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Science and Innovation Management: Sustainable Development Goals 8 and 9 as Challenges for Poland

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Abstract: This manuscript continues the series of research publications on Sustainable Development Goals 8 and 9 (SDGs 8 and 9). Innovations play an essential role in the global and national economies, as they contribute to the growth of economic productivity, the creation of new products, services, and jobs, and improve the quality of life. In the context of innovation, economy and artificial intelligence (AI) are the ideological and technological components of the innovation process. The authors hypothesized that the Polish system for assessing the importance of scientific economic journals is ineffective for social development and for creating an innovation-based economy. The research methods are a scientometric analysis of 795,070 scientific sources by the keywords "Economy" and "Artificial Intelligence", a bibliometric analysis of 219,739 sources by the keywords "Economy", "Economic productivity", and "Innovation", correlation analysis, and testing statistical hypotheses. The study led to the adoption of an alternative statistical hypothesis, which is a strong confirmation of the basic hypothesis. A new model for assessing the weight of scientific journals was created based on the existing system. Two management recommendations were formulated in the rules for determining the weight of journals. The high R^2 value indicates that the new model effectively predicts the result. The correlation coefficient of the weight of journals in the new model is more than 98%. When verifying statistical hypotheses, a high significance level of 99.0 was used. The study's practical significance is in the movement of Polish science to a leading place in the world market of scientific products.

Keywords: SDG 8; SDG 9; economy; economic productivity; innovation; scientific products; science management; new model; sixth technological paradigm; Poland

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1. Introduction

The full title of Sustainable Development Goal (SDG) 8 is to 'Foster sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all' [1]. Target 8.2 is to 'Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors' [2]. This target reflects the innovative nature of the economy, its innovativeness, and its ability to respond to changes.

SDG 9 is to 'Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation' [1]. Target 9.5 is to 'Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the

number of research and development workers per 1 million people and public and private research and development spending' [2].

The authors continue to study SDGs 8 and 9 [3,4]. Innovation is implementing ideas that introduce new goods or services or an improved offering [5]. ISO TC 279 in ISO 56000:2020 defines innovation as 'a new or changed entity that realizes or redistributes value' [6].

The authors investigated the basic hypothesis concerning SDGs 8.2 and 9.5: The Polish system for assessing the importance of scientific economic journals is ineffective for social development and creating an innovation-based economy since it does not sufficiently motivate Polish scientists to publish their research results in international journals. Such a system not only limits the international recognition of Polish scientific output but also hinders the integration of Polish research into global scientific processes, slowing down the dissemination of innovations and their implementation in economic practice. Moreover, the lack of proper motivation for publishing at the international level reduces the opportunities for Polish scientists to gain access to international grants and partnership projects, which negatively affects the development of the national research infrastructure and its ability to generate innovative solutions for the economy.

The scientific novelty is as follows:

- For the first time, data were analyzed that showed problems regarding SDG 8 and SDG 9 in Poland;
- The basic hypothesis put forward by the researchers was proven;
- A new authors' model for assessing the weight of scientific journals was proposed.

As a result of this interdisciplinary work, it was possible to identify essential dependencies and trends in sustainability, innovation, and management.

The reliability of the results obtained is guaranteed by modern research methods: large datasets processed during scientometric and bibliometric analyses, modern knowledge from many scientific sources and official documents, acceptance of an alternative hypothesis, and a high level of significance (0.99) in the verification of statistical hypotheses.

The study's main conclusions are based on a joint analysis of the scientific data array and verification of statistical hypotheses. The results showed a problem regarding SDGs 8.2 and 9.5. The study results helped the authors prove the basic hypothesis, formulate two management recommendations, and create a new authors' model for assessing the weight of scientific journals in Poland.

2. Literature Review

In [7–11], scholars viewed innovation as a socially constructed process. Therefore, their concept depended on the political and societal context in which innovation occurs. Today, the goal of innovation is the valorization of capital and profit maximization, which is confirmed by the appropriation of knowledge and the practice of planned obsolescence [12]. Other scholars and practitioners had different definitions of innovation. A common element in the definitions was the emphasis on novelty, improvement, and dissemination of ideas or technologies.

Innovations play a crucial role in economic growth, as they contribute to increased productivity, the creation of new products and services, and the improvement of the quality of life [13–15]. In this context, the economy and artificial intelligence (AI) play essential roles, forming the ideological and technological components of the innovation process. The economy plays the role of an ideological component, creating a basis for the development and implementation of innovations [5,6]. Economic models determine the priorities, resources, and directions for innovation development. AI, in turn, acts as a technological platform that ensures the creation and optimization of innovations [5,6]. Its capabilities include big data processing, predictive analytics, modeling of complex systems [3,16,17] and routine task automation, making the innovation development process more efficient and scalable. AI accelerates research, helping scientists and developers find new solutions faster [18,19], optimize processes, and predict results. The importance of

AI as a technological component lies in its ability to accelerate and improve the quality of innovative solutions, making them more accurate and focused on the market's real needs, the preservation of nature [20], and jobs [21]. The economy and AI set the parameters within which innovations can benefit individual companies and society, stimulating economic growth and social development [22–25].

The sixth technological paradigm requires new knowledge. They become available after being published in scientific journals. Patents and publications in scientific journals are considered indicators of innovation [26–28]. Regular publications in scientific journals are a critical element of innovative development. They not only confirm the quality of research but also contribute to the creation and implementation of innovative ideas and the integration of scientific achievements into economic processes.

The Scopus and Web of Science databases are the world's largest scientific electronic libraries, which contain abstracts and references to scientific publications in all fields of knowledge [29–31]. Researchers [27] have shown that although the number of results obtained for the same query varies significantly in these databases (Web of Science and Scopus), the databases differed only slightly in search relevance. The work [28] did not give specific recommendations on the greater accuracy of one of these databases.

The final argument for deciding to favor the Scopus database is the Polish national university ranking system "Perspektywy" [32]. This system uses the number of publications and citations in the Scopus database to assess the place of each university in the form of 5 out of 31 criteria [32].

Thus, the Scopus database allows for an objective multidimensional scientometric analysis of scientific output, identifying transnational and interdisciplinary collaboration networks and the positions of different journals and countries in each area of science [27,33].

So, let us see how Poland's ranking in the world's scientific products (number of publications) on economy and AI indexed in the Scopus database is changing.

The change in Poland's place in the market of scientific products in the economy against the background of the total volume of scientific products in the economy is shown in Figure 1. Figure 1 is based on a scientometric analysis of 424,778 publications on the keyword "Economy" in journals indexed in the Scopus database (https://www.scopus.com/sources.uri, accessed on 2 July 2024).

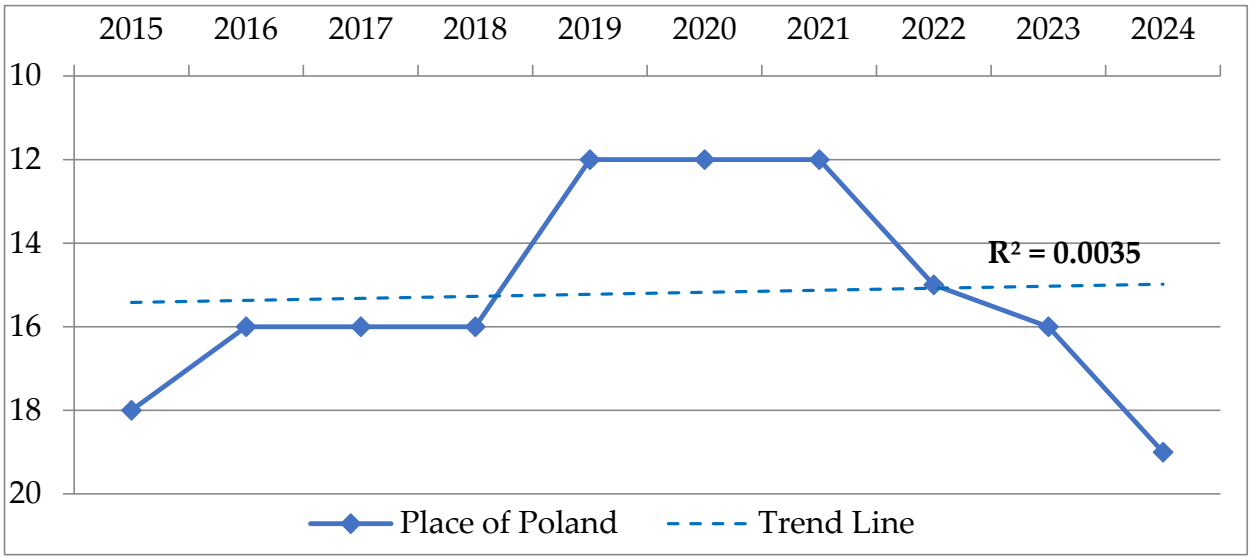


Figure 1. Place of Poland in the market of scientific products on economy in journals indexed in the Scopus database, accessed on 2 July 2024.

Figure 1 shows that Poland's place in the world market of scientific products in 2024 is lower than in 2015.

Figure 1 shows a weakly ascending trend line with a very low correlation coefficient $R^2 = 0.0035$. According to [34], R^2 values 0.0035 indicate low explanatory power of dependence, where the predictors explain most of the variation in the dependent variable. Such a low value indicates that the model is ineffective in predicting the outcome [34].

The quadratic fit better describes the broken line in Figure 1 ($R^2 = 0.7699$). In this case, the trend line shows a decline in Poland's place in the market of scientific products in the economy starting in 2020 and a sharp decline beginning in 2021.

Since 2021, Poland's place in the world market of scientific products has decreased. So, Figure 1 shows the decline in the ideological component of the innovation process since 2021. Based on the analysis of 424,778 publications, this fact requires additional study.

The change in Poland's place in the AI scientific products market against the background of the total volume of AI scientific products is shown in Figure 2. Figure 2 is based on a scientometric analysis of 370,292 publications on "Artificial Intelligence" in journals indexed in the Scopus database (https://www.scopus.com/sources.uri, accessed on 2 July 2024).

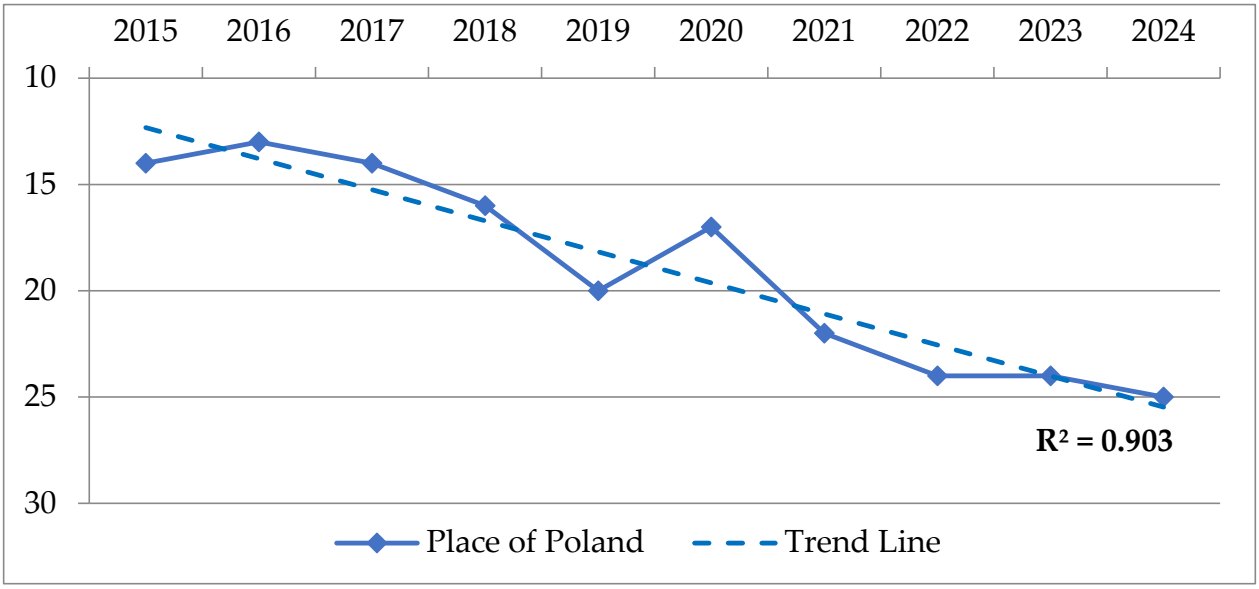


Figure 2. Place of Poland in the market of scientific products on artificial intelligence in journals indexed in the Scopus database, accessed on 2 July 2024.

Figure 2 shows a gradual decline in Poland's ranking in the global volume of scientific products on AI from 2016 to 2024. The correlation coefficient has a high value ($R^2 = 0.9030$). According to [34], R^2 values of 0.9030 indicate high explanatory power of dependence, where the predictors explain most of the variation in the dependent variable. Such a high value indicates that the model effectively predicts the outcome [34].

Figure 2 shows the decline in the technological component of the innovation process. Based on the analysis of 370,292 publications, this fact requires additional study.

This nature of the change in Poland's ranking in the scientific products market (Figures 1 and 2) does not meet the requirements of Article 2 of the Law of the Republic of Poland "On Higher Education and Science" [35]. This article talks about the development of an innovation-based economy.

Figures 1 and 2 together lead to the assumption of a decrease in the motivation of Polish scientists to publish their research results in journals indexed in the Scopus database. Such a situation is possible if the system of assessing the weight of scientific journals assigns a higher weight to national journals rather than foreign ones.

3. Materials and Methods

The research methodology in this scientific paper included several classical methods, including scientometric analysis [16,30], bibliometric analysis [4,31], correlation analysis [34], tabular and graphical presentation of data, and testing statistical hypotheses [34]. These methods allowed us to evaluate and analyze the contribution of various disciplines to the study of sustainability, innovation, and management, as well as their interrelationships. The first stage of the study consisted of conducting a scientometric analysis to determine the rating of publications by Polish scientists. The authors performed a scientometric analysis using the keywords "Economy" and "Artificial Intelligence". This analysis allowed us to identify trends in research on these topics and highlight key issues for further study in the field of sustainability (SDGs 8.2 and 9.5).

Next, a bibliometric analysis of scientific publications related to sustainability (SDGs 8 and 9) and innovation was conducted. The authors conducted a bibliometric analysis of scientific publications using the keywords "Economy", "Economic productivity", and "Innovation". For this purpose, specialized databases and tools were used to analyze scientific literature using keywords.

At the next stage, the authors performed a correlation analysis of the results of the scientometric analysis in terms of the weight of Polish and international scientific economic journals.

After that, the authors accepted the basic hypothesis of the study.

Article 5 of the Law on Higher Education and Science [35] stipulated that the Ministry of the Republic of Poland responsible for higher education and science determines the classification of fields of science and scientific disciplines and the system of evaluating journals [36]. The scientific discipline "Innovation" was not included in this classification. Even though the decision of the Ministry defined the scientific discipline "Economy and Finance" [36], further processing applied only to one part of it—to the scientific discipline "Economy". This decision was justified by SDGs 8 and 9. The authors studied the volume of scientific products in Poland in the scientific field of "Economy" in the Scopus, Web of Science, SCImago Journal, and Country Rank (SJR).

For comparison, 10 Polish and 10 international journals registered in the List of the Ministry of Higher Education and Science of the Republic of Poland were selected [36].

Some Polish journals were indexed in the Scopus and Web of Science databases. One of them has an impact factor. Two were not indexed in the Scopus and Web of Science databases. All foreign journals were indexed in one or both databases. Additionally, two journals had an impact factor.

Finally, statistical hypotheses were tested to assess the results' significance and identify possible correlations between variables [3,16,34]. This method allowed us to test competing hypotheses in the study, draw conclusions, and formulate recommendations. In this step, the authors created a new authors' model for assessing the weight of scientific journals.

4. Results

4.1. Results of Bibliometric Analysis for the Keywords "Economy", "Economic Productivity", and "Innovation"

4.1.1. Query: "Economy"

Total number of articles in Scopus database: 765,044.

Period of analysis: 2015–2023.

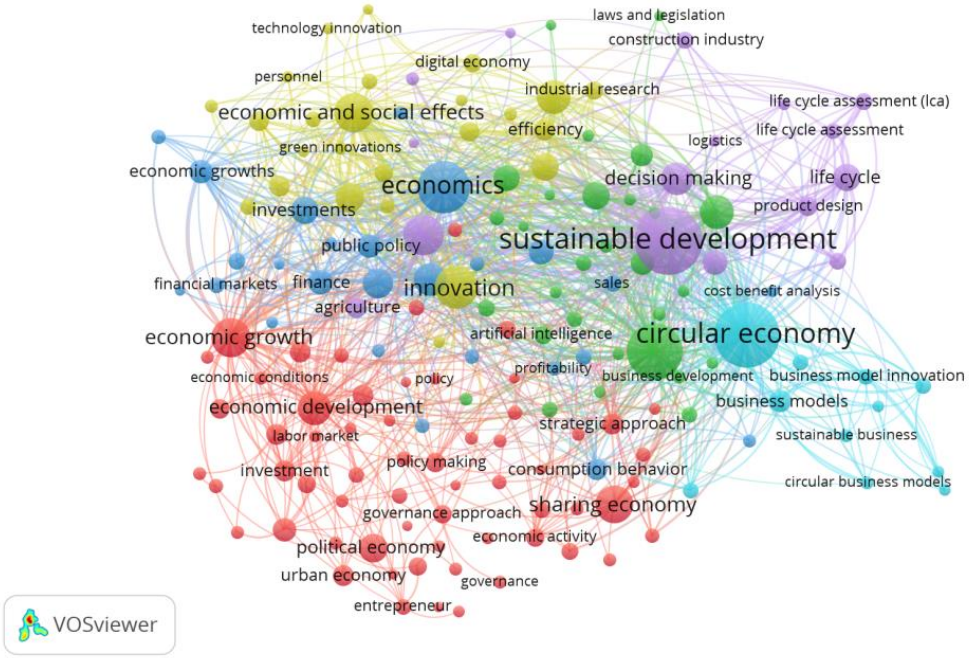
Areas: social sciences; economics, econometrics, and finance; business, management, and accounting.

Number of articles after limitation: 219,739.

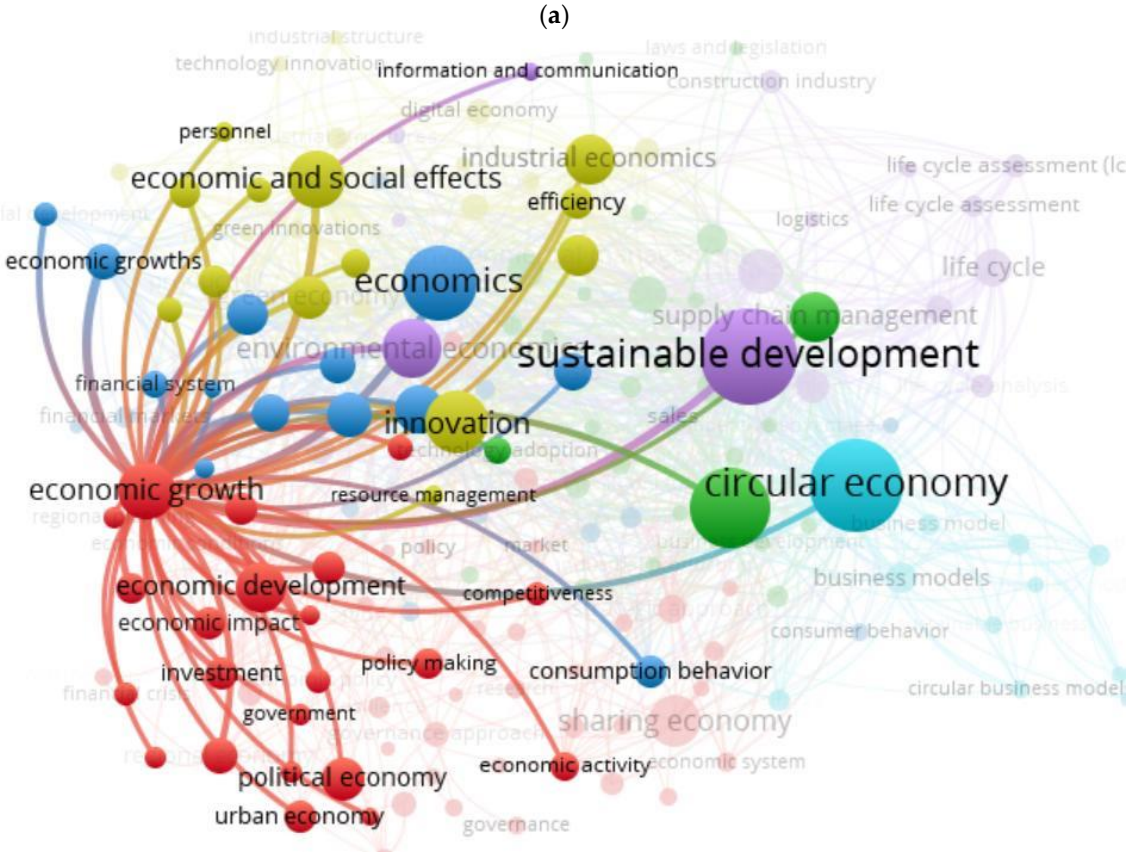
Dataset for analysis: 2000 most cited from 219,739.

Total number of keywords in VOSviewer: 3876. Keywords for analysis—369 (not less than ten occurrences in search results).

Explanations of Figure 3 are given in Table 1.

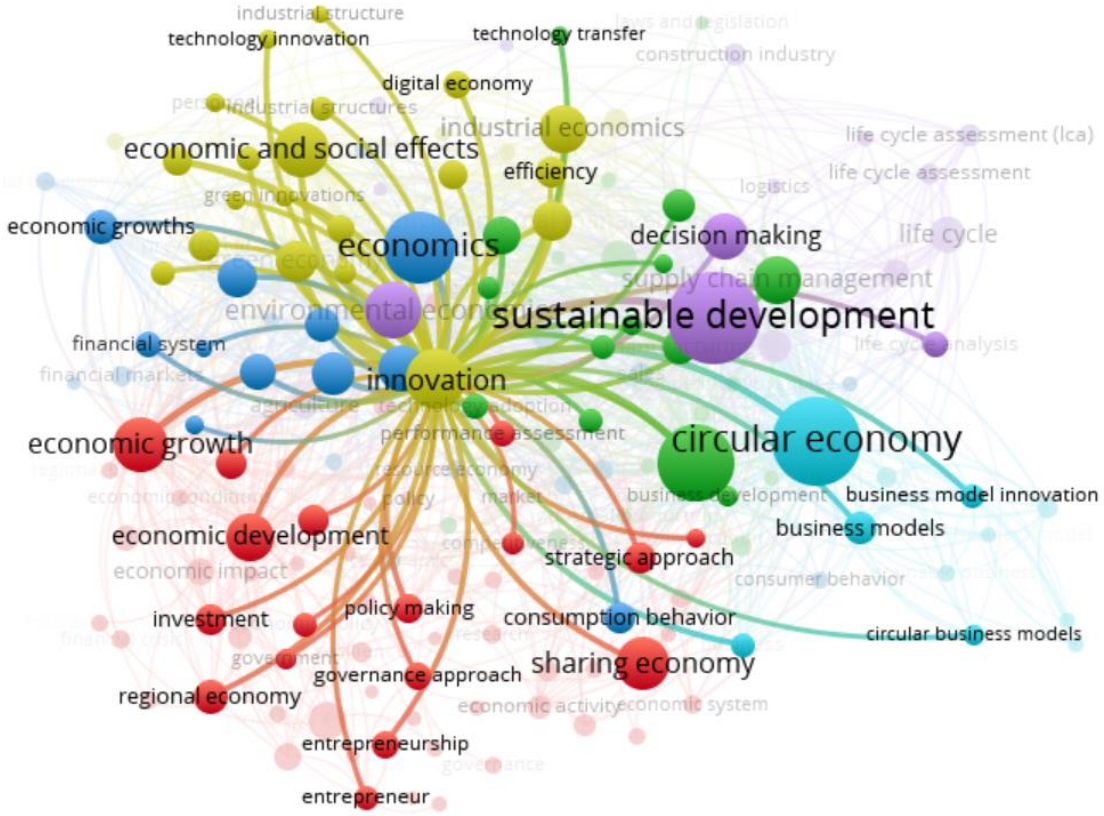


(**a**)



(**b**)

Figure 3. *Cont*.



(**c**)

Figure 3. Query "economy": Keyword map (**a**), cluster "economic growth (**b**), cluster "innovation" (**c**). (https://www.scopus.com/ accessed on 28 September 2024, analysis tool—VOSviewer, version 1.6.19, ©2009–2023 Nees Jan van Eck and Ludo Waltman).

Table 1. Overview of the map (Figure 3).

Central Terms	**The Most Prominent Terms in the Network Are "Sustainable Development", "Economics", "Circular Economy", and "Innovation". These Large Nodes Indicate Frequent Co-Occurrence in Research or Publications, Suggesting Their High Relevance to the Broader Discussion on Sustainability and Economic Growth**
Breakdown of clusters	The green cluster includes terms like "sustainable development", "economics", "decision making", "efficiency", and "industrial research". This cluster seems to focus on sustainable practices in decision-making processes, emphasizing the economic impact of sustainable development. The purple cluster contains terms such as "circular economy", "product design", "life cycle assessment", "sustainable business models", and "logistics". This cluster represents the discussion on the circular economy and its various components. It focuses on how resources can be reused and recycled in business models and product designs to support sustainability. The red cluster includes terms like "economic growth" (Figure 3b), "economic development", "investments", "political economy", and "urban economy". This cluster focuses on economic growth and development, particularly the policies, investments, and political aspects necessary for promoting development in urban areas and other economic sectors. The yellow cluster contains terms such as "economic and social effects", "technology innovation", "digital economy", and "green innovations". This cluster highlights the social and economic impacts of technological innovations and the green economy, emphasizing the effects of these developments on society and various economic systems. The blue cluster includes terms like "innovation" (Figure 3c), "public policy", "agriculture", and "financial markets". This cluster focuses on the role of innovation in public policy and other sectors like agriculture, discussing how new technologies and policies affect economic practices and financial markets.

Table 1. *Cont.*

Central Terms	**The Most Prominent Terms in the Network Are "Sustainable Development", "Economics", "Circular Economy", and "Innovation". These Large Nodes Indicate Frequent Co-Occurrence in Research or Publications, Suggesting Their High Relevance to the Broader Discussion on Sustainability and Economic Growth**
Key Insights	1. Sustainable development is a central concept, connected to many other terms across different clusters, which signifies its importance in economic, environmental, and business-related discussions. 2. The circular economy is tightly linked with sustainable development, focusing on resource efficiency, logistics, and sustainable business models. 3. Innovation is a recurring theme, showing its vital role across sectors, from public policy to economic growth and industrial research. 4. Economic development and economic growth are grouped in a solid thematic area connecting the political and social aspects of economies' evolution.

4.1.2. Query: "Economic Productivity"

Total number of articles in Scopus database: 1986.

Period of analysis: 2015–2023.

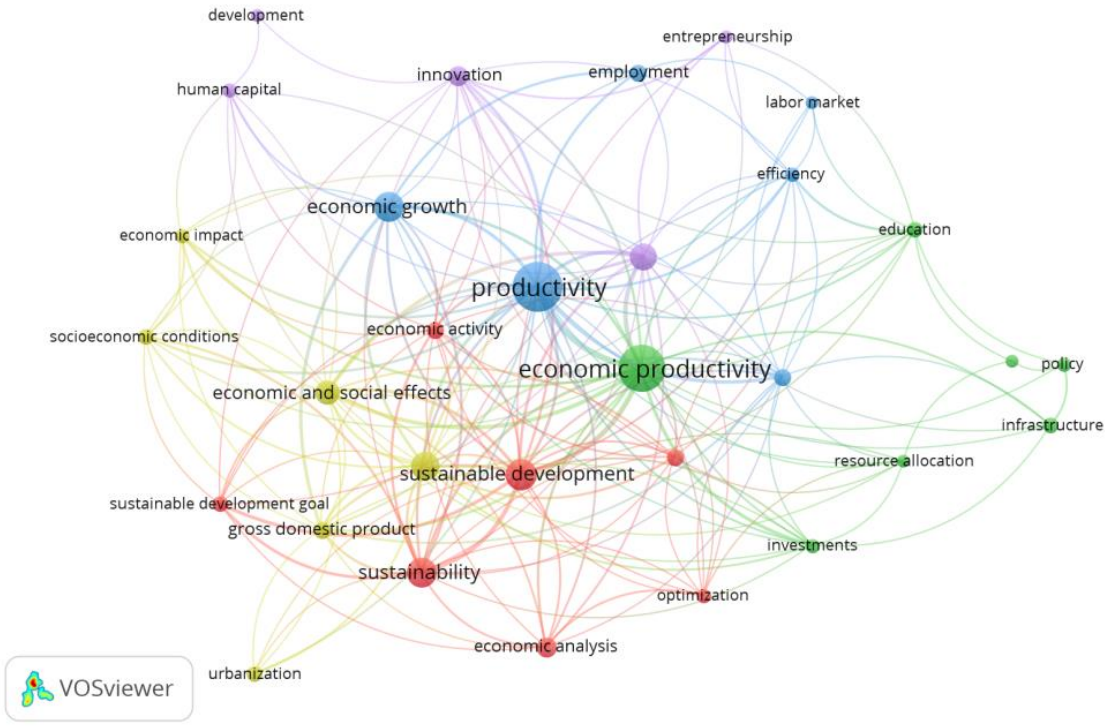
Areas: social sciences; economics, econometrics, and finance; business, management, and accounting.

Number of articles after limitation: 504.

Dataset for analysis: all from 504.

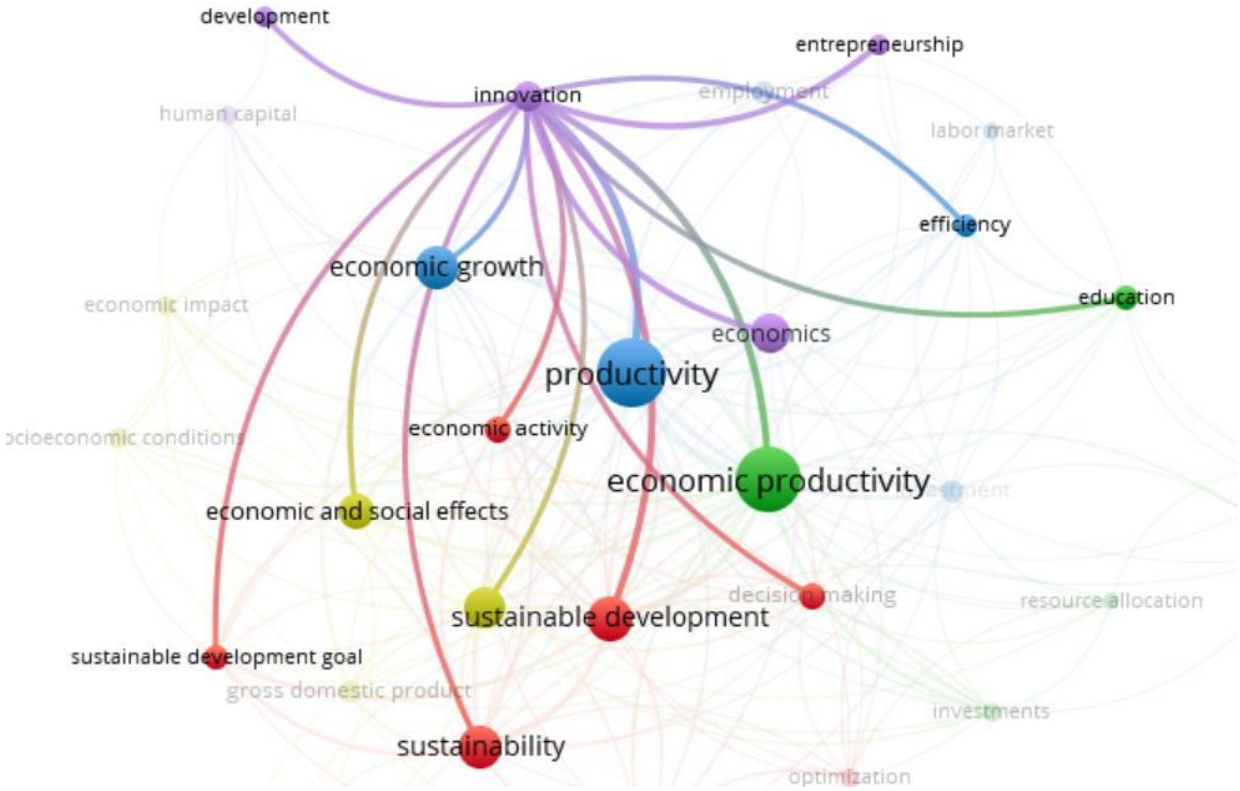
Total number of keywords in VOSviewer: 1345. Keywords for analysis—65 (not less than ten occurrences in search results).

Explanations of Figure 4 are given in Table 2.



(**a**)

Figure 4. *Cont.*



(**b**)

Figure 4. Query "economic productivity": Keyword map (**a**), cluster "innovation" (**b**). (https://www.scopus.com/ accessed on 28 September 2024, analysis tool—VOSviewer, version 1.6.19, ©2009–2023 Nees Jan van Eck and Ludo Waltman).

Table 2. Overview of the map (Figure 4).

Central Terms	The Most Prominent Term is "Economic Productivity", with Closely Related Terms Like "Productivity", "Sustainable Development", and "Economic Growth"
Breakdown of clusters	The green cluster contains terms such as "economic productivity", "resource allocation", "policy", "infrastructure", and "investments". This cluster focuses on the drivers of economic productivity, specifically how resources, investments, and policy decisions impact efficiency and overall productivity. It emphasizes the role of infrastructure and efficient allocation of resources in enhancing economic productivity. The blue cluster includes terms like "economic growth", "employment", "labor market", "entrepreneurship", and "efficiency". This cluster relates to economic growth and its impact on the labor market and employment. It highlights the link between productivity, innovation, and the economy's overall growth. The role of entrepreneurship is also a key factor here. The red cluster contains terms such as "sustainability", "sustainable development", "gross domestic product", and "urbanization". This cluster is centered on sustainable development, showing the balance between economic growth and sustainability goals. It ties economic development with the need to maintain sustainability, looking at urbanization, GDP, and how these are managed for long-term growth. the yellow cluster includes terms like "economic and social effects", "economic impact", "socioeconomic conditions", and "economic activity". This cluster discusses the broader social and economic effects of economic productivity and growth, examining how productivity and economic conditions affect societal well-being, socioeconomic conditions, and overall economic activity. The purple cluster includes terms such as "innovation" (Figure 4b), "human capital", and "development". This cluster highlights the role of human capital and innovation in driving economic productivity and growth. It focuses on how human resources and innovative approaches contribute to sustainable and long-term economic development.

Table 2. *Cont.*

Central Terms	The Most Prominent Term is "Economic Productivity", with Closely Related Terms Like "Productivity", "Sustainable Development", and "Economic Growth"
Key Insights	1. Economic productivity is central to discussions, closely linked to sustainable development and economic growth. This shows that productivity is critical to achieving broader economic and sustainability goals. 2. Sustainability and economic growth are closely interconnected, reflecting the need to balance economic expansion with environmental and social responsibility. 3. Human capital and innovation are crucial for boosting productivity and ensuring sustainable development, emphasizing the importance of education, workforce development, and innovative practices.

The results of the research allowed us to draw such intermediate conclusions that would be useful for further study of the subject of the paper:

- Interconnectedness of sustainability, economics, and innovation: The visualizations clearly demonstrate the interconnectedness of these three key concepts. They are frequently discussed together, highlighting their mutual influence and dependence.
- Central role of sustainable development: Sustainable development serves as a central theme, linking various aspects of economic growth, innovation, and social well-being. This observation emphasizes the importance of balancing economic goals with environmental and social considerations.
- Economic productivity as a driver: Economic productivity is a core concept closely connected to sustainable development and economic growth. It underscores the need for efficient resource allocation, innovation, and effective policies to enhance economic performance.
- Innovation as a catalyst: Innovation emerges as a key driver of economic growth and development. It is connected to various sectors, including public policy, agriculture, and technology, highlighting its transformative potential.
- Balancing economic and social goals: The visualizations emphasize the importance of considering economic and social factors in development strategies. This includes addressing issues such as employment, income distribution, and overall societal well-being alongside economic growth.

Several literary sources confirmed the validity of the results. The study [37] reported that the quality of educational and training programs is essential for prospective innovation creation. Investigation [38] identified the most influential factors in assessing scientific quality as researcher effectiveness, scientific outcomes, and technology transfer (innovations for economic growth). Authors of research [39] found that AI-based training can be implemented individually or together to achieve organizational and management purposes in science. Article [40] by Runiewicz-Wardyn and Winogradska emphasized the need for a deeper understanding of trust-based open innovation collaboration and its perception as mutually beneficial. The research [41] highlighted unresolved issues hindering the full benefits of innovative progress for economic development. The paper [42] proposed a financial model for educational institutions to increase innovation generation effectiveness. At the same time, the study [43] utilized the Gini coefficient and convergence tests to examine disparities in higher education fiscal expenditures from the future technology transfer point of view. In research [44], it was noted that the Technology Innovation Board, as an example of an official body, was launched to support economic transition and deleverage the economy. The article [45] confirmed personal financing as the primary funding for startup innovation. The study [46] identified determinants of higher education leadership as a driver of innovations in 31 European countries (2017–2021). The research [47] analyzed funding mechanisms for business innovation, identifying research gaps. According to [48,49], robust university-industry R&D collaboration supported sustainable development and reduced the informal economy, while the latter hinders such collaborations. The authors of

the investigation [50] outlined key directions for scientific infrastructure development to achieve SDGs. For example, digital health innovations enhanced healthcare efficiency by reducing costs and increasing service availability, flexibility, and adaptability [51].

4.2. Results of Scientometric Analysis of Publications in the Field of Economic Science

To analyze the reasons for the change in Poland's place in the market of scientific products in the economy (Figure 1), the authors studied the time frame from 2019 to 2024.

Figure 5 shows Polish economic science consistently occupied the 12th position in the world ranking in 2019–2021. Then, from 2021 to 2024, the place of Polish economic science fell from 12th to 19th position. The trend line for the last period has high correlation coefficient values (R^2 = 0.9680). According to [34], R^2 values of 0.9680 indicate high explanatory power of dependence, where the predictors explain most of the variation in the dependent variable. Such a high value indicates that the model effectively predicts the outcome [34].

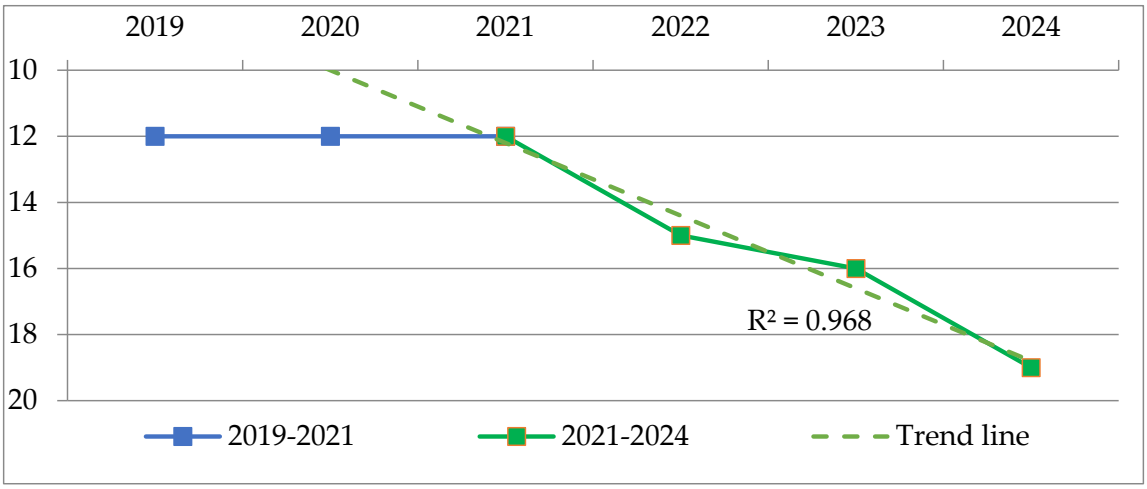


Figure 5. Place of Poland in the world ranking of publications on economy in journals indexed in the Scopus database from 2019 to 2024.

The authors described the reasons and explanations for the decline in the rating in 2021–2024 below. Let us analyze the two sections of the graph in Figure 5 from the point of view of changes in the regulatory acts of the Government of the Republic of Poland from 2018 to 2024.

4.3. The Impact of Changes in the Regulatory Legal Acts of the Government of the Republic of Poland on the Place of Poland in the World Market of Scientific Products

4.3.1. First Change

A new version of the Law on Higher Education and Science was adopted in 2018 [35]. This law provided for a sharp increase in funding for universities. According to the source [52], funding for higher education in Poland increased from 0.76% to 1.06%, a share of public expenditure in GDP (by 30%) from 2018 to 2019. The increase in funding for Polish universities led to the rise in Poland's place in the market of scientific products in the economy from 16th to 12th position (by 4 points or 25%). Poland maintained its 12th position in the world market of scientific products until 2021. Then, the place of Polish economic science fell from 12th to 15th position (by 3 points or 20%) from 2021 to 2022.

Thus, the 30% increase in university funding [52] led to an adequate rise in Poland's place in the scientific products market in economics in 2018–2019 (Figure 4). Linking publication activity with innovation, we saw a relatively rapid positive impact of the growth in university funding on SDGs 8.2 and 9.5.

A further increase in university funding [52] did not increase the ranking in 2019–2021 (Figure 5). The ranking value was fixed at one level.

The authors then continued to analyze regulatory acts to find the reasons for the decline in Poland's place in the scientific products market in 2021 and later.

4.3.2. Second Change

Figure 6 is a modified screenshot from the site [36] by the authors. The web page address is written in a red rectangle without a number.

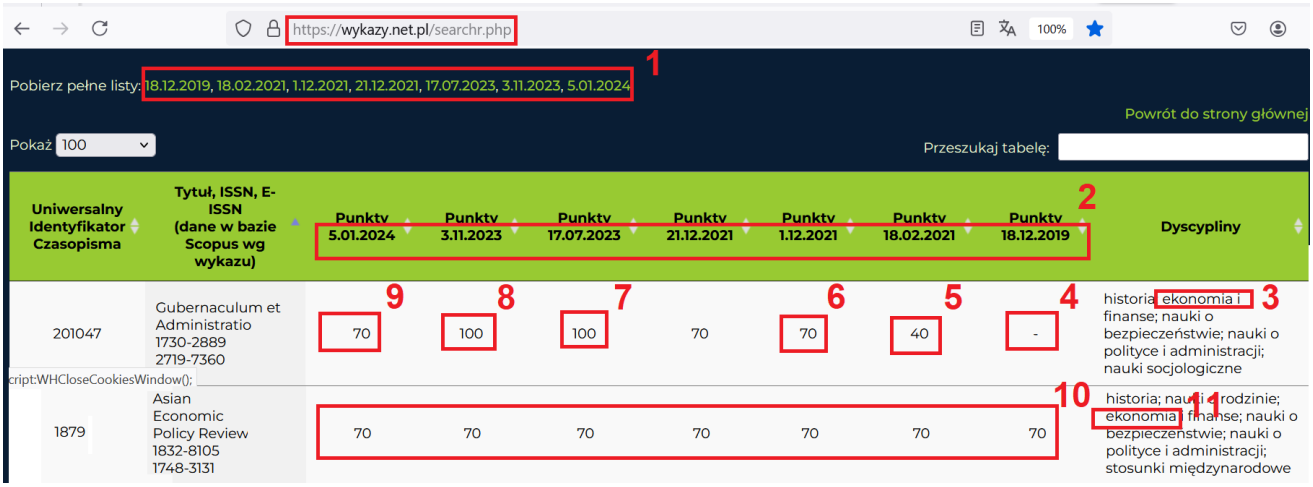


Figure 6. Screenshot of the scientific journal evaluation system using the example of the Polish journal *Gubernaculum et Administratio* and the Australian journal *Asian Economic Policy Review* [36].

Figure 6 shows the dates of the journal weighting rule changes [36]. These dates are written in red rectangles 1 and 2.

During 2021, the rules for assessing the "weight" of scientific journals [36] were changed three times (rectangle 5, rectangle 6, and the number "70" to the left of rectangle 6, Figure 6). Let us consider how the changes in the rules for assessing the weight of journals affected the example of two journals, one Polish and the second foreign. The Polish journal *Gubernaculum et Administratio* was recorded before several scientific disciplines. One of them is "Economy" (rectangle 3). This journal was not indexed in the Scopus and Web of Science databases. Therefore, it had 0 (zero) points on 18 December 2019 (rectangle 4).

The second journal was *Asian Economic Policy Review* (indexed in Scopus, Web of Science and has an impact factor). It had 70 (seventy) points on 18 December 2019 (rectangle 10, rectangle 11).

Figure 6 shows that the journal *Gubernaculum et Administratio* received a weight of 40 points when the journal weights changed on 18 February 2021 (rectangle 5). Then, this journal received 70 points on 1 December 2021 (rectangle 6). And, for the third time in 2021, this journal retained 70 points (the number "70" to the left of rectangle 6) on 21 December 2021. In 2021, the journal was not indexed in the Scopus and Web of Science databases. Still, it became as attractive to Polish scientists as the *Asian Economic Policy Review*, indexed in the Scopus and Web of Science databases, and has an impact factor (rectangle 10).

At the same time, Poland's place in the scientific products market fell by three points from 12th to 15th from 2021 to 2022 (Figure 5). Thus, the threefold change in the "rules of the game" in favor of high evaluation of Polish journals has leveled the motivation of Polish scientists to publish articles in ordinary Polish and foreign journals. This fact negatively affected SDGs 8.2 and 9.5.

4.3.3. Third Change

During 2023, the rules for assessing the weight of scientific publications were changed two times (Figure 6, red rectangles 7 and 8). The journal *Gubernaculum et Administratio* already received 100 points (17 July 2023, rectangle 7). The journal was still not indexed

in the Scopus and Web of Science databases. However, its weight exceeded that of the journal *Asian Economic Policy Review*, which was indexed in the Scopus and Web of Science databases and had an impact factor (rectangle 10). After another 4 months, the "rules of the game" changed again, maintaining the high rating of the journal *Gubernaculum et Administratio* (rectangle 8).

Thus, publishing scientific articles on economics in *Gubernaculum et Administratio* has become more motivating than in the journal *Asian Economic Policy Review* (indexed in the Scopus and Web of Science databases and had an impact factor). Poland's place in the global scientific products market has fallen by three points from 16 to 19 from 2023 to 2024 (Figure 5). Thus, a two-fold change in the "rules of the game" in favor of a high assessment of Polish journals has led to an increase in the motivation of Polish scientists to publish articles on the economy in ordinary Polish journals rather than in foreign journals. This fact negatively affected SDGs 8.2 and 9.5.

4.3.4. Fourth Change

The Ministry's decision of 5 March 2019 approved the conditions for assessing the quality of scientific activity [53]. The Classification of Fields of Science and Scientific Disciplines [36] had 53 scientific disciplines. According to the abovementioned decision, 'articles in journals classified as belonging to the discipline being assessed will be automatically recognized as belonging to this discipline' [53]. At the same time, 'the possibility of including in the assessment an article published in a journal to which the discipline being assessed was not classified would not be limited (provided that the achievement is thematically related to research conducted in this discipline)' [53]. Theoretically, these rules for assessing journals discriminated against interdisciplinary and multidisciplinary research, such as that on artificial intelligence. Polish scientists have become more motivated to publish articles 'in journals belonging to the discipline under assessment' than to prove later that an interdisciplinary or multidisciplinary article 'was related to research conducted in that discipline' [53].

Research in AI was an interdisciplinary (multidisciplinary) area of research. They were not included in the classification of scientific disciplines [36,53]. Figure 2 showed a steady decline in Poland's place in the world market of scientific products on AI from 2016 to 2024. Thus, Figures 2 and 5 confirmed that problems existed with publications in journals for economy and AI as ideological and technological components of the innovation process (SDGs 8.2 and 9.5).

4.3.5. Fifth Change

5 January 2024 the system of assessing the weight of scientific journals was returned to the state of 21 December 2021 (Figure 6, red rectangles 2, 9, and 10). The journal *Gubernaculum et Administratio* again "weighed" 70 points, not having indexation in the Scopus and Web of Science databases. This fact equalized the motivation of Polish economists to publish articles in this journal and the journal *Asian Economic Policy Review* (indexed in the Scopus and Web of Science databases and has an impact factor).

So, another change in the "rules of the game" preserved the motivation of Polish scientists to publish articles in ordinary Polish, along with foreign journals. This observation lowered Poland's place in the scientific products market by 3 points from 16 to 19 (Figure 5). This fact negatively affected SDGs 8.2 and 9.5.

4.3.6. Brief Summary

Figures 1, 2, 5 and 6 indirectly showed the existence of problems with innovation in Poland (SDGs 8 and 9).

Figure 6 showed changes in the rules for assessing the weight of journals seven times in 4 years from 18 December 2019 (rectangle 4) to 5 January 2024 (rectangle 9). Such a number of changes in the "rules of the game" excluded the possibility of planning publications due to the long duration of the publication process. Frequent changes in the "rules of

the game" deprived Polish scientists of the opportunity to use the first management function: "Planning".

The first recommendation of the authors was to change the rules for assessing the weight of journals no more often than once every 3–5 years.

The weight of ordinary Polish journals seemed to be overstated compared to foreign journals (Figure 6). Overstating the weight of Polish journals compared to foreign ones motivated Polish scientists to publish in ordinary Polish journals rather than in foreign journals. This is confirmed by a scientometric analysis of 795,070 scientific sources from 2015 to 2024 (Figures 1, 2 and 5).

The authors' second management recommendation was to equate the weight of foreign journals with Polish ones in the Rules for Assessing the Weight of Journals [36].

4.4. Tabular and Graphical Processing of Data

The authors selected journals to test statistical hypotheses in the period between 2021 and 2023. This was the period when the assessment system worked stably, without changes. A neutral date of 9 August 2022 was chosen for the analysis and testing of statistical hypotheses. The number of journals in the scientific discipline "Economy and Finance" with different weights was 1970 on the List of the Ministry of Higher Education and Science of Poland [36]. The authors randomly selected ten Polish and ten foreign journals registered in the List of the Ministry of Higher Education and Science of the Republic of Poland [36]. These were 20 journals with a weight of 20 to 100 points, i.e., 1% of the total number of journals in the scientific discipline "Economy" (Table 3). When selecting journals, the authors tried to ensure maximum diversity.

Table 3 shows that eight Polish journals are indexed in Scopus and Web of Science. One of them has an impact factor. Two journals are not indexed in Scopus and Web of Science. All foreign journals are indexed in Scopus and Web of Science. Two of them have an impact factor.

Table 3. Sample characteristics.

№	Title of Journal	Indexed	Indicators [36]		
			Scientific Field	Number	Points
		Polish journals			
1	*Oeconomia Copernicana*, ISSN 2083-1277, 2353-1827	Scopus, Q1-Q2, Web of Science, Impact Factor	economy and finance, . . .	15,370	100
2	*Equilibrium. Quarterly Journal of Economics and Economic Policy*, ISSN 1689-765X, 2353-3293	Scopus, Q1-Q2, Web of Science	economy and finance, . . .	5903	100
3	*Economics and Sociology*, ISSN 2071-789X, 2306-3459	Scopus, Q2, Web of Science	economy and finance, . . .	5382	100
4	*Entrepreneurial Business and Economics Review*, ISSN 2353-883X, 2353-8821	Scopus, Q2, Web of Science	economy and finance, . . .	5769	100
5	*Contemporary Economics*, ISSN 2084-0845	Scopus, Q2-Q3, Web of Science	economy and finance, . . .	4361	100
6	*Journal of International Studies*, ISSN 2071-8330, 2306-3483	Скопус, Q3	economy and finance, . . .	24,139	100
7	*Gospodarka Narodowa*, ISSN 0867-0005, 2300-5238	Web of Science	economy and finance, . . .	27,368	70
8	*Ekonomista*, ISSN 0013-3205, 2299-6184	Web of Science	economy and finance, . . .	5531	40
9	*Gubernaculum et Administratio*, ISSN 1730-2889	-	economy and finance, . . .	201,047	70
10	*Zeszyty Naukowe Wydziału Zarządzania GWSH*, ISSN 2451-4535	-	economy and finance, . . .	201,076	20

Table 3. *Cont.*

№	Title of Journal	Indexed	Indicators [36]		
			Scientific Field	Number	Points
		International journals			
11	*Review of World Economics*, ISSN 1610-2878, Germany	Scopus, Q1, Web of Science, Impact Factor	economy and finance, . . .	17,380	100
12	*Asian Economic Policy Review*, ISSN 1832-8105, 1748-3131, Australia	Scopus, Q1, Web of Science, Impact Factor	economy and finance, . . .	1879	70
13	*Environmental Economics and Policy Studies*, ISSN 1432-847X, 1867-383X, Japan	Scopus, Q2, Web of Science	economy and finance, . . .	5806	70
14	*Journal of Economics, Finance and Administrative* Science, ISSN 2218-0648, Peru	Scopus, Q2	economy and finance, . . .	23,974	70
15	*WSEAS Transactions on Business and Economics*, ISSN 1109-9526, Greece	Scopus, Q4	economy and finance, . . .	27,145	70
16	*Journal of Southeast Asian Economies*, ISSN 2339-5095, 2339-5206, Singapore	Scopus, Q3, Web of Science	economy and finance, . . .	12,679	20
17	*Scientific Annals of Economics and Business*, ISSN 2501-1960, 2501-3165, Romania	Scopus, Q3, Web of Science	economy and finance, . . .	26,363	20
18	*Journal of Finance and Data Science*, ISSN 2405-9188, China	Scopus, Q2	economy and finance, . . .	29,737	20
19	*Universal Journal of Accounting and Finance*, ISSN 2331-9712, 2331-9720, the USA	Scopus, Q4	economy and finance, . . .	29,607	20
20	*Journal for Studies in Economics and Econometrics*, ISSN 0379-6205, the Republic of South Africa	Scopus, Q4	economy and finance, . . .	23,742	20

To compare the scientific value of Polish and foreign journals, the authors assigned weighting coefficients to each journal based on the following criteria:

- One point when indexing a journal in the Scopus scientometric database;
- One point when indexing a journal in the Web of Science scientometric database;
- One point if the journal has an impact factor.

If these criteria are absent, the journal receives 0 points.

Therefore, a journal can have a sum from 0 points without indexing to 3 points when indexing in both databases and having an impact factor.

Table 4 shows a combination of assessments on the Ministerial List [36] with a weight from 0 to 3, according to the criteria proposed by the authors.

Table 4. Comparison of the weight of selected journals in the current system [36] with the weight according to indexing in scientometric databases and impact factor.

№	Title of Journal	Weight According to Authors	Points [36]
	Polish journals		
1	*Oeconomia Copernicana*	1 + 1 + 1 = 3	100
2	*Equilibrium. Quarterly Journal of Economics and Economic Policy*	1 + 1 = 2	100
3	*Economics and Sociology*	1 + 1 = 2	100
4	*Entrepreneurial Business and Economics Review*	1 + 1 = 2	100
5	*Contemporary Economics*	1 + 1 = 2	100
6	*Journal of International Studies*	1	100
7	*Gospodarka Narodowa*	1	70
8	*Ekonomista*	1	40
9	*Gubernaculum et Administratio*	0	70
10	*Zeszyty Naukowe Wydziału Zarządzania GWSH*	0	20

Table 4. *Cont.*

№	Title of Journal	Weight According to Authors	Points [36]
	International journals		
11	*Review of World Economics*	1 + 1 + 1 = 3	100
12	*Asian Economic Policy Review*	1 + 1 + 1 = 3	70
13	*Environmental Economics and Policy Studies*	1 + 1 = 2	70
14	*Journal of Economics, Finance and Administrative Science*	1	70
15	*WSEAS Transactions on Business and Economics*	1	70
16	*Journal of Southeast Asian Economies*	1 + 1 = 2	20
17	*Scientific Annals of Economics and Business*	1 + 1 = 2	20
18	*Journal of Finance and Data Science*	1	20
19	*Universal Journal of Accounting and Finance*	1	20
20	*Journal for Studies in Economics and Econometrics*	1	20

Table 4 shows that, on average, Polish economic journals have a higher weight in the Polish evaluation system [36] under equal conditions of indexing in scientometric databases and the presence of the impact factor. For example, Table 4 shows that four Polish journals with dual indexing have 100 points each. Two foreign journals with dual indexing have only 20 points each. The third foreign journal with dual indexing has 70 points. Figure 7 presents the data from Table 4 together with the results of the correlation analysis. The authors grouped the weight of the journals according to the proposed criteria along the horizontal axis. The vertical axis shows the weight of the journals according to Poland's evaluation system [36].

Figure 7 demonstrates that the weight of Polish economic journals is higher than that of foreign economic journals, including under equal conditions of indexing in the Scopus and Web of Science databases. The fairest weight assessment is for journals with dual indexing and impact factor. The largest difference in weight is between Polish and foreign journals with dual indexing without impact factor. The correlation coefficient for Polish journals is high, $R^2 = 0.8973$ (Figure 7). This means that the criteria for assessing the weight of journals proposed by the authors allow for a reasonably accurate prediction of the weight of Polish journals in their evaluation system [36].

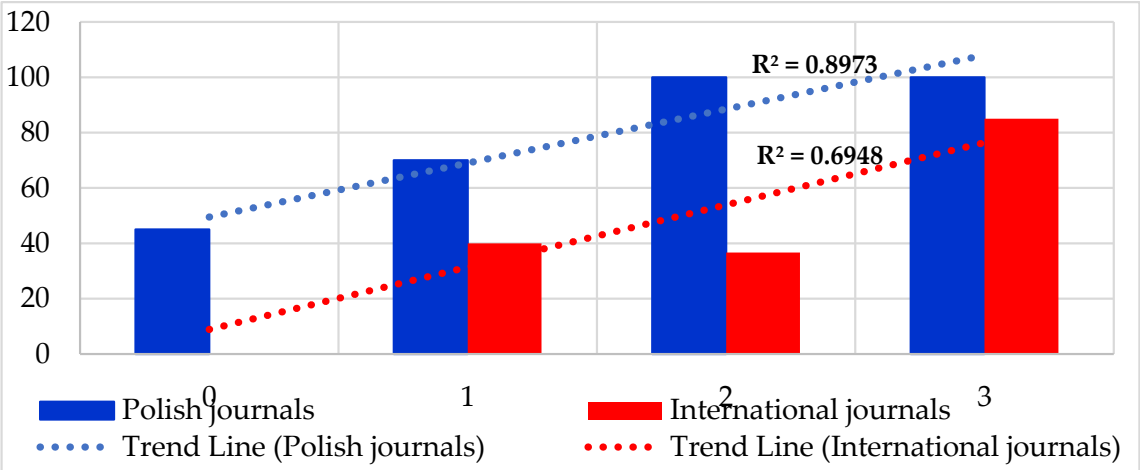


Figure 7. Comparison of the weight of Polish and foreign economic journals in terms of indexing in Scopus and Web of Science databases (the horizontal axis is the weight of journals according to the criteria proposed by the authors. The vertical axis is the weight of the journals according to Poland's evaluation system [36]).

The correlation coefficient for foreign journals is not very high, $R^2 = 0.6948$ (Figure 7). Correlation coefficient values from 0.5 to 0.7 are interpreted as average or moderately high,

indicating that the model explains a significant portion of the variation. However, there is still a significant proportion of unexplained factors. For foreign journals, the correlation coefficient demonstrates sufficient, but not perfect, predictive ability. Changing the model for assessing the weight of foreign journals will allow for a more accurate prediction of their weight in the system of their assessment [36].

Both trend lines confidently went up from journals without indexing to journals with dual indexing and impact factor. The trend line of Polish journals was 30–40 points higher than foreign journals (Figure 7). This means that Polish scientists were more motivated to publish their economics articles in regular Polish journals rather than foreign ones. This negatively affected SDGs 8.2 and 9.5.

However, Table 4 and Figure 7 did not allow for deciding with an exact, predictable probability. Testing hypothesis was needed.

Statistical indicators describing each sample are given in Table 5.

Table 5. Statistical indicators fulllengtheconomic journal samples, % [16,34].

Country	Average of Sample, $\dot{X}_x$	Standard Deviation for Sample, δ_x	Standard Deviation for Population, δ_{x-1}
Polish journals	80.00	27.93	29.44
International journals	48.00	29.26	30.84

Table 5 allows us to compare the statistical indicators of the two samples. We saw that the average sample for Polish journals is 32% (1.67 times) greater than the average for foreign journals. The standard deviation values were approximately the same for the sample and the population. Table 3 presented the necessary data to verify the statistical hypotheses about the equality of the two-sample means.

4.5. Verification of Statistical Hypotheses About the Equality of Two-Sample Means

The authors formed two competing statistical hypotheses [34].

The null hypothesis states that the weights of Polish and foreign economic journals are equal.

The null Hypothesis: $\mu_1 - \mu_2 = 0.00$.

The alternative hypothesis states that the weight of Polish and foreign economic journals is unequal.

Alternative hypothesis: $\mu_1 - \mu_2 \neq 0.00$.

When verifying the statistical hypotheses, we proceed from the previously proposed criteria: indexing in the Scopus and Web of Science databases and the presence of the impact factor. A two-sided test was performed. The verification showed that $|Z_{stat}| = 11.602$ is more than $Z_{tabl} = 2.58$. That was why the alternative hypothesis was accepted: the weight of Polish and foreign economic journals is not equal. We did not take random deviations into account.

Figure 7 explained that the weight of Polish economic journals was higher than the weight of foreign journals under equal conditions of indexing in the Scopus and Web of Science databases and the presence of the impact factor.

So, the authors confirmed the basic hypothesis. This decision was made with an exact, predictable probability (the high significance level is 99.0). This meant that the second recommendation was important and relevant. Otherwise, the Polish economy would face further growth problems in SDG 8.2 and 9.5.

4.6. New Authors' Model for Assessing the Weight of Scientific Journals in Poland

Having studied the features of assessing the weight of scientific journals [36], the authors have compiled and proposed a new model for determining the weight of scientific journals based on indexing in the Scopus and Web of Science databases and the presence of the impact factor. The new authors' model is presented in Table 6.

Table 6. The new authors' model for assessing the weight of journals based on the current system [36].

№	Point Thresholds [36]	Polish Journals	International Journals
1	20	peer-reviewed journals not indexed in Scopus and Web of Science	-
2	40	peer-reviewed journals funded by the Support for Scientific Journals program	peer-reviewed journals not indexed in Scopus and Web of Science
3	70	peer-reviewed journals indexed in one database (Scopus or Web of Science)	
4	100	peer-reviewed journals indexed in both databases (Scopus and Web of Science)	
5	140	peer-reviewed journals indexed in both Scopus and Web of Science and with an impact factor < 5.0	
6	200	peer-reviewed journals indexed in both Scopus and Web of Science and with an impact factor = 5.0 and more	

In Table 6, the new authors' model divided journals into six groups, as did the current system [36]. In groups 1 and 2, the new model motivated Polish scientists to write articles for foreign journals to expand into foreign scientific markets. In groups 3–6, the author model assigned equal weight to Polish and foreign journals. This equally motivated Polish scientists to write articles fulllengthjournals. The authors re-evaluated the weights of the previously selected journals (Table 3) based on the authors' model. Table 7 shows the previous and new weights of these journals.

Table 7. Comparison of the weight of the selected journals in the current system [36] and the authors' model from Table 6.

№	Title of Journal	Current Points [36]	Group According to Authors' Model	Points According to Authors' Model
		Polish journals		
1	*Oeconomia Copernicana*	100	5	140
2	*Equilibrium. Quarterly Journal of Economics and Economic Policy*	100	4	100
3	*Economics and Sociology*	100	4	100
4	*Entrepreneurial Business and Economics Review*	100	4	100
5	*Contemporary Economics*	100	4	100
6	*Journal of International Studies*	100	3	70
7	*Gospodarka Narodowa*	70	3	70
8	*Ekonomista*	40	3	70
9	*Gubernaculum et Administratio*	70	2	40
10	*Zeszyty Naukowe Wydziału Zarządzania GWSH*	20	1	20
		International journals		
11	*Review of World Economics*	100	5	140
12	*Asian Economic Policy Review*	70	5	140
13	*Environmental Economics and Policy Studies*	70	4	100
14	*Journal of Economics, Finance and Administrative Science*	70	3	70
15	*WSEAS Transactions on Business and Economics*	70	3	70
16	*Journal of Southeast Asian Economies*	20	4	100
17	*Scientific Annals of Economics and Business*	20	4	100
18	*Journal of Finance and Data Science*	20	3	70
19	*Universal Journal of Accounting and Finance*	20	3	70
20	*Journal for Studies in Economics and Econometrics*	20	3	70

Table 7 shows that, according to Table 5, Polish and foreign journals receive the same weight under equal indexing conditions in the scientometric databases.

Figure 8 shows the data from Table 5, together with the results of the correlation analysis. The authors indicated the number of the journal group according to the new

model on the horizontal axis. The vertical axis shows the weight of the journals in the current system [36].

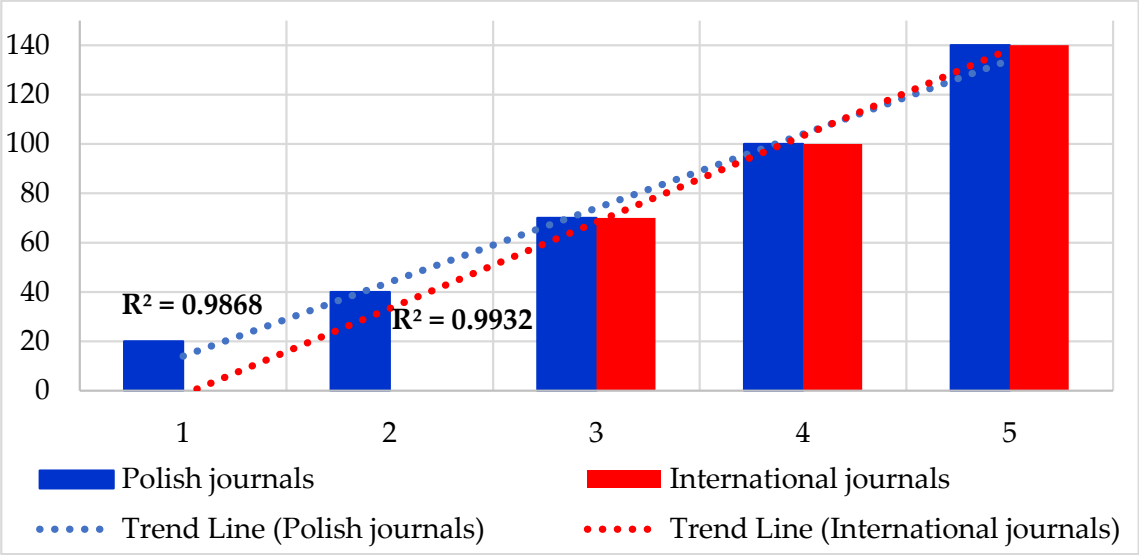


Figure 8. Comparison of the weight of Polish and foreign economic journals in the new authors' model for assessing the weight of journals (the horizontal axis is the number of the journal group according to the new authors' model. The vertical axis is the weight of the journals in the current system [36]).

Figure 8 shows two ascending trend lines with a slight difference in slope. The correlation coefficient for Polish journals is R^2 = 0.9868. The correlation coefficient for foreign journals is R^2 = 0.9932. These values of the correlation coefficients are much higher than those of the correlation coefficients for the two samples, both fulllengthjournals, in Figure 7. R^2 values close to 1.000 indicate the high explanatory power of the model, where most of the variation in the dependent variable is explained by the predictors [34]. Such a high R^2 value indicates that the authors' model effectively predicts the outcome within the selected data.

Verification of statistical hypotheses for Table 7 and Figure 8 conditions led to the acceptance of the null hypothesis: the weights of Polish and foreign economic journals are equal.

This also meant that the new authors' model for assessing the weight of journals (Table 6) was well integrated into the system approved by the Minister of Higher Education and Science of the Republic of Poland [35,36].

5. Discussion

The authors discuss and interpret the results in terms of the basic hypothesis. The starting points of the study were Figures 2 and 5. The analysis of these figures showed a decrease in Poland's position in the world market for scientific products in areas such as economics and artificial intelligence. These two areas of research are the ideological and technological components for the growth of innovation (SDGs 8.2 and 9.5).

Bibliometric analysis of the keywords "Economy", "Economic productivity", and "Innovation" showed the interconnectedness of sustainability, economics, and innovation.

Interesting consequences were found when combining the results of the scientometric analysis with changes in the conditions for assessing the weight of scientific economic journals [35–38]. Figure 7 shows an increase in the weight of Polish economic journals compared to foreign economic journals for sample data. The comparison of journals was performed based on the indexing of journals in the Scopus and Web of Science databases and the availability of the impact factor. A moderately high correlation coefficient (R^2 = 0.6948) demonstrates sufficient, but not ideal, predictive ability to assess foreign economic journals'

weight [36]. The verification of statistical hypotheses proved that the sample means were not equal to each other. In other words, the weight of Polish and foreign economic journals according to the system described in the document [36] is unequal. In turn, Figure 7 clearly shows that the weight of Polish economic journals is higher than that of foreign journals.

As a result of the conducted research, the authors proposed a new authors' model for assessing the weight of journals (Table 6) and formulated several recommendations.

The new authors' model (Table 6) has several significant differences from the current system for assessing the weight of scientific journals [36]:

- The first important difference in the new authors' model is its clarity for use. To select a journal when preparing a manuscript for publication, it is enough to know information about the journal's indexing bases.
- The second significant difference is the increased motivation of Polish scientists to publish the results of their research in foreign journals (group 2) instead of national ones (group 1) in the absence of their indexing in scientometric bases (Table 6). This increases the level of scientific research and contributes to their introduction to foreign markets for scientific products.
- The third significant difference is the increased motivation of Polish scientists to publish the results of their research in journals with indexing in scientometric bases and the presence of an impact factor. This applies to both foreign and Polish journals. This fact confirms the high quality of research and contributes to the creation and implementation of innovative ideas and the integration of scientific achievements into global economic processes.
- The fourth significant difference is in its use's simplicity, low cost, and reliability. The current system of assessing the weight of scientific journals [36] is complex and expensive. Journals are divided into six groups (the so-called point thresholds): 20, 40, 70, 100, 140, and 200 points. The weight is assessed based on the decisions of advisory groups of authoritative scientists (experts) [54]. Initially (on 30 January 2019), the participation of 348 experts in 44 advisory groups was planned [55]. After that, the Scientific Assessment Committee members assess the journals. The most authoritative scientists, instead of directly developing innovations in scientific laboratories [35], are forced to spend time and intellectual resources in meetings of 44 groups and the Committee when assessing the weight of each of the 34.088 journals included in the document [36]. Some shortcomings of the current system of evaluation of scientific journals [36] are published in the document of the Academy of Sciences of the Republic of Poland [56]. However, they did not offer strong management solutions for its improvement. The new authors' model will free up the time and intellectual resources of the best Polish experts for direct research work.
- The fifth important difference is in the objective regulation of the weight of scientific journals. The new authors' model combines journals indexed in the Scopus and Web of Science databases with journals without such indexing. Indexing of journals in these scientometric databases and exclusion from them is carried out based on evaluation according to objective criteria. The impact factor value is adjusted dynamically.
- Finally, the new authors' model for assessing the weight of scientific journals integrates well with the current system [35,36]. It has a high correlation (R^2 = 0.98–0.99) with the current system [35,36] when assessing the weight of Polish and foreign journals.

Society is at the beginning of the sixth technological order [57,58]. The sixth technological paradigm requires new knowledge created by scientific research. New knowledge becomes publicly available as a result of publications in scientific journals. So, the main practical result of using the authors' model will be the movement of the Polish economy towards innovation (SDGs 8.2 and 9.5). Also, the practical value of the study is in freeing the system [36] from excessive regulation. Reputable Polish scientists can devote their time to researching and preparing high-quality manuscripts.

Our study has several limitations. The first limitation is that the authors considered SDGs 8.2 and 9.5 in isolation from the remaining tasks of SDGs 8 and 9. The second

limitation is that the authors used only the Scopus database without the Web of Science database for scientometric analysis. The third limitation is that innovations are assessed only based on Scopus database data without considering patents and protection rights.

6. Conclusions

1. The authors proved the basic hypothesis: since the system of assessing the weight of Polish scientific economic journals does not motivate Polish scientists to publish research results in international journals, this Polish system is not an effective instrument for social development and the creation of an economy based on innovation (SDGs 8.2 and 9.5).
2. The authors formulated two management recommendations: to equate the weight of foreign journals to the weight of Polish journals in the Rules for Assessing the Weight of Journals; to change the Rules for Assessing the Weight of Journals no more than once every 3–5 years.
3. The authors created and proposed a new authors' model for assessing the weight of scientific journals in Poland (Table 4). The new model's practical benefit lies in the greater motivation of Polish scientists to publish research results in Polish and foreign journals. This is achieved in the following way: Polish peer-reviewed journals without indexation in Scopus and Web of Science are valued at 20 points. Similar foreign journals are valued at 40 points. This approach motivates Polish scientists to write articles for foreign journals. At the 70-point level and above, Polish and foreign journals are valued equally.

The study confirms the need to develop effective tools for assessing the weight of scientific products. The new model automatically activates scientists, and Poland again becomes one of the leaders and exporters in the world market of scientific products. The results of the work can be useful for making management decisions in scientific policy and stimulating the innovative activity of scientists in the economy of Poland and other countries.

The goals of future research are to study the conditions that are limitations, for example, to discuss the trends obtained using Scopus and Web of Science databases separately and to analyze the reasons for the consistency or inconsistency of trends between the two databases. Exploring the best foreign techniques for assessing the weight of journals is also interesting. Creating an automatic method for accurately evaluating the weight of scientific journals based on artificial intelligence tools is practically interesting. This method can be based on Scopus and Web of Science database data.

The authors invite interested scholars to engage in an open discussion of international and national systems to assess the importance of scientific economic journals, using this Special Issue as a discussion platform.

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