Impact of Selected Regional Characteristics on Innovation Effectiveness of the SME Sector

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Abstract:

Purpose: *The purpose of the study is to try to determine whether there is a relationship between the determinants of a region's innovativeness and the effectiveness of innovation activities carried out by small and medium-sized companies (SMEs) operating in the area. The author formulated the following research hypothesis: (H1) There is a positive correlation between the determinants of a region's innovativeness and the effectiveness of innovation activities carried out by SMEs in a given region.*

Design/Methodology/Approach: *The study is based on the exploratory-descriptive method, which involves the statistical compilation of the collected results in selected analytical contexts. The survey was conducted between July 2023 and September 2023 and included 1,745 companies from all regions of Poland. The analysis uses basic descriptive statistics and measures of innovation effectiveness accepted in the literature. Data was collected through an online survey. Official data published by EUROSTAT and the Central Statistical Office (CSO) were used for comparative analysis of the level of innovation in different regions of Poland*

Findings: *The article examines the relationship between the specific characteristics of the region (geographically and at the national administrative level) and the measurable effects of the innovative activities of SME companies that operate in the region. The author refers to his own previous research in the field of measuring the effects of innovation activities of SME companies. The article identifies key features of the region that significantly affect the innovative efficiency of the SME sector.*

Practical Implications: *The research conducted can be used in two main areas/stakeholder groups: (1) regional authorities - shaping regional policies in support of innovation, (2) SME business owners - increasing the efficiency of innovation activities.*

Originality/Value: *The article presents the results of the Author's own cyclical research. The presented results have not been published and discussed scientifically before.*

Keywords: *Innovation, determinants of innovation, SME sector, regional policy.*

JEL codes: O30, O31, L20.

Paper type: *Research article.*

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1. Introduction

In today's economic paradigm, innovation is widely considered to be a key factor influencing the economic growth of individual countries. The dominant theory of economic growth emphasizes that the long-term development of GDP depends on three main elements: capital accumulation, population growth and technological progress.

In the European Union's economic strategy, promoting innovation is considered a necessary condition for development to enable competitiveness with economies such as the United States, Japan and China. This assumption is reflected in the currently implemented Community strategy and is widely discussed in the scientific literature (Kasperkiewicz, 2016; Janger *et al.,* 2016; Camagni and Capello, 2013).

Currently, there is an increasing emphasis on developing innovation at the regional level. This approach is confirmed by the creation of regional innovation systems that bring together enterprises, research institutions and administrative bodies that cooperate with each other in order to effectively create, support and disseminate innovations. Regional research conducted in recent years strongly emphasizes that innovation processes are territorial in nature and that innovations are local processes (Mitra, 2019).

Currently, the region is not only perceived as a geographical space where enterprises are located due to the costs of transport, access to land or labor, as described by classical economic theories. The region is understood as a place where the processes of knowledge creation and innovation develop, constituting the foundation for organizing the innovative potential of entities (Parrili *et al.,* 2016).

Nowadays, innovation processes are based primarily on the region's internal resources, therefore innovations are perceived as geographically conditioned, strongly supported by the region's potential (Giannakis and Bruggeman, 2017). In this context, regional factors contribute to reducing the risk of innovative activities of companies operating in a given area. Likewise, regions that do not demonstrate the right characteristics do not provide a favorable environment for companies seeking to innovate.

This situation results primarily from the revaluation that has occurred in the last few years in terms of socio-economic development factors. Nowadays, the main emphasis is placed on information and knowledge resources and the innovations

related to them, which leads to the economy being defined as knowledge-based. Many socio-economic processes have been transferred from the national to the regional level.

Therefore, the region has become a key area for development processes and shaping economic policy, constituting an important element in the process of generating, absorbing and spreading innovations. According to Cappelo and Lenzi (2019), the evolution of regional innovation support systems, as well as a new understanding of their role in the modern economy, have a significant impact on the effectiveness of innovation processes undertaken by enterprises.

Poland is characterized by a low level of innovation compared to other European Union countries, which is confirmed by the latest report of the European Commission entitled "European Innovation Scoreboard", placing Poland in 25th place (Hollanders *et al.,* 2019).

This low level of innovation at the national level is a direct result of the limited innovation of Polish regions. Even the most innovative region in Poland, Małopolska, ranks 155th out of 239 voivodeships surveyed. Generally speaking, Polish regions are classified as areas with a moderate or low level of innovation (Hollanders *et al.,* 2019).

Due to this low level of innovation in Polish regions, there is an urgent need to identify regional factors that support the effective initiation of innovation processes, as well as factors that limit the development of innovation at the regional level. Research in this area is of particular importance because it can contribute to the development of mechanisms for improving innovation in regions with lower development potential, which will ultimately increase their competitiveness (Asheim, 2019).

2. Literature Review - Factors Influencing Regional Innovation Levels and the Efficiency of Innovative Endeavors Pursued SMEs Companies

In the modern economic paradigm, innovation is the main factor determining economic development at the macroeconomic and microeconomic levels. In the macroeconomic context, innovation strongly stimulates economic growth, and at the microeconomic level, innovations directly affect the company's competitiveness (Farinha, Ferreira, and Gouveia, 2016; Carayannis and Grigoroudis, 2013; Thalassinos and Berezkinova, 2013).

The role and importance of innovation are discussed in depth in the literature, and a review of research clearly shows that, especially in the case of small and medium-sized enterprises (SMEs), innovation is crucial due to their important role in the modern economy (Dibrell, Davis, and Craig 2008, p. 203-218;

Salvato, Lassini, and Wiklund 2007, pp. 282-305; Low and Chapman 2007, pp. 878-891).

The innovative activity of companies takes place in conditions that influence the level of innovation - conditions can be divided into: internal (endogenous), related to the company's internal resources and management method, and external (exogenous) conditions, resulting from the company's broad environment. In this study, the author assumed that the specificity of the region in which companies operate is treated as an exogenous factor.

Based on a literature review, the classification of exogenous regional determinants of innovation includes (Romao and Neuts, 2017), economic factors, social factors, spatial factors, environmental factors, technical and technological factors.

The indicated features of the region may both stimulate and inhibit (constitute a barrier) regional development (Pytlak and Wojnicka-Sycz, 2017). Taking into account this stimulating and inhibiting nature of the region's factors, it should be noted that the determinants of innovation may increase the innovativeness of companies by developing regional potential, but do not automatically guarantee the effectiveness of innovative activities.

Therefore, it is necessary to identify those specific characteristics of the region that have a direct impact on the effectiveness of innovative activities undertaken by local enterprises.

The key element in the assessment of all innovation processes is their economic efficiency. The implementation of innovations usually involves investment outlays and costs related to their development. In the case of innovations accepted by recipients, profits generated by the effective implementation of new solutions appear only after the implementation process is completed (in practice, this time may vary greatly, depending on the type of innovation being implemented).

The concept of operational efficiency is often used in economic sciences to evaluate and optimize activities. In the economic literature, efficiency is usually defined as the ratio of the effects achieved to the costs incurred (Stoner 1994, pp. 29-30; Cristea *et al.,* 2022).

Issues related to efficiency are widely discussed in economic literature, and the same methods are usually used to assess the effectiveness of innovative activities as those used in the assessment of investment projects, such as NPV, IRR, MIRR or the profitability index - PI (Foreman-Peck, 2013).

In this study, the author adopted the definition of innovation effectiveness

(effectiveness of innovative activities) proposed by Sukanlaya Sawang, Kerrie Unsworth and Tamma Sorbello, which defines innovation effectiveness as the total benefits from the implementation of the innovation (Sawang, Unsworth, and Sorbello 2012).

According to the literature, the basic tool for assessing the effectiveness of innovative activities is the ROI2 (Return on Innovation Investment) indicator. ROI2 is based on a calculation taking into account the ratio of total profits obtained from innovative products and services in a specific period of time to the total financial costs incurred on innovative activities in a specific period

The method of using ROI2 and the calculation methodology were described in detail by Alexander Kandybin (Kandybin 2014), Miles Drake (Drake *et al.,* 2006) and Thomas Kuczmarski (2000). There are several ways to calculate the return on innovation (ROI2), but this article will use the method proposed by Bernard Marr (2012).

$$ROI2 = \frac{\sum of\ net\ profits\ from\ innovations}{\sum of\ innovation\ implementation\ costs}$$

Although the ROI2 indicator is usually used to assess the effectiveness of individual innovation initiatives (Bloom *et al.,* 2013), in practice it can also be used to assess the level of innovation of groups of enterprises, such as industries or sectors. The results obtained in this way can be aggregated at the regional or national level.

3. Results - Impact of Selected Regional Characteristics on Innovation Effectiveness of the SME Sector

The research goal is to understand whether there is a connection between the factors influencing the region's innovativeness and the effectiveness of innovative activities undertaken by SMEs in this area. The author formulated a hypothesis: (H1) There is a positive correlation between the factors influencing the region's innovativeness and the effectiveness of innovative activities of SME companies operating in this region.

The study is based on the exploratory and descriptive method, which involves a statistical comparison of results obtained in specific analytical categories. The analysis is carried out in two stages:

1. The first stage involves conducting empirical research on the effectiveness of innovative activities of SME companies in all regions of Poland.
2. The second stage involves comparing the assessed effectiveness of innovation activities carried out by SME companies with published

regional factors influencing innovation processes.

The author chose as the object of research regions that are identical with the administrative units of Poland, i.e., voivodeships according to the European NUTS 2 classification. The first part of the empirical study used a questionnaire containing 64 questions allowing for detailed data, including:

1. Number of successful and unsuccessful innovation implementations.
2. Directions of implemented innovations (absorption/diffusion).
3. Type of innovations implemented.
4. Total financial costs for innovation activities.
5. Total net revenues from innovation activities.
6. Market acceptance assessment of implemented innovations.
7. Implementation period of innovative activities.
8. Sources of financing for innovation (use of EU funds or lack thereof).

1,745 companies from all regions of Poland participated in the study. The selection of companies for the study was random (selection from data from the Central Registration and Information on Economic Activity). All companies met the criterion of belonging to the SME sector (maximum employment less than 250 employees). The research sample was not differentiated due to the type of business, legal form or ownership. The research was carried out from July 2023 to September 2023.

The collected data allowed for the calculation of the ROI2 index for all companies covered by the study. It was assumed that the cumulative flow of profits/expenses of each of the surveyed enterprises was realized (documented) over a period of at least one year. The results obtained were compared at the level of individual regions of the country.

In the second stage of the study, the results of the calculated ROI2 innovation effectiveness index were compared with regional factors influencing innovation. The study used data from EUROSTAT and information contained in the report "Millennium Index 2023 - Regional Innovation Potential" (Millennium, 2023), which describes the level of innovation in various regions of Poland and was published by the Central Statistical Office. The author adopted the following determinants of the region's innovativeness:

1. Labor productivity in the region, understood as gross added value generated by one employee (in thousands of zlotys).
2. Research and development (R&D) expenditure in the region, expressed as the ratio of research and development expenditure to GDP (in percent).
3. Number of employees in the field of R&D in the enterprise sector for every 1,000 professionally active people.

4. Higher education in the voivodeship, expressed as the number of students per 10,000 inhabitants.
5. Number of patents, calculated as the average number of patents registered in a given voivodeship over the last 3 years for every 1 million inhabitants of the region.

All categories were assigned equal weight, and the results for individual voivodeships were assessed on a scale from 1 to 100, where 100 goes to the best region in all categories. Based on these assessments, the Author calculated the average value of the innovation potential, called the Millennium index. The calculated indicator will be used to analyze the relationship between innovation effectiveness and the factors determining the innovation potential of the studied regions.

In order to verify the research hypothesis (H1), the author calculated the arithmetic mean ROI2 for all surveyed companies. This indicator reflects the efficiency of innovation activities, i.e. the level of return on invested funds in innovative activities carried out by the surveyed companies.

The results of these calculations were ordered from the highest to the lowest values, and then aggregated at the level of each region. The results in Table 1, where the color indicates the values of the first quartile, the values of the last quartile and the values that exceed the average.

Table 1. *Effectiveness of innovative activities of SMEs on the regional level*

Region	ROI2 indicator	Average share of profits from innovations in total profits	Average share of innovation development costs in total costs
Małopolskie	2,209	0,402	0,182
Dolnośląskie	2,245	0,339	0,151
Mazowieckie	2,251	0,448	0,199
Wielkopolskie	1,733	0,331	0,191
Pomorskie	2,067	0,279	0,135
Śląskie	2,165	0,301	0,139
Lubelskie	2,044	0,325	0,159
Łódzkie	2,020	0,301	0,149
Podkarpackie	2,000	0,348	0,174
Zachodniopomorskie	1,532	0,216	0,141
Kujawski-pomorskie	2,211	0,199	0,09
Opolskie	1,591	0,288	0,181
Warmińsko-	1,536	0,172	0,112

mazurskie			
Podlaskie	1,255	0,182	0,145
Lubuskie	1,518	0,167	0,11
Świętokrzyskie	1,417	0,17	0,12

Source: Own study.

Companies from the Malopolska, Mazovia, Lower Silesia and Greater Poland provinces show the highest efficiency in innovation activities, as confirmed by ROI2 indicators. The results of these enterprises fall within the first quartile of the normal distribution of the presented statement.

In addition, it is worth noting that Pomeranian, Silesian, Lublin, Lodz and Subcarpathian provinces also achieved ROI2 higher than the average. This means that companies in these regions record efficiency in innovation activities above average.

In the opposite direction, Podlaskie, Lubuskie and Świętokrzyskie provinces are at the end of the ranking of efficiency of innovative activities, with results falling in the last quartile of the normal distribution of the statement. It is worth noting that the arithmetically averaged score for enterprises in these regions is less than 1. This proves that local enterprises are not successful innovators - profits from the sale of innovations do not cover expenses for their development.

Figure 1 shows the relationship between the average shares of innovation-related profits in overall profits and the average shares of innovation development costs.

Table 2. The effectiveness of innovative activities of SMEs in relation to the innovative potential of the examined regions

Region	ROI2 indicator	Indeks Millenium	Labour productivity	R&D expenditure	Post-secondary education	Persons working in R&D	Number of patents
Małopolskie	2,209	79,6	69	95	92	72	70
Dolnośląskie	2,245	76,75	88	49	89	5`	81
Mazowieckie	2,251	98	98	92	100	100	100
Wielkopolskie	1,733	58	72	3`	73	30	57
Pomorskie	2,067	57,6	71	57	79	42	39
Śląskie	2,165	52,8	84	33	55	31	61
Lubelskie	2,044	51	51	40	73	30	61
Łódzkie	2,020	51,8	71	37	66	31	54
Podkarpackie	2,000	44,2	61	58	45	34	23

Zachodniopomorskie	1,532	46	79	22	53	23	53
Kujawski-pomorskie	2,211	41,2	66	29	55	23	33
Opolskie	1,591	41,8	71	21	49	20	48
Warmińsko-mazurskie	1,536	33	59	24	45	18	19
Podlaskie	1,255	39,8	59	34	57	28	21
Lubuskie	1,518	29,6	74	22	22	17	13
Świętokrzyskie	1,417	30,8	59	19	43	12	21

Source: Own study.

The second step in the conducted research was the comparison of the obtained arithmetically averaged ROI2 indicator for the examined regions with the published data concerning the evaluation of determinants of regions' innovation potential. The list is presented in Table 2 (the values of the first quartile, the values of the last quartile and the values above the average were marked in colour).

4. Discussion

The relationship between the level of innovation potential and the efficiency of SMEs' innovative activity in the studied regions is clearly visible in the above comparison. Regions with strong innovation potential, such as Malopolska, Lower Silesia and Mazovia, show higher innovation efficiency of SMEs (the distribution of SME efficiency is similar to the distribution of innovation potential of these regions).

The exception here is Pomerania, where the innovation potential is high (it is in the first quartile of the distribution), and the efficiency of innovative activity of the surveyed SMEs exceeds the level of the first quartile of the sample.

Similar correlations can be seen in the case of regions ranked at the end of the ranking in terms of innovation potential, such as Warmian-Mazury, Podlaskie, Lubuskie and Świętokrzyskie. SMEs operating in these regions achieve significantly lower innovation efficiency compared to other surveyed companies.

Figure 1 graphically illustrates the relationship between the calculated ROI2 and the innovation potential index of the analyzed regions.

Figure 1. *The relationship between the calculated ROI2 and the innovation potential index of the analyzed regions*
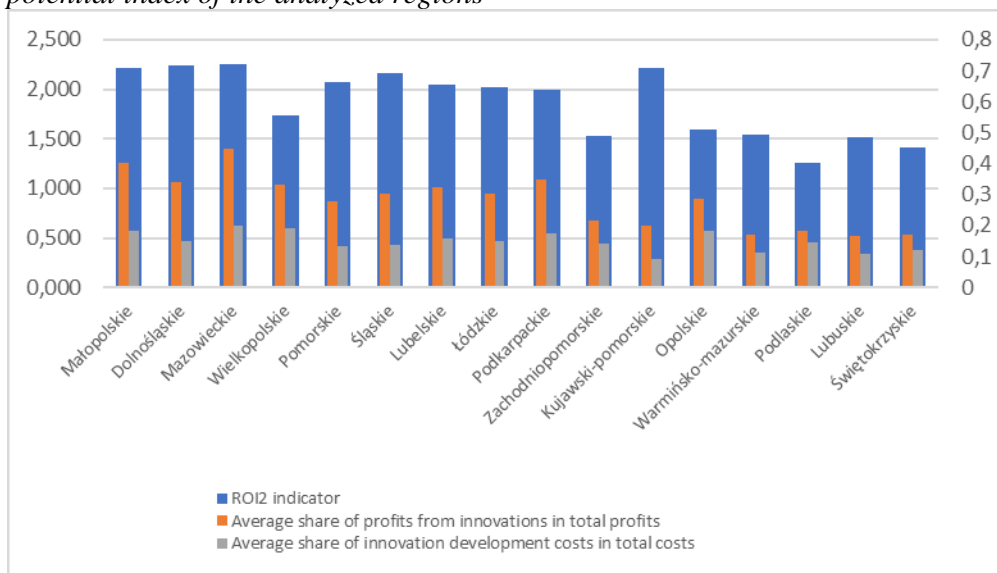
Source: Own study.

5. Conclusions

A comparison of the efficiency of innovation activities in the surveyed SMEs in the context of the innovation potential of the regions confirms the research hypothesis (H1): companies operating in regions with higher innovation potential achieve better innovation results. This is confirmed by the results obtained for companies in the Małopolska, Lower Silesia, Mazowieckie and Wielkopolskie provinces.

Similarly, companies operating in areas with low innovation potential show significantly lower efficiency in innovation activities, as confirmed by companies from the Warmian-Mazury, Podlaskie, Lubuskie and Świętokrzyskie.

The main determinants affecting the efficiency of innovation processes are the presence of well-qualified labor available in the region, the number of employees in research and development, and the number of registered patents in the region. Labor productivity and R&D expenditures incurred by the surveyed companies seem to be of lesser importance.

It is worth noting that the research method used allowed comparing the efficiency of innovation processes carried out by the surveyed SMEs in relation to the innovation potential of the regions in which these companies operate. Nevertheless, the purpose of the author's work did not include a statistical analysis of the correlation or cause-and-effect relationships between the effects

of the innovative activities of these companies and the characteristics of the regions.

It is worth noting that the next stage of the research could be to conduct a causal analysis in order to further understand the relationship between factors influencing the innovativeness of companies and regional characteristics. Such research could contribute to the development of a comprehensive list of innovation determinants and a more precise definition of their role in the context of innovation processes.

An additional research area could be the comparison of the determinants of innovativeness of Polish SMEs in regional terms with foreign enterprises, especially those that are leaders in innovation (for example, from the most innovative countries of the European Union).

A comparative analysis in this regard could contribute to the development of a model of optimal determinants of innovativeness at the regional level, which, as a result, could help remove barriers to effective and efficient innovation activities carried out by Polish SMEs.

References:

Asheim, B. 2019. Smart specialisation, innovation policy and regional innovation systems: what about new path development in less innovative regions? Innovation: The European Journal of Social Science Research, 32(1), 8-25.

Bloom, N., Romer, P.M., Stephen, S.J., Van Reenen, J. 2013. A Trapped-Factors Model of Innovation. American Economic Review, 103(3), 208-213.

Camagni, R., Capello, R. 2013. Regional Innovation Patterns and the EU Regional Policy Reform: Toward Smart Innovation Policies. Growth Change, 2(44), 355-389.

Capello, R., Lenzi, C. 2019. Regional innovation evolution and economic performance. Regional Studies, 53(9), 1240-1251.

Carayannis, E., Grigoroudis, E.J. 2014. Linking innovation, productivity, and competitiveness: implications for policy and practice. The Journal of Technology Transfer, 2(39).

Chang, Y., Chen, M., Lin, Y. 2012. Measuring Regional Innovation and Entrepreneurship Capabilities. J. Knowl. Economics, 3, 90-108.

Cristea, M., Noja, G.G., Thalassinos, E., Cîrciumaru, D., Ponea, C.Ș., Durău, C.C. 2022. Environmental, Social and Governance Credentials of Agricultural Companies—The Interplay with Company Size. Resources, 11(3), 30.

Dibrell, C., Davis, P., Craig, J. 2008. Fuelling innovation through information technology in SMEs. Journal of Small Business Management, 46(2), 203-218.

Drake, M.P., Sakkab, N.Y., Jonash, R.S. 2006. Maximizing Return on Innovation Investment. Research-Technology Management, 49(6), 32-41.

Farinha, L., Ferreira, J., Gouveia, B.J. 2016. Networks of Innovation and Competitiveness: A Triple Helix Case Study. Journal of the Knowledge Economy, 7(1), 259-275.

Foreman-Peck, J. 2013. Effectiveness and efficiency of SME innovation policy. Small Business Economics, 41(1), 55-70.

Giannakis, E., Bruggeman, A. 2017. Determinants of regional resilience to economic crisis: a
European perspective. European Planning Studies, 25(8), 1394-1415.

Janger, J., Schubert, T., Andries, P., Rammer, Ch., Hoskens, M. 2016. The EU 2020
innovation indicator: A step forward in measuring innovation outputs and outcomes?
Research Policy, 46(1), 30-42.

Kandybin, A., Kihn, M. 2004. Raising Your Return on Innovation Investment. Each
company has an intrinsic innovation effectiveness curve. Here are three ways to lift
IT. Strategy+business, 5(11), Resilience Report.

Kandybin, A. 2009. Which Innovation Efforts Will Pay? Mit Sloan Management Review, 51.

Kasperkiewicz, W. 2016. Wyzwanie innowacyjne dla gospodarek Unii Europejskiej w
świetle Strategii Europa 2020. Studia Prawno-Ekonomiczne, 99, 275-292.

Kuczmarski, T. 2000. Measuring your return on innovation. Marketing Management, Vol. 9,
no. 1.

Low, D., Chapman, R. 2007. Inter-relationships between innovation and market orientation
of SMEs. Management Research News, 30(12), 878-891.

Maliszewski, G., Berent, A., Buczek, Ł., Pulnar, A. 2023. Indeks Millenium 2023, Potencjał
Innowacyjności Regionów, Warszawa.

Mitra, J. 2010. Entrepreneurship, Innovation and Regional Development: An Introduction.
Routledge.

Parrilli, M., Dahl Fitjar, R., Rodriguez-Pose, A. (Ed). 2016. Innovation Drivers and Regional
Innovation Strategies. Routledge, New York.

Pytlak, K., Wojnicka-Sycz, E. 2017. Miscellanea Geographica Regional studies on
development, Vol. 21, No. 2, 51-59.

Romao, J., Neuts, B. 2017. Territorial capital, smart tourism specialization and sustainable
regional development: Experiences from Europe. Habitat International, 68, 64-74.

Salvato, C., Lassini, U., Wiklund, J. 2007. Dynamics of external growth in SMEs. Process of
model acquisition capabilities emergence. Schmalebach Business Review, 59(3).

Sawang, S., Unsworth, K., Sorbello, T. 2012. An Exploratory Study of Innovation
Effectiveness Measurement in Australian and Thai SMEs. International Journal of
Organisational Behaviour, 12(1), 110-125.

Thalassinos, E., Berezkinova, L. 2013. Innovation Management and Controlling in SMEs.
European Research Studies Journal, 16(4), 57-70.