

Empirical Paper

Małgorzata Juchniewicz, Magdalena Łada*

Diversification of the competitive position of the advanced technology sector in EU

<https://doi.org/10.2478/ijme-2020-0006>

Received April 01, 2019; accepted February 06, 2020

Abstract: The high-technology sector has a particular importance in the development of modern national economies. It affects both the level of competitiveness and innovation. This was a prerequisite for the study to assess the competitive position of the advanced technology sector in the European Union (EU) countries. The starting point of the discussion was the definition of the concept of competitiveness, the competitive position of the advanced technology industry, and the classification of the high-tech sector. Based on the selected indicators, the competitive position and the rank of countries have been established. As for this, the indicators of the export share of the advanced technology sector in the intra-export market, the profitability of the high-tech sector, and the degree of export–import coverage were used. Based on the adopted indicators, a synthetic indicator of a competitive position has also been calculated which enabled determination of the most competitive country in the EU in reference to the industry. This enabled the identification of factors influencing the competitive position of the advanced technology sector in the EU member countries.

Keywords: competitive position, industry, advanced technologies, European Union

JEL Classification: O1, O3

1 Introduction

The global economy can be characterized as processes of progressing integration, regionalization, internationalization, and globalization. These phenomena are associated with increasing competition and improvement of the competitiveness of the economies that are the part of these processes. The European Union (EU) member countries should create the economies so that they are able to compete not only on the European market but also on the global market [Krasiuk, 2017, p. 207]. Stachowiak [2009, p. 23] emphasized that the increase of competitiveness depends on the ability of enterprises to conduct activities related to modern technology intense investments and efficient production systems. According to Lee and Tang [2013, p. 18], countries with high use of advanced technologies have better perspectives to achieve long-term economic growth and the potential to achieve a lasting competitive advantage.

Knowledge-based economies are the most competitive global economies. These economies are based on production, distribution, and use of knowledge and information. According to Fagerberg [2000, p. 393] and Miechael [2003, p. 427], a country that increases the share of the high-tech sector in its economy achieves a higher rate of productivity compared with countries that do not pay sufficient attention to this sector. Industries and technologically advanced services play a significant role in these countries. It is complicated to define them in the traditional division. Therefore, they are classified as industries and products with a

*Corresponding author: Magdalena Łada, Uniwersytet Warmińsko-Mazurski w Olsztynie, Wydział Nauk Ekonomicznych, Olsztyn, Poland. E-mail: magdalena.lada@uwm.edu.pl

Małgorzata Juchniewicz, Uniwersytet Warmińsko-Mazurski w Olsztynie, Wydział Nauk Ekonomicznych, Olsztyn, Poland

relatively high share of expenditure on research and development (R&D) in the final or added value; industries and products using advanced technologies that are rapidly “aging”; and industries and products that have a high share of employees with higher education and the ones who cooperate with research centers, use knowledge-intensive services, and cooperate with manufacturers of advanced technology products. Skórska [2016, p. 241] presented the division of the high-tech sector in line with technical levels. The division is based on the list of areas, published by the Organization for Economic Cooperation and Development (OECD). The division is as follows: production of computers, electronic and optical products, basic pharmaceutical substances, medicines, pharmaceutical products, aircraft, spacecraft, and similar machines production. In terms of services, high-tech activities are related to the production of films, video recordings, television programs, sound and music recordings, broadcasting of public and subscription programs, and activities related to software and consultancy in the field of informatics and related activities, information services, scientific research, and development work. On the other hand, Bartos [2007, p. 32] divides the sector into two separate groups. The first group is based on the results that refer to technical complexity of the final product. The second one is based on specifying the advancement of R&D of the industry.

Knowledge is an inseparable part of technologies and products belonging to the high-tech sector. It determines the innovation, level of modernization, and dynamics of a given economy. The use of knowledge is possible due to intensive R&D. R&D in high-tech sector is carried out with much higher intensity than in other sectors. It promotes the growth of competitiveness [Nordhaus, 2005, p. 5; Bogliacino et al., 2012, p. 57]. According to Albulescu [2011, p. 29], countries that realize an innovative model of economic growth obtain high competitive positions on the international arena. It is possible due to the use of the latest technological achievements and the production of highest quality products. As a result, the main source of competitive position growth is the technical and production knowledge contained in high-tech products [Turkowski, p. 94]. In developed post-industrial economies, the high-tech sector is included in areas with the highest degree of use. It is also included in the areas that depend on specialized factors of production, i.e., knowledge and human capital. Rapacki et al. [2018, p. 3] emphasized that the ability to create radical or small improving innovations describes the resulting side of the economy, i.e., selected dimensions and achieved economic results. The high-tech sector is characterized by the importance of conducting continuous and intensive innovation-related activities. This kind of activity involves large expenses on R&D. Constant development of companies affects their competition. It has positive effects on the environment. The development of the modern world economy caused by technological progress, automation of production, the liberalization of trade, and the reduction of transport-related costs affects the evolution of industry from a traditional to an innovative form. This is related to the reduction of human involvement in the production process. Its consequence is the production dematerialization and increasing importance of services in creating wealth [Ulbrich, 2016, p. 254]. In the 1930s and 1940s of the 20th century, services became an important part of the economy. Services can be divided into three categories: technological, institutional, and social. The development of knowledge-based economies effects on the use of specialized knowledge services [Ulbrich, 2016, p. 258]. This was the premise for undertaking the study. The objective of this study was to assess the international competitive position of the high-tech sector in the EU countries. This study considered a high-technology industry and technologically advanced services.

2 Methods

The objective of this study is to discuss the competitiveness of the high-tech sector. A sector was defined by Smid [2010, p. 216] as the entirety of enterprises that deal with the same basic activity. Enterprises that belong to the same sector manufacture products or services for similar purposes. There are several divisions of high-tech sector. One of them, formulated by the OECD, is based on the amount of expenditure for R&D in relation to the value added of individual industries. The second division of high-tech sector is based on the Eurostat guidelines, which is used in the statistical reports of the members, candidates, and associated countries of the European Free Trade Association (EFTA). Moreover, it is used in the statistical reports of the third parties [Ratajczak-Mrozek, 2011, p. 2]. In the following study, the division formulated by Eurostat was

used. The EU member countries were taken into account and the numerical data available in the Eurostat database were used. Accordingly, the high-tech sector is divided into aviation equipment, pharmaceutical products, computers and office machines, radio, television and communication equipment and apparatus, scientific and precise instruments, and services such as post and telecommunications, IT, R&D [Ratajczak-Mrozek, 2011, s. 2].

Special attention was paid to the competitive position of the sector in individual EU countries. The definition of competitiveness formulated by the OECD is frequently used in research commissioned by the European Commission. It was the reason why the mentioned definition was accepted as the proper one in the study. The competitive is defined as the ability of companies, industries, regions, nations, or supranational groupings to cope up with international competition. Additionally, it is the ability to ensure a relatively high rate of return from the used production factors and relatively high employment on a permanent basis [Grzebyk, 2009, s.111]. According to Weresa [2008, p. 102] and Misala [2011, p. 80], the competitive position (results competitiveness) is the place of the country or industry within the global economy. Moreover, it reflects country's/industry's share in international trade, which indicates the position achieved by trade in goods and services, and the flow of international factors of production.

In order to determine the competitive position, four factors were used: share of exports sector in the intra-EU export market (EMS), index of imports coverage by exports (TC), profitability (M) that defines the share of operating surplus in the value of turnover, and the synthetic index (W) that is used for comprehensive competitive position assessment.

The data used for calculation of these indicators were downloaded from Eurostat guidelines (refer ec.europa.eu). The EMS indicator was expressed on a percentage scale (0%–100%). The interpretation was made in the following manner: the higher the value of this indicator, the larger the share of exports of the product group and the higher competitive position. The calculations were made using the Banterle formula [2005, p. 3]:

$$EMS_{ij} = \frac{X_{ij}}{\sum_{i=1}^{28} X_{ij}}$$

where X is the export to the EU market, i is the country, and j is the category of product.

The TC indicator referred to the balance of the trade. The index described the extent to which export receipts covered import expenses, which defined the country's export specialization. The following formula was used for calculations [Pawlak, 2013, p. 98]:

$$TC_{ij} = \frac{X_{ij}}{M_{ij}}$$

where X is the export to the EU market, i is the country, j is the category of product, and M is the import.

The next indicator used in this study is the profitability of the industry, which expresses to what extent the company achieved its main goal to make a profit. The measurement of profits was conducted with the use of the gross operating surplus. The ratio mentioned was calculated as a relation of gross operating surplus to turnover with the following formula [Fischer and Schornberg, 2006, p. 8]:

$$M = \frac{GOS}{TURN}$$

where M is the industry profitability, GOS is the gross operating surplus, and TURN is the rotation.

In order to comprehensively assess a competitive position, the summary method was used. It used the previously discussed indicators (EMS, TC, and M) that were considered to be stimulants. It means that the higher their level, the more competitive they are. To mark the value of the synthetic index, the model method was used, in line with which a reference object is built. This model object is created based on the considered features (indicators) that describe the competitiveness of the sector (hypothetical country characterized by the highest competitiveness of the sector analyzed). The reference unit is shown using the following vector [Wysocki and Lira, 2003, s. 175]:

$$z = (z_{01}, z_{02}, \dots, z_{0m})^2$$

where z_{0j} is the maximum value of the j -th feature (assuming that all characteristics are stimulants).

Later, the distance between each of the tested member countries and the standard was calculated using the Euclidean distance [Suchecki and Lewandowska-Gwarda, 2010, s. 60]:

$$d_{i0} = \sqrt{\sum_{j=1}^n (z_{ij} - z_{0j})^2}$$

where d_{i0} is the Euclidean distance of the object and the reference object.

The last step taken in this study was to calculate the synthetic competitive position of the advanced technology sector [Wysocki and Lira, 2003, s. 176]:

$$d_i = 1 - \frac{d_{i0}}{d_0}$$

where d_i is the synthetic indicator of the “ i ” country and d_0 is the critical distance of a given unit from the standard assuming that [Wysocki and Lira, 2003, s. 176]:

$$d_0 = \bar{d}_0 + 2S_d$$

where $\bar{d}_0$ is the arithmetic average of the taxonomic distance and S_d is the standard deviation of the taxonomic distance.

The competitive position of the high-tech sector was assessed in line with six typological groups used to estimate the level of competitiveness: high ($W_i \geq \bar{W} + S_w$), relatively high ($\bar{W} + 0.5 * S_w \leq W_i < \bar{W} + S_w$), medium ($\bar{W} \leq W_i < \bar{W} + 0.5 * S_w$), delayed ($\bar{W} - 0.5 * S_w \leq W_i < \bar{W}$), significantly delayed ($\bar{W} - S_w \leq W_i < \bar{W} - 0.5 * S_w$), and low ($W_i \leq \bar{W} - S_w$) [Strzała and Przechlewski, 2006 s. 116].

3 Results

The high-tech sector is present on all EU member countries' markets. The intra-industry competitiveness is associated with competition of enterprises with each other. It is continued in order to maintain current customers and gain new ones in home country and abroad. Determining the competitive position against other competitors is the effect of this competition. One of the measures that can be used to assess the country's ability to create, assimilate scientific and technical knowledge, and transform it into specific products is the export index of high-tech industry products. The low value of this index indicates low level of modernization of a given country's economy and the need to develop high-technology industries. Production of technologically advanced products and the provision of knowledge-based services are considered as a source of high added value. High added value entails higher rates of economic growth

[Zakrzewska-Bielawska, 2011, p. 31]. The economic integration, liberalization of trade, and the number of countries belonging to EU had an influence on the fact that the majority of EU exports were made on the intra-EU market. The study shows that each member country exported high-tech goods. Exports share differed among countries. To some of the founding countries (Germany and the Netherlands), exports were of great importance. The impact of export was significantly higher than other competitors. In all analyzed years, the share of export of these countries amounted to almost 50% (Table 1). More than half of the exported goods came from one of the countries mentioned earlier. The value of goods exported by Germany in 2017 amounted to 96.9 billion euro, and the Netherlands 95.8 billion euro. According to the study carried out by Juchniewicz and Łukiewska [2014, p. 83], these countries also dominated in the export of food products at the same time. Domination of the country in the rankings of various industries may indicate the high competitiveness of these countries and their advantages over competitors. It applies not only to the advanced sector but also to low technology sector. A country with a relatively high level of export share in the intra-EU export market was France. Although France had high position in the ranking, it was three times lower than the dominant countries (9.09%). A group of five countries with an average level of

Table 1. Share of the high-technology sector export in the intra-EU export market of the industry (%)

No.	Specification	Year			Rate in 2017
		2009	2013	2017	
1	Germany	24.32	24.38	23.43	High
2	The Netherlands	18.86	20.06	23.17	
3	France	13.05	12.69	9.09	Relatively high
4	United Kingdom	7.82	6.83	5.74	Medium
5	Belgium	5.92	5.64	5.44	
6	Czech Republic	3.69	4.18	4.59	
7	Ireland	3.52	3.24	4.22	
8	Italy	3.47	3.70	4.15	
9	Austria	2.68	3.68	3.38	Delayed
10	Poland	1.57	2.12	3.05	
11	Hungary	3.31	2.65	2.97	
12	Spain	1.78	2.10	2.52	
13	Sweden	2.20	2.36	1.87	
14	Slovakia	0.76	1.56	1.67	
15	Denmark	1.58	1.11	1.04	
16	Romania	0.67	0.70	0.99	
17	Finland	1.27	0.42	0.42	Significantly delayed
18	Portugal	0.24	0.29	0.37	
19	Lithuania	0.18	0.27	0.31	
20	Slovenia	0.23	0.24	0.29	
21	Estonia	0.13	0.44	0.27	
22	Bulgaria	0.12	0.16	0.22	
23	Greece	0.18	0.14	0.21	
24	Luxembourg	2.13	0.63	0.20	
25	Croatia	0.12	0.12	0.17	
26	Latvia	0.07	0.19	0.16	
27	Malta	0.08	0.04	0.04	
28	Cyprus	0.05	0.04	0.04	
Average		3.57	3.57	3.57	
Standard deviation		0.059	0.060	0.060	
Coefficient of variation		164.62	167.06	168.25	

Source: Own study based on Eurostat data (<https://ec.europa.eu/eurostat/data/database> 10.10.2018).

Table 2. Coverage of imports by export of the advanced technology sector in intra-EU trade (euro/euro)

No.	Specification	Year			Rate in 2017
		2009	2013	2017	
1	The Netherlands	3.09	3.60	3.55	High
2	Hungary	1.87	1.37	1.29	Relatively high
3	Austria	0.92	1.21	1.23	
4	Czech Republic	1.22	1.34	1.21	
5	Ireland	1.97	1.45	1.19	
6	Germany	1.20	1.13	1.16	
7	Belgium	1.04	0.96	0.99	Medium
8	Estonia	0.72	0.98	0.88	
9	Slovenia	0.56	0.71	0.79	Delayed
10	Poland	0.51	0.62	0.77	
11	Slovakia	0.75	0.75	0.77	
12	France	0.90	0.90	0.70	
13	Malta	0.48	0.26	0.68	
14	Romania	0.69	0.52	0.66	
15	Lithuania	0.79	0.77	0.66	
16	Italy	0.51	0.61	0.66	
17	Luxembourg	5.87	1.89	0.64	
18	Sweden	0.72	0.71	0.63	
19	United Kingdom	0.83	0.65	0.60	
20	Latvia	0.49	0.83	0.58	
21	Denmark	0.80	0.58	0.57	
22	Spain	0.33	0.52	0.55	
23	Cyprus	0.45	0.61	0.55	
24	Bulgaria	0.34	0.38	0.50	Significantly delayed
25	Croatia	0.44	0.54	0.49	
26	Portugal	0.15	0.30	0.35	
27	Greece	0.14	0.21	0.34	
28	Finland	0.90	0.31	0.30	
Average		1.02	0.88	0.83	
Standard deviation		1.130	0.666	0.600	
Coefficient of variation		110.31	75.43	72.08	

Source: Own study based on Eurostat data (<https://ec.europa.eu/eurostat/data/database> 10.10.2018).

the discussed indicator included the United Kingdom, Belgium, the Czech Republic, Ireland, and Italy. In Ireland, the index was 3.52% in 2009 and 4.22% in 2017. The development of the high-tech sector in Ireland was mainly the result of foreign investment in the chemical–pharmaceutical, IT, and electrical instruments and equipment sectors [s. 29]. Ireland ranked seventh among countries with an average level of export share. The share of countries with an average level of sector export in the EU export market amounted to around 20%. In this ranking, Poland ranked 10th among the countries with a delayed level. The value of goods exported by this country in 2017 amounted to 12.6 billion euro. It is worth paying attention to the share of exports of countries with a delayed level. Austria, Poland, and Hungary exported two times more goods than other countries qualified for this group. Therefore, these countries have the potential to improve their share in intra-EU exports. The share of countries with a significantly delayed level was below 0.50%. The lowest share was recorded in Malta and Cyprus (0.04%). There were no significant deviations observed in the analyzed years. Luxembourg was only one exception. In this country, a significant decrease in the share of high-tech exports in intra-EU exports was noted. Surprisingly, the average value of export share in individual years was constant (3.57%) (Table 1).

Table 3. Average level of profitability in the advanced technology sector in the EU (%)

No.	Specification	Year			Rate in 2014
		2009	2013	2014	
1	Belgium	19.39	23.77	22.68	High
2	United Kingdom	22.33	21.26	22.06	
3	Lithuania	22.09	20.07	21.45	Relatively high
4	Romania	23.03	20.39	20.93	
5	Poland	23.91	21.78	20.84	
6	Denmark	16.64	18.98	20.79	
7	Portugal	21.02	19.30	20.51	
8	Slovenia	16.08	18.33	19.97	Medium
9	Italy	19.94	19.60	19.86	
10	Greece	25.04	19.62	19.29	
11	Spain	21.20	18.73	18.32	Delayed
12	Germany	17.95	17.96	18.09	
13	Austria	15.92	16.42	15.61	Significantly delayed
14	Hungary	12.72	15.05	15.31	
15	Czech Republic	15.17	14.97	14.12	Low
16	The Netherlands	17.62	18.06	13.54	
17	France	13.78	11.93	11.00	
Average		19.05	18.60	18.50	
Standard deviation		0.040	0.036	0.043	
Coefficient of variation		20.05	19.61	24.17	

Source: Own study based on Eurostat data (<https://ec.europa.eu/eurostat/data/database> 10.10.2018).

The international competitive position belongs to a relative category. It is closely related to the results achieved in foreign trade. According to the studies on a competitive position, the value of export can be referred to the value of import of the high-tech sector in a given country. The coverage rate of imports by exports is one of the most important criteria for assessing foreign trade performance. It is the relation of import and export, relative surplus, or deficit in trade in goods, which in this case is the high-tech industry. The surplus of exports over imports indicates export specialization. It also affects the relative advantage over competitors and international competitiveness. This study shows that the average level of this indicator in consecutive years is gradually decreasing. Countries that have a surplus in trade in high-tech products are those whose coverage of imports by exports is high and relatively high. There were six countries in this group: the Netherlands, Hungary, Austria, the Czech Republic, Ireland, and Germany. In addition, Belgium and Estonia export coverage exceeds the EU average. Again, the Netherlands achieved a significantly higher rate of 3.55 than its competitors (Table 2). EU founding countries are placed at the top of the ranking with high and relatively high levels. The only country that took a fairly low position (noting the negative balance of foreign trade) was Italy—0.59. Poland was again in the 10th position among the countries with a delayed level. The ranking shows that the countries of southern Europe (Spain, Cyprus, Portugal, Greece) export much less than the countries from Central Europe. The extent of coverage of imports by exports of these countries did not exceed 0.5 (Table 2). Surprisingly, Finland is placed low in the ranking. Finland has been the leader in ICT solutions for years. The share of high-tech products in sold production is several times higher than that in other member countries [Zakrzewska-Bielawska, 2011, p. 29]. Once again, Luxembourg is an interesting case. In 2009, the revenues from exports of high-tech products were almost six times higher than import expenses in this country. In 2014 they reduced to less than two points, while in 2017 there was even a negative balance of trade. In 2009, Luxembourg was classified among countries with a high level of coverage of imports by exports; however, in 2017 it dropped to the rank of countries with a delayed level of imports coverage.

The profitability indicator is the next indicator useful in assessing the competitive position. This measure determines the share of operating surplus in the value of industry turnover. The higher the level of this the profitability the better situation of the sector is. A drop in the level of the indicator forces the sector to realize higher sales in order to achieve the intended profit. Due to the lack of data from 2017, the data from 2014 were used to calculate mentioned indicator. Moreover, the data were not complete. The classification had to be made using data only from 17 out of 28 member countries. The studies showed that the average level of profitability in the advanced technology sector in the investigated period was around 19% (Table 3).

The highest profitability (over 22%) was achieved in Belgium and the United Kingdom. Lithuania, Romania, Poland, Denmark, and Portugal were among the countries with a relatively high level of profitability. Profitability of entities operating in these countries amounted to approximately 20%. Among countries with a medium level of the index, a rate around 19% was recorded. Spain and Germany, belonging to the group of countries with a delayed level, had the indicator level of approximately 18% (Table 3). There are slight differences in the level of profitability among these countries. It is worth to note that a significant difference is noticeable comparing Belgium (22.68%) with the Netherlands (13.54%)—the leader in the previous qualifications. Among the countries with low levels of profitability were France and the Czech Republic. A positive phenomenon is the high position of Poland in the general classification. In this comparison, the domination of the “old” countries over the countries of the “new” union is no longer visible.

The development of the high-tech sector is necessary to increase the competitiveness and the level of modernization of the economy of a given country, and it is crucial for achieving economic benefits. Countries that are unable to restructure their industries toward a higher share of the advanced technology sector are doomed for backwardness and a deepening technological gap. Therefore, countries are trying to support the development of advanced technology which is the main stimulator for economic development and social enrichment. Furthermore, the high-tech sector creates demand, accelerates the growth rate of enterprises, and can have a positive impact on investment profitability [Zakrzewska-Bielawska, 2011, p. 28]. Due to the above mentioned reasons and the complexity of the competitiveness category, the next stage of this study included taking into account at the same time all of the aspects analyzed so far. Overall analysis is needed to use summary methods that consider its various aspects. The synthetic indicator refers to the previously examined share of exports in the intra-EU export market, the coverage rate of imports by exports, and the profitability assessment of the advanced technology sector. Based on the values of the synthetic measure, a ranking of the competitive position of the advanced technology industry was created which encompassed the member countries of the EU. The highest competitive position in 2009 was achieved by the Netherlands—0.65 (Table 4). It was caused by high share of exports and a high level of coverage of imports by exports. The second position in the ranking pertained to Germany, which recorded the highest share of high-tech sector exports among countries belonging to the EU. Germany was also in the top five of the member countries with the highest coverage of imports by exports in 2009. The United Kingdom was among the first three. The United Kingdom reached one of the highest levels of profitability and recorded a high share of exports of the high-technology sector in the intra-EU export market of the industry in 2009. When it comes to Poland, this country was placed in the middle of the presented ranking. This is a consequence of taking an average position in previous rankings concerning the share of high-tech sector exports in the intra-EU export market, the extent of export coverage in the high-tech sector, and the average level of profitability. Referring to the impact of the division of the EU on the founding member and the countries acceding at various times on the ranking position, a higher competitive position of the countries belonging to the EU for a longer time is clearly visible.

In 2013, the synthetic index did not change significantly. The Netherlands, Germany, Belgium, and the United Kingdom were noted as the first four countries with the highest competitive position. A significant change was the Great Britain position drop (by one place) in the ranking and the rise of Belgium (from fourth to third position). Moreover, three countries have improved their competitive position: Austria, Italy, and Slovenia. The improvement of competitiveness of Austria was linked to the improvement of all indicators—mostly with an increase in the share of high-technology exports in EU exports. The improvement of Italy

Table 4. Synthetic indicator of the competitive position of the high-tech sector

No.	Specification	Year			Ranking	Rate in 2017
		2009	2013	2017*		
1	The Netherlands	0.65	0.75	0.71	1	High
2	Germany	0.47	0.46	0.47	2	
3	Belgium	0.33	0.36	0.34	3	Relatively high
4	Hungary	0.25	0.28	0.31	4	Medium
5	Austria	0.21	0.30	0.31	5	
6	Czech Republic	0.25	0.30	0.31	6	
7	United Kingdom	0.36	0.31	0.27	7	
8	Poland	0.23	0.25	0.27	8	
9	Italy	0.22	0.26	0.26	9	
10	France	0.27	0.25	0.23	10	Delayed
11	Slovenia	0.13	0.21	0.23	11	
12	Romania	0.24	0.21	0.23	12	
13	Lithuania	0.24	0.24	0.22	13	
14	Spain	0.18	0.21	0.21	14	
15	Denmark	0.19	0.21	0.21	15	
16	Slovakia	–	0.18	0.20	16	
17	Croatia	–	0.22	0.19	17	Significantly delayed
18	Estonia	–	0.11	0.17	18	
19	Portugal	0.13	0.16	0.16	19	
20	Greece	0.14	0.15	0.16	20	
21	Finland	–	–	0.06	21	Low
22	Cyprus	0.20	–	–	–	–
Average		0.26	0.27	0.26		

Source: Own study based on Eurostat data (<https://ec.europa.eu/eurostat/data/database> 10.10.2018).

*The profitability index data from 2014 was used.

was due to an increase in the coverage of imports by exports (from 0.51 to 0.61) (Table 4). In Slovenia, two indicators improved—the level of coverage imports by exports and the profitability (value over 2%). However, there were two countries whose competitive position weakened—France and Romania—where the profitability in the high-tech sector deteriorated significantly. The remaining countries included in the ranking did not significantly change their position in the analyzed period.

The discussed indicator was prepared using the latest data and it did not change significantly. The Netherlands, Germany, and Belgium continue to be high-tech sector leaders. The United Kingdom, which was also considered as a leader, significantly weakened its position. It was due to the result of the reduction of export share in the intra-EU market and reduction of the coverage of imports by exports. Croatia was another country with a downward trend. Although the changes in the ratios were small, it dropped from 12th to 17th place in the ranking (Table 4). Austria and Slovenia managed to maintain their competitive position, obtained after their growth in 2013.

4 Conclusions

The international high-tech sector competitiveness, in times of rapidly progressing processes of integration, regionalization, internationalization, and globalization, is an important current area of research in economics. Opening up the economies and the related flow of people, capital, goods, and provision of services affect the increasing competition of high-tech enterprises in the international

arena. The competitiveness and raising the competitive position became important aspects of enterprises and industries operation. The high-tech industry is one of the fastest growing sectors in the EU and in individual member countries.

After determining the high-tech sector competitiveness level in the EU countries, it was found that Germany and the Netherlands were in the group of countries with the highest level of export of advanced technologies in the intra-EU export market. The total share of these countries in 2017 was almost 50%. The country with a relatively high level was France, but its share was three times lower than the leaders of this ranking. The Netherlands (3.55) had the highest level of import coverage by exports from the high-tech sector. Countries with a relatively high coverage level fluctuated within 1.20. The highest level of profitability was recorded in Belgium and the United Kingdom. It is worth noting that the volatility of this indicator was lower than the volatility of other indicators.

The highest synthetic level of competitiveness in the EU was noted in the Netherlands. It is linked to a high share of exports and the highest level of import coverage by export in the EU. The Netherlands is one of the most developed countries in Europe, which is reflected in its competitiveness. The second country with the highest level of competitiveness is Germany. For many years, this country has been a leader in the market economy development. Germany dominates, among others, in agriculture, industry, transport, telecommunications, and energy industry. Poland belongs to the countries with a medium level of competitiveness. A positive phenomenon is a systematic improvement of the synthetic index in the considered period. This trend is noticeable in most member countries.

References

- Albulescu, C. (2011), Economic and financial integration of CEECs: the impact of financial instability, *AUCO Czech Economic Review*, Vol. 5, p. 29.
- Banterle, A. (2005), Competitiveness and agri-food trade: an empirical analysis in the European Union, Paper presented at the 11th Congress of the European Association of Agricultural Economists, Copenhagen.
- Bartos, P.J. (2007), Is mining a high tech industry? Investigations into innovation and productivity advance. *Resources Policy*, Vol. 32, No. 4, pp. 149–158.
- Bogliacino, F., Piva, M., Vivarelli, M. (2012), R&D and employment: an application of the LSDVC estimator using European microdata, *Economics Letters*, Vol. 116, No. 1, pp. 56–59.
- Fagerberg, J. (2000), Technological progress, structural change and productivity growth: a comparative study, *Structural Change and Economic Dynamics*, Vol. 11, pp. 393–411.
- Juchniewicz, M., Łukiewska K. (2014), Konkurencyjność wybranych branż polskiej gospodarki na rynku Unii Europejskiej, Wydawnictwo PTE w Olsztynie.
- Kraciuk, J. (2017), Konkurencyjność gospodarki Polski na tle gospodarek krajów Europy Środkowo-Wschodniej UE11, *Problems of World Agriculture/Problemy Rolnictwa Światowego*, Vol. 17, No. 32, Part 3, p. 207.
- Lee, T., Tang, K.K. (2013), Impacts of high-tech research on high-tech manufacturing growth: evidence from supercomputer data. Hoa Sen.
- Michael, P. (2003), Industrial structure and aggregate growth. *Structural Change and Economic Dynamics*, Vol. 14, No. 4, pp. 427–448.
- Misala, J. (2011), *Międzynarodowa konkurencyjność gospodarki narodowej*, PWE, Warszawa.
- Nordhaus, W. (2005), The source of productivity rebound and the manufacturing employment puzzle, NBER Working Paper, 11354, May 2005.
- Pawlak, K. (2013), Międzynarodowa zdolność konkurencyjna sektora rolno-spożywczego krajów Unii Europejskiej, *Rozprawy Naukowe* Nr 448, Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu, Poznań.
- Rapacki, R., Gardawski, J., Czerniak, A., Horbaczewska, B., Karbowski, A., Maszczyk, P. (2018), Emerging varieties of capitalism in Central and Eastern Europe: a review, *Ekonomista*, Vol. 5, pp. 523–552.
- Ratajczak-Mrozek, M. (2011), Specyfika przedsiębiorstw zaawansowanych technologii (high-tech), *Przegląd Organizacji*, Nr. 2, p. 2.
- Skórska, A. (2016), Sektor high-tech jako czynnik wzrostu konkurencyjności polskiej gospodarki w perspektywie 2020 roku, *Zarządzanie i Finanse Journal of Management and Finance*, Vol. 14, No. 3/2/2016, p. 241.
- Smid, W. (2010), Leksykon przedsiębiorcy, Poltext, Warszawa, p. 216.
- Stachowiak, K. (2009), Ewolucja przemysłu zaawansowanej technologii i sektora teleinformatycznego (ICT) w Finlandii. *Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego*, 13, p. 23.
- Strzała, K., Przechlewski, T. (2006), *Ekonometria inaczej*, Wyd. Uniwersytetu Gdańskiego, Gdańsk.

- Sucheckie, B., Lewandowska-Gwarda, K. (2010), *Klasyfikacja, wizualizacja i grupowanie danych przestrzennych*, [w:] *Ekonometria przestrzenna. Metody i modele analizy danych przestrzennych*, Bogdan Sucheckie (red.), Wyd. C.H. Beck, Warszawa, pp. 60–69.
- Turowski, K. (2006), *Sektor wysokiej techniki jako czynnik rozwoju kapitału ludzkiego - implikacje dla konkurencyjności polskiej gospodarki* [w:] *Kapitał ludzki w gospodarce opartej na wiedzy*, red. D. Kopycińska, Katedra Mikroekonomii, Uniwersytet Szczeciński, Szczecin.
- Ulbrych, M. (2016), *Serwicyzacja produkcji przemysłowej. Wnioski dla Polski*, *Finanse, Rynki Finansowe, Ubezpieczenia*, Nr. 3(81), pp. 253–264.
- Weresa, M. A. (2008), *Polska. Raport o konkurencyjności 2008*, Instytut Gospodarki Światowej, SGH, Warszawa.
- Wysocki, F., Lira, J. (2003), *Statystyka opisowa*, Poznań: Wyd. AR im. Augusta Cieszkowskiego.
- Zakrzewska-Bielawska, A. (2011), *Relacje między strategią, a strukturą organizacyjną w przedsiębiorstwach sektora wysokich technologii*, Zeszyty Naukowe nr 1095, Wydawnictwo Politechniki Łódzkiej, Łódź, retrieved from <https://ec.europa.eu/eurostat/data/database>.