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DISTRIBUTION DIFFERENTIATION OF AID FUNDS FOR AGRICULTURE IN POLAND – AN ANALYSIS USING MULTIVARIATE STATISTICAL METHODS

ZRÓŻNICOWANIE DYSTRYBUCJI FUNDUSZY POMOCOWYCH DLA ROLNICTWA W POLSCE – ANALIZA Z WYKORZYSTANIEM WIELOWYMIAROWYCH METOD STATYSTYCZNYCH

Słowa kluczowe: środki pomocowe, rolnictwo, wielowymiarowa analiza statystyczna
Key words: aid funds, agriculture, multidimensional statistical analysis

Abstract. The article presents an example of applying multidimensional statistical methods in the ranking of provinces in terms of the amount of funds received from the selected programs implemented under the Rural Development Programme (RDP).The purpose of this paper is to build the ranking and specify the homogeneous groups of provinces in regard to the analysed attributes. On the basis of volatility analysis and a matrix of correlation coefficients, six variables characterizing this issue were chosen for the final calculation. The paper uses three methods which enable multidimensional statistical analysis, i.e. the measure of Hellwig, the Czekanowski Diagram and Prim's dendrite. All the mentioned methods made it possible to draw the same conclusion, namely that the provinces which have been using EU funds supporting agricultural activities to the greatest extent are zachodnipomorskie, pomorskie and warminsko-mazurskie. The lowest positions are occupied by podkarpackie, małopolskie and śląskie.

Introduction

Poland's integration process with the European Union has created many opportunities for receiving funds from a number of EU programmes. The Rural Development Programme 2007-2013 was the largest programme financially supporting the agri-food sector. Financial assistance was mainly provided to local governments, entrepreneurs and farmers. This programme focused on activities aimed at rural development which were carried out within the framework of four axes: Axis 1 "Improvement of the competitiveness of the agricultural and forestry sector", Axis 2 "Improving the environment and the countryside", Axis 3 "The quality of life in rural areas and diversification of rural economy" and Axis 4 "LEADER". In total, RDP comprised 22 campaigns which have contributed to the development of the Polish countryside. The article presents some activities which had a significant impact on the development of Polish agriculture and shows statistical analysis of the financial resources in the selected actions.

The Rural Development Programme for the years 2007-2013 included many activities. One of them was the Local Action Groups (LAGs). A Local Action Group is a territorial partnership of rural areas. The creation of each partnership's identity is based on the sense of common interests and values i.e. on social ties [Skrzypczak 2009]. LAGs are part of the LEADER axis 4 of the RDP 2007-2013. In Poland there are 335 Local Action Groups [Agency for Restructuring and Modernisation of Agriculture ARMA 2013]. The vast majority of them concentrate in the małopolskie province – 39 and the least is in the lubuskie province – 10. Their main task is the creation and then the implementation of the Local Development Strategy. The existence of LAGs increases the economic and social activity of the rural population. Nearly 800 million Polish Zloty (PLN) was allocated for this purpose in years 2007-2013. Within the activity of the functioning of the Local Action Groups there were 1170 applications submitted around the country for the amount of PLN

575.94 mln, the most in the following provinces: małopolskie, mazowieckie, podkarpackie and wielkopolskie, and the least in lubuskie, opolskie and warmińsko-mazurskie. According to the information provided by ARMA dated as at 30.11.2013, within the functioning of LAGs activity there were 996 contracts signed for a total amount of PLN 541.76 mln, including payments made for a total of PLN 318.19 mln. This programme was aimed at strengthening cooperation between the rural partners. These groups collected and combined human and financial resources from the private and public sector. Joint projects were also implemented for multi-sectoral activities that supported economic competitiveness of the selected area. Strengthening the cooperation between partners and many other aspects caused the Local Action Groups to reinforce rural development.

Another area of activity for which Poland received financial support is the establishment and development of micro-enterprises. A micro-enterprise is a company characterized by the employment of not more than 9 persons and by a turnover not exceeding EUR 2 million [Act on Freedom of Economic Activity Dz.U.2013.0.672]. The main objective of this program was to boost the competitiveness of rural areas and to increase employment in these territories. The grants from this activity were directed both to legal persons and individuals and to commercial law companies without legal personality [Agency for Restructuring and Modernisation of Agriculture 2013]. In 2013 this activity resulted in the submission of 14 201 applications for a total amount of PLN 2915.07 mln out of which 408 contracts were concluded for the amount of PLN 81.04 mln. In Poland, in 2012, economic activities were carried out by over 1783 thousand micro-enterprises dominated by companies representing the car trade and repair sector, construction, scientific and technical activities, as well as industry. These enterprises employed 3543.6 thousand people. For 80% of them it was the main place of work. In the previous year, i.e. in 2012, the revenue generated from operations amounted to PLN 819.6 billion. Companies involved in the repair and trade of cars and construction activity had the largest share in revenues, respectively 46.7% and 10.1% respectively. The companies from the insurance and financial sector showed the largest share of costs in revenues (over 90%) in contrary to firms from fishing, forestry, social and health area which accounted for the lowest share of 60% and below [*Central Statistical Office* 2013]. Self-employment was the dominant form of micro-enterprise as 88% of companies had no wage-earners [*Strategia niszy...* 2010]. Micro-enterprises play an important role in the Polish economy because they promote the labour market by creating new jobs. They represent almost 96% of all enterprises in the country and their contribution to GDP is significant and amounts to 30.4% [*Polish Agency...* 2013].

The RDP 2007-2013 also includes the Agricultural Producer Groups. The purpose of this activity was to support the already existing agricultural producers and to motivate them to create new groups of producers and mutual cooperation. It was also important to adjust the production generated on farms to market requirements and to prepare it for sale and launch on the manufactured goods market. It was also meant to encourage the creation of a good information flow about crops, their availability and production. As part of this assistance the animal, plant and special agricultural production sectors were supported. The financial support was to help in the creation of these groups and in the investment and administration activities. In Poland there are 1132 Agricultural Producer Groups [Ministry of Agriculture and Rural Development 2013]. As the result of the Rural Development Programme 2007-2013, 2244 decisions were issued amounting to PLN 412.97 mln.

Another financial support that could be obtained from the EU funds from the RDP is setting up of young farmers. The purpose of this activity was to lead to structural changes in the agriculture. It was implemented by facilitating the acquisition and establishment of new farms by young farmers with appropriate professional qualifications. More than 23 thousand young farmers received ARMA funds to invest in farms. Financial support was targeted at young people who had agricultural education or proved to have work experience in the agriculture area. The aid included a one-time payment of 50 thousand PLN. The support in facilitating young farmers was announced every year in the period of 2008-2011. Having analysed all the campaigns carried out for the activity „setting up of young farmers" it occurred that the highest application value was filed in 2010 and amounted to PLN 970.13 mln. The payments in all four calls were equal to PLN 1 595.90 mln.

The next activity supporting rural areas was the agri-environmental program. It was aimed at improving the rural environment and countryside. It was crucial to maintain and restore the natural values of the rural areas, to promote the sustainable management system and to protect endangered animals and plants as well as to properly use the soil. The funds were given to farmers who met certain criteria i.e.: had an identification number and the total area of their agricultural parcels amounted to a minimum of 1 ha [Agency for Restructuring and Modernisation of Agriculture 2013]. According to the data from the ARMA the 2013 campaign resulted in the submission of 119 986 applications and 77 947 decisions were issued summing up to PLN 791.87 mln.

The activity called "semi-subsistence farming support" provided financial aid for small farms in order to increase their investment opportunities. It was paid for a period of five years in the amount equal to EUR 1250 per year. The mandatory condition for the receiving funds was to have a farm of economic size from 2 to 4 ESU. As a result of the funding received, the farmer was obliged to restructure the farm through the implementation of the objectives set out in the semi-subsistence farming development plan [Ministry of Agriculture and Rural Development 2013]. After three years the partial goals had to be achieved in order to receive a bonus for the 4th and 5th year of business. The payments made for the semi-subsistence farming support in the years 2004-2006 amounted to PLN 2 130.18 mln.

Material and research methodology

In order to conduct the multidimensional comparative analysis of certain objects, the purpose and the scope of the analysis must be defined. Then the next step is to collect relevant statistical data. Next the matrix is built up in the following form [Kola-Bezka 2012]:

$X = (X_{ij})$ n x m where each object w_i ($i = 1, 2, 3, ..., n$) is characterized by the m-dimensional feature vector $x_1 = (x_{i1}, x_{i2}, x_{i3}, ... x_{im})$.

For the purpose of this paper, the following variables have been chosen:

X_1 – functioning of the local action group (payments made till 30.11.2013),
X_2 – the creation and development of micro-enterprises (payments made within all calls),
X_3 – the groups of agricultural producers (payments made till 30.11.2013),
X_4 – setting up young farmers (payments made within all calls),
X_5 – agri-environmental programme (payments for the 2007-2013 programming period),
X_6 – support for the semi-subsistence farming (payments for the 2007-2013 programming period).

In order to bring all variables to comparability, the variables expressed in the monetary units were divided by the number of registered farms in selected provinces in 2012.

The above listed set of variables is the result of selection, i.e. after eliminating quasi – constant variables. The study was based on the coefficient of variation defined by the following formula $V_j = S_j/X_j$ where the critical value was 10%. In the next step the analysis of correlation coefficients between the pairs of individual variables was conducted. Assuming that the critical value of the correlation coefficient was as follows: $r^* = 0.5$, the elimination of variables strongly correlated with each other was made (to avoid a situation in which the same information is reproduced) [Łogwiniuk 2011]. The selection of variables describing the formulated research problem was made using brainstorming, bearing in mind such factors as the popularity of individual programmes, the availability of data and the desirability in relation to the subject of this study. The resulting subset of variables was used for further analysis, namely for ordering the provinces in terms of use of the resources supporting agricultural activities.

The multidimensional methods of the objects organisation can be divided into linear and non-linear ordering methods. The former organisation allows the analysed objects to be arranged in such a way that it is possible to transfer them to a straight line, taking into account the hierarchy of objects standing at the highest levels to those involved in the lowest positions [Kisielińska, Stańko 2009]. This group includes such methods as diagrammatic methods, methods based on synthetic variable (model and non-model) and iterative methods. For the purpose of study analysis, the Hellwig measure and the Czekanowski Diagram were used. The second group of methods

includes the methods of non-linear ordering. As a result of their use it is possible to project the analysed objects on a plane without the ranking opportunity. It is only possible to compare the similarity of objects. Here one can mention such methods as dendrite methods, the method of agglomeration or the nearest neighbour method. The mentioned methods were selected due to the fact, that in literature we might find a wide range of their possible applications. The Hellwig measure is used especially often to build rankings. A broader explanation of these methods may be found in positions given in the bibliography. For the purpose of the work we limited deliberation only to the usage of these methods.

Study results

The starting point for the creation of Czekanowski Diagram is the so called distance matrix between the objects formed by any metric (in this study the Euclidean distances are used). In the next step the individual compartments of these distances are assigned to the appropriate graphic symbols. In this way a disordered Czekanowski Diagram is obtained. In the last stage the iterations are performed, namely the shift of rows and their corresponding columns. The closer the diagonal of a square matrix (the darkest fields) the smaller the distances allocated. The farther the diagonal, the bigger the distances. This is how the certain groups of similarities are formed. The diagram presents two groups of provinces (Fig 1). The first group includes provinces which are similar to each other: dolnośląskie, podkarpackie, małopolskie and śląskie. The second group form: mazowieckie, lubelskie, łódzkie and świętokrzyskie. The other two groups are less numerous because each of them consists of only two provinces of warmińsko-mazurskie and pomorskie, the second of opolskie and lubuskie. Other provinces do not show similarities with the above groups.

The study continues with the calculation of the development index called the Hellwig measure. First place was occupied by the zachodniopomorskie province followed by pomorskie, warmińsko-mazurskie and kujawsko-pomorskie. The lowest positions in the table were held by podkarpackie, małopolskie and śląskie (Tab. 1).

The final method used for the purpose of this study is the Prim's dendrite. It is a graphic illustration of the non-linear organization of provinces. The next procedure steps (iterations) involve the construction of a dendrite whose apexes are formed by the province, while the lengths of the lines connecting them are equal to the distances between the respective provinces (Fig. 2).
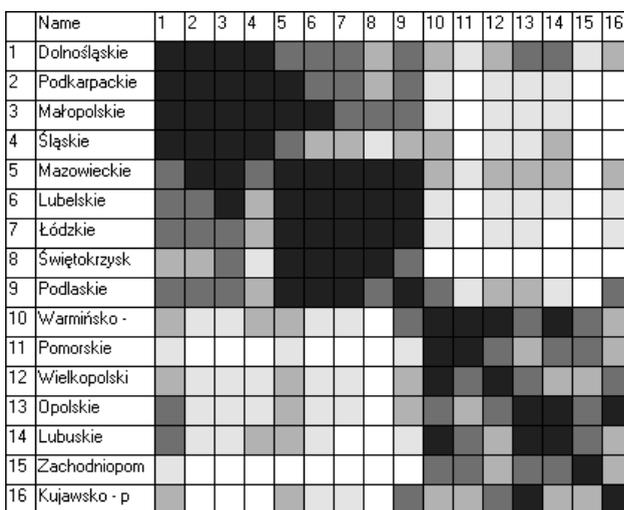

Figure 1. Cluster analysis by using Czekanowski Diagram
Rysunek 1. Porządkowanie województw za pomocą diagramu Czekanowskiego
Source: own study
Źródło: opracowanie własne

Table 1. Ranking of provinces
– Hellwig measure
*Tabela 1. Ranking województw
– miara Hellwiga*

Provinces/ *Województwo*	Hellwig measure/ *Miara Hellwiga*
Zachodnio-pomorskie	0.552295
Pomorskie	0.549233
Warmińsko-mazurskie	0.476364
Kujawsko-pomorskie	0.473492
Wielkopolskie	0.456017
Opolskie	0.409389
Lubuskie	0.393056
Podlaskie	0.298193
Mazowieckie	0.268103
Lubelskie	0.240027
Świętokrzyskie	0.226624
Dolnośląskie	0.217449
Łódzkie	0.193632
Podkarpackie	0.101681
Małopolskie	0.101649
Śląskie	0.099951

Source: own study
Źródło: opracowanie własne

Pomorskie						
1.59						
Warmińsko-mazurskie	1.97	Wielkopolskie	3.76	Zachodnio-pomorskie		
2.18						
Dolnośląskie	2.37	Lubuskie	1.9	Opolskie	1.99	Kujawsko-pomorskie
1.77						
Podkarpackie	1.02	Śląskie				
0.38						
Małopolskie						
1.33						
Świętokrzyskie						
1.27						
Łódzkie						
0.47						
Lubelskie						
0.98						
Mazowieckie						
1.09						
Podlaskie						

Figure 2. Prim's dendrite
Rysunek 2. Dendryt Prima
Source: own study
Źródło: opracowanie własne

Conclusions

1. The funds were mainly dedicated to rural area development and significantly supported any kind of agricultural activity and entrepreneurship in the Polish countryside. A large number of applications submitted for these programmes shows that many people benefited from the RDP 2007-2013 funds.

2. The Czekanowski Diagram allowed distinguished groups of provinces with similar characteristics. An important conclusion is that two large clusters can be observed while four provinces strongly differ from the rest.

3. The conducted research resulted in meeting the study objectives by means of multidimensional statistical methods. Thus, it can be concluded that these procedures can be used for this type of research problems and allow the visualization of more complex relationships. On the basis of the Hellwig development measure it can be stated that the provinces which used the financial aid to the greatest extent were zachodniopomorskie, pomorskie, warmińsko-pomorskie and kujawsko-pomorskie. In contrast, the lowest absorption of funds could be credited to podkarpackie, małopolskie and śląskie provinces.

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Streszczenie

Przedstawiono przykład zastosowania wielowymiarowych metod statystycznych do hierarchizacji województw pod względem wysokości uzyskanych środków z wybranych programów realizowanych w ramach PROW. Celem badań było stworzenie rankingu oraz wyszczególnienie jednorodnych grup województw pod względem analizowanych cech. Dokonując analizy zmienności oraz macierzy współczynników korelacji do ostatecznych obliczeń wybrano sześć zmiennych charakteryzujących omawiany problem. W pracy zastosowano trzy metody umożliwiające wielowymiarową analizę statystyczną, tj.: miarę Hellwiga, diagram Czekanowskiego oraz dendryt Prima. Wszystkie pozwoliły na sformułowanie podobnego wniosku – do województw w największym stopniu wykorzystujących środki unijne wspierające działalność rolniczą można zaliczyć: zachodniopomorskie, pomorskie oraz warmińsko-mazurskie. Natomiast najniższe pozycje zajęły: podkarpackie, małopolskie oraz śląskie.

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