance for measuring service sector competitiveness across various EU economies. These studies confirm that, despite its initial focus on manufacturing trade, the RCA index remains a valuable tool for analyzing comparative advantages in services.

In the context of the European Union, trade in services is shaped not only by globalization but also by deep economic integration among member states. The creation of the EU's Single Market has significantly facilitated cross-border service exchanges by ensuring the free movement of services, one of the four

fundamental freedoms enshrined in the Treaty on the Functioning of the European Union (TFEU). The elimination of internal barriers and the harmonization of regulations have played a crucial role in enhancing service sector competitiveness within the EU. A key milestone in this process was the adoption of the Services Directive (2006/123/EC), which came into force in 2010. This directive aimed to simplify administrative procedures, promote competition, and remove unjustified restrictions on service providers operating in different EU countries. By fostering regulatory convergence, it has contributed to the increased specialization of EU economies in various service sectors, reinforcing comparative advantages at the regional level.

This paper attempts to deepen the understanding of international trade in services by examining the countries of the European Union. We aim to determine which EU countries specialize in which types of services and to find the optimal method for measuring comparative advantages. The case of Poland is analyzed in greater depth in comparison to other EU countries, identifying the sectors in which it holds comparative advantages, with a detailed focus on the stability of these advantages over time.

Measures of Comparative Advantages

The concept of comparative advantage was developed by Ricardo through the creation of the Ricardian model. The Ricardian model, which forms the foundation of the theory of comparative advantage, was first introduced by David Ricardo in his seminal work *On the Principles of Political Economy and Taxation* (Ricardo, 1817). According to this model, trade between two countries can be beneficial if both countries export goods in which they have a comparative advantage. Through specialization, each country participating in trade can achieve greater benefits than in the absence of trade (Francois & Hoekman, 2010). After many years of investigation several types of indices can be used to estimate comparative advantages (Langhammer, 2004; Gaurav & Bharti, 2018).

The most common index of revealed comparative advantage is the H.H. Liesner index from 1958, which was improved by Balassa (1965, 1989), now known as the Balassa Index or the Revealed Comparative Advantage (RCA) Index. This indicator shows a country's position in the export of particular goods or services. The Balassa index is given by the following formula (1):

$$\mathrm{RCA}_i = \left(\frac{X_{ij}}{X_j}\right) : \left(\frac{X_i}{X}\right) \tag{1}$$

where:

X_{ij} – the export value of the i-th product group in the j-th country,

X_j – the total export value of the j-th country,

X_i – the export value of the i-th product group in the reference countries (or globally),
X – the total export value in the reference countries (or globally).

The index ranges from 0 to infinity. A country exhibits a comparative advantage when the share of exports from i-th sector in the country's total exports is higher than the share of that sector in the export structure of the reference countries, meaning when RCA is greater than 1. Values between 1 and 2 indicate a weak comparative advantage, values between 2 and 4 signify a moderate advantage, and values above 4 indicate a strong comparative advantage. Values below 1 suggest that the country lacks a comparative advantage in the given sector (Balassa, 1965; Vollrath, 1991; Laursen, 2015).

Although the Revealed Comparative Advantage (RCA) initially seems like a robust method for estimating revealed comparative advantages, further analysis has shown that it is imperfect in several ways. One of the major limitations of the RCA index is that it is not consistent over time. It does not adequately capture changes in global trade patterns or shifts in comparative advantages. To address this issue, researchers have proposed the Corrected Revealed Comparative Advantage (CRCA) index (Laursen, 2015; Yu *et al*., 2009). Unlike the traditional RCA, the CRCA adjusts for biases that arise from changes in the global export structure, providing a more accurate reflection of a country's comparative advantage over time. It is given by the following formula (2):

$$\mathrm{CRCA}_i = \frac{X_i}{\sum_i X_i} - \frac{M_i}{\sum_i M_i} \tag{2}$$

where:
X_i – the export volume in the given product group,
M_i – the import volume in the given product group,
$\Sigma_i X_i$ – the total export volume,
$\Sigma_i M_i$ – the total import volume.

Positive CRCA values indicate product groups in which a given country has a revealed comparative advantage (Vollrath, 1991; Laursen, 2015).

Another issue affecting the RCA is that its distribution depends on the number and size of the sectors and countries used in the analysis. Additionally, the mean RCA is unstable and cannot be interpreted in economic terms. To address these limitations, Hoen and Oosterhaven (2006) developed the ARCA, which adjusts the RCA by making it additive. This modification allows for a more accurate comparison across sectors and countries, correcting the instability of the average RCA value, which often leads to misleading interpretations. By utilizing ARCA, researchers can obtain more reliable results when analyzing comparative advantages, as this method accounts for the structural variations in the dataset that the traditional RCA does not. Additive RCA (ARCA) is defined by the following formula (3):

$$\mathrm{ARCA}_{ij} = \left(\frac{X_{ij}}{X_j}\right) - \left(\frac{X_i}{X}\right) \tag{3}$$

where:

X_{ij} – the export value of the *i*-th product group in the *j*-th country,
X_j – the total export value of the *j*-th country,
X_i – the export value of the *i*-th product group in the reference countries (or globally),
X – the total export value in the reference countries (or globally).

If country j has a revealed comparative advantage in sector *i*, then this value is greater than zero. Conversely, if country *j* does not have a revealed comparative advantage, this value is less than zero (Hoen & Oosterhaven, 2006). It is also possible to aggregate these values to obtain an aggregated ARCA for the entire country. This is given by the following formula (4):

$$\mathrm{ARCA}_j = \frac{1}{2}\sum_i \left|\left(\frac{X_{ij}}{X_j}\right) - \left(\frac{X_i}{X}\right)\right| \tag{4}$$

Thus, we are dealing with an Additive RCA (ARCA), with bell-shaped distributions between −1 and +1, and a mean value of zero, which by definition is independent of the number and classification of distinguished countries and sectors. Furthermore, for a country as a whole, the overall Aggregated ARCA ranges from 0 to 1, indicating pure intra-sectoral trade and pure inter-sectoral trade, respectively. Hoen and Oosterhaven (2006) also point out that to obtain an objective ARCA, the country or region under analysis should be excluded from the group of reference countries or regions.

There are also alternative ways of measuring comparative advantages. One of them is the Trade Coverage Index (TC), which is a useful alternative, particularly when analyzing the balance between a country's exports and imports in a specific sector (Vollrath, 1991; Laursen, 2015). This index measures the extent to which a country's exports can "cover" its imports, providing insights into the trade balance of particular sectors. The formula for the TC index is typically (5):

$$\mathrm{TC}_i = \frac{X_i}{M_i} \tag{5}$$

where:

X_i, M_i – represent the export and import of products from the *i*-th industry in a given country, respectively.

A TC index level above one indicates a surplus in the trade of products within a specific category for the given country, which in turn points to a competitive advantage in trading products from this sector. On the other hand, values below one indicate a trade deficit, resulting in a weak position in foreign markets. (Tian *et al.*, 2024; Jiang & Lin, 2020).

The final indicator we will mention is the Trade Balance Index (TBI), developed by Lafay (1992). It is measured in the following way (6):

$$\mathrm{TBI}_{ij} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} \tag{6}$$

where:

X_{ij}, M_{ij} – represent the export and import, respectively, of the i-th product group by country j.

The index takes values in the range (-1,1). Positive values, which indicate a trade surplus in the exchange of a given good, signal the country's specialization in trading that particular product group. On the other hand, values below 0 suggest a lack of export specialization by the country (Lafay, 1992)

Other approaches include the Normalized RCA (NRCA) index, which adjusts for size effects in trade data and improves comparability across sectors and countries (Yu *et al.*, 2009).

Additionally, the choice of RCA modification depends on the specific research objective, as different indices capture distinct aspects of comparative advantage. As highlighted by Stellian and Danna-Buitrago (2022), there is no universally superior measure, and selecting an appropriate index requires balancing theoretical consistency with empirical applicability.

Data and Methodology

The balance of payments data required for the empirical analysis of the aforementioned indices was obtained from the Eurostat website. The year 2016 was selected for the RCA analysis due to the greatest availability of data. For the CRCA analysis, data from the years 2010-2018 was used. The CRCA analysis was concluded in 2010, as this year marked the end of a uniform methodology for data collection and reporting, allowing the use of a single database. The dataset analyzed extends until 2018, which may make the analysis seem temporally distant. However, this approach enables the identification of the comparative advantages of EU countries without distortions caused by shocks such as the COVID-19 pandemic and the armed conflict in Ukraine. The recent shifts in comparative advantages due to these shocks could be an important subject for future research.

To calculate a country's export or import figures, the 28 European Union countries (EU28) were used as trading partners. The formulas presented above were applied for the calculation of the analyzed indices. Service categories were divided according to the EBOPS2010 classification into the following services: S – Total Services, SA – Manufacturing services on physical inputs owned by others, SB – Maintenance and repair services, SC – Transport

services, SE – Construction services, SF – Insurance and pension services, SG – Financial services, SH – Charges for the use of intellectual property, SI – Telecommunications, computer, and information services, SJ – Other business services, SK – Personal, cultural, and recreational services, SL – Government goods and services not elsewhere classified.

This study excludes travel services (SD) due to the complexity of their interpretation within Revealed Comparative Advantage (RCA) analysis. Unlike other service sectors, which involve structured business transactions, travel services primarily reflect consumer spending by non-residents on domestic services such as accommodation and dining. This makes it difficult to attribute them to a specific sectoral specialization or assess their competitiveness using traditional trade indicators. Additionally, comparative advantage measures focus on stable, supply-driven trade patterns, whereas travel services are highly demand-driven and volatile, influenced by economic cycles, mobility trends, and temporary external factors. Since RCA assumes competitiveness is based on sectoral efficiency, applying it to travel services could lead to misleading conclusions. To maintain methodological consistency, travel services were excluded, as their nature as a consumption-driven sector does not align with the supply-side focus of RCA.

The question that naturally arises during such an analysis is whether the obtained results are stable over time. Unfortunately, the RCA index cannot be used for such comparisons due to the limitations of its formula. To address this question, the Corrected Revealed Comparative Advantage (CRCA) index was applied. Calculations were performed for the period between 2010 and 2018. While this is a relatively short period, analyzing periods before 2010 would require using different data sets, which raises concerns that the results may not be comparable. For the results obtained, a comparative advantage correlation analysis was conducted. For each year, a value of one was assigned if a country exhibited a comparative advantage in a given service sector, and zero otherwise. Correlation coefficients were then calculated for these binary variables across consecutive years.

Results

The results of the RCA analysis are presented in Appendix 1. To maintain clarity and facilitate the interpretation of the results, gradient maps were created to reflect RCA levels across various countries, divided into service categories. Countries that did not have a revealed comparative advantage in a particular service sector, i.e., those for which $RCA_i < 1$ (where i represents the respective sectors), were marked in white.

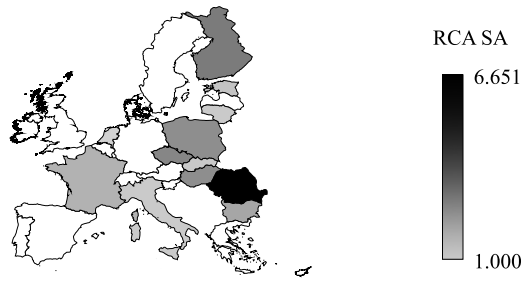


Fig. 1. RCA SA Index; manufacturing services on physical inputs owned by others
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

The chart for RCA SK was omitted, as no country had a comparative advantage in this service category. However, this deviation should be considered as an underestimation of RCA SK due to significant data gaps in this category.

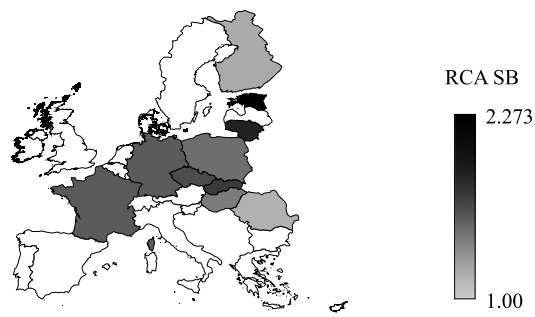


Fig. 2. RCA SB Index; maintenance and repair services
Source: own elaboration based on data: Eurostat (2024). Balance of payments data.

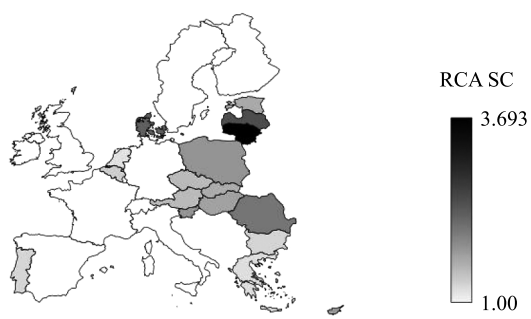


Fig. 3. RCA SC Index; transport services
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

The analysis of the charts leads to conclusions consistent with both expectations and empirical observations, aligning with previous studies on comparative advantages in services trade. For example, Balassa (1986) and Francois and Hoekman (2010) highlight the role of labor costs in shaping trade specialization, particularly in labor-intensive service sectors. Similarly, Bobirca and Miclaus (2007) and Wosiek and Visvizi (2021) provide evidence that Eastern European countries maintain comparative advantages in services requiring high labor inputs, such as manufacturing services based on inputs from other firms, transport services, and construction services, due to their relatively lower labor costs compared to Western Europe.

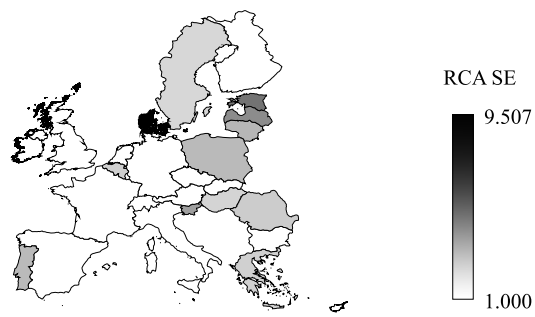


Fig. 4. RCA SE Index; construction services
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

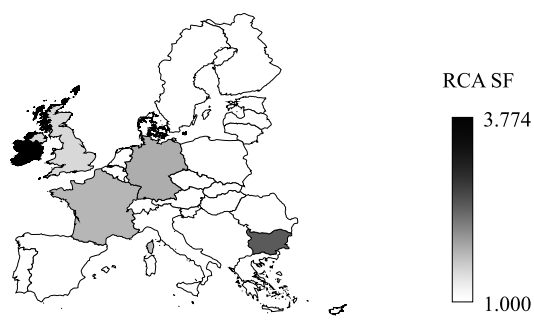


Fig. 5. RCA SF Index; insurance and pension services
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

In the case of maintenance and repair services, France and Germany also show strong comparative advantages. This is consistent with research indicating that such services often require high technological sophistication and significant capital investments, areas where developed countries hold competitive edges (IMF, 2013; Cieślik, 2022).

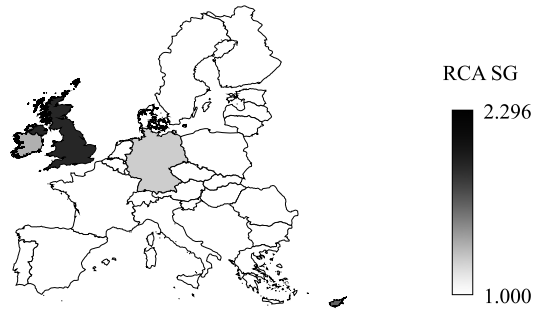


Fig. 6. RCA SG Index; financial services
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

Regarding the financial services sector, the United Kingdom exhibits the most significant comparative advantage, aligning with empirical findings that emphasize London's dominance as Europe's leading financial hub and its global position in banking and investment services (Brei & von Peter, 2018; Schoenmaker, 2022).

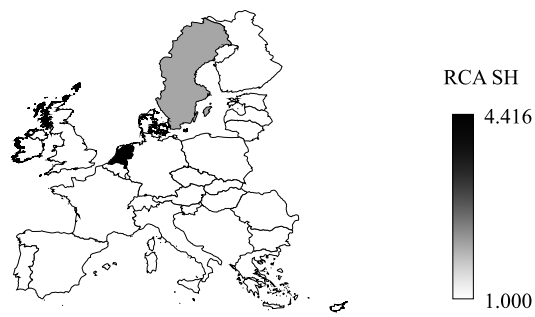


Fig. 7. RCA SH Index; charges for the use of intellectual property
Source: own elaboration based on data source: Eurostat (2024). Balance of payments data.

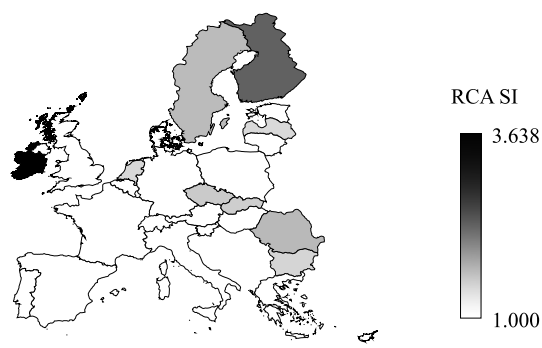


Fig. 8. RCA SI Index; telecommunications, computer and information services
Source: own elaboration based on data source: Eurostat (2024). Balance of payments data.

Additionally, business services and insurance reveal comparative advantages in highly developed Central European countries and Ireland. This observation is supported by more recent studies, which identify Ireland's strong export position in knowledge-intensive services, particularly in IT, financial, and business consulting sectors (Barry & Bergin, 2019; Department of Finance Ireland, 2021). Ireland's success in these industries is linked to favorable tax policies, foreign direct investment (FDI) inflows, and its integration with multinational corporations, reinforcing its role as a global hub for high-value service exports.

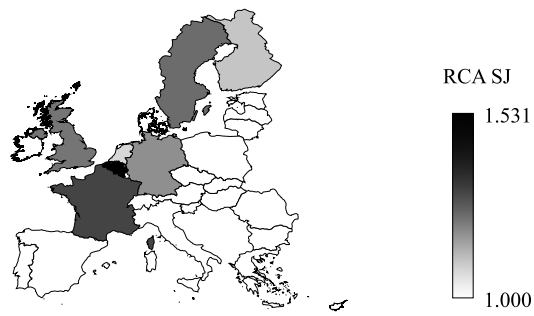


Fig. 9. RCA SJ Index; other business services
Source: own elaboration based on data source: Eurostat (2024). Balance of payments data.

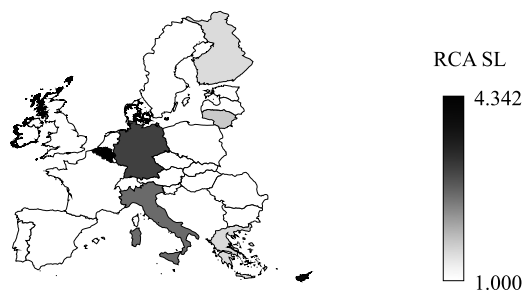


Fig. 10. RCA SL Index; government goods and services not elsewhere classified
Source: own elaboration based on data source: Eurostat (2024). Balance of payments data.

The Other Business Services sector, which includes consulting, legal, accounting, engineering, and R&D services, exhibits comparative advantages primarily in Western and Northern Europe. France shows the highest RCA value, likely due to its strong consulting and legal sectors, while Germany and the UK also perform well, reflecting their roles as major business hubs. The Netherlands and Nordic countries demonstrate strengths in business advisory and management services, benefiting from knowledge-intensive economies. In contrast, Central and Eastern European countries lack significant comparative advantages in this sector, likely due to a less developed market for specialized business services and a lower presence of multinational consulting firms.

The obtained correlation coefficients for the previously described binary variables indicating the presence or absence of comparative advantage over time were as follows: 2018-2017: 0.768, 2017-2016: 0.714, 2016-2015: 0.722, 2015-2014: 0.745, 2014-2013: 0.652, 2013-2012: 0.680, 2012-2011: 0.735, 2011-2010: 0.735. These values are relatively high, especially considering that data gaps between consecutive years increasingly affect the indicator's value. Nonetheless, it can be reasonably assumed that comparative advantages are relatively stable over a eight-year period. To answer definitively whether CRCA is stable over time, a panel data analysis would be required.

It is also important to consider whether the other indices proposed in this paper yield consistent results. To examine the consistency between the different computational methods used to estimate comparative advantages in the services sector, the TBI, TC, and ARCA indices were calculated for 28 European Union countries and each service group for the year 2016 (see Appendix 1, 2, 3, 4). Based on these indices, it was determined whether a country exhibited a comparative advantage in a given sector. A value of one was assigned when a comparative advantage was present, and zero when it was not. Correlation coefficients were then calculated for these binary variables (Tab. 1).

Table 1

Correlation matrix of RCA, TBI, TC, and ARCA indices for 2016

Specification	RCA	TBI	TC	ARCA
RCA	1	–	–	–
TBI	0.416	1	–	–
TC	0.416	1	1	–
ARCA	0.965	0.461	0.461	1

Source: own elaboration based on data Eurostat (2024). Balance of payments data.

The correlation analysis reveals that RCA yields consistent results only with the ARCA index, as indicated by the high correlation coefficient of 0.965. This consistency can be explained by the fact that both indices use the same set of variables in their calculations. However, there is a significant divergence when comparing RCA with the TBI and TC indices. This divergence can be attributed to the inclusion of a new variable – the volume of imports – into the calculations.

While RCA provides valuable insights into a country's export specialization, it does not account for import structures, which can distort the interpretation of comparative advantages if considered in isolation. In this regard, the TBI index serves as a complementary measure, offering a broader view of trade competitiveness by incorporating the balance between exports and imports (Lafay, 1992; Vollrath, 1991). The high correlation (1.0) between TBI and TC suggests that these indices capture similar aspects of trade performance,

further emphasizing the need to analyze RCA and TBI together rather than interchangeably. By combining RCA for export specialization and TBI for trade balance analysis, a more comprehensive understanding of a country's comparative advantage in services can be achieved.

Based on the calculations of the aggregated ARCA index for entire countries, we can conclude that the most inter-sectoral trade (indicative of inter-industry specialization) is observed in Romania, with an aggregated ARCA value of 0.073. In contrast, the most intra-sectoral trade (suggesting intra-industry specialization) occurs in Slovenia, where the aggregated ARCA value is 0.002. The ARCA index, by construction, provides insight into whether a country's trade structure is more sectorally diversified (higher ARCA values, reflecting inter-industry trade) or concentrated within specific industries (lower ARCA values, reflecting intra-industry trade) (Hoen & Oosterhaven, 2006). However, while ARCA allows for a broad classification of trade specialization, a more detailed assessment of intra-industry trade (IIT) requires complementary measures such as the Grubel-Lloyd index, which explicitly captures the extent of simultaneous imports and exports within the same industry (Grubel & Lloyd, 1975; Fontagné & Freudenberg, 1997).

From the analysis of RCA data for 2016 (Fig. 11), it is evident that Poland holds comparative advantages in manufacturing services based on third-party owned materials, maintenance and repair services, transport services, and construction services. Considering the structure of services in Poland, this aligns with expectations (Wosiek & Visvizi, 2021). Undoubtedly, Poland remains a country with relatively low labor costs within the European Union, making it competitive in labor-intensive service sectors. It is also worth noting that Poland has a comparative advantage in the maintenance and repair sector, which, as discussed earlier, indicates a relatively high level of technological sophistication and capital investment in the country.

Fig. 11. RCA Index for Poland in 2016
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

If we look at the CRCA data for Poland over the period from 2010 to 2018, we can draw conclusions similar to those for RCA. Figure 12 shows how this index has changed over time. Its analysis allows us to conclude that Poland's comparative advantages have been relatively stable. This is not surprising, considering the

observation period is eight years, as in this case. However, if a period of over 20 years were considered, we would expect changes in comparative advantages. To thoroughly analyze the stability of this index over time, it would be necessary to gather data from a longer period and conduct a time-series analysis, which exceeds the scope of this paper. Therefore, we limit ourselves to a graphical analysis.

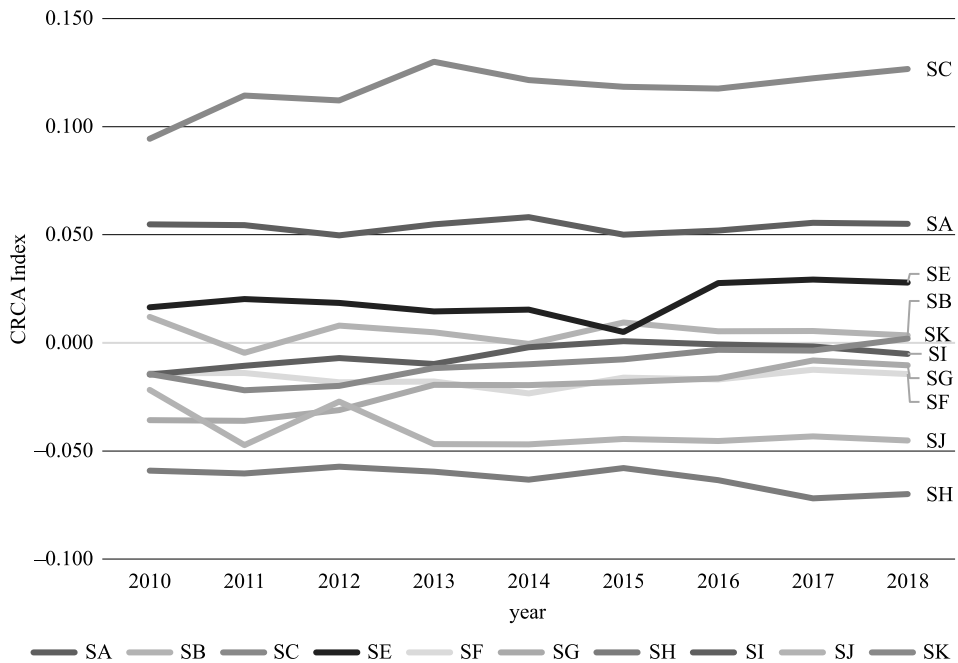


Fig. 12. CRCA Index for Poland from 2010 to 2018
Source: own elaboration based on data Eurostat (2024). Balance of payments data.

Conclusions

This paper has examined the comparative advantages of Poland and other European Union countries in the international trade of services, focusing particularly on the period from 2010 to 2018. Through the analysis of the Revealed Comparative Advantage (RCA) and Corrected Revealed Comparative Advantage (CRCA) indices, as well as other alternative measures like TBI, TC, and ARCA, we identified the sectors in which Poland exhibits significant comparative advantages, including labor-intensive sectors such as manufacturing services, transport services, construction services, and maintenance and repair services. The results confirm that Poland's comparative advantages are relatively stable over time, particularly in sectors where lower labor costs offer

a competitive edge compared to Western Europe. Moreover, the inclusion of other EU countries in the analysis has allowed for a broader understanding of the specialization patterns within the union, showing that countries with more advanced technological infrastructure, such as France and Germany, demonstrate comparative advantages in sectors requiring high technological sophistication and capital investment.

Although the RCA and CRCA indices provide a robust framework for analyzing comparative advantages, we identified certain limitations. For instance, the RCA index alone cannot capture long-term changes in trade patterns due to its dependency on a fixed dataset. To improve the robustness of future studies, panel data analysis over a longer period should be conducted, which would provide deeper insights into the evolution of comparative advantages in services trade.

Finally, the results suggest that while labor-intensive service sectors continue to be areas of strength for Eastern European countries, further research into the impact of technological developments on the comparative advantages of advanced economies would offer a more comprehensive view of how these factors shape international trade in services.

Translated by Piotr Malinowski

References

Balassa, B. (1965). Trade Liberalisation and 'Revealed' Comparative Advantage. *The Manchester School*, *33*(2), 99-123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x.

Balassa, B. (1986). Comparative Advantage in Manufactured Goods: A Reappraisal. *The Review of Economics and Statistics, 68*(2), 315-319. https://doi.org/10.2307/1925512.

Balassa, B. (1989). *Comparative Advantage, Trade Policy, and Economic Development*. New York: Harvester Wheatsheaf.

Baldwin, R. (2016). *The Great Convergence: Information Technology and the New Globalization*. Cambridge: Harvard University Press. https://doi.org/10.4159/9780674972667.

Barry, F., & Bergin, A. (2019). FDI and Ireland's Sectoral Specialization. *The Economic and Social Review, 50*(1), 53-79. Retrieved from https://www.esr.ie/article/view/1040 (16.03.2025).

Bobirca, A., & Miclaus, P.G. (2007). A Multilevel Comparative Assessment Approach to International Services Trade Competitiveness: The Case of Romania and Bulgaria. *International Journal of Economics and Management Engineering*, *1*(6), 122-127. Retrieved from https://publications.waset.org/10058/a-multilevel-comparative-assessment-approach-to-international-services-trade-competitiveness-the-case-of-romania-and-Bulgaria (16.03.2025).

Brei, M., & von Peter, G. (2018). The Resilience of Large International Banks. *BIS Quarterly Review, March 2018*. Retrieved from https://www.bis.org/publ/qtrpdf/r_qt1803e.htm (16.03.2025).

Cieślik, E. (2022). A New Era is Beginning in Central and Eastern Europe: Information and Communication Technology Services Exceed Manufacturing in the Global Production Chain. *Journal of the Knowledge Economy*, *13*, 2607-2639. https://doi.org/10.1007/s13132-021-00801-0.

Deardorff, A.V. (1985). Comparative Advantage and International Trade and Investment in Services. *The World Economy, 8*(2), 125-138. https://doi.org/10.1111/j.1467-9701.1985.tb00498.x.

Deardorff, A.V. (2005). Ricardian Comparative Advantage and Trade in Services. In L.A. Winters & M. Gasiorek (Eds.), *Liberalizing Trade in Services*. Princeton: Princeton University Press.

Department of Finance Ireland. (2021). *The Impact of Multinational Corporations on Ireland's Economy*. Dublin: Government Report. Retrieved from: https://www.gov.ie/en/publication/1d3c3-the-impact-of-multinational-corporations-on-irelands-economy/ (16.03.2025).

Eurostat. (2024). *Balance of Payments Data*. Retrieved from http://ec.europa.eu/eurostat/web/balance-of-payments/data/database (16.03.2025).

Fontagné, L., & Freudenberg, M. (1997). Intra-Industry Trade: Methodological Issues Reconsidered. *CEPII Working Paper, 97*(1). Retrieved from: http://www.cepii.fr/PDF_PUB/wp/1997/wp1997-01.pdf (16.03.2025).

Francois, J., & Hoekman, B. (2010). Services Trade and Policy. *Journal of Economic Literature*, *48*(3), 642-692. https://doi.org/10.1257/jel.48.3.642.

Gaurav, K., & Bharti, N. (2018). India-Japan CEPA: What RCA Index Reveals for Trade in Services. *International Trade Journal*, *53*(3). https://doi.org/10.1080/08853908.2017.1386148.

Grubel, H.G., & Lloyd, P.J. (1975). *Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products*. New York: Macmillan.

Hindley, B., & Smith, A. (1984). Comparative Advantage and Trade in Services. The World *Economy, 7*(4), 369-390. https://doi.org/10.1111/j.1467-9701.1984.tb00071.x.

Hoekman, B., & Matoo, A. (2000). Services in International Trade: Unlocking Barriers to Trade. *World Bank Policy Research Working Paper, 2436*. Retrieved from: https://openknowledge.worldbank.org/handle/10986/21320 (16.03.2025).

Hoen, A.R., & Oosterhaven, J. (2006). On the Measurement of Comparative Advantage. *The Annals of Regional Science*, *40*(3), 677-691. https://doi.org/10.1007/s00168-006-0076-4.

IMF. (2013). German-Central European Supply Chain-Cluster Report: Staff Report, First Background Note, Second Background Note, Third Background Note. *IMF Country Report*, *13*(263), 1-45. Retrieved from https://www.imf.org/en/Publications/CR/Issues/2016/12/31/German-Central-European-Supply-Chain-Cluster-Report-40897 (16.03.2025).

Jiang, L., & Lin, C. (2020). Analysis on the International Competitiveness of China's Trade in Services. *Emerging Markets Finance and Trade*, *56*(13), 3033-3043. https://doi.org/10.1080/1540496X.2019.1698358.

Krugman, P., Cooper, R.N., & Srinivasan, T.N. (1995). Growing World Trade: Causes and Consequences. *Brookings Papers on Economic Activity. Brookings Papers on Economic Activity*, *1995*(1), 327-377. https://doi.org/10.2307/2534577.

Lafay, G. (1992). The Measurement of Revealed Comparative Advantages. In M.G. Dagenais & P.A. Muet (Eds.), *International Trade Modelling*. London: Chapman & Hall.

Langhammer, R.J. (2004). Revealed Comparative Advantages in the Services Trade of the United States, the European Union, and Japan: What do They Tell Us? *The World Economy Journal*, *5*(6), 887-896. https://doi.org/10.1111/j.1467-9701.2004.00640.x.

Laursen, K. (2015). Revealed Comparative Advantage and the Alternatives as Measures of International Specialization. *Eurasian Business Review*, *5*(1), 99-115. https://doi.org/10.1007/s40821-015-0017-1.

Lejour, A.M., & de Paiva Verheijden, J. (2004). Services Trade Within Canada and the European Union. What do They Have in Common? *CPB Netherlands Bureau for Economic Policy Analysis*, *42*. Retrieved from https://www.cpb.nl/sites/default/files/publicaties/download/services-trade-within-canada-and-european-union-what-do-they-have-common.pdf (16.03.2025).

Liesner, H.H. (1958). The European Common Market and British Industry. *The Economic Journal*, *68*(270), 302-316. https://doi.org/10.2307/2227597.

Nusbaumer, J. (1987). *Services in the Global Market*. Alphen aan den Rijn: Kluwer Academic Publishers.

Peterson, J., & Barras, R. (1987). The International Trade in Producer Services: Theory and Evidence. *The Service Industries Journal, 7*(2), 139-150. https://doi.org/10.1080/02642068700000022.

Ricardo, D. (1817). *On the Principles of Political Economy and Taxation*. London: John Murray. Retrieved from https://www.econlib.org/library/Ricardo/ricP.html (16.03.2025).

Schoenmaker, D. (2022). The UK as a Global Financial Centre After Brexit. *Journal of Financial Regulation and Compliance, 30*(1), 17-35. https://doi.org/10.1108/JFRC-05-2021-0049.

Seyoum, B. (2007). Revealed Comparative Advantage and Competitiveness in Services. *Journal of Economic Studies*, *34*(5), 376-388. https://doi.org/10.1108/01443580710823194.

Stellian, R., & Danna-Buitrago, J.P. (2022). Which Revealed Comparative Advantage Index to Choose? Theoretical and Empirical Considerations. *CEPAL Review*, *138*, 45-66. Retrieved from: https://www.cepal.org/en/publications/47989-which-revealed-comparative-advantage-index-choose-theoretical-and-empirical (16.03.2025).

Tian J., Zhu Y., Hoang T.B.N., & Edjah B.K.T. (2024). Analysis of the Competitiveness and Complementarity of China-Vietnam Bilateral Agricultural Commodity Trade. *PLoS ONE*, *19*(4), e0302630. https://doi.org/10.1371/journal.pone.0302630.

Vollrath, T.L. (1991). A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage. *Weltwirtschaftliches Archiv*, *127*(2), 265-280. https://doi.org/10.1007/BF02707986.

Wosiek, R., & Visvizi, A. (2021). The VWRCA Index: Measuring a Country's Comparative Advantage and Specialization in Services. The Case of Poland. *Economies*, *9*(2), 48. https://doi.org/10.3390/economies9020048.

Wyszkowska-Kuna, J. (2016). *Usługi biznesowe oparte na wiedzy. Wpływ na konkurencyjność gospodarki na przykładzie wybranych krajów Unii Europejskiej.* Łódź: Wydawnictwo Uniwersytetu Łódzkiego. Retrieved from: https://wydawnictwo.uni.lodz.pl/produkt/uslugi-biznesowe-oparte-na-wiedzy-wplyw-na-konkurencyjnosc-gospodarki-na-przykladzie-wybranych-krajow-unii-europejskiej/ (16.03.2025).

Yu, R., Cai, J., & Leung, P. (2009). The normalized revealed comparative advantage index. *The Annals of Regional Science*, *43*(1), 267-282. https://doi.org/10.1007/s00168-008-0213-3.

APPENDIX

Appx. 1. RCA index values for 11 service categories in 2016

Country	RCA SA	RCA SB	RCA SC	RCA SE	RCA SF	RCA SG	RCA SH	RCA SI	RCA SJ	RCA SK	RCA SL
Austria	0.645	0.804	1.460	0.863	0.397	0.327	0.303	0.827	0.868	0.033	0.312
Belgium	no data	0.578	1.306	1.867	0.536	0.591	0.548	0.950	1.531	0.064	4.342
Bulgaria	1.949	0.995	1.259	0.212	2.266	0.156	0.080	1.050	0.505	0.002	0.038
Cyprus	0.007	0.000	1.762	0.068	0.255	1.741	no data	no data	0.047	0.001	4.206
Czech Republic	3.371	1.852	1.455	0.996	0.404	0.202	0.157	1.142	0.877	0.007	0.000
Germany	0.683	1.772	0.929	0.597	1.692	1.058	no data	0.895	1.202	no data	2.899
Denmark	0.114	0.394	2.271	9.507	0.277	0.150	0.545	0.706	0.584	0.019	0.451
Estonia	1.406	2.273	1.595	3.988	0.023	0.239	0.039	0.807	0.840	0.003	0.987
Greece	0.028	0.273	1.181	1.293	0.628	0.057	0.051	0.455	0.338	0.007	1.018
Spain	no data	no data	0.685	0.388	0.277	0.245	0.197	0.555	0.579	no data	no data
EU28	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Finland	3.636	1.198	0.942	0.366	0.270	0.223	0.859	2.529	1.037	0.003	1.005
France	1.725	1.579	0.917	0.303	1.585	0.442	0.664	0.738	1.375	0.133	0.854
Hungary	3.167	1.587	1.671	1.191	0.048	0.087	0.663	0.694	0.915	no data	no data
Republic of Ireland	0.150	0.746	0.522	0.062	3.774	1.306	0.478	3.638	0.791	0.002	0.841
Italy	1.304	0.608	0.664	0.145	0.586	0.879	0.435	0.851	0.798	0.004	2.303
Lithuania	1.288	1.933	3.693	1.998	no data	0.084	0.108	0.386	0.425	no data	1.190
Latvia	0.656	0.439	2.473	3.204	0.025	0.463	0.025	1.155	0.553	0.001	0.639
Malta	0.000	0.791	0.184	0.000	0.307	2.296	0.466	0.069	0.891	no data	no data
Netherlands	1.169	no data	1.158	0.900	0.205	0.249	4.416	1.024	1.008	0.039	no data
Poland	2.421	1.666	1.789	2.644	0.426	0.159	0.125	0.891	0.918	0.038	no data
Portugal	0.563	0.860	1.241	1.871	0.187	0.102	0.044	0.415	0.584	0.010	0.643
Romania	6.651	1.172	2.066	1.396	0.143	0.132	0.063	1.282	0.793	0.003	0.473
Sweden	0.625	0.463	0.962	1.106	0.272	0.664	1.956	1.267	1.203	0.019	0.563
Slovenia	0.866	0.729	1.768	3.643	0.411	0.062	0.087	0.671	0.484	0.005	0.182
Slovakia	1.321	1.763	1.578	0.922	0.176	0.184	0.040	1.102	0.699	0.002	0.867
United Kingdom	0.409	0.843	0.713	0.691	1.022	2.081	0.973	0.806	1.184	no data	no data

Source: own elaboration based on data Eurostat. (2024). Balance of payments data.

Appx. 2. TBI index values for 11 service categories in 2016

Country	TBI SA	TBI SB	TBI SC	TBI SE	TBI SF	TBI SG	TBI SH	TBI SI	TBI SJ	TBI SK	TBI SL
Austria	-0.351	-0.061	0.001	0.048	-0.068	0.060	-0.217	0.082	0.035	-0.401	0.339
Belgium	no data	-0.014	-0.025	-0.044	0.030	-0.039	0.077	0.127	-0.033	0.039	0.955
Bulgaria	0.769	0.220	0.123	0.073	0.352	-0.034	-0.660	0.459	0.005	-0.053	no data
Cyprus	no data	no data	0.344	0.500	-0.586	0.368	no data	no data	-0.545	-0.798	no data
Czech Republic	0.722	-0.043	0.296	0.253	-0.530	0.137	-0.718	0.202	-0.038	-0.243	no data
Germany	-0.188	-0.030	-0.135	-0.059	0.286	0.208	no data	-0.119	-0.048	no data	0.529
Denmark	-0.805	-0.158	0.045	0.332	-0.080	-0.019	-0.041	-0.165	-0.155	-0.545	0.438
Estonia	0.635	0.439	0.027	0.677	-0.772	0.162	-0.669	0.110	0.075	0.042	0.259
Greece	0.358	0.088	0.070	0.615	-0.462	-0.425	-0.579	0.223	0.314	-0.117	0.123
Spain	no data	no data	0.328	0.694	-0.227	-0.223	-0.626	0.031	0.029	no data	no data
EU28	0.114	0.060	0.025	0.126	0.081	0.222	-0.051	0.164	-0.023	-0.004	no data
Finland	0.064	0.159	-0.282	-0.744	-0.549	-0.589	-0.075	0.165	-0.299	-0.841	0.145
France	0.095	-0.063	-0.136	-0.206	-0.072	0.231	-0.357	-0.047	-0.007	0.065	0.981
Hungary	0.814	0.156	0.200	0.388	-0.744	-0.499	-0.104	0.052	-0.079	no data	no data
Republic of Ireland	-0.019	0.244	0.703	-0.571	0.207	0.304	-0.854	0.922	-0.146	-0.471	0.900
Italy	0.064	-0.013	-0.382	0.675	-0.349	-0.271	-0.441	-0.168	-0.216	-0.593	0.032
Lithuania	0.923	0.217	0.330	0.421	no data	-0.469	-0.287	0.041	-0.033	no data	-0.175
Latvia	0.818	0.226	0.464	0.795	-0.500	0.300	-0.758	0.303	0.087	0.529	0.294
Malta	no data	0.566	-0.052	no data	-0.302	0.083	-0.175	-0.265	-0.265	no data	no data
Netherlands	-0.003	no data	0.229	-0.012	0.266	-0.268	0.651	0.162	-0.050	-0.003	no data
Poland	0.772	0.249	0.358	0.552	-0.316	-0.214	-0.780	0.125	0.036	0.044	no data
Portugal	0.903	0.002	0.497	0.789	-0.406	-0.338	-0.866	0.071	0.044	-0.183	0.352
Romania	0.904	0.009	0.550	0.633	-0.568	-0.029	-0.817	0.312	0.052	-0.029	-0.082
Sweden	-0.094	-0.144	-0.100	-0.323	-0.027	0.371	0.285	0.093	-0.006	-0.079	0.390
Slovenia	0.883	0.020	0.362	0.570	-0.151	-0.593	-0.744	0.018	-0.143	0.091	-0.681
Slovakia	0.602	0.015	0.023	-0.092	-0.549	0.030	-0.894	0.077	-0.114	-0.292	0.499
United Kingdom	0.492	0.516	-0.120	0.098	0.406	0.652	0.318	0.211	0.221	no data	no data

Source: own elaboration based on data Eurostat. (2024). Balance of payments data.

Appx. 3. TC index values for 11 service categories in 2016

Country	TC SA	TC SB	TC SC	TC SE	TC SF	TC SG	TC SH	TC SI	TC SJ	TC SK	TC SL
Austria	0.481	0.885	1.001	1.101	0.872	1.129	0.643	1.179	1.073	0.428	2.026
Belgium	no data	0.973	0.951	0.915	1.062	0.925	1.166	1.290	0.937	1.081	43.897
Bulgaria	7.669	1.563	1.279	1.158	2.085	0.934	0.205	2.694	1.010	0.900	no data
Cyprus	no data	no data	2.047	3.000	0.261	2.165	no data	no data	0.294	0.112	no data
Czech Republic	6.194	0.918	1.842	1.679	0.307	1.318	0.164	1.507	0.926	0.608	no data
Germany	0.683	0.941	0.762	0.888	1.800	1.526	no data	0.788	0.908	no data	3.243
Denmark	0.108	0.727	1.095	1.995	0.852	0.962	0.920	0.716	0.732	0.295	2.558
Estonia	4.472	2.564	1.055	5.199	0.128	1.387	0.198	1.247	1.163	1.088	1.698
Greece	2.113	1.194	1.151	4.196	0.368	0.403	0.267	1.576	1.914	0.790	1.279
Spain	no data	no data	1.975	5.539	0.630	0.636	0.230	1.065	1.060	no data	no data
EU28	1.257	1.127	1.050	1.288	1.176	1.570	0.903	1.393	0.955	0.991	no data
Finland	1.137	1.377	0.560	0.147	0.291	0.259	0.860	1.394	0.540	0.086	1.340
France	1.209	0.881	0.760	0.658	0.866	1.602	0.474	0.911	0.986	1.138	104.333
Hungary	9.773	1.369	1.499	2.267	0.147	0.335	0.812	1.109	0.853	no data	no data
Republic of Ireland	0.962	1.645	5.737	0.273	1.523	1.874	0.079	24.502	0.745	0.360	19.059
Italy	1.138	0.975	0.447	5.161	0.483	0.574	0.388	0.712	0.645	0.256	1.066
Lithuania	25.053	1.554	1.983	2.451	no data	0.362	0.555	1.086	0.937	no data	0.703
Latvia	10.000	1.583	2.729	8.778	0.333	1.855	0.138	1.871	1.190	3.250	1.833
Malta	no data	3.609	0.901	no data	0.536	1.181	0.701	0.581	0.581	no data	no data
Netherlands	0.994	no data	1.595	0.975	1.726	0.578	4.725	1.386	0.904	0.994	no data
Poland	7.767	1.662	2.117	3.464	0.520	0.647	0.124	1.286	1.074	1.092	no data
Portugal	19.643	1.004	2.979	8.457	0.422	0.495	0.072	1.153	1.092	0.691	2.088
Romania	19.889	1.017	3.449	4.451	0.275	0.944	0.100	1.907	1.110	0.944	0.849
Sweden	0.829	0.749	0.819	0.511	0.948	2.181	1.796	1.205	0.988	0.854	2.278
Slovenia	16.056	1.040	2.137	3.655	0.738	0.255	0.147	1.037	0.750	1.201	0.189
Slovakia	4.021	1.030	1.048	0.832	0.291	1.062	0.056	1.167	0.795	0.549	2.991
United Kingdom	2.941	3.132	0.786	1.217	2.369	4.749	1.932	1.534	1.567	no data	no data

Source: own elaboration based on data Eurostat. (2024). Balance of payments data.

Appx. 4. ARCA index values for 11 service categories in 2016

Country	ARCA SA	ARCA SB	ARCA SC	ARCA SE	ARCA SF	ARCA SG	ARCA SH	ARCA SI	ARCA SJ	ARCA SK	ARCA SL
Austria	-0.009	-0.003	0.078	-0.002	-0.016	-0.069	-0.037	-0.019	-0.032	-0.002	no data
Belgium	no data	-0.006	0.052	0.014	-0.012	-0.042	-0.024	-0.006	0.128	0.000	no data
Bulgaria	0.024	0.000	0.044	-0.013	0.034	-0.087	-0.049	0.005	-0.119	-0.007	no data
Cyprus	-0.026	-0.015	0.129	-0.016	-0.020	0.076	no data	no data	-0.230	-0.011	no data
Czech Republic	0.061	0.012	0.077	0.000	-0.016	-0.082	-0.045	0.016	-0.030	-0.006	no data
Germany	-0.008	0.011	-0.012	-0.007	0.019	0.006	no data	-0.012	0.049	no data	no data
Denmark	-0.023	-0.009	0.215	0.142	-0.019	-0.088	-0.024	-0.033	-0.100	-0.004	no data
Estonia	0.010	0.019	0.101	0.050	-0.026	-0.078	-0.051	-0.021	-0.039	-0.003	no data
Greece	-0.025	-0.011	0.031	0.005	-0.010	-0.097	-0.051	-0.060	-0.160	-0.006	no data
Spain	no data	no data	-0.053	-0.010	-0.019	-0.078	-0.043	-0.049	-0.101	no data	no data
EU28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	no data
Finland	0.068	0.003	-0.010	-0.011	-0.020	-0.080	-0.008	0.169	0.009	-0.010	no data
France	0.019	0.008	-0.014	-0.012	0.016	-0.058	-0.018	-0.029	0.090	0.002	no data
Hungary	0.056	0.009	0.114	0.003	-0.025	-0.094	-0.018	-0.034	-0.020	no data	no data
Republic of Ireland	-0.022	-0.004	-0.081	-0.016	0.074	0.032	-0.028	0.292	-0.050	-0.012	no data
Italy	0.008	-0.006	-0.057	-0.014	-0.011	-0.012	-0.030	-0.016	-0.049	-0.012	no data
Lithuania	0.007	0.014	0.456	0.017	no data	-0.094	-0.048	-0.068	-0.138	no data	no data
Latvia	-0.009	-0.008	0.249	0.037	-0.026	-0.055	-0.052	0.017	-0.108	-0.009	no data
Malta	-0.026	-0.003	-0.138	-0.017	-0.019	0.134	-0.029	-0.103	-0.026	no data	no data
Netherlands	0.004	no data	0.027	-0.002	-0.021	-0.077	0.183	0.003	0.002	-0.008	no data
Poland	0.037	0.010	0.134	0.027	-0.015	-0.087	-0.047	-0.012	-0.020	0.004	no data
Portugal	-0.011	-0.002	0.041	0.015	-0.022	-0.093	-0.051	-0.065	-0.100	-0.006	no data
Romania	0.146	0.003	0.181	0.007	-0.023	-0.089	-0.050	0.031	-0.050	-0.010	no data
Sweden	-0.010	-0.008	-0.006	0.002	-0.019	-0.035	0.051	0.030	0.049	-0.005	no data
Slovenia	-0.003	-0.004	0.130	0.044	-0.016	-0.097	-0.049	-0.036	-0.124	0.001	no data
Slovakia	0.008	0.011	0.098	-0.001	-0.022	-0.084	-0.051	0.011	-0.072	-0.010	no data
United Kingdom	-0.015	-0.002	-0.049	-0.005	0.001	0.111	-0.001	-0.021	0.044	no data	no data

Source: own elaboration based on data Eurostat. (2024). Balance of payments data.

OLSZTYN ECONOMIC JOURNAL
2025, 20(1), 55–67
ISSN 1897-2721 e-ISSN 2083-4675 DOI: 10.31648/oej.10807

ORIGINAL PAPER

DISCLOSURE OF SEGMENT REPORTING IN FINANCIAL STATEMENTS OF POLISH LISTED COMPANIES BEFORE AND AFTER COVID-19 PANDEMIC

Joanna Dynowska
Institute of Management and Quality Sciences
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0003-4338-2961
e-mail: joannan@uwm.edu.pl

Grzegorz Wrona
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
e-mail: grzegorz.wrona@uwm.edu.pl

JEL Classification: M21.

Key words: operating segments, segment reporting, financial statement, sWIG-80.

Abstract

Events in recent years, such as the COVID-19 pandemic, have had an impact on the economy of many countries and markets. One of the measures of the impact of the pandemic on the Polish economy is the analysis of the behavior of the largest companies listed on the Warsaw Stock Exchange in Warsaw. The following study presents evidence of segment reporting information disclosed in financial statements of sWIG-80 listed companies before and after the COVID-19 pandemic. The purpose of the analysis was to verify the scope and method of presenting segment reporting standards in annual, consolidated financial statements, i.e. fiscal years 2019 and 2023. The analysis showed differences in the presentation of segments of information by sWIG-80 companies before and after the COVID-19 pandemic. It was found that after the pandemic companies are more willing to present incomes rather than costs in segments. However, before the pandemic, they informed more precisely about products and customers in operating segments.

How to cite: Dynowska, J., & Wrona, G. (2025). Disclosure of Segment Reporting in Financial Statements of Polish Listed Companies Before and After Covid-19 Pandemic. *Olsztyn Economic Journal*, *20*(1), 55-67. https://doi.org/10.31648/oej.10807

PREZENTACJA INFORMACJI O SEGMENTACH OPERACYJNYCH W SPRAWOZDANIACH FINANSOWYCH SPÓŁEK GIEŁDOWYCH W OKRESIE PRZED PANDEMIĄ I PO PANDEMII COVID-19

Joanna Dynowska
Instytut Nauk o Zarządzaniu i Jakości
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Grzegorz Wrona
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: M21.

S ł o w a k l u c z o w e: segmenty operacyjne, sprawozdawczość segmentowa, sprawozdanie finansowe, sWIG-80.

A b s t r a k t

Zdarzenia ostatnich lat, jak pandemia COVID-19, wywarły wpływ na gospodarki i rynki wielu krajów. Jedną z miar wpływu pandemii na polską gospodarkę jest analiza zachowania się największych spółek notowanych na warszawskiej giełdzie papierów wartościowych. W artykule przedstawiono wyniki badania poświęconego sprawozdawczości segmentowej spółek wchodzących w skład indeksu sWIG-80 w okresach porównawczych przed pandemią COVID-19 i po niej. Celem badania była analiza sposobu i zakresu prezentacji informacji na temat segmentów operacyjnych w rocznych, skonsolidowanych sprawozdaniach finansowych w okresach porównawczych, tj. za lata 2019 i 2023. Przeprowadzone badania wykazały różnice w prezentacji informacji o segmentach operacyjnych przed pandemią COVID-19 i po niej przez spółki z indeksu sWIG-80. Wykazano, że po pandemii spółki chętniej prezentują dane o przychodach w podziale na segmenty operacyjne niż dane o poniesionych kosztach. Przed pandemią natomiast w większym stopniu ujawniały informacje o klientach i produktach w podziale na segmenty operacyjne.

Introduction

The sWIG-80 index collects companies with unique characteristics. As an index comprising small- and medium-cap companies (small-cap and partially mid-cap), it consists of enterprises that are more susceptible to economic fluctuations, supply chain disruptions, and changes in demand – factors that were particularly affected by the COVID-19 pandemic. Unlike large, well-diversified corporations of WIG20 or mWIG40, many sWIG-80 companies focus on specific market segments, making their financial performance and reporting practices more sensitive to external shocks.

The dynamic economic environment and the global impact of the COVID-19 pandemic have significantly influenced the way publicly traded companies report their financial results, particularly in the presentation of information on operating

segments. Analyzing segment reporting of sWIG-80 companies before and after the pandemic provides a deeper understanding of how smaller publicly traded firms adapted their financial disclosures to evolving market conditions, shifting investor expectations, and increasing regulatory requirements.

The principle of presenting financial information by business or geographical area is defined by International Financial Reporting Standards 8 (IFRS 8) "Operating segments" and is applicable to annual periods beginning January 1, 2009. This new guidance superseded the International Accounting Standards 14 (IAS 14) issued in August 1997 (Lipiński, 2012).

IFRS 8 requires principle-based disclosures intended to help financial reporting users assess the nature and financial effects of their business activity (IFRS 8.1), including geographic regions (IFRS 8.33).

There is no clear definition of segments: however, Hucklesby (2022) defined operating segments as components of an entity with three characteristics: the component engages in business activities from which it can earn revenues and incur expenses, the component's operating results are regularly reviewed by CODM (Chief Operating Decision Maker) and discrete financial information is available for the component

The increasing demand for information from the accounting system is increasingly used for domestic economic decision-making and in the international market (Czubakowska, 2009, p. 35). International Financial Reporting Standards, and in particular IFRS 8, are designed to standardize the format of data disclosed to the public and to provide as much detailed information as possible that is relevant to its recipients and that will help to determine the financial and economic position of the company and to assess the impact of the economic activities undertaken.

The purpose of the study was to analyze the method and scope of presenting information on operating segments in annual consolidated financial statements in comparative periods, that is, for 2019 and 2023. We use all sWIG-80 companies listed on the Warsaw Stock Exchange consolidated financial statements for 2019 and 2023.

Literature Review

In August 2004 Polish Parliament approved amendment to Polish Accounting Act to meet requirements of European Union IFRS standards on consolidated financial statements. This obligation initially applied to issuers of securities admitted to public trading on the Warsaw Stock Exchange and banks. Later it was extended to individual and consolidated financial statements of entities applying to conduct public offering (IPO) and capital groups.

The financial statement is defined as the document prepared according to applicable regulations and within the specified period. It presents financial data with explanations. The financial statement is used to analyze the profitability of financial decisions (Bauer & Macuda, 2018).

The financial statement could be defined by the following criteria (Mućko, 2012):

1. Always refers to the past period. Usually, it is fiscal year or reporting year.
2. Reflect the current financial situation of the entity. The data presented could be used to conduct a comparative analysis to present the current financial situation.
3. The financial statement is based on reliable and objective financial data, which ensures the credibility and comparability of financial reports.

The purpose of unification of the information presented was to facilitate the comparison of financial data between different companies for stakeholders.

Data presented and complied with IFRS 8 let the reader better understand the area of activity. On the other hand, many companies faced problems due to the diverse nature of business profiles subject to the obligation of presenting information about operating segments. That was because companies had to identify segments in their own way and IFRS 8 does not specify strict provisions on how to determine it. This was also noticed by Prewysz-Kwinto and Voss, who analyzed WIG-30 companies listed on the Warsaw Stock Exchange (Prewysz--Kwinto & Voss, 2015). As shown by his analysis of the financial statements of the largest companies listed on the Warsaw Stock Exchange, the scope of presented information varies greatly, which makes data comparability difficult.

The operational segments disclosed by companies in the financial statements significantly support the analysis of the company's financial condition and the daily decisions made by the responsible persons.

Sojak (2011) found that publication of data on business segments is a beneficial phenomenon enabling the forecasting and verification of processes occurring within the organization that may be an important factor in attracting investors. In his opinion, it allows investors for estimating the investment attractiveness measures for the economic entity as a whole and for its individual areas, thus indicating the level of the generated rate of return, the accompanying risk and the importance of these areas for the whole (Sojak, 2011). The most common criteria used by enterprises are product line, geographical regions or customers.

Following Klimczak (2016) investigation, the data presented in financial statements is largely dependent on the internal solutions used in individual companies. Each entity decides for itself which operational segments it distinguishes, what principles of measuring segment data it applies. Therefore, the final shape of segment information is very individual and may vary between individual companies (Klimczak, 2016).

Superseding IAS 14 by IFRS 8 had both positive and negative effects in terms of financial statements suitability. As marked by Michalak (2014), the number

of entities presenting data on only one segment decreased, but the number of disclosed segments and the scope of disclosed information increased, especially in relation to main customers, products and geographical areas.

But at the same time, as it was investigated by Dynowska and Zapadka (2018) who analyzed companies in the wood and paper industry that replacing IAS 14 with IFRS 8 did not change the quality of the presented information.

Consulting and auditing companies operating in Poland, such as Big 4 (Deloitte, Ernst & Young, KPMG, PricewaterhouseCoopers), offer guides and tutorials on their websites that describe in detail how to implement IFRS 8 requirements (Deloitte, 2009; *Niezbędnik MSSF…*, 2021).

Methodology

The research sample includes the consolidated financial statement of the sWIG-80 companies listed on the Warsaw Stock Exchange for 2019 and 2023. We use 2019 as the last year before the COVID-19 pandemic starts and 2023 as the first year after the COVID-19 pandemic ended.

To initiate analysis, we took the consolidated financial statements for the analyzed period obtained from their website and the official Warsaw Stock Exchange website.

In this analysis, we compared the method and scope of presenting information on operating segments before and after the COVID-19 pandemic and searched answers the following research questions[1]:

– RQ1: Did the sWIG-80 companies listed on the Warsaw Stock Exchange disclose information about operating segments in their financial reports?

– RQ2: What criteria were used to define the operating segments?

– RQ3: Did the sWIG-80 companies listed on the Warsaw Stock Exchange disclose geographical segment information?

– RQ4: Did sWIG-80 companies listed on the Warsaw Stock Exchange disclose required operating segment general information?

– RQ5: Did the sWIG-80 companies listed on the Warsaw Stock Exchange disclose detailed financial information about operation segments?

The answers to the above questions will allow us to assess the impact of the COVID-19 pandemic on the quality of sWIG-80 companies listed on the Warsaw Stock Exchange segment reporting. To answer defined research questions we studied relevant literature, analyzed obtained data and compared achieved results.

[1] The research used the methodology presented in the article by Klimczak (2016).

Results

For preliminary examination, we verified whether sWIG-80 companies listed on the Warsaw Stock Exchange disclosed operational and geographical segments in their financial statements.

This analysis (Tab. 1) revealed that in the first year after the COVID-19 pandemic, the number of entities qualified for sWIG-80 that disclosed geographical segment information decreased by around 35% and by 7% for companies that recognized operational segments defined as business, geographical and mixed criteria.

Table 1

Number of companies identified operational segments

Specification	2019	%	2023	%	Change	% change
Operational segments:	75	94	56	70	-5	-7
– business	65	87	47	84	-18	-28
– geographical	1	1	4	7	3	300
– mixed	9	12	5	9	-4	44
Geographical segments	52	65	34	42.5	-13	-34.6

Source: own elaboration.

Further analysis showed that companies recognize 1 to 9 operational segments. Most of the examined companies presented 1 to 4 segments, that is below the median (73.7% in 2023, and 80.5% in 2019) and at the same time, the number of companies that presented more than 4 segments in their financial statements that is above the median (26.3% in 2023 and 19.5% in 2019) (Tab. 2).

Table 2

Number of operational segments disclosed by companies

Number of segments	Companies disclosed operational segments		% change
	2019	2023	
1 segment	10	12	20.0
2 segments	17	10	-41.2
3 segments	20	9	-55.0
4 segments	11	11	–
5 segments	8	7	-12.5
6 segments	5	1	-20
7 segments	0	4	–
8 segments	1	1	–
9 segments	0	2	–
Total	14	15	7.1

Source: own elaboration.

The data presented in Table 3 show a tendency to reduce the scope of information displayed by listed companies in key items. In 2019 and 2023, there was a decrease in this value both for all sWIG-80 index companies and for those that occurred in both years.

Table 3

Number of companies disclosure required items

Items disclosed – all sWIG-80 index companies	2019	2023	% change
Factor used to identify segments	70	60	-14.3
Identify the types of products and services each segment	64	51	-20.3
Identify main customers	10	9	-10.0
Items disclosed – companies occurred in both years	2019	2023	% change
Factor used to identify segments	41	36	-12.2
Identify the types of products and services each segment	42	38	-9.5
Identify main customers	5	4	-20.0

Source: own elaboration.

The number of companies reported factors used to identify segments decreased by 14.3% for all sWIG-80 index companies and by 12.2% for those repetitive in both years. Other findings reveal that type products and service segment revenue and identification of main customers also decreased (product revenue 20%, identification of customer 10% for all sWIG-80 index companies and 9.5% and 20% for those repeated respectively) (Tab. 3).

Table 4 presents the entity's approach to items of the income and profit segment disclosure before and after the COVID-19 pandemic. As it shown, inter-segment revenue and revenue to external customer significantly increased in 2023 compared to 2019 for all sWIG-80 index companies and for those that occurred in both years. The number of companies that presented the data has doubled. This may be due to the growing need for internal monitoring and optimization of the segment activities, which may suggest more emphasis on the transparency of internal activities or pressure from investors who are interested in a stable position on the business partners market. On the other hand companies are not willing to disclose such financial data as EBIT, EBITDA.

After the COVID-19 pandemic, both all sWIG-80 index companies and those that occurred in both years decided not to disclose such data. The number of entities decreased by a comparable amount.

This may be due to a decrease in the profitability of the companies, e.g. because of rising cost or price pressure. Companies not do not want to lose their position among potential business partners can limit the disclosure of these data.

On the contrary segment interest revenue increased 150% for all sWIG-80 index companies, which may suggest that companies began more to use financial instruments that generate interest and decreased 12% for those that occurred in both years, which may suggest opposite tendency (Tab. 4).

Table 4

Number of companies disclosure revenue and profit

Items disclosed – all sWIG-80 index companies	2019	2023	% change
Inter-segment revenue	15	33	120.0
Revenue to external customers	18	35	94.4
Interest Revenue	8	20	150.0
EBIT	51	41	-19.6
EBITDA	44	30	-26.8
Items disclosed – companies occurred in both years	2019	2023	% change
Inter-segment revenue	14	27	92.8
Revenue to external customers	17	24	41.2
Interest Revenue	21	15	-28.6
EBIT	36	32	-12.5
EBITDA	28	21	-25.0

Source: own elaboration.

After the COVID-19 pandemic, the companies analyzed increased transparency in disclosing information on the costs of operational segments in their financial statements.

Table 5 presents data for the balance sheet costs of the operational segments. The increase in assets (64%), CAPEX (35%), and liabilities (33%) was revealed. Both for all sWIG-80 index companies and for those that occurred in both years.

Table 5

Number of companies disclosure balance sheet costs

Items disclosed – all sWIG-80 index companies	2019	2023	% change
Assets	25	41	64.0
Liabilities	24	32	33.3
CAPEX	23	31	34.8
Amortization and depreciation	41	37	-9.8
Items disclosed – companies occurred in both years	2019	2023	% change
Assets	18	30	66.6
Liabilities	17	24	41.2
CAPEX	17	23	35.3
Amortization and depreciation	28	25	-10.7

Source: own elaboration.

Amortization and depreciation are exceptions to this. For this segmental cost item, we found a 10% decrease in the examined financial statements.

As required by IFRS 8, the consolidated financial statements should also include information on identified geographical segments. The analysis of the companies in the years under review made it possible to identify the number of companies included in the sWIG-80 index and those that occurred in both years present data by geographical category (Fig. 1).

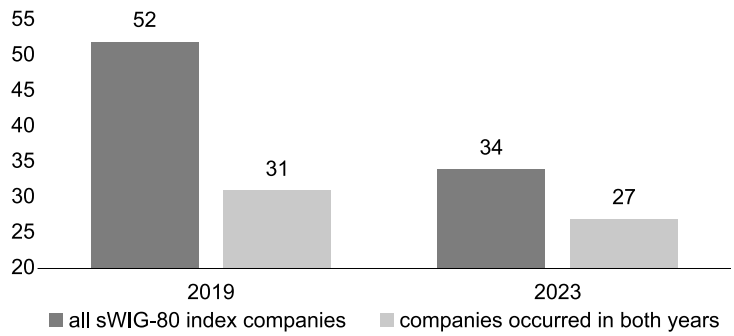


Fig. 1. Number of companies that disclosure geographical segments
Source: own elaboration.

The presented analysis shows that in both cases less number of companies presented geographical segmentation in 2023. This might be caused by possible business profile changes over 4 years, which exclude the sense of geographical segmentation.

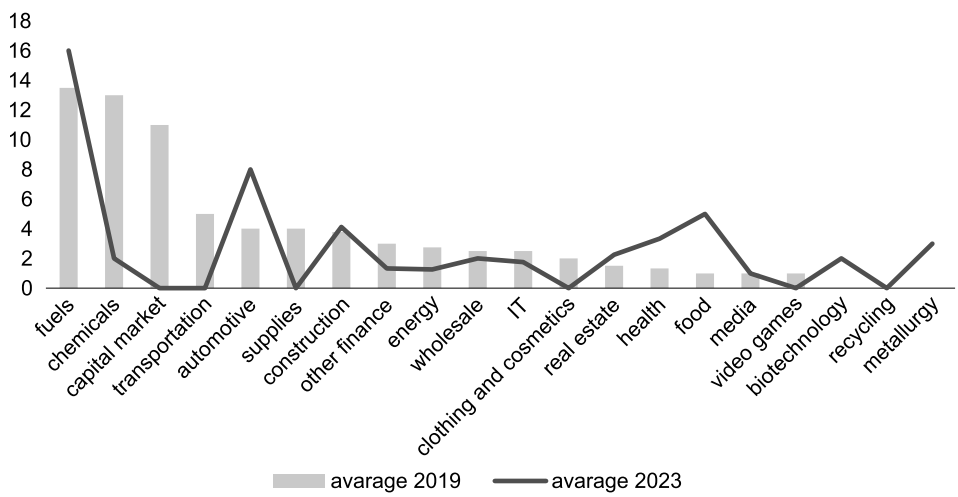


Fig. 2. Average number of identified geographical segments
Source: own elaboration.

We examined all sWIG-80 index companies by industry and found that markets such as fuels, chemicals and capital showed the largest tendency to decrease average number of geographical segments to be identified and at the same time industry such as food and automotive reverse trend (see Fig. 2). This may indicate regional expansion in these markets.

57 entities disclosed revenue from geographical segments in 2019 (32 for those that occurred in both years) and 35 in the year after the COVID-19 pandemic (27 for those that occurred in both years). We also mention that fixed assets by geographical segments decreased slightly over the years (Tab. 7).

Table 7

Number of companies disclosure items on geographical segments

Items disclosed – all sWIG-80 index companies	2019	2023	% change
Revenue	57	35	-38.6
Assets	24	19	-20.8
Items disclosed – companies occurred in both years	2019	2023	% change
Revenue	32	27	-15.6
Assets	15	14	-7.1

Source: own elaboration.

IFRS 8 requires disclosure of main customers if annual revenue exceeds 10% of the total. The data presented in Table 8 show that the entities examined are skeptical about sharing information about their customers in geographical segments. Only six companies disclosed it in 2023 compared to 18 in 2019 in total. A similar decreasing trend was observed for those that occurred in both years (4 in 2023 and 7 in 2019). One of the reasons for this could be protection of commercial confidentiality or to minimization of the risk of losing business.

Table 8

Number of companies that disclose the main customers in geographical segments

Item disclosed	2019	2023	% change
Main customers – all sWIG-80 index companies	18	6	-66.7
Main customers – companies occurred in both years	7	4	-42.8

Source: own elaboration.

Significantly decreased number of companies that present information about products by geographic segments. For all companies in the sWIG-80 index, this number decreased by 72% over 4 years and for those that occurred in both years by 60% (see Tab. 9).

Table 9

Number of companies that disclose types of products and services by geographical segments

Detailing	2019	2023	% change
Products and service – all sWIG-80 index companies	32	9	-71.9
Products and service – companies occurred in both years	15	6	-60.0

Source: own elaboration.

This trend related to the lack of product information by geographical segments may reflect the low significance of this item, the lack of a clear obligation to present such data resulting from the provisions and interpretation of IFRS 8 or changes in the business profile of individual companies.

Summary

IFRS 8 Operating Segments require companies to disclose information 'through the eyes of management' and it has always been a contentious issue for both standard setters and entities to which these apply.

The purpose of the analysis was to verify the scope of presenting segment reporting standards in annual, consolidated financial statements, i.e. fiscal years 2019 and 2023.

The research carried out shows that although most of the analyzed companies identified and disclosed operational and geographical segments either before or after the COVID-19 pandemic, the number of companies identifying operating segments decreased (rel. RQ1).

Analysis of the sWIG-80 consolidated financial statements showed that 84% of the entities after the pandemic compare to 87% of the entities before identify operational segments mainly by business (rel. RQ2). Only a few companies identified geographical or mixed segments.

Also, a similar trend was observed in geographical segment disclosure, and 57 companies analyzed in 2019 identified it, while in 2023 almost a third less. The analyze companies disclose information on the geographical segment, but their number decreased (rel. RQ3).

Information about the main customers is not publicly revealed either. Surprisingly small number of companies (only 8 in 2019 and 4 in 2023) disclosed main customers and only 9 presented product and service each segment. The popularity of publishing general information about segments is lower in 2023 (rel. RQ4).

The item for which the largest increase was observed in relation to the base period was revenue. Specially inter-segment revenue showed a triple increase

of the number of entities. The presented segmental cost data is worse. Companies are not willing to disclose EBIT or EBITDA result (20% decrease).

Entities' fear of disclosing strategic or confidential information to competitors may lead to a reduction in the scope of disclosures. This conclusion was also drawn by Michalak (2014). With regard to disclosures on balance sheet item breakdowns, it has been demonstrated that for both assets, liabilities and capital expenditure there has been an increase in the number of companies presenting this information, but only half of the companies included in the sWIG-80 index still present this information in their consolidated financial statements (rel. RQ5).

Understanding the operational and geographical segment information presented in the consolidated financial statements, and, in particular, the principles for their identification, is of the utmost importance to all stakeholders who analyze and use the data presented therein.

The observed reduction in transparency can affect stakeholders, including investors and analysts, in their decision-making processes. Given these findings, it is recommended that regulatory bodies and companies consider measures to encourage greater disclosure of segment information. Specifically, companies should be incentivized to provide detailed EBIT and EBITDA figures, as well as information on key customers and product/service segmentation. Increased standardization and clarity in segment disclosure requirements could enhance comparability between firms and industries and allow internal, individualized information to be organized.

Future research could further explore the reasons behind declining disclosure trends, particularly the impact of regulatory changes, industry, specific factors, or internal corporate policies. Additionally, a comparative study on different stock indices or international markets could provide a broader perspective on segment disclosure practices. One limitation of this study is its focus solely on the sWIG-80 index, which may not be representative of all market segments. Further research could include a larger sample size and a more detailed qualitative analysis of company disclosures to gain deeper insight into corporate reporting behaviors.

Translated by Grzegorz Wrona

Acknowledgements

Special thanks to Mr. Marcin Gwiazda for his cooperation and help in carrying out the research.

References

Bauer, K., & Macuda, M. (2018). Sprawozdanie finansowe jako źródło informacji dla interesariuszy restrukturyzowanego szpitala. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *503*, 37-47.

Czubakowska, K. (ed.). (2009). *Rachunkowość według prawa bilansowego*. Warszawa: Ch. Beck.

Deloitte Polska (2009). *MSSF 8 Segmenty Operacyjne – Przewodnik po Standardzie*. Retrieved from https://www.iasplus.com/en/binary/dttpubs/0906ifrs8polish.pdf.

Dynowska, J., & Zapadka, M. (2018). Wdrożenie MSSF 8 Segmenty operacyjne w spółkach branży drzewno-papierniczej. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu* (*Research Papers of Wrocław University of Economics*), *513*, 99-107. https://doi.org/10.15611/pn.2018.513.09. Retrieved from https://www.dbc.wroc.pl/dlibra/publication/72512/edition/47048?language=pl.

Niezbędnik MSSF. Zmiany w MSSF: Standardy i interpretacje opublikowane na dzień 31 marca 2021 r., z uwzględnieniem statusu wdrożenia w Unii Europejskiej. (2021). EY. Retrieved from https://www.ey.com/pl_pl/mssf/publikacje-mssf/niezbednik-mssf-standardy-i-interpretacje-opublikowane-na-dzien-31-marca-2021.

Hucklesby, M, & Carroll, S. (2022). *Identifying operating segments*. Grant Thorton. Inside of IFRS 8. Retrieved from https://www.grantthornton.global/en/insights/articles/ifrs-8/ifrs-8-identifying-operating-segments/.

Klimczak, K. (2016). Prezentacja informacji o segmentach operacyjnych w sprawozdaniach finansowych spółek giełdowych. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, *285*, 90-100.

Lipiński, C. (2012). Segmentacja wyników finansowych polskich banków – praktyka realizacji zaleceń MSSF 8. *Finansowe Aspekty Zarządzania Organizacjami*, *109*.

Michalak, J. (2014). Wpływ wprowadzenia MSSF 8 na przydatność sprawozdawczości segmentów na przykładzie największych spółek europejskich. *Zeszyty Teoretyczne Rachunkowości*, *80*(136), 173-191.

Mućko, P. (2012). Atrybuty sprawozdania z działalności na tle sprawozdania finansowego. *Zeszyty Teoretyczne Rachunkowości*, *66*, 143-152.

Prewysz-Kwinto, P., & Voss, G. (2015). Segmenty operacyjne w sprawozdaniach finansowych spółek giełdowych – porównywalność czy różnorodność informacji. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *388*, *Teoria rachunkowości, sprawozdawczość i analiza finansowa*, 322-330.

Regulamin Rodziny Indeksów Giełdowych, przyjęty Uchwałą Zarządu GPW Benchmark SA nr 21/2019 z dnia 24 lipca 2019 roku (ze zm.). Retrieved from https://gpwbenchmark.pl/pub/BENCHMARK/files/PDF/Regulamin_Rodziny_Indeksow_Gieldowych.pdf

Rozporządzenie Komisji (WE) nr 1126/2008 z dnia 3 listopada 2008 r. przyjmujące określone międzynarodowe standardy rachunkowości zgodnie z rozporządzeniem (WE) nr 1606/2002 Parlamentu Europejskiego i Rady – Międzynarodowy Standard Sprawozdawczości Finansowej 8 – Segmenty operacyjne, ze zmianami.

Sojak, S. (2011). Wartości informacyjne sprawozdawczości według segmentów działalności na przykładzie grupy kapitałowej Orbis. *Nauki o Finansach*, *2*(07), 219-239.

OLSZTYN ECONOMIC JOURNAL
2025, 20(1), 69–81
ISSN 1897-2721 e-ISSN 2083-4675 DOI: 10.31648/oej.11517

ORIGINAL PAPER

CHANGES IN THE SPATIAL DIFFERENTIATION OF THE DEVELOPMENT OF WARMIA AND MAZURY IN THE YEARS 2000-2022

Rafał Warżała
Faculty of Economic Sciences
University of Warmia and Mazury in Olsztyn
ORCID: https://orcid.org/0000-0001-8677-977X
e-mail: rafal.warzala@uwm.edu.pl

JEL Classification: R12, R30.

K e y w o r d s: region, regional development, structural changes.

A b s t r a c t

The aim of the article is to assess the level of economic development of the Warmia and Mazury region in the years 2000-2022 in three aspects: in comparison to the average development level in Poland, in comparison to the average value of regional GDP growth for the entire EU and in comparison to the internal differentiation of economic development in Warmia and Mazury according to NUTS 3 subregions.

The research process was carried out using primary data from public statistics: Eurostat and the Central Statistical Office. Classical methods of statistical analysis were used to achieve the research objective, i.e. dynamics analysis, structure indicators and comparative analysis. The reference point was all EU regions, all regions in Poland, and the Warmia-Masuria voivodeship itself. The results obtained indicate that the Warmia and Mazury region is still in one of the last places in terms of the level of development achieved, but this process is progressing in a positive direction and results in slow approach both to the EU and Polish average. This is accompanied by internal differentiation of development, which is also – although to a lesser extent – decreasing.

How to cite: Warżała, R. (2025). Changes in the Spatial Differentiation of the Development of Warmia and Mazury in the Years 2000-2022. *Olsztyn Economic Journal*, *20*(1), 69-81. https://doi.org/10.31648/oej.11517

ZMIANY ZRÓŻNICOWANIA PRZESTRZENNEGO ROZWOJU WARMII I MAZUR W LATACH 2000-2022

Rafał Warżała
Wydział Nauk Ekonomicznych
Uniwersytet Warmińsko-Mazurski w Olsztynie

Kody JEL: R12, R30.

Słowa kluczowe: region, rozwój regionalny, zmiany strukturalne.

Abstrakt

Celem artykułu jest ocena poziomu rozwoju gospodarczego regionu Warmii i Mazur w latach 2000-2022 na tle średniej wartości wskaźników ogółem w Polsce, na tle średniej wartości wzrostu regionalnego PKB dla całej Unii Eureopejskiej oraz ocena wewnętrznego zróżnicowania rozwoju gospodarczego na Warmii i Mazurach według podregionów NUTS 3.

Proces badawczy przeprowadzono z wykorzystaniem danych pierwotnych statystyki publicznej: Eurostatu oraz Głównego Urzędu Statystycznego. Do realizacji celu badań wykorzystano klasyczne metody analizy statystycznej, tzn. analizę dynamiki, wskaźniki struktury oraz analizę porównawczą. Punktem odniesienia były wszystkie regiony UE, wszystkie regiony w Polsce oraz samo województwo warmińsko-mazurskie. Otrzymane wyniki wskazują, że region Warmii i Mazur pozostaje wprawdzie na jednym z ostatnich miejsc pod względem osiągniętego poziomu rozwoju, proces ten jednak postępuje w pozytywnym kierunku i skutkuje powolnym zbliżaniem się do średniej UE oraz Polski. Towarzyszy temu wewnętrzne zróżnicowanie rozwoju, które również – choć w mniejszym stopniu – ulega zmniejszeniu.

Introduction

The issue of regional development, taken up in many scientific and non-scientific discussions, is still relevant. The development of regions is the subject of interest of both economic theory, economic practice and the regional authorities themselves. However, the analysis of regional development processes is not an easy task. This results from the complexity and multidimensionality of this phenomenon. The dynamics of regional development is of great importance for the economy of each country, and its strengthening with external (EU) funds is currently the subject of many substantive discussions conducted at the national and international level (Warżała, 2012, p. 57).

The implementation of regional development policy in Poland actually took place with the administrative reform initiated in 1999, and then strengthened by Poland's accession to the European Union. This created conditions for applying for European funds, the purpose and scale of which had no equivalents before. Thus, 2000 can be considered a breakthrough year for the implementation of regional development policy in Poland. After 23 years of conducting regional

policy, a certain assessment can be made from the point of view of the position of the Warmia and Mazury region among all other regions in Poland and changes in the internal situation in the studied region. The above constitutes the aim and research intention of this article.

Regional Development – Literature Review

The concept of regional development has already been widely described in the literature on the subject. Therefore, this work focuses on the latest research related to it.

The issue of regional development is multi-faceted, which is why it is difficult to define it unambiguously. Nevertheless, the literature indicates a certain set of factors influencing the direction, efficiency and pace of development (Tuziak, 2022, p. 57; Pike *et al.*, 2006, p. 23; Hudson, 2007, p. 79; Larty *et al.*, 2017, p. 16). In the general sense, the concept of regional development refers to the growth of the socio-economic potential of a region, which is accompanied by a lasting improvement in its functioning and the standard of living of its inhabitants (Poliński, 2020, p. 13).

The literature on the subject indicates four dimensions of regional development (Strzelecki, 2008, p. 26). The first is the process of all changes taking place in the region, mainly of an economic nature, consisting in the transformation of regional factors and resources into goods and services. Secondly, regional development is also a social process, due to the fact that it creates the basis for changes in the way, level and quality of life of the inhabitants of the region. Thirdly, regional development also has an efficiency dimension, i.e. it aims to use the endogenous factors and resources of the region more effectively and rationally. The fourth dimension is environmental in nature. In this case, it is a process referred to a sustainable development. It should be emphasized that this last aspect of regional development is currently gaining in importance. However, the overall process of regional development should certainly be a process encompassing changes taking place in all these four spheres simultaneously. Balancing the process can enable the durability of economic and social development (Augustyn, 2020, p. 17).

Regardless of the review presented above, in the contemporary paradigm of regional development, in addition to economic and spatial factors, the importance of qualitative factors of the location of economic activity is emphasized. These include issues such as the diversity of the economic structure, the efficiency of administration, living conditions, the quality of human capital, as well as the quality and condition of transport infrastructure (Gorzelak, 2003, p. 28). In such a multidimensional perspective, regional development is understood as the coexistence of phenomena of an economic, socio-cultural and political nature

(Hryniewicz, 2000, p. 41). The above characteristics of regional development are universal, regardless of the way in which the region was designated (Dębowski, 2013, p. 87).

According to Nowak (2018, p. 53), regional development should be interpreted as a process of changes of a socio-economic nature that takes place within the social system in a given area. As he states, the endogenous potential of the region and the flow of people, information and goods are integral parts of regional development. The flows of production factors – as the Author notes – are more intensive within the territory, which is characterized by homogeneity, than in relation to exogenous areas.

Churski *et al*. (2018, p. 78) takes a similar position, stating that regional development is a process of a socio-economic nature that takes place in a regional system or within the boundaries of a single region. However, he emphasizes that its nature or mechanism deviates from a uniform, linear vision of development. This results from the complexity of development processes and aspects such as the state or transformation of factors influencing development (Churski *et al*., 2018, p. 19).

Ziółkowski (2018, p. 24) and Tuziak (2022, p. 59) unanimously emphasize the multidimensional nature of regional development. Tuziak emphasizes social aspects as key in assessing the level of regional development. Ziółkowski recognizes that regional development, which is supported by social factors, can become one of the most important elements of decentralization progress and the development of local government at the local level.

The concept of regional development is a category that is currently used all over the world. Regardless of the method of delimitation of the region, i.e. the method of marking the border of the region using the selected method, it is always possible to indicate whether and with what intensity the process of regional development occurred in a given area. Identification of this phenomenon is possible thanks to the use of selected tools for measuring the direction and pace of regional development. Regional development is also an important component of regional policy, i.e. the policy pursued by local government authorities in the region and the policy of central authorities focused on the development of specific areas. In the context of the conducted regional policy, the ongoing development enables the implementation of its goals. It is also in itself the goal of regional policy and is at the same time its creator, because the achieved level of development poses new challenges for the entities of regional policy and leads to periodic reorientation of goals. Regional development is therefore a phenomenon that directly affects the shape of regional policy, creating conditions for its rational and effective implementation.

Methodology and Research Objective

Since 1 January 2018, there have been 17 administrative units in Poland subject to the criteria for allocating funds under regional policy. The city of Warsaw has been excluded from the Mazovian Voivodeship and has become a separate statistical unit at the NUTS 2 level. Thus, the eastern and northern areas of the Mazovian Voivodeship may still be beneficiaries of the aforementioned funds. In addition to the analysis at the NUTS 2 level, the Central Statistical Office publishes data at the NUTS 3 level, the so-called subregions.

In relation to the average value of regional GDP in the EU countries, measured in PPS, in the Warmia and Mazury region there was an increase in the value of the indicator from 38% of the EU average in 2000, to 47% in 2010 and 56% in 2022. Of course, it should be remembered that as a result of the accession of new countries to the EU in the analyzed period, the average value of regional GDP evolved, which also affected the relationship of this indicator for Warmia and Mazury to the EU average.

The share of the Warmia-Masuria voivodeship in the total value of the country's GDP decreased from 2.8% in 2000 to 2.5% in 2022. Taking into account the average GDP value for the entire Polish regions as a reference point, the GDP of the Warmia-Masuria voivodeship constituted 77.5% of the regional average GDP value in 2000, 72.9% in 2010, while in 2022 it was only 71.3% of this average. As it results, the problem is not even maintaining the value in relation to the average regional development, but not increasing the distance that occurred at the time before accession to the EU. This is to some extent the result of a specific economic structure and the fact that the two largest metropolitan centers of Warmia and Mazury – Olsztyn and Elbląg – do not have such a strong impact on the region as, for example, Wrocław. The comparison of regions in terms of population is even less favorable. Here, the Warmia-Masuria voivodeship, together with the Podlaskie voivodeship, belong to the group of two regions of Poland with the lowest population density per 1 km^2 of area. In 2004, the population density in Warmia and Mazury was 36.6% of the national average, while in 2022 it was only 33% of the average. This strengthens and perpetuates the negative consequences in the form of poorly developed infrastructure, and thus poor communication accessibility of some areas of Warmia and Mazury.

The main objective of the research is to assess the position of the Warmia and Mazury region in terms of the dynamics of economic development compared to the average development level both in Poland and the entire EU area and changes in the internal economy in the studied region. In view of such a defined research objective, three main research questions can be formulated:

1. How and whether it is possible to talk about the economic development of the Warmia-Masuria voivodeship in the years 2000-2022?

2. Are there processes of convergence or polarization of development within the Warmia and Mazury region?

3. What is the development of entrepreneurship in the region in the period studied?

The time scope of the analysis, due to data availability – covered the years 2000-2022. The spatial scope concerns the area of the Warmia-Masuria voivodeship.

Classical methods of statistical analysis were used to assess changes in the economy of Warmia and Mazury in the period under study, i.e. dynamics analysis, structure indicators and comparative analysis. The reference point in the last case were all EU regions, all regions in Poland, and the Warmia-Masuria voivodeship itself. When it was possible – analysis was made on the Warmia and Mazuria subregions level, i.e. NUTS 3. All obtained results are presented in graphs and tables.

Research Results

The Warmia-Masuria voivodeship is divided into three subregions: Elbląg, Ełk and Olsztyn. In terms of the differentiation of development measured by the value of GDP per capita in terms of purchasing power parity, in the period under review (2000-2022) there was an increase in all three subregions (Fig. 1).

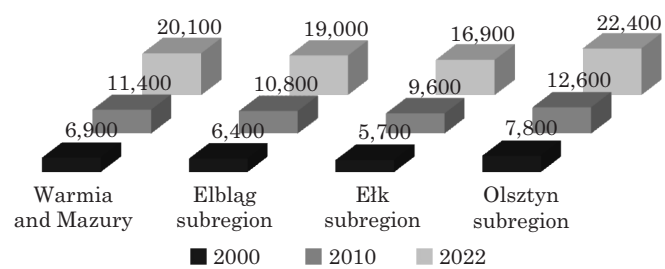


Fig. 1. Value of GDP per capita of Warmia and Mazury region according to purchasing power parity (in euro)

Source: based on data from Eurostat.

If we take into account the absolute changes in the indicator level, then the highest increase in GDP per capita was noted in the Olsztyn subregion (an increase from EUR 7,800 to EUR 22,400, i.e. 14,600 EUR more). The second in this respect was the Elbląg subregion (an increase from EUR 6,400 to EUR 19,000, i.e. 12,600 EUR more). The lowest level of development throughout the entire period under review was noted in the Ełk subregion (an increase from EUR 5,700 to EUR 16,900, i.e. 11,200 EUR more. However, if the dynamic of growth

will be compared, the highest value in this respect presents Elbląg subregion (growth by 196% in the analyzed period). The second was the Olsztyn subregion (growth by 187%), and the lowest – but slightly, was the share of Elk subregion (growth by 197%). This means that over the course of 22 years all subregions managed to increase about three times their income per capita.

Taking the average value of GDP per capita for the EU27 as a reference point, in the years 2000-2022 the Warmia-Masuria voivodeship reduced its development gap from 37% of the EU average in 2000 to 56% of the average in 2022, which means an increase of 19 percentage points. Taking into account subregions, the increases were as follows: for the Olsztyn region 19 percentage points (from 43% to 62%), for the Elbląg region 18 percentage points (from 35% to 53%), and for the Ełk region 16 percentage points (from 31% to 47%) (Fig. 2).

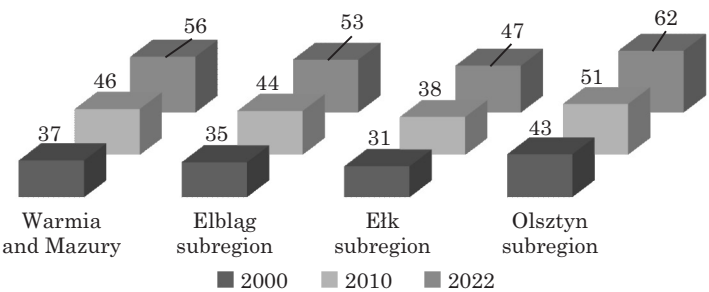


Fig. 2. Value of GDP per capita of Warmia and Mazury region according to purchasing power parity (EU = 100)

Source: based on data from Eurostat.

Taking into account the differences between regions in terms of the value of income calculated according to purchasing power parity, Warmia and Mazury managed to reduce the economic gap from 37% of the EU average in 2000 to 56% in 2022. This is an important and positive change, although it does not result solely from the result of GDP growth in the region, but is also a consequence of the so-called statistical effects (decline in population and absorption of larger flows of funds for regions whose GDP does not exceed 75% of the EU average). Currently, some regions of Poland, such as metropolitan Mazovia, Lower Silesia or Greater Poland, have exceeded the above-mentioned threshold and will no longer be able to apply for funds on such a scale as before. The new 17th region is also noteworthy – regional Mazovia, which in the years 2000-2022 achieved an increase in relation to the EU average by 36 percentage points (from 38% to 74% of the EU average). This is the effect of the strong influence of the Warsaw metropolitan area. Overall, Poland reduced its gap to the EU average in the years 2000-2022 from 49% to 78%, i.e. by 29 percentage points, which should undoubtedly be considered a success of integration with the EU in the economic dimension.

In relation to the dynamics of development for Poland in general, the situation is less favourable for Warmia and Mazury (Fig. 3). Thus, in the period under review, there was a regression of the development gap from 77.5% to 71.3% of the national average value of GDP per capita calculated for the country as a whole. However, if we take into account individual subregions, the Elbląg subregion lost the least in relation to the national average (from 72.4% to 69.2%, or 3.2 percentage points), followed by the Ełk subregion (from 64.5% to 57.9%, or 6.6 percentage points), and the Olsztyn subregion by as much as 8.8 percentage points (from 88.1% to 79.3%). The decrease in the value in relation to the national average means that during the analyzed period, other regions of the country developed relatively faster than all subregions of Warmia and Mazury.

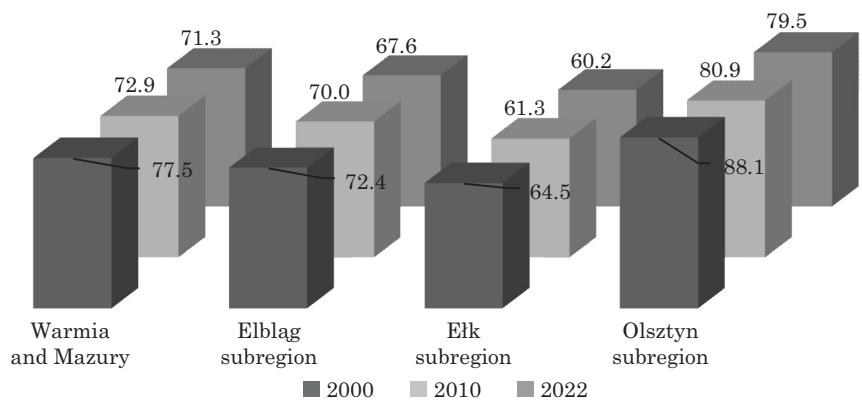


Fig. 3. Gross domestic product per capita of Warmia and Mazury region by subregions (Poland = 100)
Source: own study based on Central Statistical Office data.

Moving on to the assessment of the development of the Warmia-Masuria voivodeship itself, divided into districts, it should be noted that this development is very diverse (Fig. 4). The lowest level of development in 2000, i.e. four years before the accession data, was recorded by the following districts: Węgorzewski, Gołdapski, Olecki and Nidzicki. The highest values are characteristic of two cities – Olsztyn and Elbląg, together with the area directly adjacent to them. In the period under review, a high level of stability of this differentiation can be observed. A positive phenomenon in this context is the fact that despite the fact that the districts from the southern and eastern part of the voivodeship (Nidzica, Szczytno, Piski, Ełk, Gołdap and Olecko) remain at the lowest level of development in the Warmia and Mazury region, the economic distance to the districts with the highest level of development is decreasing. This means that while on an interregional scale in Poland divergence processes prevail, within the Warmia and Mazury region a slight but progressive convergence can be observed in this respect.

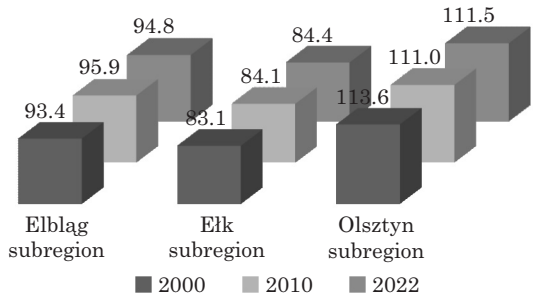


Fig. 4. Gross domestic product per capita of Warmia and Mazury by subregions (voivodeship = 100)
Source: own study based on Central Statistical Office data.

Moving on to the analysis of spatial differentiation within the Warmia-Masuria voivodeship, it can be noted that in the period under review, the Elbląg subregion developed the fastest, with the GDP per capita value increasing from 93.4% to 94.8% of the average for the Warmia-Masuria voivodeship. In contrast to Elbląg, the Olsztyn subregion lost 2.1 percentage points during this time (a drop from 113.6% to 111.5%). The third subregion – Ełk noted similar do Elbląg growth scale, i.e. 1.3 percentage point (growth from 83.1% to 84.4% of the voivodship average – Fig. 4).

In the light of the literature, the convergence mentioned above may take two forms – sigma and beta convergence (Próchniak, 2019, p. 224). Sigma convergence means a decrease in the differences in income per capita between regions or countries over time (Heller & Warżała, 2019, p. 4). Beta convergence occurs when less developed areas (with lower GDP per capita) show a faster rate of economic growth than more developed countries (regions) (with higher GDP per capita) (Próchniak, 2006, p. 27). While not in all Polish regions these processes take place in the desired direction, in the case of the Warmia-Masuria voivodeship there are positive changes in both types of convergence, which should of course be considered a success of internal regional policy.

In the case of spatial analysis of GDP calculated per 1 km2 of area in the analyzed period, a regression can be observed in relation to three northern counties of the region (Węgorzewski, Gołdapski, Olecki) and three southern ones (Nidzicki, Szczycieński and Piski). This process is also due to the increasingly worse economic relations with the Królewiec Oblast, whose presence and functions have changed from a development opportunity into a threat and burden for the region, and in particular for the border districts.

To sum up, it can be stated that in all counties of the Warmia-Masuria voivodeship, there was an increase in real GDP per capita, but the dynamics of this growth were varied. In three counties (Bartoszyce, Węgorzewo, Gołdap) and in the city of Elbląg, the increase in real GDP per capita was lower than the average indicator for Poland. In turn, a higher dynamics of GDP per capita growth compared to the national average was recorded for three counties: Olsztyn, Elbląg and Działdowo.

Referring to the division of the Warmia-Masuria voivodeship into NUTS 3 subregions, it can be stated that two out of three subregions distinguished by the European Commission are clearly stronger economically (Elbląg and Olsztyn), while the third one – Ełk – is much weaker in this respect. However, despite this, we observe convergence processes within the subregions, which should be considered a positive phenomenon.

Table 1

Structure of gross value added by type of activity in the Warmia-Masuria voivodeship (in %)

Year	Total	Agriculture, forestry, hunting and fisheries	Industry	Construction	Trade, repairs, transport, packaging, Treatment	Financial activities and insurance	Other services
2000	100	10.4	20.3	7.8	27.4	10.4	23.7
2010	100	8.2	24.0	8.0	25.5	9.3	25.0
2022	100	7.3	27.0	6.4	23.7	9.9	25.7

Source: own study based on Central Statistical Office data.

One of the manifestations of development – apart from the growth of GDP per capita – is the change in its structure, presented in Table 1. In the Warmia-Masuria voivodeship, this evolution was consistent with general global trends, i.e. there was a decrease in the share of agriculture (from 10.4% in 2000 to 7.3% in 2022) in favour of an increase in the share of the industry sector (from 20.3% to 27%). Regarding to services the slight decrease was observed (from 61.5% to 59.3%), mainly due to the drop of trade, repairs and transport sectors. The individual subregions were characterized by much greater dynamics of structural changes. In the Elbląg subregion, the largest decrease concerned agriculture, including forestry, hunting and fishing (by 4.2 percentage points), while the largest increase occurred in the share of the industry sector (by 10.3 percentage points). In the Ełk subregion, the largest decrease occurred in the following sectors: agriculture (5.3 percentage points) and trade and repairs (by 5.5 percentage points). The largest increase in the share of GDP in this subregion concerned industry (by 8.2 percentage points). In the Olsztyn subregion, the largest decrease was observed in the agriculture sector (by 4.5 percentage points) and financial services (by 5.3 percentage points), while the largest increase was observed in the services sector (by 7.7 percentage points). The share of services increased in each of the remaining subregions, but to a slightly smaller extent. Similar changes concerned the share of employees in the individual sectors of the economies of the individual subregions.

The positive development trend in the years 2010-2022 is also evidenced by the increase in the level of entrepreneurship in Warmia and Mazury region (Fig. 5). It can be presented by the increase in the number of active microenterprises (entities employing up to 9 people). In all three subregions, the number of active microenterprises increased (Fig. 5). In the Elbląg subregion, this was an increase of 10.5%, in the Ełk subregion by 5.7%, and in the Olsztyn subregion there was an increase of as much as 17%. Based on the information presented above, a general conclusion can be drawn that Warmia and Mazury as a region noted positive changes in development in the analyzed period, although with different levels of intensity for individual subregions.

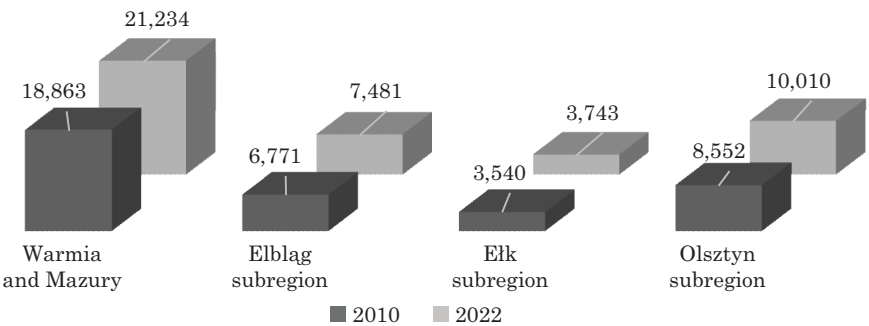


Fig. 5. Change in the number of microenterprises in Warmia and Mazury region in the years 2010-2022

Source: *Business demography…* (2025).

When analyzing the process of changes on the map of the economic development of the Warmia and Mazury region, attention should be paid to the change in the situation in five border counties of the region: Braniewo, Bartoszyce, Kętrzyn, Węgorzewo and Gołdap. Although there are no spectacular changes in GDP per capita, it should be remembered that these are the counties with the largest outflow of population, which causes an "artificial" increase in GDP per capita. Given their proximity to the Królewiec Oblast, these areas should be considered problematic. This is particularly important in the context of the ongoing war in Ukraine and the related defense operations in the areas directly adjacent to the Królewiec Oblast. The current situation creates significant barriers to the local development of border areas. Therefore, two processes are observed here at the same time – depopulation as a result of the ageing population and the decline of entrepreneurship due to unfavorable changes in the economic environment.

Conclusions

The Warmia-Masuria voivodeship, as one of the five regions of the so-called Eastern Poland, is one of the least developed voivodeships in Poland. However, this does not mean that no changes have occurred in this region over the past 23 years. Although in terms of wealth, it still shows a negative distance not only in relation to the average value for the entire EU, but also in comparison to other regions in Poland. In this context, the fact that the economic distance to average GDP per capita values is decreasing is a positive thing. Even if this is to some extent due to the "statistical effect" related to the admission of relatively poor countries to the EU, in absolute terms these changes are positive.

Referring to internal changes in the development of the Warmia and Mazury region, it should be noted that it is not uniform and depends mainly on the location of a given subregion and related conditions. Generally, subregions located in the central and western part of the province show a higher level and dynamics of development, compared to eastern subregions. In some cases, the GDP growth is technical in nature (as a result of population outflow), and in others it is due to the location – in the vicinity of the richest region in Poland, which is the Mazovian province, or in the vicinity of important corridors and road or rail junctions. In the longer term, further development of the Warmia and Mazury region can be assumed. However, what is currently emphasized in the literature on the subject and which also corresponds to the image of the Warmia-Masuria voivodeship is important – that this development is sustainable, i.e. that the economic, ecological and social goals are correlated with each other and do not cause degradation of this naturally valuable region, which is Warmia and Mazury.

Translated by: Rafał Warżała

References

Augustyn, A. (2020). *Sustainable Development of Cities in The World of The Smart City Idea*. Białystok: University of Białystok Publishing House.

Business Demography by Size Class and NUTS 3 Region. 2025. Eurostat. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/bd_size_r__custom_16909460/default/table?lang=en (29.05.2025).

Churski, P., Perdał, R., Konecka-Szydłowska, B., & Herodowicz, T. (2018). Redefinition of Regional Development Factors in the Light of Socio-Economic Megatrends. *Regional and Local Studies*, *3*(73), 70-98.

Dębowski, T. (2013). Regional Development of Poland in the Context of the Use of EU Funds. *Optimum. Economic Studies*, *2*(62), 79-91.

Eurostat. www.eurostat.eu.

Gorzelak, G. (2003). Poverty and Wealth of Regions. Assumptions, Hypotheses, Examples. *Regional and Local Studies*, *1*(11), 37-58.

Heller, J., & Warżała, R. (2019). Effects of Entering the Eurozone in Some of the Central and Eastern European Countries as a Prospect for Poland. *Journal of Competitiveness*, *11*(1), 5-21. https://doi.org/10.7441/joc.2019.01.01.

Hryniewicz, J. (2000). Endogenous and Exogenous Factors of Economic Development of Communes and Regions. *Regional and Local Studies*, *2*, 53-77.

Hudson, R. (2007). Regions and Regional Uneven Development Forever? Some Reflective Comments Upon Theory and Practice. *Regional Studies*, *41*(9), 1149-1160. http://dx.doi.org/10.1080/00343400701291617.

Larty, J., Jack, S., & Lockett, N. (2017). Building Regions: A Resource-Based View a Policy Led Knowledge Exchange Network. *Regional Studies*, *51*(7), 994-1007. http://dx.doi.org/10.1080/00343404.2016.1143093.

Nowak, A. (2018). The Place of Functional Urban Areas in the Process of Regional Development. *Regional Development and Regional Policy*, *41*, 51-69.

Pike, A., Rodriguez-Pose, A., & Tomaney, J. (2006). *Local and Regional Development*. London: Routledge.

Poliński, R. (2020). Rozwój regionalny: główne problemy teorii i praktyki. Prakseologia i zarządzanie. *Zeszyty Naukowe Towarzystwa Naukowego Prakseologii*, *2*, 65-81.

Próchniak, M. (2006). Real Convergence of Beta (β) and Sigma (σ) Types in the Light of Empirical Research. *International Journal of Management and Economics*, *20*, 74-91.

Próchniak, M. (2019). Beta, Sigma and Gamma Convergence of Post-Socialist Countries to Western Europe. *Yearbook of the Institute of Central and Eastern Europe*, *17*(1), 217-243. http://dx.doi.org/10.36874/RIESW.2019.1.10.

Statistics Poland. www.stat.gov.pl.

Strzelecki, Z. (Ed.). (2008). *Regional and Local Economy*. Warszawa: Wydawnictwo Naukowe PWN.

Tuziak, A. (2022). Regional Development and the Paradigm of the New Regionalism. *Social Inequalities and Economic Growth*, *2*(70), 55-69.

Warżała, R. (2012). *Measurement and Forecasting of the Economic Situation in a Regional Perspective, on the Example of the Warmia-Masuria Voivodeship*. Olsztyn: Publishing House of the University of Warmia and Mazury.

Ziółkowski, P. (2018). Citizens, Activity of Youth and Seniors for Regional Development. *Education – Family – Society, Scientific Papers, WSG*, *32*(3), 211-227.

OLSZTYN ECONOMIC JOURNAL
2025, 20(1), 83–92
ISSN 1897-2721 e-ISSN 2083-4675 DOI: 10.31648/oej.11340

ORIGINAL PAPER

THE CONCEPT OF JUST ENERGY TRANSITION

Julia Wrzal vel Kosowska
ORCID: https://orcid.org/0009-0005-2843-5692
e-mail: julia.jwvk@gmail.com

JEL Classification: O13, Q56, Q40.

K e y w o r d s: just energy transition, energy transition, energy justice, just transition.

A b s t r a c t

Energy transition is an inevitable process of restructuring energy systems in response to climate challenges. Justice, although frequently invoked in this context, remains an ambiguous concept interpreted in various ways by researchers, policymakers, and society. Despite growing interest in this concept in scientific literature, there is a lack of coherent understanding of this phenomenon. The purpose of this article is to identify and analyze the key dimensions of just energy transition in order to better understand the multidimensional nature of this concept. To achieve this, a systematic literature review was conducted. The study analyzed publications on just energy transition available in the Scopus database. Based on the analysis conducted, a synthetic framework integrating existing approaches was presented. The study describes just energy transition as a multidimensional socio-economic process, extending beyond technological aspects, which requires addressing the needs of the entire society.

POJĘCIE SPRAWIEDLIWEJ TRANSFORMACJI ENERGETYCZNEJ

Julia Wrzal vel Kosowska

Kody JEL: O13, Q56, Q40.

S ł o w a k l u c z o w e: sprawiedliwa transformacja energetyczna, transformacja energetyczna, sprawiedliwość energetyczna, sprawiedliwa transformacja.

How to cite: Wrzal vel Kosowska, J. (2025). The Concept of Just Energy Transition. *Olsztyn Economic Journal*, *20*(1), 83-92. https://doi.org/10.31648/oej.11340

Abstrakt

Transformacja energetyczna jest nieuniknionym procesem przebudowy systemów energetycznych w odpowiedzi na wyzwania klimatyczne. Sprawiedliwość, choć niejednokrotnie przywoływana w tym kontekście, pozostaje pojęciem niejednoznacznym i interpretowanym na różne sposoby przez badaczy, decydentów oraz społeczeństwo. Pomimo rosnącego zainteresowania tą koncepcją w literaturze naukowej, brakuje spójnego ujęcia tego zjawiska. Celem artykułu jest identyfikacja i analiza kluczowych wymiarów sprawiedliwej transformacji energetycznej w celu lepszego zrozumienia wielowymiarowego charakteru tego zjawiska. Aby tego dokonać, przeprowadzono systematyczny przegląd literatury. W ramach badania przeanalizowano publikacje dotyczące sprawiedliwej transformacji energetycznej dostępne w bazie Scopus. Na podstawie przeprowadzonej analizy przedstawiono syntetyczne ujęcie integrujące dotychczasowe podejścia. Przeprowadzone badanie ukazuje sprawiedliwą transformację energetyczną jako wielowymiarowy proces społeczno-ekonomiczny, wykraczający poza aspekty technologiczne, który wymaga uwzględnienia potrzeb całego społeczeństwa.

Introduction

Energy transition has become one of the key challenges facing modern societies in the context of the escalating climate crisis. The transition from a fossil fuel-based economy to low-carbon systems is an inevitable process, but the way to implement it remains contentious. In response to growing concerns about the social and economic impacts of transformation, questions of justice are increasingly prominent in both public debate and academic discourse.

In recent years, we have observed the growing importance of ESG concepts in corporate strategies and public policies, as demonstrated by the introduction of European Sustainability Reporting Standards (ESRS) under the CSRD, which oblige companies to disclose environmental, social and corporate governance practices (Komunikat Komisji…, 2019). The different ESRSs require organizations to disclose decarbonization strategies, assess the impact of energy infrastructure on ecosystems, or regulate pollution in the energy production process. With regard to just transition, the social aspect is also important. It considers the impact of change on affected communities, defined as communities living or working in a region that is or may in the future be impacted by an organization's activities or its value chain (*European Sustainability Reporting*…, 2023).

Moreover, a significant concern is energy poverty, which Bouzarovski and Petrova (2015) define as a phenomenon characterized by the inability of households to afford an adequate level of energy services, including access to facilities, infrastructure and social norms. It must not be forgotten that transformation brings significant changes to the labor market, and therefore needs to account for the interests of those currently employed in high – emission industries.

The aspects mentioned above demonstrate the multidimensionality of the concept of just energy transition. The purpose of this article is identify the key dimensions of just energy transition. To do this, the literature review was conducted. The introductory section of this article examines the meaning behind

concepts such as social justice and energy transformation. Then the approaches to equitable energy transition presented in the literature were compared and specific aspects of it were detailed. Finally, the conducted analysis resulted in a comprehensive framework of just energy transition.

Social Justice and Energy Transition

The definition of justice has evolved over the centuries. Aristotle (1956) distinguished compensatory justice, that is, rewarding for good and punishing for evil, and, particularly relevant to this topic, distributive justice, saying that everyone should receive a share proportional to the value they represent. For the proper application of the law, the formal concept of justice, formulated in the 20th century by Rawls (1971), will be most relevant. This definition asserts that though inequalities are inevitable, they should be distributed to benefit the most disadvantaged, while ensuring equal access to public institutions. Justice is therefore an abstract idea to which a rational legislator should strive, paying attention to whether the solutions applied will improve the situation of the least well-off, and whether they will not introduce discrimination in access to public institutions. Rawls argued that social inequalities and privileges stemming from birth circumstances are unjust, despite being natural.

Moving forward, energy transformation refers to a change in the structure of primary energy, which leads to the creation of a new paradigm of the energy system. As pointed out by Smil (2010), this is a long-term phenomenon that can be examined in terms of the duration of time between the emergence of a new energy source and the acquisition of a significant share in the energy mix both locally and globally. Meanwhile, Cantarero (2020) emphasizes that the energy transition integrates assumptions related to energy efficiency, affordability, reliability and energy independence. York and Bell (2019) draw attention to the accurate understanding of the concept of energy transition. True transformation is not only about implementing new energy sources, but also about replacing existing ones and changing the entire energy mix.

Research Method

In order to identify key dimensions of just energy transition, approaches to just energy transition present in the literature were analyzed. This was accomplished by using the Scopus database. This is one of the largest databases of scientific literature, including peer-reviewed articles, conferences and monographs, which provides access to up-to-date and reliable sources. In addition, this database allows advanced citation analysis, which is crucial for a comprehensive evaluation of this issue.

In the first stage of the research, efforts were concentrated on identifying occurrences of the term "social justice" in the Scopus database among titles, keywords and abstracts. This resulted in 104,777 papers. The search was then limited to those in which one of the keywords was "energy transition" or "energy transitions". As a result, 372 publications were found. Next, the search was narrowed to include only English-language publications in the fields of social sciences, energy and economics, econometrics and finance. The choice of literature from these domains was motivated by their immediate relevance to the analyzed topic, thereby improving the value of the collected research data. As a result of this measure, the number of analyzed publications was reduced to 325.

The first publications meeting the search criteria are from 2013. The largest increase in interest in this term occurred after 2019. The largest number, 74 publications, was published in 2024. What's more, as of March 22, 2025, 22 publications had already been published in 2025, which indicates, an ongoing growth trend. This study deliberately avoided implementing the restrictions of the time frame of the analyzed literature, which made it possible to identify key works, that contributed to its conceptualization. The searched articles were published in a total of 99 journals. The most common titles included: Energy Research and Social Science – 74 times, Energy Policy – 29 times, Energies – 13 times, Applied Energy – 12 times, Sustainability (Switzerland) – 11 times. Meanwhile, the most frequently occurring keywords included "energy policy", "energy transitions", "energy justices", "alternative energy", "environmental justice" and "sustainable development".

Results of Analysis

Due to the generous number of publications searched, it was decided to include only those with the highest number of citations. Therefore, a limitation was imposed according to which publications with more than 50 citations were analyzed. As a result of applying this criterion, 60 publications were qualified for analysis. A total of 8,283 citations of these publications were recorded. However, not all the papers directly addressed the issue of just energy transition. As a result, the number of analyzed publications was once again reduced. In the end, 19 works were included, which are summarized in the Table 1. The analyzed papers were assigned to groups due to the aspects of just energy transition that are analyzed.

The concept of just transition emerged from labor unions and environmental organizations, which noted the need to move away from harmful industries while providing workers with adequate retraining opportunities. In the 1990s, the Just Transition Alliance initiated a groundbreaking dialogue between workers in carbon-intensive industries and the communities affected by their operations

Table 1

Publications searched in Scopus database by category related to the dimension of equitable energy transition. Status as of March 22, 2025

Dimension	Author	Year	Number of citations
Public policies	S. Bouzarovski, H. Thomson, M. Cornelis	2021	127
	N. van Bommel, J.I. Höffken	2021	93
	W. F. Lamb et al.	2020	59
	A.D. Boyle et al.	2021	52
Justice	D. McCauley et al.	2019	302
	K. Yenneti, R. Day, O. Golubchikov	2016	250
	D. Streimikiene et al.	2021	92
	K. O'Sullivan, O. Golubchikov, A. Mehmood	2020	77
	A. Dall-Orsoletta, P. Ferreira, G. Gilson Dranka	2022	75
	Z. Hu	2020	51
Energy poverty	S. Carley, D.M, Konisky	2020	699
	P. Newell, D. Mulvaney	2013	668
	L. Middlemiss	2022	57
Social participation	K. Jenkins, B.K. Sovacool, D. McCauley	2018	241
	D. Fairchild, A. Weinrub	2017	52
Theoretical approach	N. Healy, J. Barry	2017	502
	T. Kalt	2021	78
	S. Bouzarovski	2022	52
Possible actions	S. Carley, D.M Konisky	2020	699
	B.K. Sovacool, D. Furszyfer Del Rio, S. Griffiths	2020	150

Source: own analysis based on data from the Scopus database.

in response to new regulations aimed at protecting the environment, which resulted in the closure of facilities deemed harmful to the environment (Newell & Mulvaney, 2013).

When analyzing the publications, it can be observed that they take into account various aspects of just transition, which are detailed in Table 1. In the 4 cited publications, the authors emphasized the importance of political aspects in the energy transition process. Lamb *et al.* (2020) consider that energy policy can have both positive and negative impacts on society. They believe it is possible to achieve climate goals while improving living conditions, employment and social cohesion, as long as policies that incorporate justice and equity are implemented. In contrast, van Bommel and Höffken (2021) note that it is not clear that initiatives implemented by the European Union that aim at just transition will actually ensure it. The authors find it essential to provide support to marginalized groups and low-income communities. Bouzarovski *et al.* (2021)

cite the approach presented by the European Commission, according to which combating energy poverty is an integral part of just energy transition. Moreover, they point to the need for consistency between environmental and social policies and the involvement of citizens in the decision-making process. Meanwhile, Boyle *et al.* (2021) note that just transition is linked to a shift away from a narrow, cost-based approach to climate policy to a more comprehensive view that takes into account social aspects.

Another aspect included in the analyzed articles is justice. Yenneti *et al.* (2016) focus on spatial justice, recognizing that even ecologically progressive projects such as solar farms can negatively affect local communities by taking away their sources of income. Large-scale photovoltaic farms, like hydroelectric power plants, require the conversion of large areas of land, excluding its agricultural use. Unlike water reservoirs, which can also serve other purposes, solar parks usually completely exclude the land from other uses. On the other hand, O'Sullivan *et al.* (2020) pay attention to spatial justice in relation to the differences between the center and the periphery. According to the authors, although the transition supports decentralization and democratization of energy and local economic development, for socially, economically and politically marginalized regions the offered opportunities are difficult to use. While the dispersal of energy systems and markets could provide a solution to existing problems, the hegemonic nature of market mechanisms continually favors the center, marginalizing the periphery. This results in the periphery's dependence on external decisions that determine the type of technologies, their location, and their impact on the local landscape and economy. Hu (2020) in his work refers to restorative justice, which aims to provide compensation to individuals negatively affected by energy projects. He mentions government subsidies for marginalized communities as part of the transformation, but as he points out, these can lead to increased inequalities among energy consumers. Meanwhile, McCauley *et al.* (2019) refer to the idea of energy justice, recognizing that the basis of this concept in times of cutting carbon consumption should be just transition to a net-zero economy. Another approach to the aspect of justice is presented by Dall-Orsoletta *et al.* (2022), who emphasize that low-carbon technologies are not fundamentally just. Despite many benefits, they can exacerbate inequalities in the initial cost of vehicles and the availability of charging infrastructure for the poorest. They mention in their paper the disregard for local communities during lithium and cobalt mining, which results in conflict and forced relocation of indigenous people.

Streimikiene *et al.* (2021) develop indicators to track just energy transition. Economic indicators include per capita income, energy consumption, energy intensity, electricity and gas prices for households. Social indicators, on the other hand, include variables depicting energy poverty, such as the inability to maintain adequate heat in a housing facility, energy arrears, leaky housing and damp walls. Environmental variables, on turn, are greenhouse gas emissions and the share of energy from renewable sources in total energy consumption.

Energy poverty is another aspect that researchers highlight in the context of just energy transition. As Middlemiss (2022) points out, just transition may exacerbate the problems of energy-poor households, as they are in a worse initial position. According to Carley and Konisky (2022), energy poverty can occur as a result of rising energy costs due to the transition. Also, Newell and Mulvaney (2013) highlight the need to include increased access to electricity for those affected by energy poverty as part of just transition.

Some authors emphasize in their works the importance of social participation in just energy transition. Jenkins *et al.* (2018) stress that the transition cannot be effective without the participation of the entire society. According to Fairchild and Weinrub (2017) the basis of just energy transition is democracy, where both employees and communities influence the choices that shape their lives.

In the 3 cited publications, theoretical approaches to just energy transition were also noted. Kalt (2021) points to the ambiguity of the term and its different interpretation by various groups. On the other hand, Bouzarovski (2022) postulates a change in the approach to just energy transition, since the current approach to this issue is characterized by excessive technocratism and rootedness in capitalist structures. Whereas, in the view of Healy and Barry (2017) without addressing issues of power, political economy and politics, the conflict between "decarbonization" and "equity" will last forever.

Two publications presented recommended actions necessary for achieving just energy transition. Carley and Konisky (2020) list the following: workforce diversification programs, energy support and thermo-modernization, expanding access to energy technologies, collective action initiatives, and energy innovation in business. Meanwhile, Sovacool *et al.* (2020) identify measures such as financial support for workers, tools for affected communities serving economic development, and training programs.

A Comprehensive Approach to Just Energy Transition

Fairchild and Weinrub (2017) perceive just transition as a concept that involves transforming a destructive profit-driven economy into an ecologically sustainable and socially inclusive one. Its foundation is democracy, where both workers and communities influence the decisions that shape their lives. Carley and Konisky (2020) indicate that just transition refers to both energy transition and energy justice, emphasizing the need for equitable distribution of benefits and costs associated with changes in the energy system. Meanwhile, Newell and Mulvaney (2013) write about transition as a just, sustainable and reasonable in the eyes of citizens transition to a low-carbon economy. According to Bouzarovsky (2022), just transition is a process that combines climate action with socioeconomic transformation. A different approach to just transition is presented by Sovacool

et al. (2020), who quote the definition presented by Henry *et al.* (2020) and identify its purpose – to guarantee that no individual is marginalized.

As evidenced by the review of the literature, merely five of the referenced publications offer an explicit and unequivocal definition of just energy transition. Papers on this issue often focus on one particular aspect of the problem. Just energy transition is an interdisciplinary concept that combines terms such as social justice and energy transition. This process involves a transition towards a low-carbon economy, synthesizing established climate goals with social justice and economic development. Its basis is democracy, which enables both workers and local communities to engage in actions that have a real impact on the decisions that determine their existence. This approach goes beyond the traditional cost – oriented perspective of climate policy, introducing a comprehensive view that takes into account social aspects.

Just transition is not only a concept in the fields of technology and social economics, but also in politics. It emphasizes the need to redistribute wealth, in order to ensure that all citizens have access to adequate energy services and infrastructure, while supporting economically vulnerable households. Addressing the needs of all social groups is the foundation of the transformation. It is particularly important to pay attention to the situation of employees in carbon-intensive sectors and local communities, as these groups, in particular, are the ones bearing the costs of the transformation. The integral element of just energy transition is the elimination of energy poverty.

When discussing just energy transition, it is also necessary to mention the actions supporting it. Firstly, it is necessary to provide appropriate financial support for workers in high-carbon sectors and implement tools to enable local economic development for affected communities. Moreover, workers should have the opportunity to attend training and retraining programs, which would make it easier for them to find new employment if they lose their jobs as a consequence of the transition. Another crucial factor involves the implementation of energy assistance programs and thermal modernization initiatives, which will enhance energy access for individuals experiencing energy poverty. It is also necessary to provide broader access to energy technologies, as well as to promote collective initiatives and energy innovation.

Conclusions

Just energy transition is one of the biggest challenges today, simultaneously offering opportunities for socio-economic development for the society. The systematic review of the literature on just energy transition conducted in this article has made it possible to identify the key concepts scattered in various research approaches.

The conducted analysis provides a better understanding of the multidimensional nature of just energy transition. Based on the literature review, it is clear that the transition process goes beyond economic and technical paradigms, placing special emphasis on the social and ethical issues of energy transition. A key challenge for policymakers is to design policies that, on the one hand, enable the achievement of ambitious climate goals and, on the other, provide support for workers in carbon-intensive sectors and local communities. Another inherent aspect of just energy transition is the alleviation of energy poverty, which takes on new significance in the context of energy systems transition. Without appropriate action, transition may result in a disproportionate burden on low-income households. Participatory democracy, in which both workers and local communities can influence decisions that shape their future, also undoubtedly plays an important role.

At the same time, it should be stressed that the proposed definition should not be treated as final and unchangeable. The energy transition is a dynamic phenomenon, subject to constant change under the influence of technological progress, socio-economic changes and the evolution of climate policy priorities.

Translated by the Author

References

Arystoteles. (1956). *Etyka nikomachejska*. D. Gromska (tłum.). Warszawa: PWN.

Bommel, N. van, & Höffken, J.I. (2021). Energy Justice Within, Between and Beyond European Community Energy Initiatives: A Review. *Energy Research & Social Science*, *79*, 102157. https://doi.org/10.1016/j.erss.2021.102157.

Bouzarovski, S. (2022). Just Transitions: A Political Ecology Critique. *Antipode, 54*(4), 1003-1020. https://doi.org/10.1111/anti.12823.

Bouzarovski, S., & Petrova, S. (2015). A Global Perspective on Domestic Energy Deprivation: Overcoming the Energy Poverty-Fuel Poverty Binary. *Energy Research & Social Science, 10*, 31-40. https://doi.org/10.1016/j.erss.2015.06.007.

Bouzarovski, S., Thomson, H., & Cornelis, M. (2021). Confronting Energy Poverty in Europe: A Research and Policy Agenda. *Energies*, *14*(4), 858. https://doi.org/10.3390/en14040858.

Boyle, A.D., Leggat, G., Morikawa, L., Pappas, Y., & Stephens, J.C. (2021). Green New Deal Proposals: Comparing Emerging Transformational Climate Policies at Multiple Scales. *Energy Research & Social Science*, *81*, 102259. https://doi.org/10.1016/j.erss.2021.102259.

Cantarero, M.M.V. (2020). Of Renewable Energy, Energy Democracy, and Sustainable Development: A Roadmap to Accelerate the Energy Transition in Developing Countries. *Energy Research & Social Science*, *70*, 101716. https://doi.org/10.1016/j.erss.2020.101716.

Carley, S., & Konisky, D.M. (2020). The Justice and Equity Implications of the Clean Energy Transition. *Nature Energy*, *5*(8), 569-577. https://doi.org/10.1038/s41560-020-0641-6.

Dall-Orsoletta, A., Ferreira, P., & Dranka, G.G. (2022). Low-Carbon Technologies and Just Energy Transition: Prospects for Electric Vehicles. *Energy Conversion and Management: X*, *16*, 100271. https://doi.org/10.1016/j.ecmx.2022.100271.

European Sustainability Reporting Standards ESRS S3 Affected Communities: Basis for Conclusions. (2023). European Financial Reporting Advisory Group (EFRAG). Retrieved from https://www.efrag.org/sites/default/files/sites/webpublishing/SiteAssets/BfC_ESRS%20S3_Affected%20Communities.pdf (20.03.2025).

Fairchild, D., Weinrub, A. (2017). Energy Democracy. In: D. Lerch (eds). *The Community Resilience Reader*. Washington DC: Island Press. https://doi.org/10.5822/978-1-61091-861-9_12.

Healy, N., & Barry, J. (2017). Politicizing Energy Justice and Energy System Transitions: Fossil Fuel Divestment and a "Just Transition". *Energy Policy*, *108*, 451-459. https://doi.org/10.1016/j.enpol.2017.06.014.

Henry, M.S., Bazilian, M.D., & Markuson, C. (2020). Just Transitions: Histories and Futures in a Post-COVID World. *Energy Research & Social Science*, *68*, 101668. https://doi.org/10.1016/j.erss.2020.101668.

Hu, Z. (2020). When Energy Justice Encounters Authoritarian Environmentalism: The Case of Clean Heating Energy Transitions in Rural China. *Energy Research & Social Science*, *70*, 101771. https://doi.org/10.1016/j.erss.2020.101771.

Jenkins, K., Sovacool, B.K., & McCauley, D. (2018). Humanizing Sociotechnical Transitions Through Energy Justice: An Ethical Framework for Global Transformative Change. *Energy Policy*, *117*, 66-74. https://doi.org/10.1016/j.enpol.2018.02.036.

Kalt, T. (2021). Jobs vs. Climate Justice? Contentious Narratives of Labor and Climate Movements in the Coal Transition in Germany. *Environmental Politics*, *30*(7), 1135-1154. https://doi.org/10.1080/09644016.2021.1892979.

Komunikat Komisji do Parlamentu Europejskiego, Rady Europejskiej, Rady, Komitetu Ekonomiczno-Społecznego i Komitetu Regionów: Europejski Zielony Ład. (2019). Komisja Europejska. Retrieved from https://eur-lex.europa.eu/legal-content/PL/TXT/HTML/?uri=CELEX:52019DC0640 (20.03.2025).

Lamb, W.F., Antal, M., Bohnenberger, K., Brand-Correa, L.I., Müller-Hansen, F., Jakob, M., Minx, J.C., Raiser, K., Williams, L., & Sovacool, B.K. (2020). What are the Social Outcomes of Climate Policies? A Systematic Map and Review of the Ex-Post Literature. *Environmental Research Letters*, *15*(11), 113006. https://doi.org/10.1088/1748-9326/abc11f.

McCauley, D., Ramasar, V., Heffron, R.J., Sovacool, B.K., Mebratu, D., & Mundaca, L. (2019). Energy Justice in the Transition to Low Carbon Energy Systems: Exploring Key Themes in Interdisciplinary Research. *Applied Energy*, *233*, 916-921. https://doi.org/10.1016/j.apenergy.2018.10.005.

Middlemiss, L. (2022). Who is Vulnerable to Energy Poverty in the Global North, and What is Their Experience? *Wiley Interdisciplinary Reviews: Energy and Environment*, *11*(6), e455. https://doi.org/10.1002/wene.455.

Newell, P., & Mulvaney, D. (2013). The Political Economy of the 'Just Transition'. *The Geographical Journal*, *179*(2), 132-140. https://doi.org/10.1111/geoj.12008.

O'Sullivan, K., Golubchikov, O., & Mehmood, A. (2020). Uneven Energy Transitions: Understanding Continued Energy Peripheralization in Rural Communities. *Energy Policy*, *138*, 111288. https://doi.org/10.1016/j.enpol.2020.111288.

Rawls, J. (1971). *A Theory of Justice: Original Edition*. Cambridge: The Belknap Press of Harvard University Press.

Smil, V. (2010). *Energy Transitions: History, Requirements, Prospects*. Santa Barbara, CA: Praegar.

Sovacool, B.K., Del Rio, D.F., & Griffiths, S. (2020). Contextualizing the COVID-19 Pandemic for a Carbon-Constrained World: Insights for Sustainability Transitions, Energy Justice, and Research Methodology. *Energy Research & Social Science*, *68*, 101701. https://doi.org/10.1016/j.erss.2020.101701.

Streimikiene, D., Kyriakopoulos, G.L., Lekavicius, V., & Siksnelyte-Butkiene, I. (2021). Energy Poverty and Low Carbon Just Energy Transition: Comparative Study in Lithuania and Greece. *Social Indicators Research*, *158*(1), 319-371. https://doi.org/10.1007/s11205-021-02685-9.

Yenneti, K., Day, R., & Golubchikov, O. (2016). Spatial Justice and the Land Politics of Renewables: Dispossessing Vulnerable Communities Through Solar Energy Mega-Projects. *Geoforum*, *76*, 90-99. https://doi.org/10.1016/j.geoforum.2016.09.004.

York, R., & Bell, S.E. (2019). Energy Transitions or Additions? Why a Transition from Fossil Fuels Requires More than the Growth of Renewable Energy. *Energy Research & Social Science*, *51*, 40-43. https://doi.org/10.1016/j.erss.2019.01.008.

"OLSZTYN ECONOMIC JOURNAL"
GENERAL INFORMATION

The "Olsztyn Economic Journal" (ISSN 1897–2721, e-ISSN 2083–4675) is a scientific journal, published in English by the Faculty of Economic Sciences of the University of Warmia and Mazury in Olsztyn. It publishes scientific papers of methodical, review and empirical nature in economic sciences. During the years 2007–2012 the journal was published semi-annually and from 2013 to 2020 was published quarterly. From 2021 the journal is again published semi-annually. The "Olsztyn Economic Journal" is published by the University of Warmia and Mazury in Olsztyn Publishing House. The electronic edition is the primary version of the Journal. All numbers of the magazine are available in the electronic format on the websites: https://czasopisma.uwm.edu.pl/indeks.php/oej, http://wydawnictwo.uwm.edu.pl (subpage Czytelnia), http://www.uwm.edu.pl/wne/olsztyn-economic-journal.

„Olsztyn Economic Journal" is indexed in the following reference databases: BazEcon, BazHum, EBSCO, Index Copernicus Master List, The Central European Journal of Social Sciences Humanities (CEJSH), Central and Eastern European Online Library (CEEOL), POL-index, RePEc.

Since 4th July 2018 „Olsztyn Economic Journal" has been on the Italian, ministerial list of scientific journals prepared by National Agency for the Evaluation of Universities and Research Institutes (Italian name: Agenzia Nazionale di Valutazione del sistema Universitario e della Ricerca − ANVUR).

PUBLICATION PROCEDURE

Polish authors submit articles in Polish and in English. In order to ensure high quality of linguistic editing of the journal, the article should be verified by native English speaker(s). The costs of translating/verifying the article are borne by the Authors. Foreign authors submit articles in English. Additionally, the title, key words and abstract of the article should be submitted in Polish.

Articles should be submitted to the editorial board either: by the Journal e-Platform of the University of Warmia and Mazury in Olsztyn (https://czasopisma.uwm.edu.pl/index.php/oej), via e-mail (oej@uwm.edu.pl) or snail mail, to the following address:

"Olsztyn Economic Journal"
University of Warmia and Mazury in Olsztyn
Faculty of Economic Sciences
M. Oczapowskiego 4 Street
10-719 Olsztyn, POLAND

Articles are subject to formal evaluation, initial evaluation by the editor-in-chief and associate editors, and then to evaluation by external reviewers and the statistical editor. The formal evaluation is made by the editorial secretary and refers, among other things, to: the length of the article, the inclusion of the title, abstract and key words (in Polish and English) and correctly formatted bibliography. Articles which do not meet the guidelines are sent back to Authors for revision. Articles which meet the guidelines are subject to evaluation by the editor-in-chief and associate editors, who assess its scientific character and relevance to the thematic scope of the journal. After a positive

internal evaluation articles are submitted to the evaluation by external reviewers, who are appointed by the editor-in-chief.

The reviewing procedure:

1) At least two independent reviewers from research institutions other than the one with which the Author is affiliated are appointed to evaluate each article.
2) At least one of the reviewers is affiliated in an foreign institution other than the Author's nationality.
3) The Author or Authors do not know the identities of the reviewers and vice versa (double-blind review process). As regards the relations between the author and the reviewer, there is no:

a) direct personal relationship (kinship, legal ties, conflict),
b) professional supervisor-subordinate relation,
c) direct scientific collaboration in the course of the last two years preceding the preparation of the review.

4) The editorial board follows procedures preventing ghostwriting and guest authorship. Detailed description of the procedures can be found on the website.
5) The reviewer is obliged to abide by the copyrights. In the case of detecting copyright infringement by the Author, the reviewer is obliged to report it to the editorial board of the journal.
6) The reviewer is required to keep confidential all details of the article as well as the peer review process.
7) The review is submitted in the written form and ends with a clear statement as to whether the article is accepted for publication or rejected.
8) Only articles which have two positive reviews are submitted for printing. If one of the reviews is negative, the article is submitted for evaluation to a third reviewer.
9) The review form is available on the website.
10) Names of the reviewers for individual issues of the journal are available in the current issue and on the website.

After receiving two positive reviews and taking into considerations the reviewers' corrections and recommendations the Author revises the article and submits to the editorial board the following:

a) the final version of the article in English, together with the title, key words and abstract in Polish and English,
b) responses to reviews,
c) the Author's statement (the relevant form can be found on the website),
d) information about the name and last name of the translator and the native speaker,
e) consent for the processing of common personal data (the relevant form can be found on the website).

The final version of the article submitted by the author will be verified by the statistical editor.