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INNOVATION AND EFFICIENCY OF FOOD INDUSTRY FIRMS IN POLAND BY REGIONS

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Abstract: This paper was an attempt at assessing the innovation activity and efficiency of expenditure on innovation activity in food industry firms in Poland by regions and to identify the advantages of food industry firms from specific voivodeships in terms of their innovation activity and efficiency. Expenditure on and effects of the innovation activity in food industry firms in the respective voivodeships of Poland in 2016-2018 were analysed. As regards innovation, the most active units were those in the Mazowieckie and Małopolskie voivodeships. A strong propensity towards innovation and high efficiency were also noted in such firms in the Warmińsko-Mazurskie and Dolnośląskie voivodeships. The highest efficiency in the expenditure on innovation activity characterised the food industry in the Lubuskie and Opole voivodeships. Despite their strong propensity to innovate, the food industry firms in the Lublin and Mazowieckie voivodeships showed low efficiency, while those in the Łódź voivodeship performed the worst.

Keywords: innovation, efficiency, innovative firm, region, food industry.

1. Introduction

The food industry is a key division of every economy, and in Poland it is also deemed as one of the major areas of industrial activity (Chyłek, Kujawiński, and Niepytalski, 2016). Evidence of a high importance of the food industry includes the number of

firms, level of employment and production volume. In 2018, firms¹ carrying out activity connected with the production of foodstuffs accounted for nearly 17% of all industrial firms, every sixth industrial worker was employed in the food processing industry, and the value of products sold exceeded PLN 185 billion, that is about 17% of the total sales of products (Statistics Poland, 2020).

According to Urban (2007) and Pawlak (2016), the food industry is one of the fastest developing divisions of the Polish economy and is a European leader in terms of innovation, therefore it is more and more strongly affected by the changes occurring in the global economy. In order to adapt themselves to the changing environment and catch up with the increasing competition, firms must continually seek new development options. To this end, they use new solutions or improve the existing ones. New or considerably improved products are implemented along with innovative production or supply methods, and new organisational and marketing methods (OECD/Eurostat, 2005). However, as emphasized by Grzelak (2011), introducing innovation should not become the goal in itself. The ability to innovate is a condition for business development, creates chances of increasing the market share and should lead to achieving competitive advantage (Tidd, Bessant, and Pavitt, 2005; Castro, Verde, Saez, and Lopez, 2010; Ri, Wang, and Zhang, 2018). The firm, by undertaking innovation activity, should aim not only at increasing the level of innovation, but also at achieving adequate efficiency as a consequence (Porter 2001; Kijek, Matras-Bolibok, and Zakrzewska 2018). All business processes, including innovation activity, should be characterised by operational efficiency.

Grzybowska (2011) claims that the innovation of a region (voivodeship) is a component of innovation of all firms operating within its territory.

This paper attempts to assess the innovation activity and efficiency of expenditure on innovation activity incurred by food industry firms in Poland in respective voivodeships, and to identify the advantages of food industry firms from specific voivodeships in terms of their innovation activity and efficiency.

2. Study material and methods

The study refers to selected aspects of the innovation activity of food industry firms in Poland by region. The source material for the study was secondary data published by Statistics Poland in the statistical yearbooks of the analysed voivodeships (Regional Statistical Offices, 2017-2019) and in the Statistical Yearbook of Industry (Statistics Poland, 2018-2020), concerning businesses with more than 49 employees. For the needs of analysis, 13 voivodeships of Poland were selected. These were the: Dolnośląskie, Kujawsko-Pomorskie, Lubelskie (Lublin), Lubuskie (Lubusz), Łódzkie (Łódź), Małopolskie, Mazowieckie, Opolskie (Opole), Podlaskie, Pomorskie, Śląskie, Warmińsko-Mazurskie and Wielkopolskie voivodeships. The

¹ Data concern entities with more than 49 persons employed.

Podkarpackie, Świętokrzyskie, and Zachodniopomorskie voivodeships were not included in the calculations due to the generality of data published in their statistical yearbooks concerning industrial processing.

The analysis of business innovation activity was based on Oslo methodology (OECD/Eurostat, 2005), that is, through the prism of expenditure and outcomes related to such activity. Their 'contribution' to innovation activity was assessed based on the analysis of the level of expenditure on innovation activity per employee. The analysis of the effects of innovation activity involved performance indicators such as the value of new and significantly improved products sold per employee and the share of innovative firms² to the extent of product and business process innovations in the overall number of firms, reflecting the firms' propensity to innovate. The presentation of the value of expenditure and revenues from sales per employee made it possible to compare these figures and determine the relative innovation position of food industry firms in respective voivodeships in Poland. The efficiency of their innovation activity was analysed based on the ratio of efficiency of expenditure on innovation activity, as a relation between the value of new and significantly improved products sold and the value of expenditure on innovation activity. The calculations took into account the average values of the analysed measures for the period 2016-2018. For the purposes of illustrating the advantages of food industry firms from the specific voivodeships from the point of view of their innovation activity and the efficiency of such activity the share of innovative firms to the extent of product and business process innovations was compared in order to determine the propensity of such firms to innovate and the efficiency of expenditure incurred in innovation activity. The adopted point of reference was the average value of the above-mentioned ratios calculated for all Poland (reference value = 1.0).

3. Results

Running innovation activity requires expenditure on creating or acquiring innovations and implementing them in the firm. Expenditure on innovation activity to the extent of product and business process innovations includes, for instance, expenditure on research and development (R&D), own personnel working on innovations, materials and outsourced services purchased for the purposes of innovation activity and capital expenditure on fixed assets and intangibles, including on the purchase and development of software and intellectual property. Data provided in Table 1 shows that in 2016-2018 food industry firms allocated on average nearly PLN 4,500 per employee a year to innovation activity. This figure differed between voivodeships.

² An innovative firm, according to Oslo methodology, is a firm that in the observation period reported at least one business innovation, i.e. a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm (OECD/Eurostat, 2018).

The highest expenditure on innovation activity was incurred by entrepreneurs in the Mazowieckie voivodeship, where the average annual amount of money allocated to innovation activity was more than twice higher than the national average and exceeded PLN 9,000 per one employee. A large involvement of food processing in innovation activity was also noted in the Małopolskie voivodeship where nearly PLN 6,000 per employee were allocated to innovation activity. Similarly, in the Podlaskie voivodeship the average annual spending on innovation activity accounted for nearly PLN 5,400 per employee. In other voivodeships, expenditure on innovation activity was lower than the national average. The least innovation-active were food industry firms located in the Lubuskie and Warmińsko-Mazurskie voivodeships where the average annual expenditure on innovation activity accounted for, respectively 9% and 19% of the national average.

Table 1. Expenditure on the innovation activity of food industry firms in selected voivodeships of Poland in 2016-2018 per employee, in PLN/employee

Voivodeship	Expenditure on innovation activity [PLN/employee]		
	average	range of variation	
		min.	max.
Dolnośląskie	2 916	2 044	4 012
Kujawsko-Pomorskie	2 414	1 206	4 073
Lublin	3 678	2 520	4 835
Lubuskie	402	136	700
Łódź	2 742	1 653	6 927
Małopolskie	5 975	2 155	14 506
Mazowieckie	9 076	5 362	12 905
Opole	2 467	960	6 200
Podlaskie	5 370	5 253	5 479
Pomorskie	1 138	752	1 635
Śląskie	2 379	2 177	2 605
Warmińsko-Mazurskie	854	849	858
Wielkopolskie	2 217	1 633	2 949
Poland	4 471	2 752	6 760

Source: own calculations based on statistical yearbooks of respective voivodeships and the Statistical Yearbook of Industry for 2017-2019.

Firms, incurring expenditure on innovation activity, expect specific benefits from the implemented innovations. The basic measure for assessing the economic effects of innovation activity is the value of the new and significantly improved products sold. The data in Table 2 shows that the average annual value of new and significantly

improved products sold in 2016-2018 amounted to about PLN 21,500 per employee. This figure differed between voivodeships, where the highest average annual value of innovative food products sold was recorded in the Opole voivodeship where the average annual value of new and modernised products sold was above PLN 47,600 per employee. The effects in the form of high revenues from the sale of innovative food products were also noted in the Mazowieckie, Małopolskie and Kujawsko-Pomorskie voivodeships. The average annual value of revenues from the sale of innovative food products in those regions ranged from PLN 29,000 to PLN 30,000 per employee. In the Dolnośląskie voivodeship food producers achieved average annual revenues from the sales of innovative products at the level of PLN 25,000 per employee. The results in the Podlaskie voivodeship fluctuated around the national average. The sales of innovative products in other voivodeships generated revenues to food processing companies which were lower than the average domestic sales. In the Warmińsko-Mazurskie, Lubuskie, Lublin, Śląskie, Pomorskie and Wielkopolskie voivodeships, the average annual sales of innovative food products accounted for about 50% of the average domestic sales. The worst performing region was the Łódź voivodeship where revenues from the sales of innovative food products amounted to PLN 5,700, i.e. 27% of the average domestic sales.

Table 2. The value of new and significantly improved products sold by food industry firms in selected voivodeship of Poland in 2016-2018 per employee, in PLN/employee

Voivodeship	Value of new and significantly improved products sold [PLN/employee]		
	average	range of variation	
		min.	max.
Dolnośląskie	24 945	22 519	27 595
Kujawsko-Pomorskie	29 035	20 904	35 096
Lublin	11 816	8 367	16 801
Lubuskie	11 997	9 715	14 881
Łódź	5 727	1 725	29 583
Małopolskie	29 586	22 488	42 705
Mazowieckie	29 714	23 269	44 401
Opole	47 613	24 755	90 820
Podlaskie	21 712	16 643	30 572
Pomorskie	9 467	4 230	14 432
Śląskie	10 593	10 049	11 038
Warmińsko-Mazurskie	12 398	4 051	102 949
Wielkopolskie	9 522	5 756	18 457
Poland	21 491	17 232	31 438

Source: as for Table 1.

The level of innovation was also assessed based on the firms' propensity to innovate, measured as the share of innovative firms to the extent of product and business process innovations in the overall number of firms. Figure 1 indicates that in 2016-2018 more than 37% of the food industry firms in Poland reported at least one product or business process innovation. This figure differed between voivodeships. The highest propensity towards product or business process innovations was characteristic of food industry firms from the Warmińsko-Mazurskie, Lublin and Mazowieckie voivodeships where almost every second food industry firm was innovative. In the Dolnośląskie voivodeship more than 40% of food industry firms declared that in 2016-2018 they were going to implement at least one product or process innovation. The Małopolskie and Warmińsko-Mazurskie food industry firms showed the propensity to innovate at a level close to the national average. In other voivodeships the share of food industry firms that introduced product or business process innovations was lower than the national average. Only every third food industry firm in the Kujawsko-Pomorskie, Opole, Podlaskie, Wielkopolskie, Śląskie and Łódź voivodeships turned out to be innovative to the extent of product or process innovations. The lowest propensity to implement product or business process innovations characterised food processing companies from the Lubuskie voivodeship. Only 27.6% of the firms in Lubuskie region declared having introduced a product or business process innovation in 2016-2018.

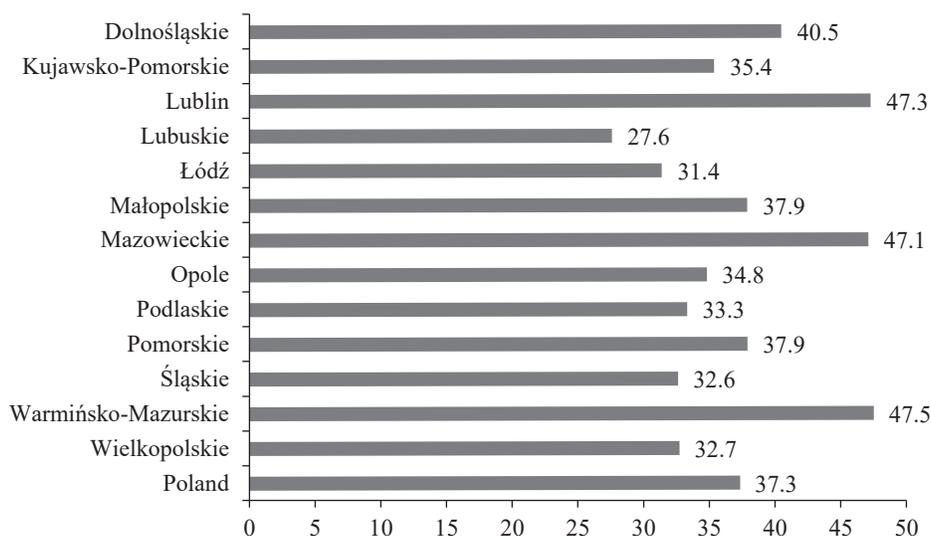


Fig. 1. Innovative firms regarding product and process innovations in the food industry in selected voivodeships in Poland in 2016-2018, % of all firms

Source: own elaboration based on statistical yearbooks of respective voivodeships and the Statistical Yearbook of Industry for 2019.

Figure 2 presents a classification of food industry firms from the analysed voivodeships based on the comparison of the value of expenditure on innovation activity per employee and the value of new and significantly improved products sold per employee. The adopted point of reference was the average value of the above-mentioned ratios calculated for all Poland (reference value = 1.0). The most innovative food industry firms were in the Mazowieckie and Małopolskie voivodeships. In the analysed period the level of both measures was higher than the average annual values calculated for all Poland. Producers from voivodeships falling into that group, incurring high expenditure on innovation activity, achieved relatively high effects in the form of innovative products sold. The ratios illustrating innovation activity of firms from the Podlaskie voivodeship fluctuated around the average value. In turn, funds allocated to innovation activity by food processing companies from the Opole, Kujawsko-Pomorskie and Dolnośląskie voivodeships were lower than the national average, which generated a relatively high value of the sales of new and significantly improved products. Firms from other voivodeships (the Lublin, Śląskie, Wielkopolskie, Łódź, Warmińsko-Mazurskie, Lubuskie and Pomorskie voivodeships) showed the lowest innovation activity. Due to low expenditure on innovation activity, revenues from the sale of innovative products was also lower than the national average.

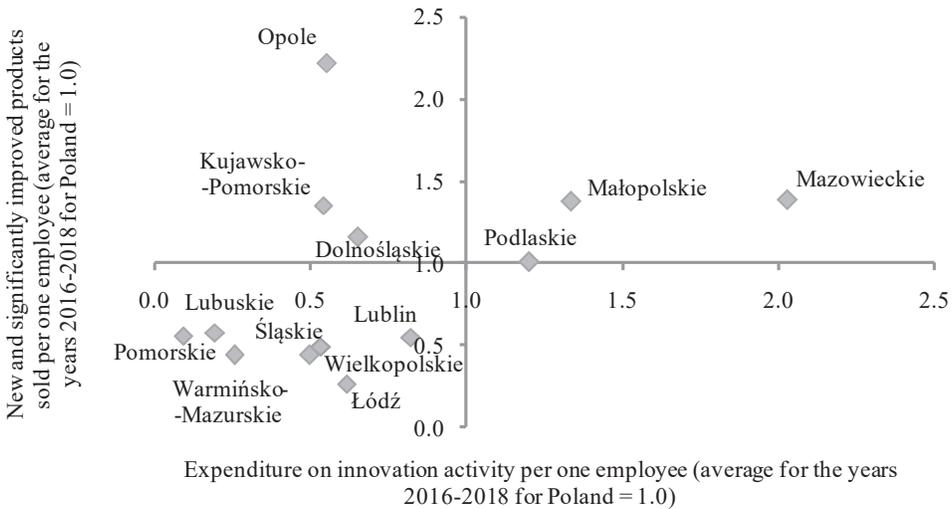


Fig. 2. Classification of selected voivodeships in Poland with respect to the relative measures of expenditure on innovation activity per employee and the value of new and significantly improved products sold per employee in food industry firms in 2016-2018

Source: own elaboration based on statistical yearbooks of respective voivodeships and the Statistical Yearbook of Industry for 2017-2019.

Figure 3 presents a classification of food industry firms from the analysed voivodeships based on the comparison of the relative measures of expenditure on innovation activity per employee and the propensity to innovate measured by the share of innovative firms to the extent of product and business process innovations in the overall number of food industry firms. The adopted point of reference was the average value of the above-mentioned ratios calculated for all Poland (reference value = 1.0). Firms from the Mazowieckie and Małopolskie voivodeships in 2016-2018 incurred relatively high expenditure on innovation activity per employee, at the same time showing a relatively high propensity to innovate. In turn, relatively high expenditure in the Podlaskie voivodeship was not reflected in the effects in the form of innovative food products or business processes. Food processing companies in the Warmińsko-Mazurskie, Lublin, Dolnośląskie and Pomorskie voivodeships, despite relatively low expenditure on innovation activity per employee, showed a relatively high propensity to implement innovative food products and business processes. The last group, being the least innovation-active, comprises food industry firms in the Opole, Kujawsko-Pomorskie, Łódź, Śląskie, Wielkopolskie and Lubuskie voivodeships. Relatively low expenditure on innovation activity is linked to relatively low propensity to implement product and process innovations.

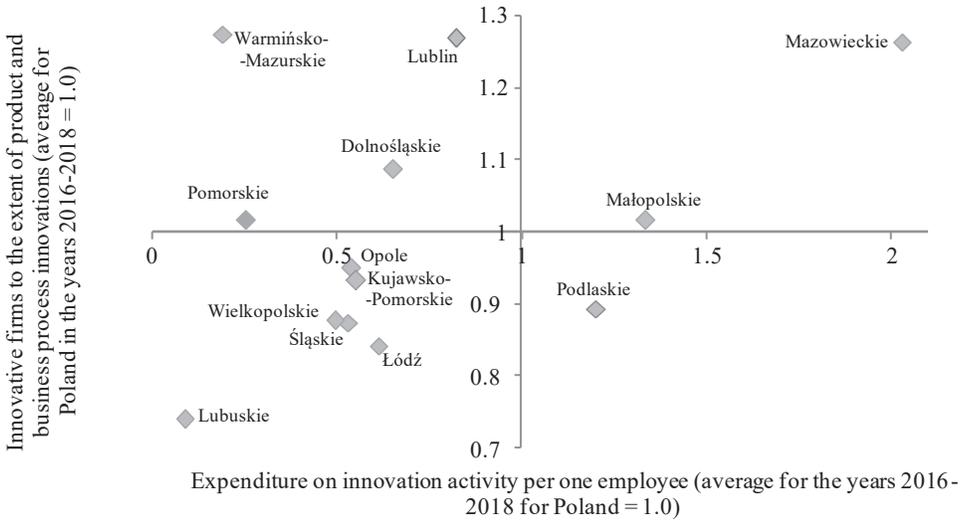


Fig. 3. Classification of selected voivodeships of Poland with respect to the relative measures of expenditure on innovation activity per employee and the share of innovative firms regarding product and business process innovations in the overall number of food industry firms in 2016-2018

Source: as for Fig. 2.

The necessary condition for evaluating the implementation of innovation is to measure the efficiency of such activity (Kijek, 2012). Figure 4 shows that in 2016-

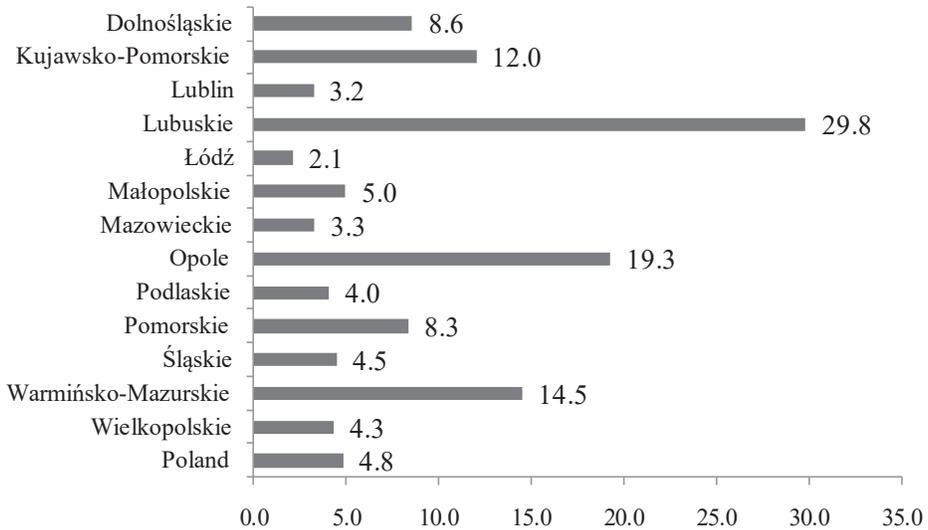


Fig. 4. Efficiency of expenditure on innovation activity in food industry firms in selected voivodeships in Poland in 2016-2018

Source: as for Fig. 2.

-2018 the average efficiency of expenditure on innovation activity in Poland was 4.8, which means that each zloty spent on innovation activity generated PLN 4.80 of revenue from the sales of new and significantly improved products. This figure differed between voivodeships. The highest efficiency of expenditure on innovation activity was characteristic of food industry firms from the Lubuskie voivodeship where one zloty spent on innovation activity generated an effect of nearly PLN 30 from the sales of innovative food products. The level of the analysed measure was high mostly due to the very low expenditure allocated by food industry firms from the Lubuskie region to innovation activity. Each zloty spent on innovation activity by food processing companies from the Opole, Warmińsko-Mazurskie and Kujawsko-Pomorskie voivodeships generated sales of innovative products with an average annual value amounting to, respectively PLN 19, PLN 14.50 and PLN 12. The high efficiency of expenditure on innovation activity in the Opole voivodeship was mostly due to the record-breaking high level of the effects of the innovation activity in the form of revenue from the sales of innovative food products. The Dolnośląskie and Pomorskie voivodeships followed the trend in respect of the analysed measure, and in those regions one zloty spent by food processing companies on innovation activity generated about PLN 8 – 9 from the sales of new and significantly improved products. The performance of the Małopolskie, Śląskie, Wielkopolskie and Podlaskie voivodeships fluctuated around the national average. Among the analysed voivodeships, food industry firms located in the Łódź, Lublin and Mazowieckie voivodeships performed the worst as their level of efficiency was the lowest at only

PLN 2 – 3. The relatively low efficiency of expenditure on innovation activity in the Łódź voivodeship was mostly a result of the low level of revenue from the sales of innovative food products.

Figure 5 presents a classification of the analysed voivodeships based on the comparison of the propensity of food industry firms to innovate, measured by the share of innovative firms to the extent of product and business process innovations and the efficiency of expenditure on innovation activity. The first group comprised the Warmińsko-Mazurskie, Dolnośląskie, Pomorskie and Małopolskie voivodeships. The local food industry firms also declared a relatively high propensity to innovate, thus achieving more than average efficiency in the form of revenues from the sale of innovative food products per one zloty of expenditure incurred on innovation activity. The second group comprised voivodeships that show a relatively low propensity to implement product and business process innovations but at the same time achieve more than average efficiency of expenditure on innovation activity. These food industry firms are from the Lubuskie, Opole and Kujawsko-Pomorskie voivodeships. Another group comprised the Lublin and Mazowieckie voivodeships that, despite a high share of innovative firms, are characterised by low efficiency of expenditure on innovation activity. While in the last group there were the Łódź, Śląskie, Podlaskie and Wielkopolskie voivodeships. Food industry firms in those regions were rarely innovative and at the same time showed low efficiency. A relatively low propensity to innovate was also reflected in the relatively low efficiency of expenditure on innovation activity.

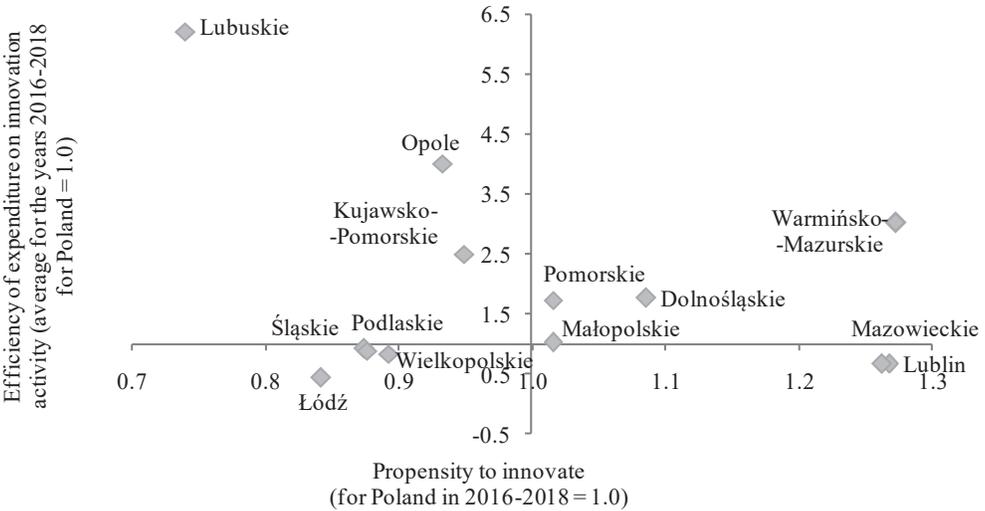


Fig. 5. Classification of selected voivodeships in Poland with respect to the relative measures of propensity to innovate and efficiency of expenditure on innovation activity in food industry firms in 2016-2018

Source: as for Fig. 2.

4. Summary and conclusion

The analysis carried out indicates diversity in the innovation activity and the efficiency of expenditure on innovation activity incurred by food industry firms in respective voivodeships of Poland in 2016-2018.

The outcomes of the analyses lead to the following conclusions:

1. The largest advantage in terms of innovation and efficiency was observed for the food industry in the Warmińsko-Mazurskie and Dolnośląskie voivodeships. Businesses from those regions showed both a relatively high propensity to innovate and a higher than average efficiency of expenditure on innovation activity.

2. The most innovation-active were food industry firms in the Mazowieckie and Małopolskie voivodeships. Firms in those regions performed excellently both in terms of expenditure on innovation activity and the effects in the form of revenues from the sales of innovative food products and the propensity to implement product and business process innovations.

3. The highest efficiency of expenditure on innovation activity was characteristic of the food industry in the Lubuskie, Opole, Warmińsko-Mazurskie and Kujawsko-Pomorskie voivodeships. Firms from those regions, allocating small funds to innovation activity, achieved relatively high results in the form of new and significantly improved products sold.

4. Despite high efficiency, the food industry in the Lubuskie voivodeship proved to be the least innovative to the extent of introducing product and business process innovations.

5. Innovation activity in food industry firms in the Lublin and Mazowieckie voivodeships, despite their high propensity to innovate, turned out to have a relatively low efficiency.

6. The food industry in the Łódź voivodeship was scarcely innovative and at the same time the least efficient. Only 28% of firms declared the propensity to innovate. Food producers from the Łódź region, allocating small funds towards innovation activity, achieved the lowest average annual value of the sales of new and significantly improved products.

References

- Castro, G., Verde, M., Saez, P., and Lopez, J. (2010). *Technological innovation. An intellectual capital based view*. Basingstoke: Palgrave Macmillan.
- Chyłek, E., Kujawiński, W., and Niepytalski, T. (2016). Innowacje i ich wpływ na zrównoważony rozwój sektora rolno-spożywczego w Polsce. *Zagadnienia Doradztwa Rolniczego*, (4), 7-25.
- Grzelak, M. (2011). *Innowacyjność przemysłu spożywczego w Polsce. Ocena, uwarunkowania, rozwój*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
- Grzybowska, B. (2011). Regionalne aspekty aktywności innowacyjnej przemysłu spożywczego. *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, XIII, (2), 118-122.

- Kijek, T. (2012). Innovation capital and its measurement. *Journal of Entrepreneurship, Management and Innovation*, 8(4), 52-68.
- Kijek, T., Matras-Bolibok, A., and Zakrzewska, A. (2018). Comparative analysis of eco-innovation efficiency in the EU member countries. In K. S. Soliman (Ed.), *Proceedings of the 31st International Business Information Management Association Conference (IBIMA) – Innovation Management and Education Excellence through Vision 2020* (pp. 6361-6368). Milan, IBIMA.
- OECD/Eurostat. (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation data, 3rd Edition*. The Measurement of Scientific and Technological Activities. A joint publication of OECD and Eurostat.
- OECD/Eurostat (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition*. The Measurement of Scientific, Technological and Innovation Activities. Paris/Eurostat. Luxembourg: OECD Publishing.
- Pawlak, K. (2016). Stan przemysłu spożywczego w Polsce na tle pozostałych krajów UE i USA. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego*, 16(3), 313-324.
- Porter, M. (2001). *Porter o konkurencji*. Warszawa: PWE.
- Regional Statistical Offices. (2017-2019). *Statistical yearbooks of Lower Silesian, Kuyavian-Pomeranian, Lublin, Lubusz, Łódź, Lesser Poland, Masovian, Opole, Podlaskie, Pomeranian, Silesian, Warmian-Masurian and Greater Poland voivodeships for 2017-2019*. Statistical offices of respective voivodeships.
- Ri, K., Wang, Y., and Zhang, X. (2018). Innovator's innovative genetic model: from biological to social perspective. *Science Journal of Business and Management*, 6(2), 38.
- Statistics Poland. (2018-2020). *Statistical Yearbooks of Industry 2017-2019*. Warsaw: Statistics Poland.
- Tidd, J., Bessant, J., and Pavitt, K. (2005). *Managing innovation: integrating technological, market and organizational change*. Chichester: John Wiley & Sons.
- Urban, R. (2007). Developmental tendencies of the Polish food industry. *Przemysł Spożywczy*, 61(8), 15-18.

INNOWACYJNOŚĆ I EFEKTYWNOŚĆ PRZEDSIĘBIORSTW PRZEMYSŁU SPOŻYWCZEGO W POLSCE W UJĘCIU REGIONALNYM

Streszczenie: Celem opracowania była próba oceny działalności innowacyjnej i efektywności nakładów ponoszonych na działalność innowacyjną w przedsiębiorstwach przemysłu spożywczego w Polsce w ujęciu regionalnym oraz wskazanie przewag przedsiębiorstw z określonych województw z punktu widzenia ich aktywności innowacyjnej i efektywności. Zbadano nakłady i efekty działalności innowacyjnej przedsiębiorstw przemysłu spożywczego w poszczególnych województwach Polski w latach 2016-2018. Najbardziej aktywne innowacyjnie okazały się przedsiębiorstwa z województw mazowieckiego i małopolskiego. Dużą skłonność do wdrażania innowacji i wysoką efektywność odnotowano w przedsiębiorstwach z województw warmińsko-mazurskiego i dolnośląskiego. Najwyższą efektywnością nakładów poniesionych na działalność innowacyjną cechował się przemysł spożywczy w województwach lubuskim i opolskim. Mimo wysokiej skłonności do wdrażania innowacji, mało efektywne okazały się przedsiębiorstwa przemysłu spożywczego w województwach lubelskim i mazowieckim. Najgorzej na tle analizowanych regionów wypadły przedsiębiorstwa w województwie łódzkim.

Słowa kluczowe: innowacyjność, efektywność, przedsiębiorstwo innowacyjne, region, przemysł spożywczy.