SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2019
ORGANIZATION AND MANAGEMENT SERIES NO. 139

SMART SPECIALISATIONS – COMPARATIVE ANALYSIS OF SELECTED POLISH REGIONS USING THE LOCATION QUOTIENT

Ewelina BERLIŃSKA

Maria Curie-Sklodowska University, Faculty of Economics, Lublin, Poland; e.berlinska@umcs.pl,
ORCID: 0000-0001-8266-8132

Abstract: The subject of regional smart specialisations is an issue analysed in the context of economic growth, creating innovation and competitiveness, engaging countries and regions in the development of R&D investments in the field of in the European Union. The purpose of this article is to characterise the issue in relation to voivodeship smart specialisations in Poland and to verify the intensity of occurrence of the discussed issue. The following voivodeships analysed in detail where IT and communication (section J of the Polish Classification of Departments) were pointed as intelligent specialisation: Lower Silesia, Łódź, Lesser Poland, Subcarpathia, Silesia and Greater Poland. Using the Location Quotient and based on the values obtained from Section J, a comparison was conducted based on the level of employment intensity and investment outlays for the whole country. The analyses allowed to state that in the case of only two voivodeships: Lower Silesia and Lesser Poland, LQ for employment assumed values greater than unity, which proves high specialisation within the IT and communication section in these voivodeships. The LQ analysis for investment outlays for the surveyed voivodeships did not exceed unity, which proves lower investment outlays in the IT and communication section in the examined areas than the average for Poland. As in the case of LQ for employment, the Lower Silesia and Lesser Poland voivodeships obtained the highest results. The analysis enabled the verification as to whether the assigned regional smart specialisations are reflected in the level of employment and investment outlays.

Keywords: intelligent specialisations, information and communication, location quotient.

1. Introduction

At the beginning of the 21st century, managers and representatives of the European Union undertook actions aimed at eliminating the ongoing disproportion in the economic development of European countries against the United States, Japan and China. The plans, goals and assumptions of the initiative to stimulate economic development, increase innovation and competitiveness of member states were developed in 2000 and referred to as the Lisbon

Strategy. Everything focused on three basic pillars: economic, social and environmental, while implementation work was to be completed in 2010 (Staśkiewicz, 2013).

The period of ten years of fulfilling the assumptions of the Lisbon Strategy did not contribute to the improvement of parameters in the field of building a knowledge-and-innovation based economy, development of the R&D sector, changes in the area of technology, science and general economic growth (Nowakowska, 2015). The failure contributed to an in-depth analysis of the situation and shaped a new approach to building competitiveness and, above all, innovation, among the European Union countries.

The document *Europe 2020 – Strategy for smart, sustainable and inclusive growth* created in 2010(Komisja Europejska, 2010) was based on three flagship priorities that are the grounds for functioning and fulfilling the adopted assumptions:

- intelligent development – economy development based on knowledge and innovation,
- sustainable development – supporting the economy that uses resources more efficiently, is more environmentally friendly and more competitive,
- inclusive growth – supporting the economy with a high level of employment, ensuring social and territorial cohesion (Szostak, 2015).

As part of the adopted document, flagship programmes were prepared, which constituted systematised and specific actions supporting the implementation of the above mentioned objectives. One of the programmes is the *Innovation Union*, which includes a plan to transform Europe into a research centre, bridge the barriers between science and the market, public and private sectors, and use innovation to solve climate, demographic and other problems (Gouardères, 2019). It is recognised that innovation, as a driving force for development and investment, in this aspect can generate above average benefits.

2. Intelligent specialisations

2.1. Characteristics of the concept

In the light of the *Innovation Union* flagship programme, EU member states have been obliged to reorganise national and regional strategies for carrying out research and development activities as well as innovation measures. The result of the work was to create the concept of smart specialisations, thanks to which each region was to prepare, through individual consultations, a way and methods to ensure the long-term development of the region and, as a result, the entire EU (Grądziel, 2014). The development of assumptions aimed at creating smart specialisations has become a prerequisite for receiving funding from the European Regional Development Fund (ERDF) (European Commission, 2010). The concept of smart specialisations is the result of the work of Knowledge for Growth Group experts (Bart van Ark

and Dorninie Foray) and is based on the assumption that each region should choose a specific specialisation taking into account geographical, social and cultural factors in which it will have a chance to gain a competitive advantage (Foray, 2016). Smart specialisation is a special feature of a given region or country that highlights the attractiveness of this area and has the chance to gather local partners and resources to further develop and build future innovations (European Commission, 2014). The region's intelligent specialisation is the field with the highest potential for flourishing and is used to build the current and future competitive position of the country using the knowledge-based economy (David, Foray, and Hall, 2007).

The task of shaping a set of innovative specialisations requires careful analysis and should be carried out with the involvement of a wide group of stakeholders, which enables building space for investment in innovation and experimentation. In addition, the specified specialisations should be subject to policy and investment support, ensuring knowledge-based development as well as constant monitoring and evaluation (Nazarko,2014).

Based on the above criteria, smart specialisations were identified by each regional voivodeship in 2014, based on a comprehensive analysis of strengths, complementarity in terms of economic, scientific, technological and innovative opportunities, as well as favourable circumstances that may arise in the future.

Given the continuously emphasised aspect related to the allocation of financial resources for R&D and the need to intensify innovative activity in implementing the concept of smart specialisations, it is worth considering these issues in the light of the recent years in Poland.

Table1.
Expenditure on research and development in Poland in 2014-2017

	2014	**2015**	**2016**	**2017**
Number of entities in R&D activity	3 474	4 427	4 871	5 102
Gross domestic expenditure on R&D activities (PLN million)	16 168	18 061	17 943	20 578

Source: own study based on *research and development activities in Poland in 2017*, Statistics Poland, data from 27 November 2018.

Considering research and development activities in Poland in 2014-2017 (Table 1), a significant increase in the share of entities and outlays in this field can be observed. The dynamics of growth in expenditure on R&D over 4 years is 27% (almost 4.5 billion). Along with the increase in outlays, there is a noticeable increase in the number of entities in the sector in question. PLN 20.6 billion was allocated in 2017, which accounted for 1.03% of the share of Polish GDP.

Table2.
Expenditure on innovative activity of enterprises in Poland in 2015-2017

	2015	**2016**	**2017**
Industrial enterprises (PLN million)	31 094	28 304	28 023
Service enterprises (PLN million)	12 640	10 706	13 142

Source: own study based on *Innovative activity of enterprises in Poland in 2015-2017*, Statistics Poland, data from 29 October 2018.

According to the data presented in Table 2, the trend in the amount of enterprises' expenditure on innovation activities has an ambiguous direction. In the case of industrial enterprises, there was a decrease of almost 10% in 2017, compared to 2015, while enterprises in the same period increased their expenditure by 4%. It is worth adding that innovative activity in the discussed years in Poland was demonstrated by over 20% of industrial enterprises and nearly12% of service enterprises.

2.2. Intelligent specialisations of Polish voivodeships

Regional innovation strategies have been prepared by all Polish voivodeships. They contain a detailed description of individual specialisations, together with their identification, goals, assumptions, monitoring method, thanks to which the document enables continuous update and verification of adopted guidelines. Table 3 presents regional smart specialisations by voivodeship. It is worth adding that the adopted terminology and the number of identified specialisations depend on the region and each area takes different forms.

Table 3.
Intelligent specialisations of Polish voivodeships

Voivodeship	Smart specialization
Lower Silesia	chemical and pharmaceutical industry; spatial mobility; high-quality food; natural and secondary raw materials; production of machinery, equipment processing; information and communication technologies (ICT)
Kuyavia-Pomerania	best safe food - processing, fertilizers and packaging; medicine, medical services and health tourism; automotive, transport equipment and industrial automation; tools, injection moulds, plastic products; information processing, multimedia, programming, ICT services; bio-intelligent specialisation - natural potential, environment, energy; transport, logistics, trade - water and land routes; cultural heritage, art, creative industries
Lublin	bio-economy; medicine and health; low carbon energy; IT and automation
Lubusz	green economy; health and quality of life in the region; innovative (modern) traditional industry; partnership and business cooperation
Łódź	modern textile and fashion industry (including design); advanced building materials; medicine, pharmacy, cosmetics; energy, including renewable energy sources; innovative agriculture and agri-food processing; IT and telecommunications
Lesser Poland	life sciences; sustainable energy; information and communication technologies; chemistry; production of metals and metal products and products from non-metallic raw mineral materials; electrical engineering and engineering industry; creative and leisure industries
Masovia	safe food; intelligent management systems; modern business services; high quality of life
Opole	chemical technologies (sustainable); sustainable construction and wood technologies; machine and metal industry technologies; energy industry technologies (including renewable energy, improvement of energy efficiency); agri-food technologies
Subcarpathia	aviation and space; quality of life; information and telecommunications
Podlasie	agri-food sector and sectors related to it by the value chain; medical services and life sciences and sectors related to them by the value chain; eco-innovations, environmental sciences and sectors related to them by the value chain; machinery industry and sectors related to it by the value chain
Pomerania	offshore and port-logistics technologies; interactive technologies in an information-saturated environment; eco-efficient technologies in the production, transmission, distribution and consumption of energy and fuels, as well as in construction; medical technologies in the field of lifestyle diseases and the ageing period
Silesia	medicine, ICT, energy
Świętokrzyskie	resource-efficient construction; metal and moulding industry; health and pro-health tourism; modern agriculture and food processing

Cont. table 3.

Warmia-Masuria	water management; wood and furniture industry; high-quality food
Greater Poland	bio-raw materials and food for informed consumers; interiors of the future; industry of tomorrow; specialised logistics processes; ICT- based development; modern medical technologies
West Pomerania	bio-economy; maritime activities and logistics; metal and machine industry; future services; tourism and health

Source: own study based on Regional Operational Programmes, https://regionalneprogramy operacyjne.pl/.

Analysis of the above-mentioned specialisations shows the level of differentiation in the form of a record as well as the number of assigned specialisations. Among the presented parameters, traditional areas can be found, but also those that constitute the basis for future regional, national and European development.

2.3. Information technology and communication

The multitude of smart specialisations of Polish voivodeships, their spatial diversity and naming ambiguity generate difficulties in comparative analysis of regions. Reviewing the above-mentioned smart specialisations and analysing the connection of regional smart specialisations with the sections and departments set out in the Annex to the Regulation of the Council of Ministers of 24 December 2007 on the Polish Classification of Business Activities (PKD), it can be seen that Section J – IT and communication, is reflected in many examples in Table 3 and this is one of the most frequently appearing categories. When selecting smart specialisations, including group J in the PKD classification, the following voivodeships included it in their regional programmes:

- Lower Silesia: information and communication technologies, section J, part 61, 62, 63.
- Kuyavia-Pomerania: information processing, multimedia, programming, ICT services, section J, part 59, 61, 62, 63.
- Lublin: IT and automation, section J, part 62.
- Łódź: IT and telecommunications, section J, part 61, 62, 63.
- Lesser Poland: information and communication technologies, section J, part 61, 62, 63.
- Masovia: intelligent management systems, section J, part 62.
- Subcarpathia: information technology and telecommunications, section J, part 61, 62, 63.
- Silesia: ICT, section J, part 61, 62, 63.
- Greater Poland: ICT-based development, section J, part 61, 62, 63.

In nine out of sixteen voivodeships, a specialisation related to IT and communication has been distinguished. These voivodeships are located in the central or southern part of Poland, the lack of this element in the rest of the country may be the evidence of other highly developed smart specialisations that determine the region's potential.

3. Purpose and research methods

The purpose of this article is to compare Polish voivodeships within the intensity of smart specialisation – IT and communication, which was separated on the basis of the PKD section. The analysis will be carried out using one of the concentration measures and applying basic statistical measures. The study used data from the analyses of the Central Statistical Office and refers to the period 2014-2017.

The selection of voivodeships to be compared was based on an analysis of PKD parts that were assigned to a particular smart specialisation. In order to best fit and avoid mistakes in interpretation, the following voivodeships were examined: Lower Silesia, Łódź, Lesser Poland, Subcarpathia, Silesia and Greater Poland. All departments in the aforementioned voivodeships converged, covering section J, i.e. IT and communications, and include:

- part 61 – telecommunications,
- part 62 – activity es related to software and consultancy in the field of information technology and related activities,
- part 63 – information service activities (Gofin.pl).

Analyses of Statistics Poland include data on the entire section J (it consists of 6 parts), hence the selection of voivodeships with identical departments enables obtaining the most reliable results.

Location Quotient was used in the calculations, which enables identifying the concentration of region's specialisation and the level of intensity of a given parameter in the examined area in relation to the entire country (Hildebrand, and Mace, 1950). The following interpretation of the location coefficient will be adopted in the article:

- LQ > 1 – indicates a higher occurrence of a given phenomenon in the studied region than the average in the reference area. This may mean a surplus of the analysed parameter, which in turn proves the region's competitiveness.
- LQ < 1 – indicates the occurrence of a given phenomenon in the studied region at a lower level than the average in the reference area. This may mean a shortage of the analysed parameter and indicate that the given phenomenon is not the region's strength.
- LQ = 1 – indicates that the occurrence of a given phenomenon in the studied region has a distribution similar to the reference area.
- LQ > 1.25 – indicates the above average occurrence of a given phenomenon in the studied region in relation to the reference area. This may indicate regional specialisation in the industry (Piórkowska,2016).

In this work, the indicator will be modified, which for the purposes of the study will take the form of a formula enabling the determination of the level of occurrence of specialisation – IT and communication in terms of employment level and the amount of investment outlays in separate voivodeships.

For the calculation of the degree of specialisation concentration in the IT and communication section based on the number of employees, the following formula was adopted:

$$LQ_{Zi} = \frac{Z_{REG(i)}/Z_{REG}}{Z_{PL(i)}/Z_{PL}} \quad (1)$$

where:

$Z_{REG(i)}$ – number of persons employed in the section (IT and communication) in the studied region of Poland,

Z_{REG} – total number of persons employed in the studied region of Poland,

$Z_{PL(i)}$ – total number of persons employed in the section (IT and communication) in the country,

Z_{PL} – total number of employed in the country (Christofakis, and Gkouzos, 2013).

Calculations related to the determination of the location coefficient based on financial outlays in the IT and communication section will be carried out in accordance with the above formula, where investment outlays will be included instead of the number of employees. The inclusion of capital expenditure incurred in section J by individual voivodeships will enable the estimation of the degree of involvement in the creation, improvement and development of fixed assets in this field.

The results obtained for each region over the years 2014-2017 will be compared and using dynamics measurement of the determined relative changes in the phenomenon over time. The above will enable the specification of voivodeships in which the IT and communication section in terms of employment and investment outlays achieves the best results and the development of this specialisation is most visible.

Basic descriptive statistics, ascent and location measures, will be used to present the amounts obtained by the analysed voivodeships from the European Funds in 2014-2020 for the implementation of projects under the category of telecommunications and e-services, which best corresponds to the J PKD section analysed in the article.

4. Results

The analysis and calculations of the location coefficient for selected voivodeships in Poland, covering only section J in the PKD classification, i.e. IT and communication, within the intensification of employment in the years 2014-2017 are presented in Table 4.

Two voivodeships: Lower Silesia and Lesser Poland have the highest LQ level in four years and achieve results in LQ block > 1.25. The above proves that in these voivodeships there is a greater number of people employed in the IT and communication section than Polish average. This means a high level of competitiveness of this area and confirms the rightness in developing

regional smart specialisations for those voivodeships that included IT and communication as their strengths.

Table4.
Location quotient – intensification of employment in the IT and communication section in Poland in 2014-2017

Voivodeship	LQ_{Zi} 2014	LQ_{Zi} 2015	LQ_{Zi} 2016	LQ_{Zi} 2017
Lower Silesia	1.24	1.32	1.35	1.47
Łódź	0.75	0.69	0.67	0.65
Lesser Poland	1.22	1.32	1.30	1.33
Subcarpathia	0.50	0.50	0.49	0.45
Silesia	0.90	0.90	0.93	0.91
Greater Poland	0.81	0.79	0.77	0.78

Source: own study based on data from Statistics Poland.

In other voivodeships, i.e. Łódź, Subcarpathia, Silesia, and Greater Poland, LQ results < 1 were obtained, which indicates a lower number of employees in the IT and communication section than on average in Poland. Considering that these voivodeships have recognised section J as an intelligent specialisation, the LQ level is below normal.

Table5.
Location quotient - intensification of employment in the IT and communication section in Poland in 2014-2017 – analysis of the dynamics of the phenomenon

Voivodeship	LQ_{Zi}2014	LQ_{Zi}2017	ΔLQ_{Zi}[%]
Lower Silesia	1.24	1.47	18.14
Łódź	0.75	0.65	-12.83
Lesser Poland	1.22	1.33	9.01
Subcarpathia	0.50	0.45	-9.14
Silesia	0.90	0.91	1.85
Greater Poland	0.81	0.78	-4.59

Source: own study based on data from Statistics Poland.

Over the four years, from 2014 to 2017, the intensification of employment in the IT and communication section in separate voivodeships adopted varied growth dynamics. In the voivodeships with the highest LQ (Lower Silesia, Lesser Poland, Silesia), the number of employees increased in relation to the whole country. LQ increased by over 18% in the Lower Silesian voivodeship, by 9% in the Lesser Poland voivodeship, and by almost 2% in the Silesian voivodeship. The above proves the intensification of activities and concentration on the development of the voivodeship based on the specialisation related to IT and communication. Other regions (Łódź, Subcarpathia, Greater Poland) showed a decrease in this parameter, which amounted to almost 13% (Łódź) to less than 5% (Greater Poland). The downward trend shown may indicate that there is a greater intensity and concentration of activities in other smart specialisations identified. The undisputed leader and the most specialised area is the Lower Silesia Voivodeship with the highest LQ (1.47) and with an increase of over 18%. The analysis of this factor in subsequent years will enable the verification as to whether the Lower Silesia Voivodeship will maintain an upward trend, and a detailed examination will enable the verification of actions taken by managers that contribute to the improvement of this factor.

Table6.
Location quotient – intensification of expenditures in the IT and communication section in Poland in 2014-2017

Voivodeship	LQ_{NIi} 2015	LQ_{NIi} 2016	LQ_{NIi} 2017	ΔLQ_{NIi}[%]
Lower Silesia	0.66	0.64	0.63	-4.43
Łódź	0.63	0.56	0.43	-32.23
Lesser Poland	0.67	1.00	0.79	17.84
Subcarpathia	0.40	0.41	0.25	-39.74
Silesia	0.54	0.49	0.35	-34.97
Greater Poland	0.74	0.52	0.47	-36.61

Source: own study based on data from Statistics Poland.

The second component that was used to calculate the measure of concentration - location coefficient – was capital expenditure incurred in section J of the PKD, i.e. for IT and communication. Table 6 contains results for six voivodeships, out of which the Lesser Poland voivodeship has the highest LQ = 0.79 (2017) and it also recorded the greatest increase in the ratio over three years. However, the results obtained are in the LQ > 1 range, which proves that investment outlays for IT and communication sections in this voivodeship are lower than Polish average. Other voivodeships are characterised by low and very low levels of investment outlays and a significant decrease in this factor over three years, from 2015 to 2017. The above results are correlated with LQ in the employment structure, because in both cases the Lower Silesia and Lesser Poland voivodeships have the highest concentration of studied phenomena.

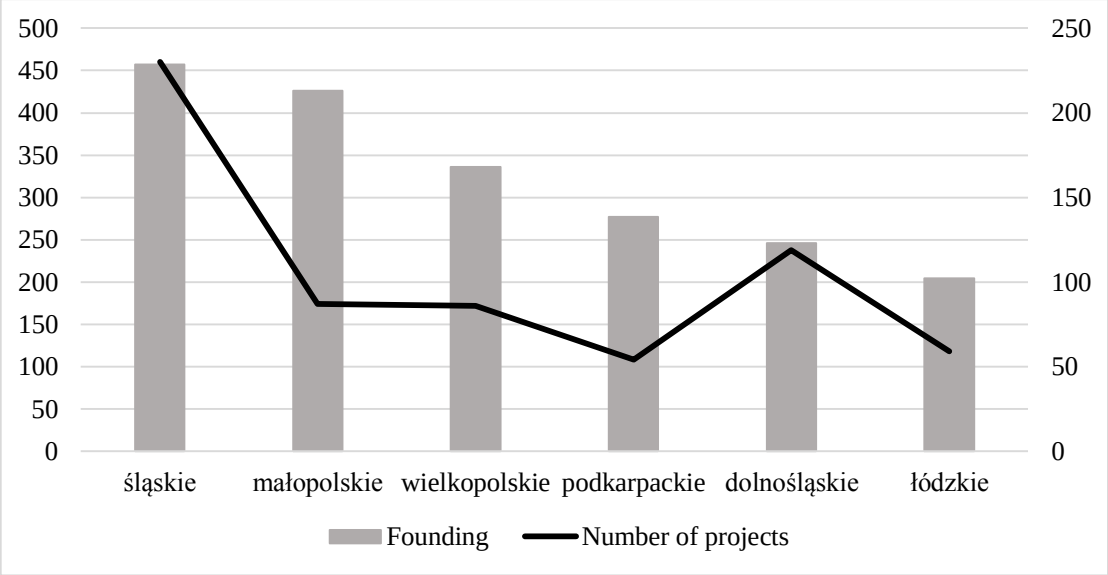

Figure 1. Level of co-financing for projects in the telecommunications and e-services category (PLN million) under European Funds for 2014-2020 in selected voivodeships; source: own study based on the EU subsidy map https://mapadotacji.gov.pl/.

Figure 1 contains information on the level of co-financing and the number of projects implemented in selected voivodeships for activities in the category of telecommunications and e-services under the European Funds for 2014-2020. The analysis of the statement shows that the highest funding was obtained by the Silesian Voivodeship (over 450 million) for 230 projects (auxiliary axis of the chart) and the Lesser Poland Voivodeship (less than

430 million) for 87 projects. The EU subsidy map allows the verification of the level of co-financing in each voivodeship broken down by category of the use of funds obtained. Among the analysed regions, the lowest co-financing (at the level of 204 million) was obtained by the Łódź Voivodeship.

5. Conclusion

Nine out of sixteen voivodeships in Poland indicated a parameter related to IT and communication as a regional smart specialisation, treating this area as the region's strength, an innovative and development field, and which could allow the voivodeship to gain a competitive advantage in its implementation. Thanks to the use of the measure of concentration, in the form of the location coefficient, the level of employment and investment outlays in the region in relation to the whole country was analysed in a group of separate voivodeships. LQ determining the employment intensity for two voivodeships: Lower Silesia and Lesser Poland obtained results above 1.25, which proves the above average occurrence of this phenomenon and may mean that these two areas will prove to be specialists in the industry and will gain a competitive advantage. Lower LQ results for investment outlays in the aforementioned voivodeships were below unity, however, on the scale of the comparison carried out in the group of six regions, they obtained the highest results.

In order to implement the assumptions under regional innovation strategies, voivodeships showing information technology and communication as an intelligent specialisation should intensify their activities and strive for continuous improvement of this area, which is the potential for the future development of the region and the European Union. The examples of the Lower Silesia and Lesser Poland voivodeships may constitute a reference point for other areas striving for the development of this factor.

References

1. Christofakis, M., and Gkouzos, A. (2013). Regional specialisation and efficiency of the agricultural sector in Greece: the relationship with regional funding allocation. *Regional and Sectoral Economic Studies, 13-1,* 119-130.
2. David, P., Foray, D., and Hall, B. (2007). Smart Specialization – The Concept. *Knowledge Economist Policy Brief, 9.* Retrieved from https://ec.europa.eu/invest-in-research/pdf/download_en/kfg_policy_brief_no9.pdf, 27 September 2019.

3. Foray, D. (2016). On the policy space of smart specialization strategies. *Journal European Planning Studies, 24*, 1428-1437.
4. *Gofin.pl*. Available online http://www.klasyfikacje.gofin.pl/pkd/5,1,1518,informacja-i-komunikacja.html#sekcja, 28 September 2019.
5. Gouardères, F. (2019). *Polityka innowacyjności.* Retrieved from https://www.europarl. europa.eu/factsheets/pl/sheet/67/polityka-innowacyjnosci, 27 September 2019.
6. Grądziel, A. (2014). Strategia inteligentnej specjalizacji stymulatorem rozwoju gospodarczego regionów. *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania*, *37(2)*, 243-253.
7. Hildebrand, G. and Mace, M. (1950). The Employment Multiplier in an Expanding Industrial Market: Los Angeles Country, 1940-47. *Review of Economics and Statistics*, *32*, 241-249.
8. *Komisja Europejska* (2010). EUROPA 2020 Strategia na rzecz inteligentnego i zrównoważonego rozwoju sprzyjającego włączeniu społecznemu. Available online https://ec.europa.eu/eu2020/pdf/1_PL_ACT_part1_v1.pdf, 27 September 2019.
9. *Komisja Europejska* (2014). Strategie innowacji krajowych/regionalnych na rzecz inteligentnej specjalizacji (RIS3). Available online https://ec.europa.eu/regional_policy/ sources/docgener/informat/2014/smart_specialisation_pl.pdf, 27 September 2019.
10. Nazarko, Ł. (2014). Inteligentne specjalizacje polskich regionów – przyczynek do ewaluacji. *Przedsiębiorczość i Zarządzanie, XV(8),*247-262.
11. Nowakowska, A. (2015). Inteligentne specjalizacje regionalne – nowa idea i wyzwanie dla polityki regionalnej. *Research papers of Wroclaw University of Economics, 380,* 310-318.
12. Piórkowska, P. (2016). Analiza koncentracji sekcji Polskiej Klasyfikacji Działów w wybranych regionach Polski. *Catalaxy, 1(1),* 5-16.
13. Staśkiewicz, J. (2013). Introduction of the Lisbon Strategy in Poland within the Innovation Area. *Trends in the World Economy*, 155-170.
14. Szostak, E. (2015). Inteligentne specjalizacje w rozwoju regionu. *Studia Ekonomiczne*, *209,* 209-218.