

DETERMINANTS OF MILK PRODUCTION DIVERSITY IN THE MACROREGIONS OF THE EUROPEAN UNION*

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ABSTRACT

The paper aims to distinguish economic determinants of milk production in clusters of FADN regions with farms similar to each other in terms of total utilized agricultural area, number of milk cows and annual milk yield in the light of selected taxonomic methods, i.e. cluster and factor analysis. Observed by the analysis of standard deviations and Gini coefficients, increasing diversity of the majority of characteristics of FADN dairy farms (in 2011 relative to 2004) led to think that production in farms similar to each other in terms of the number of dairy cows, the amount of utilized agricultural area and an annual milk yield can be conditioned by similar determinants, which may differ depending on the membership in a particular group. Classification of groups of regions with similar dairy farms was made using cluster analysis, and the diversification of production determinants was illustrated on the basis of factor analysis in the distinguished clusters. In order to determine the variability distinguished determinants analysis was performed for two research periods (years 2011 and 2013).

Key words: taxonomic analysis, cluster analysis, factor analysis, diversity of milk production

INTRODUCTION

Taxonomy, as a scientific discipline, stems from the life sciences, and the concept was introduced by biologists in relation to the classification of plants and animals. The word itself is a combination of two Greek words: *taksis* – (arrangement, order) and *nomos* – law, the principle [Siudek 2006]. Objects grouping is a very complex task because of the multitude of factors that influence the obtained solution. Among these can man mention: the number of grouped units (the need to use other methods of grouping for sets of dozens of units and the other for hundreds of thousands), the number of characteristics of variables describing the unit (the problem of multidimensionality), used measurement scales for all the features, units spatial structure or the existence of missing data or extreme values (outliers). Each of these factors cause a necessity for personalized approach to the problem of clustering of the case. That diversity is also the cause of the existence of many clustering algorithms, based on different ideas. The examples of taxonomic methods can be cluster analysis and factor analysis, which are used in this paper to present the diversity of milk production in the macro-regions of the European Union.

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DISCUSSION

The European Union is characterized by diversity on many levels, among which as one of the first man mention agriculture [Matuszczak 2012]. Beside independent of man's will diversity of the soil, climate and nature factors there are also differences in the level of production and economic indicators of farms [Grontkowska 2012]. Increased values of the standard deviation and the Gini coefficient in 2011 in relation to 2004 for most variables from the field of FADN observation data base provide persistent, and even increasing diversity of economic and production indicators of FADN dairy farms in the regions of the European Union [Guth 2015]. In the case of milk production the most important role in shaping differences in economic indicators plays production scale. This is confirmed by the study of many economists specializing in the deliberations on the milk market – Parzonko [2006, 2013], Sass [2007], Ziętara [2010], Seremak-Bulge [2011], Śwityk and Ziętara [2012], Wójcik [2012]. Another reason for diversification may be different course of structural transformations in the eastern and western parts of the European Union [Pocza et al. 2008]. These factors indicate that the determinants of milk production may vary significantly by region in the European Union. In order to find similarities between the diverse dairy farms in the regions of the European Union cluster analysis was used.

To check what factors determine the milk production in the macro-regions of the European Union in 2011 and how they changed in 2013, it was necessary to investigate the effect of a number of measures, explaining resource variability of joint matrix of observation. It significantly hinders the versatile and comprehensive synthesis of data [Czyżewski 1976], Okoń [1964] says that the phenomena in a particular area, despite the diversity and variation, are related in some way and at least in part determined by a relatively small number of functional units, parameters or factors. In multivariate analysis, finding similarities in the breaking of each variable, hence the existence of a correlation, leads to the finding that some of them overlap, and thus differentiate the cases in the same way [Stanisz 2007].

The existence of these correlations between variables allows the formulation of a hypothesis that underlying variation phenomena hides a more important structure [Czyż 1971]. In view of the foregoing considerations and the difficulty of interpretation too many pending attributes it was decided to use factor analysis. In this approach new variables, called factors, retain a relatively large part of the information contained in the original variables and each of them is a carrier other substantive content [Czopek 2013]. The issue of the determinants of the diversity of milk production in the European Union particularly in regional terms is rarely raised in scientific studies. While statistics on production, prices of milk, the amount of dairy cows and their milk yield in individual countries are generally available, the complete interpretation requires fine-tuning. The results of the research will help answer the question of which factors and to what extent influenced the production of dairy farms in the macro-regions of the European Union similar to each other in terms of utilized agricultural area, the number of cows and their average annual milk yield, and how these factors changed in the perspective of milk quota abolition in 2015.

METHODOLOGY

In connection with the statement of growth of differentiation among FADN dairy farms in macro-regions of the European Union in 2011 in relation to 2004 [Guth 2015], it was decided to conduct a study of the factors having the greatest impact on the production of milk in 2011¹ in different groups of regions with similar farms. This test procedure was then repeated for the latest published FADN data for the year 2013 in order to verify if in the perspective of the abolition of milk quotas the determinants of milk production have changed. There was

¹ Data for 2011 were the “latest” for the implementation of the project data obtained in accordance with the schedule in January 2015.

cluster analysis performed. Typology was based on three of the firstly four selected features from the FADN², field of observation, describing the examined farms, i.e. the utilized agricultural area, number of dairy cows and the average annual milk yield of cows. Grouping was performed using hierarchical method. Among the possible techniques there was the agglomeration procedure used. The distances between the clusters that had arisen from the combined facilities were determined using the method of Ward. Solution was checked by silhouette indicator (separability of clusters in terms of the studied traits) *SI*, which in both cases exceeded the required critical level³. It can therefore be concluded that the distinguished groups are disjoint from the studied traits, so the solution qualify for the correctness of the distribution made in the context of cluster analysis.

The starting point for the analysis of the determinants of production in selected clusters was to create a matrix of observation, which was a collection of 49 FADN indicators that illustrate various features of the dairy farms in the macro-regions of the European Union with a predominance of intensive and extensive production of milk in 2011 and 2013. Variables were standardized. The method of grouping variables based on the criterion of maximum correlation was used. Then, the factor analysis was performed (principal components analysis). In terms of factor analysis the determinants of milk production in both macro-regions of the European Union with a predominance of extensive and intensive production in 2011 was determined using 34 features selected from among the 49 indicators analyzed, fulfilling a condition of the size of the matrix within the factor analysis, while in 2013 the intensive production was determined by 36 indicators and extensive by 32 features out of 49 surveyed indicators. On the basis of the criterion of sufficient proportions (above 75% explained variance) and the analysis of the scree plot there were independent factors that explain more than 75% of the common resource (cumulative) variation isolated. To narrow the scope of the factors and standardize their nature, the solution was subjected to the procedure of rotation, using for further research the solution obtained by the analytical method Varimax raw version.

RESULTS

As a result of the cluster analysis of the 108 regions⁴ analyzed there were three internally homogeneous groups obtained with predominance of:

- intensive milk production – I typological group, consisting of 60 regions, including the majority of regions in the EU-15 and the Czech Republic, Estonia, Malta and Hungarian Nyugat-Dunántúl (an average of 192.53 ESU, a relatively large area of agricultural land (80.43 ha) and number of dairy cows (63.91 pcs), and milk yield at an average of more than 7,560 kg per year);
- so-called milk factories – II typological group, which accounted for five regions of northern and central Germany, and Slovakia (an average of 950.07 ESU, the largest area of agricultural land 598.06 ha, and the number of cows nearly 250 cows per farm) and the highest annual milk yield – almost 8,000 kg per year (excluding Slovakia significantly underestimating the result of other regions – more than 8,500 kg per year);
- extensive milk production – III typological group, consisting of 42 regions, with predominance of regions from the EU-12 (an average of 56.40 ESU, with an area of agricultural land of 30 ha, with an average of about 25 dairy cows and annual milk yield of 4,638 kg per year) [Guth 2015].

² Due to too high correlation with other features the economic size of farms had been discarded from the analysis.

³ Silhouette index – *SI*, silhouette coefficient – *SK*, index was introduced by P.J. Rousseeuw in 1987 [Migdał-Najman and Najman 2013].

⁴ The presented results represent a part of a wider research resulting from the Preludium project, under which there is monograph A. Czyżewski, M. Guth, Zróżnicowanie produkcji mleka w makroregionach Unii Europejskiej z wyróżnieniem Polski, PWN, Warszawa 2016, formed.

Among the clusters of predominantly intensive milk production concentrated in large farms (group typological) and very large – milk factory (group II typological) prevailed so-called relatively prosperous regions of EU-15 countries. Among groups of predominantly extensive production of milk (III typological group) strongly dominated regions of the EU-12. For the year 2013 in the light of cluster analysis there only two clusters distinguished – numbering 59 cases concentration of predominantly intensive milk production (of farms with an average economic size of more than 261 ESU, average of 137 ha of agricultural land, with an average of more than 79 dairy cows with average milk yield 7,194 kg per year) and a cluster of 49 cases of predominantly extensive production (of farms with an average economic size almost 96 ESU, an average of almost 35 ha of agricultural land, with an average of more than 36 dairy cows with an average milk yield 5,276 kg per year), which may mean that dairy farms in the perspective of the abolition of milk quotas increased scale and production efficiency. Therefore occurred in 2011 differences between the largest farms in 2013 had become blurred, as evidenced by the lack for the period of the narrow cluster of milk factories. In view of the observed diversity of FADN dairy farms in the regions of the European Union, it was considered that the determinants of milk production may vary in the resulting clusters. Therefore, it was decided to carry out factor analysis within distinguished by the cluster analysis groups of EU macro-regions with the predominance of intensive and extensive production. The results of the factor analysis led to the emergence of the three factors determining milk production in the surveyed farms in the regions of the European Union with a predominance of intensive and two factors in the case of extensive production for both periods (2011 and 2013) – Table 1.

As the leading factor in both cases should be considered the first factor (F_1), because it explains the largest resource of common variation. The smallest resource of common variation explained the third factor for farms from regions with a predominance of intensive production and the second factor (F_2) for farms from regions with a predominance of extensive production, which means that they conditioned the production for the smallest of factors distinguished manner. Turning to the interpretation of the results it was concluded that due to the features included in it the first factor can be defined as the price – cost relationships⁵ of milk farms in the EU regions with a predominance of intensive milk production in 2011 and the financial – assets situation for farms in the EU regions with a predominance of extensive milk production (Table 2). After analyzing the indicators included in the second factor (F_2) it was found that for both – farms in regions with a predominance of intensive and extensive production – it represented the variables related to non-productive costs of running dairy farms in

Table 1. Factor solution for regions with a predominance of intensive and extensive milk production in 2011

Factor	Self-value of correlation matrix				Share in the use of variation (%)							
					common				cumulative			
	production intensive	production extensive	production intensive	production extensive	production intensive	production extensive	production intensive	production extensive	2011	2013	2011	2013
2011	2013	2011	2013	2011	2013	2011	2013	2011	2013	2011	2013	
F_1	11.99	16.70	15.82	13.69	31.55	46.39	40.58	42.78	31.55	46.39	40.58	42.78
F_2	9.10	8.54	13.52	11.28	23.94	23.73	34.69	35.25	55.49	70.12	75.27	78.03
F_3	7.42	5.07	–	–	19.52	14.07	–	–	75.01	84.19	–	–

Source: Own study based on the results of own research using FADN data for the “dairy cows” type of production by region in 2011 and 2013.

⁵ In structure of features forming factor F_1 in farms from the EU regions with a predominance of intensive milk production also predominate factors related to costs (9 out of 13 traits). The author concluded that prices indirectly affect both the costs and resources in the surveyed farms, because of their height and relationship to the costs, farms take decisions on the scale and type of production, what justified the above names.

2011⁶. The third factor (F_3) included variables representing or having an impact on the income of dairy farms in the macro-regions with a predominance of intensive milk production.

The structure of features forming factor F_1 and their assigned weights indicate that the price and cost relationships in dairy farms from the regions of the European Union with a predominance of intensive milk production in 2011 were conditioned mostly by farmhouse consumption, as well as by liabilities in total, of which to more extent by long-term liabilities (Table 2). There should be the high importance of the share of feed for grazing livestock in direct costs noted and the high impact of share of home grown feed for grazing livestock in total amount of feed for grazing livestock on price-cost relationships. It can therefore be concluded that farms erode the risk of feed prices rising through their partial production on the farm. It is worth noting that the high impact on the price-cost relationships in farms from the regions with a predominance of intensive production had interest paid, including interest and financial charges paid for the loans taken for the purchase of land, buildings, machinery and equipment, animals and materials, as well as interest and financial charges for the liabilities. This may mean that the farms in the EU regions with a predominance of intensive milk production carry a lot of investment to modernize and improve its production, seeing in it a chance for further development (Table 2). Significant impact on the price – cost relations in farms in the regions with a predominance of intensive milk production next to costs had also subsidies on external factors. In 2013, more importance gained long and medium term loans, gross investment and rent paid, which can be a basis for finding that farmers preparing for the liberalization of the EU milk market did investments aimed at increasing production scale and improve its efficiency (hence the high position of interest paid, depreciation, as well as short-term liabilities).

The biggest impact on the financial and assets situation of milk farms in the EU regions with a predominance of extensive production of milk in 2011 had net worth and average farm capital⁷. Big impact on the financial-assets situation of dairy farms in regions with a predominance of extensive production had also the level of assets (of which more fixed than current assets), farm net income from and farm net value added. Also productivity, measured as the value of animal production per unit and indirectly by the impact of farmhouse consumption has become a significant indicator of the financial situation of farms in the regions with a predominance of extensive production. This is understandable, when taking into account the need to compete in the single European market with more efficient farms from the regions in which the intensive production model prevailed. An interesting phenomenon appears to be relatively high impact of crop production on the financial situation of farms in the regions with a predominance of extensive production, which also contributed to the large significance of the share of home grown feed for grazing livestock in total amount of feed for grazing livestock (Table 2). This means that the farms in the EU regions with a predominance of extensive production were able to mitigate the risk of rising prices feed through partial their production on the farm. You should be aware, however, that it was connected with the character of extensive production, which prevails grazing breeding. In the farms from the regions with a predominance of extensive production in the leading factor there were also indicators on the ability of the farm to self-finance its activities and creating savings in operating activities (cash flow I). This can be explained by the need to repay long-term loans, taken for the modernization of farms in order to meet the accession requirements by prevailing in this group farms from the regions of the EU 12. In 2013, to the set of variables determining the financial and assets situation joined the value of live cattle, other cattle, depreciation, short-term loans and decoupled payments.

⁶ The author is aware that the variables included in the factor structure represent costs associated with the milk production, but not directly. Among the features forming the second factor also there are included two non-cost items, i.e. subsidies on external factors and decoupled payments, what can be the basis for the claim that subsidies had a significant impact on the cost structure of milk farms in EU regions with a predominance of extensive production.

⁷ According to FADN, net worth consists of the value of the animal, permanent crops, drainage facilities, buildings, machinery, equipment and working capital. Quotas and other rights that can not be separated from the value of land are not taken into account.

Table 2. The structure of factor F_1 in FADN milk farms in the EU regions with a predominance of intensive and extensive production in 2011 and 2013

Intensive production				Extensive production			
price-cost relationships				financial and assets situation			
2011		2013		2011		2013	
characteristic	factor load	characteristic	factor load	characteristics	factor load	characteristics	factor load
Farmhouse consumption	0.86612	Rent paid	0.89874	Net worth	0.92853	Net worth	0.9237
Share of home grown in total amount of feed for grazing livestock	0.86443	Long & medium-term loans	0.89328	Farm net income	0.89926	Cash Flow(I)	0.90263
Long-term liabilities	0.84120	Gross Investment	0.88631	Cash flow (I)	0.88594	Farm Net Income	0.86113
Interest paid	0.83955	Other direct inputs	0.88561	Average farm capital	0.86680	Gross Investment	0.85730
Short-term loans	0.83071	Machinery & building current costs	0.87270	Farm net value added	0.85263	Beef and veal	0.85229
Wages paid	0.79701	Interest paid	0.86277	Fixed assets	0.83574	Other cattle	0.84182
Subsidies on external factors	0.73966	Short-term loans	0.85248	Current assets	0.81729	Depreciation	0.80094
Beef and veal	0.73277	Subsidies on intermediate consumption	0.84775	Share of home grown in total amount of feed for grazing livestock	0.80217	Other direct inputs	0.79441
Share of feed for grazing livestock in direct costs	0.72902	Depreciation	0.83875	Farmhouse consumption	0.79647	Short-term loans	0.76321
Fixed assets	0.72070	Other cattle	0.79093	Taxes	0.75570	Average farm capital	0.74789
Direct costs	0.71016	Beef and veal	0.78705	Total livestock output / LU	0.72641	Farm Net Value Added	0.74766
Farm use	0.70379	Farm Net Value Added	0.7824	Total output crops & crop production	0.72231	Total fixed assets	0.74537
Current assets	0.70177	Contract work	0.7687			Decoupled payments	0.73350

Source: Own study based on the results of own research using FADN data for the “dairy cows” type of production by region in 2011 and 2013.

After analyzing the components of the second factor it was decided that it contains features which can be defined as non-productive costs of running dairy farms in EU regions with a predominance of intensive and extensive milk production in 2011 and 2013. Among the features forming F_2 factor the biggest impact on not directly related to milk production costs of running dairy farms in the macro-regions with a predominance of intensive production exert short-term liabilities, used mainly to finance operating activities. Significant influence had also “decoupled” payments, what may mean that even in farms with intensive production subsidies have a significant impact on the level of costs. It should be noted that on the size of the costs not directly related to milk production significant impact had keeping other cattle except of dairy cows, and proceeds from the sale of cattle and veal (Table 3). Among the variables forming this factor the greatest impact on non-productive costs of running a dairy farm in the EU regions with a predominance of extensive production in 2011 exerted a long-term liabilities and current liabilities. A significant impact on operating costs had also services, machinery and building current costs, buildings and other direct inputs (Table 3). Crucial for non-productive costs of running dairy farms in the EU macro-regions with a predominance of extensive production in 2011 were costs of external factors. Especially important position appear to be interest paid, which is relatively important factor in the structure of non-productive costs of running a dairy farm with the European Union macro-regions with a predominance of extensive production in 2011. This may mean that its liabilities were a significant burden for these entities.

Table 3. Non-productive costs of running dairy farms from EU regions with a predominance of intensive production in 2011 and 2013 (construction of factor F_2)

characteristic	Intensive production			Extensive production		
	factor load	characteristic	factor load	characteristic	factor load	characteristic
	2011	2013		2011	2013	
Short term liabilities	0.84382	Total support for rural development	0.8888	Long & medium-term loans	0.9343	Subsidies on external factors
Decoupled payments	0.84123	Farm use	0.8748	Short term liabilities	0.9320	Long & medium-term loans
Other direct inputs	0.83901	Forage crops	0.8725	Services	0.9246	Interest paid
Depreciation	0.79976	Paid labour input	0.8578	Machinery & building current costs	0.8910	Total output crops & crop production
Other cattle	0.79651	Total output crops & crop production	0.6291	Interest paid	0.8227	Forage crops
Services	0.75866	Energy	0.6286	Wages paid	0.7987	Farm use
Rent paid	0.74291	Decoupled payments	0.6171	Payments for rural development	0.7839	Wages paid
Beef and veal	0.70673	Wages paid	0.6166	Other direct inputs	0.7652	Contract work
	x			Decoupled Payments	0.6363	Rent paid
						0.7042

Source: Own study based on the results of own research using FADN data for the “dairy cows” type of production by region in 2011 and 2013.

However, this may also mean that dairy farms in the macro-regions with a predominance of extensive production perceive their chances of increasing concentration and enlarging production scale in order to reduce costs of external factors. It should also be noted that the level of the non-productive cost of running dairy farms of macro-regions with a predominance of extensive production in 2011 was significantly affected by the subsidies for rural development and “decoupled” payments (though less than in the case of farms in the regions in which the intensive production prevailed) [Guth 2016]. In 2013, on non-productive costs of running a dairy farm in the EU macro-regions with a predominance of intensive production the greatest impact have payments for rural development, variables associated with self-supply of farms in the feed for dairy cows and the cost of external factors. In importance compared to 2011 lost decoupled payments and current liabilities, which had a material impact on previously distinguished factor (price – cost relationship). In the macro-regions with a predominance of extensive production this factor was conditioned to the greatest extent by subsidies to external factors, significantly increased the importance of the interest paid on liabilities, self-supply of farms in the feed for dairy cows and the cost of external factors, what may mean that dairy farms in the face of changes in the instruments of the EU milk market tried to rationalize the cost of running farms.

The third factor (F_3) due to the criterion of sufficient proportions was established only for milk farms from EU regions with the predominance of intensive production in 2011 and 2013. The analysis of features contained in it allowed to specify that it was represented by the variables having an impact on the income of dairy farms in the macro-regions with a predominance of intensive milk production. Among the forming factor variables the biggest influence in both surveyed periods exerted farm net income, understood as a fee for the involvement of their own factors of production to the operation activity of farms and the fee for the risk taken by farmer in the financial year (Table 4).

The construction of the factor F_3 shows that a significant impact on the income of dairy farms from regions with a predominance of intensive production had also cash flow I, showing the ability of a farm to self-finance its activities and create savings in operating activities. Great importance for the income of dairy farms in the macro-regions with a predominance of intensive milk production in 2011 and to a smaller extent in 2013, had also net worth, reflecting the value of total assets reduced of the value of total liabilities. It should be noted that in the structure of this factor there had also current assets appeared, which may mean that in relation to the concluded liabilities they had a significant impact on the value of the income of dairy farms in the macro-regions with a predominance of intensive milk production in 2011 and to a smaller extent in 2013 (Table 4). An interesting phenomenon appears to be the emergence in 2013 of the variable concerning efficiency of production (the value of animal production per unit conversion), which may confirm previous findings about the need to improve production efficiency in order to maintain a certain level of farm income.

Table 4. Income of dairy farms in the macro-regions of the European Union with a predominance of intensive production in 2011 and 2013 (construction of factor F_3)

Characteristics	Factor load	Characteristics	Factor load
	2011		2013
Farm net income	0.964261	Farm Net Income	0.861126
Cash flow (I)	0.907015	Change in net worth	0.836824
Net worth	0.810942	Net worth	0.725166
Farm net value added	0.803390	Total livestock output / LU	0.653102
Current assets	0.789202	Total current assets	0.596829

Source: Own study based on the results of own research using FADN data for the “dairy cows” type of production by region in 2011 and 2013.

CONCLUSIONS

The above presented research allows to draw following conclusions:

- Among the cluster with a predominance of intensive milk production concentrated in large farms and very large – i.e. milk factories prevailed relatively prosperous regions of EU-15 countries, while among groups of predominantly extensive production of milk definitely dominated regions of the EU-12, what may confirm the thesis of existing polarization of European milk production. Trends of this polarization despite the increase in the scale of production on average in the EU maintained also in 2013.
- Production of dairy farms in regions with a predominance of intensive milk production was conditioned mainly by price-cost relationships, further non-production related costs of running dairy farms and in the least of distinguished factors, income of listed entities.
- Milk production in the macro-regions with a predominance of extensive production depended mainly on the financial assets situation of farms, to a lesser extent on non-production costs of running a dairy farm, on which the greatest influence had liabilities and costs of external factors (wages and interest), what may mean that these dairy farms from the regions with a predominance of extensive production perceive their chances of increasing concentration and enlarging production scale, in order to reduce costs of external factors.
- Meaningful indicator of the financial assets situation of farms in the regions with a predominance of extensive production was annual milk yield. This may mean that farms located there, taking into account the need to compete in the single European market with more efficient farms in regions where intensive production model prevailed, took care of increasing the efficiency of their production. An interesting phenomenon appears to be the relatively high impact of crop production on the financial situation of farms in the regions with a predominance of extensive production, what also contributed to the great importance of share of home grown feed for grazing livestock. This means that the farms in regions with a predominance of extensive production are taking an example of farms in regions with a predominance of intensive production and they were able to at least partially mitigate the risk of feed prices rising through partial their production on the farm.
- The observed changes in the constituent of factors in 2013 relative to 2011 allow to conclude that the farm acted anticipated given the impending liberalization of the EU milk market and took appropriate investment activities to increase the scale and efficiency of production and rationalize the level of costs.

REFERENCES

- Czopek, A. (2013). Analiza porównawcza efektywności metod redukcji zmiennych – analiza składowych głównych i analiza czynnikowa. [In:] J. Mika, K. Zeug-Żebro (Eds), *Zastosowania metod matematycznych w ekonomii i zarządzaniu, Studia ekonomiczne*. Zeszyty Naukowe Wydziałowe Uniwersytetu Ekonomicznego w Katowicach, 132, 7–23.
- Czyż, T. (1971). *Zastosowanie metody analizy czynnikowej do badania ekonomicznej struktury regionalnej Polski*. Instytut Geografii Polskiej Akademii Nauk, Wrocław – Warszawa – Kraków – Gdańsk.
- Czyżewski, A. (1976). *Miasta wielkopolski w Polsce Ludowej. Ekonomiczno-demograficzne podstawy rozwoju w okresie 1946–1970*. PWN, Warszawa – Poznań.
- Czyżewski, A., Guth, M. (2016). Zróżnicowanie produkcji mleka w makroregionach Unii Europejskiej z wyróżnieniem Polski. PWN, Warszawa.
- Grontkowska, A. (2012). Zmiany w wynikach produkcyjnych i ekonomicznych gospodarstw mlecznych najsilniejszych ekonomicznie w latach 2004–2009 w krajach Unii Europejskiej. *Roczniki Nauk Rolniczych, Seria G Ekonomika Rolnictwa*, 99, 1, 58–69.
- Guth, M. (2015). Diversity of FADN milk farms in milk farms in the regions of the European Union in 2011. *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu AR w Poznaniu (Roczniki Naukowe SERiA)*, 17 (3), 119–124.
- Guth, M. (2016). Determinants of milk production in FADN dairy farms in the regions of the European Union with predominance of intensive production in 2011. *Management* (in print).

- Matuszczak, A. (2012). Podobieństwa i różnice w rozwoju regionów rolnych UE-25 – próba określenia czynników prowizyjnych. [In:] K. Pająk, T. Różański (Eds), *Determinanty rozwoju regionów w Europie. Społeczeństwo, gospodarka, turystyka*. Poli Druk Poznań, Piła, 156–174.
- Migdał-Najman, K., Najman, K. (2013). Analiza porównawcza wybranych metod analizy skupień w grupowaniu jednostek o złożonej strukturze grupowej. *Zarządzanie i Finanse* 11, 3, cz. 2, 179–194.
- Okoń, J. (1964). *Analiza czynnikowa w psychologii*. PWN, Warszawa.
- Parzonko, A. (2006). Możliwości rozwojowe gospodarstw ukierunkowanych na produkcję mleka. *Roczniki Nauk Rolniczych*, Seria G Ekonomika Rolnictwa 93, 1, 83–91.
- Parzonko, A. (2013). Globalne i lokalne uwarunkowania rozwoju produkcji mleka. Wydawnictwo SGGW, Warszawa.
- Pocztą, W., Sadowski, A., Średzińska, J. (2008). Rola gospodarstw wielkotowarowych w rolnictwie Unii Europejskiej. *Roczniki Nauk Rolniczych*, Seria G Ekonomika Rolnictwa, 95, 1, 42–56.
- Sass, R. (2007). Wielkość stada a dochód z zarządzania w gospodarstwach wyspecjalizowanych w chowie bydła mlecznego. *Roczniki Nauk Rolniczych*, Seria G Ekonomika Rolnictwa, 93, 2, 71–79.
- Seremak-Bulge, J. (2011). *Rynek mleka na progu 2011 r.* Polska Izba Mleka, Białystok.
- Siudek T. (2006). Badanie regionalnego zróżnicowania sytuacji ekonomiczno-finansowej banków spółdzielczych w Polsce z wykorzystaniem metod taksonomicznych. *Zeszyty Naukowe SGGW, Ekonomika i Organizacja Gospodarki Żywnościowej* 58, 41–53.
- Stanisz, A. (2007). Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Tom 3. Analizy wielowymiarowe. StatSoft, Kraków.
- Świtłyk, M., Ziętara, W. (Eds) (2012). *Analiza efektywności produkcji mleka i żywca wołowego. Raport 2012*. Wydawnictwo SGGW, Warszawa.
- Wójcik, A. (2012). Koszty i dochodowość produkcji mleka w europejskich gospodarstwach utrzymujących do 50 krów. *Roczniki Nauk Rolniczych*, Seria G Ekonomika Rolnictwa, 99, 1, 100–107.
- Ziętara, W. (2010). Koszty i dochodowość produkcji mleka w polskich gospodarstwach w latach 2006–2008. *Roczniki Nauk Rolniczych*, Seria G Ekonomika Rolnictwa, 97, 1, 53–66.

DETERMINANTY ZRÓŻNICOWANIA PRODUKCJI MLEKA W MAKROREGIONACH UNII EUROPEJSKIEJ

STRESZCZENIE

Celem artykułu jest określenie determinant produkcji mleka w skupieniach gospodarstw FADN podobnych do siebie pod względem areału wykorzystywanych użytków rolnych, liczby krów mlecznych oraz ich rocznej mleczności w świetle wybranych metod taksonomicznych, tj. analizy skupień i analizy czynnikowej. Zaobserwowane wzrastające zróżnicowanie większości cech gospodarstw mlecznych FADN (w 2011 roku względem 2004 roku) skłoniło do przemyśleń, że produkcja w gospodarstwach podobnych do siebie pod względem liczby krów mlecznych, ilości wykorzystywanych użytków rolnych i rocznej mleczności krów może być uwarunkowana przez podobne determinanty, różniące się w zależności od przynależności do określonych grup. Klasyfikacji grup regionów o gospodarstwach mlecznych podobnych pod względem wyróżnionych cech dokonano za pomocą analizy skupień, a zróżnicowanie determinantów produkcji zobrazowano na podstawie wyników analizy czynnikowej w wyróżnionych skupieniach. Celem określenia zmienności wyróżnionych determinant analizę wykonano dla dwóch okresów badawczych (lat 2011 i 2013).

Słowa kluczowe: taksonomiczna analiza, analiza skupień, analiza czynnikowa, zróżnicowanie produkcji mleka