

TAXONOMIC MEASURE OF ECONOMIC STABILITY OF POLISH COMPANIES AS A TOOL SUPPORTING MANAGEMENT PROCESS IN THE ENTERPRISES

Aneta Włodarczyk, Agata Mesjasz-Lech

Częstochowa University of Technology, 69 Dąbrowskiego Street, 42-201 Częstochowa, Poland

Abstract

The main purpose of the paper is to present the taxonomy measure of economic stability and the usefulness of information about the economic conditions of Polish companies in the management process in the enterprises. In order to do this, the rankings of Polish companies are based on a synthetic indicator, which is constructed as a weighted average of the economic variables which may provide important information on the competitive position of Polish enterprises. The following variables are included in this study: current assets, long-term liabilities, liquidity ratio of the second degree, net turnover profitability ratio, gross turnover profitability ratio, sales profitability rate, cost level indicator from total activity. Then it is analyzed whether the positioning of the Polish companies in the annual rankings remain stable over the period 2010-2013. In this work, the Spearman's rank correlation coefficient is used for this purpose.

Key words: management process, taxonomy measure, Spearman's rank correlation coefficient, companies economic stability

1. INTRODUCTION

The nature of the economic activity produces the need to limit threats to achieving the goals of the enterprise in relation to numerous conditionings on the side of the external environment features as well as the features of the subject which undertakes this activity. The nature of modern enterprise management reflects the process of making decisions, which solves problems of the enterprise and protects them from negative effects of risk which accompanies its activity. Thus, managers have to face the necessity to search for new, unconventional organizational, product and technological solutions concerning management, which will enable them to avoid threats resulting from turbulent changes of the external environment (Grabowska, Otolá & Mesjasz-Lech 2014). One of them is to reach for intuition and sub-consciousness of the manager, which enables a deeper penetration of the decision-making problem in relation to its logical analysis, which makes it possible to switch smoothly from analytical logic and rational thinking to system thinking, which is connected with synthesis of knowledge (Henry 2013).

Nevertheless, contemporary enterprise management theories stress the importance of managerial information system in the management practice (Karim & Hussein 2008). The works devoted to the information management process show it as the control process over the information lifecycle, whereby the process of accessing and using of information becomes more efficient and effective (Detlor 2010). Making quick and proper decisions by managerial staff concerning functioning of the enterprises in the conditions of strong competition and unstable external environment requires constant flow of reliable information. On this basis decisions are made both of strategic nature defining the most important parameters of enterprise future development as well operational ones concerning current activity of the enterprise. Information obtained from the conducted in this paper empirical research concerning taxonomic evaluation of economic situation of Polish enterprises in the regional grasp makes it possible to identify voivodeships whose enterprises are characterized by best and worst financial condition.

For the above reason the aim of the paper is to evaluate the stability of financial condition of Polish enterprises in the years 2010-2013 with the use of taxonomic tools. The evaluation of economic situation of enterprises in particular regions of Poland was conducted in two stages. Firstly, the value

of the synthetic indicator was determined for groups of enterprises registered in particular voivodeships, in order to elaborate on this basis the ranking of enterprises in relation to their economic situation. Then, on the basis of estimated Spearman's rank correlations coefficients for selected orderings of enterprises in the rankings with reference to the value of the synthetic indicator the authors conducted an analysis of stability of these subjects' financial results in the changeable conditions of the environment.

2. CONSTRUCTION OF THE SYNTHETIC INDICATOR ON THE BASIS OF ECONOMIC VARIABLES

In order to create a regional ranking of Polish enterprises which would reflect their economic situation, the author constructed a synthetic indicator according to the following procedure (Jajuga & Walesiak 2000; Kolenda 2006):

- 1) the first stage is connected with unitarization of variables, which results in their normalization in the unit interval:

$$z_{jk} = \frac{(y_{jk} - \min_j \{y_{jk}\})}{R_k} = \frac{(y_{jk} - \min_j \{y_{jk}\})}{\max_j \{y_{jk}\} - \min_j \{y_{jk}\}} \quad (1)$$

where: z_{jk} - unitarized value of k-nth variable for j-nth object ($j = 1, 2, \dots, n$),

y_{jk} - primary value of k-nth variable for j-nth object,

R_k - range of k-nth variable in the n-object sample;

- 2) the second stage comprises transformation of destimulant variables into stimulants, according to the formula described below:

$$u_{jk} = 1 - z_{jk} \quad (2)$$

where u_{jk} - value of k-nth variable, being initially a destimulant, after transforming it into a stimulant for j-nth object;

- 3) the last stage consists in determining the value of the synthetic indicator S_j according to the following relation:

$$S_j = \sum_{k=1}^m w_k \cdot u'_{jk} \quad (3)$$

$$\text{for } u'_{jk} = \begin{cases} z_{jk} & \text{for the stimulant} \\ u_{jk} & \text{for the destimulant} \end{cases} \quad (4)$$

where: S_j – value of the synthetic indicator for j-nth object,

m – number of variables included at constructing the synthetic indicator,

w_k - weight assigned to k-nth variable fulfilling the following restricting conditions:

$$\sum_{k=1}^m w_k = 1, \quad w_k > 0 \quad \text{dla } k = 1, 2, \dots, m. \quad (5)$$

The described above synthetic indicator takes values from the 0 to 1 interval, thanks to which it is possible to use the indicator in a clear and transparent way for comparative analyses for various objects. The model object will have the value of the synthetic indicator equal 1, which results from maximum values achieved by all variables included in the definition of this measure. After

unitarization and transforming each variable into a stimulant the maximum value taken by the variable is 1, and the minimal 0. Similarly, anti-model is a hypothetical object for which the value of the synthetic indicator is 0, which is the consequence of the fact that each of m variables takes the lowest value for the given object (Kolenda 2006; Strzelecka & Nieszporska 2009).

In order to evaluate the financial condition of Polish enterprises considering regional division of the country, the following variables describing selected positions of the balance and the profits and loss account of enterprises have been included (Włodarczyk 2011; Łukomska-Szarek 2011; Goncharuk & Karavan 2013):

- value of enterprise current assets (X_1 variable, a stimulant),
- value of enterprise long-term liabilities (X_2 variable, a destimulant),
- enterprise financial liquidity ratio (X_3 variable, a nominant),
- ratio of net turnover profitability (X_4 variable, a stimulant),
- ratio of gross turnover profitability (X_5 variable, a stimulant),
- ratio of sales profitability of products, goods and materials (X_6 variable, a stimulant),
- ratio of cost level from the overall activity (X_7 variable, destimulant).

Table 1 presents a more detailed characteristics of decision making variables included at the construction of the synthetic indicator.

Table 1. Variables characterizing enterprise economic situation

Decision-making variable	Variable description
X_1	Current assets include: stocks, short-term liabilities, short-term investments and accruals; while one should notice that a low share of non-current assets in total assets allows to react more quickly to changes of conjuncture and connected with it sales level; additionally, the decrease in the proportion of current assets in total assets is accompanied by an increase in fixed costs connected with maintaining non-current assets and the risk of change in the price of possessed long-term financial assets.
X_2	Long-term liabilities are the whole of liabilities whose repayment period on the balancing day is longer than a year, except for liabilities arising from the purchase of goods and services; while they may concern credits and long-term loans, issued bonds and other debts. Maintaining long-term liabilities in enterprises at a high level indicates that they use foreign capital to finance their own activity; however, the proportion of long-term liabilities to own capitals should not exceed one.
X_3	Financial liquidity ratio reflects the relation between the level of short-term investments and short-term receivables and the level of short-term liabilities. An enterprise possesses a short-term financial liquidity if it is characterized by the ability to pay timely short-term liabilities. In practice the optimum value of this indicator may differ for enterprises from various sectors, and additionally it depends on the conducted by the enterprise financial policy ¹ .
X_4	Ratio of net turnover profitability is a quotient of the net financial result and the total operating income; which illustrates in the synthetic way effectiveness of

¹ A broader discussion on this subject is conducted by Jerzy Kitowski, 'Methodological aspects of assessing liquidity in a static approach', *Zeszyty Naukowe Uniwersytetu Szczecińskiego* 689 (2012), pp. 283-293.

	management in the enterprise. This measure indicates the share of net profit (loss) in the value of sales income plus operational and financial incomes. The higher the value of this indicator, the higher value of profit is attributable to a unit of achieved profit from the total of activity.
X ₅	Ratio of gross turnover profitability is the relation of the gross financial result to the incomes from the total activity; while the difference between the net and gross turnover profitability may inform either about high tax rates or high level of costs not included into the tax-deductible expenses. Significant differences between the fourth and fifth variables occur in enterprises that are losing financial liquidity.
X ₆	Ratio of sales profitability defines the relation of the sales results of products, goods and materials in relation to net incomes from the sales of products, goods and materials. This measure shows the position of the enterprise on the market of products offered to clients as it reflects inter alia the unit level of own sales costs, enterprise pricing policy, sales volume depending on conjunctural cycle.
X ₇	Ratio of cost level expresses the relation of the tax-deductible expenses from the overall activity (own cost of sold products, goods and materials, other operational and financial costs) in relation to incomes from overall activity (incomes from sales of goods and materials, other operational and financial incomes). This measure is applied to measure the economic activeness of the enterprise with reference to using own material resources and intellectual capital, and additionally it is used to evaluate the ability of the enterprise management to control and decrease costs.

Source: own elaboration on the basis of information by GUS, www.stat.gov.pl (accessed on 4 March 2015) and Sierpińska M., Jachna T., *Evaluating Enterprises According to World Standards*, PWN, Warszawa 2009, pp.145-200.

The empirical research will include information concerning selected position of the balance and the profits and losses account of economic subject conducting activity in particular voivodeships, which will enable to carry out analyses not only in the dynamic grasp but also in the spatial one. The source of information on incomes, costs, financial results and current assets are quarterly reports made by the subjects that keep accounting books, which registered business activity in the territory of one of the voivodeships in Poland (comp. Fig. 1). In the paper the author used annual statistical data from the period 2010-2013 which comes from the Local Data Bank of GUS on financial results of Polish enterprises according to the PKD 2007 classification.

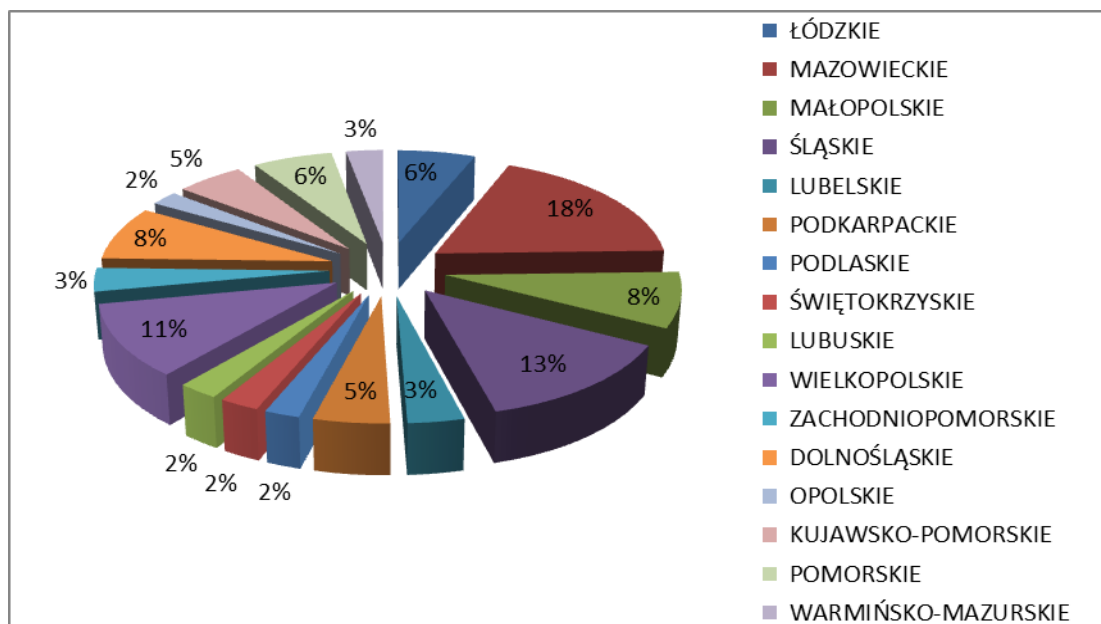


Fig.1 Spatial distribution of Polish enterprises surveyed by GUS in the year 2013
(division according to voivodeships)

Source: own elaboration on the basis of information by GUS, www.stat.gov.pl (accessed on 24 March 2015)

The most numerous group constituted enterprises from the Mazowieckie Voivodeship (18% of all surveyed enterprises), the Śląskie Voivodeship (13% of all surveyed enterprises) and the Wielkopolskie Voivodeship (11% of all surveyed enterprises). The least numerous group in the survey of GUS constituted enterprises registered in the Opolskie Voivodeship, the Świętokrzyskie Voivodeship, the Lubuskie Voivodeship and the Podlaskie Voivodeship (2% of all surveyed enterprises each). While analyzing the ownership form of the economic subjects participating in the GUS survey one should notice that in each voivodeship the proportion of the units included in the private sector is overwhelmingly bigger in relation to the units representing the public sector (comp. Fig. 2).

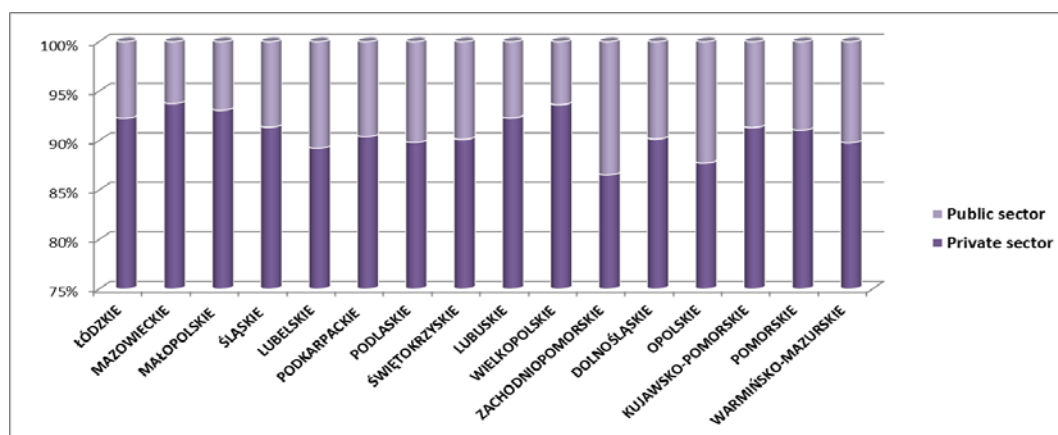


Fig. 2 Ownership structure of enterprises surveyed by GUS in 2013

Source: own elaboration on the basis of information by GUS, www.stat.gov.pl (accessed on 24 March 2015)

Values of particular variables characterizing economic situation of Polish enterprises in the scale of a given voivodeship have been presented in Table 2, while in order to increase the comparability of data current assets values and values of long-term liabilities have been presented in the form of intensity ratios.

Table 2. Values of variables included at constructing the synthetic indicator for the year 2013

Polish voivodeships	X ₁ [thous. zł/1entity]	X ₂ [thous. zł/1entity]	X ₃ [%]	X ₄ [%]	X ₅ [%]	X ₆ [%]	X ₇ [%]
ŁÓDZKIE	32581.29	10332.63	93.3	5.4	6.5	6.8	93.5
MAZOWIECKIE	78933.99	35545.38	105.1	3.3	3.9	3.5	96.1
MAŁOPOLSKIE	33438.92	11882.95	97.1	4.2	4.9	4.5	95.1
ŚLĄSKIE	41415.90	11062.41	90.3	3.3	3.8	3.1	96.2
LUBELSKIE	30601.76	7513.01	111.3	4.7	5.9	7.0	94.1
PODKARPACKIE	31177.31	4689.02	97.7	5.8	6.4	5.0	93.6
PODLASKIE	25729.05	6616.15	86.7	2.5	3.2	2.8	96.8
ŚWIĘTOKRZYSKIE	34816.48	13268.60	83.1	2.2	2.6	2.5	97.4
LUBUSKIE	21188.50	5457.23	109.1	4.5	5.1	4.5	94.9
WIELKOPOLSKIE	38873.78	13700.15	74.0	4.4	5.1	5.2	94.9
ZACHODNIOPOMORSKIE	23597.78	8770.57	85.9	3.3	3.9	4.1	96.1
DOLNOŚLĄSKIE	38962.92	13368.67	98.6	4.6	5.6	6.3	94.4
OPOLSKIE	24338.16	4389.21	88.6	2.7	3.4	3.6	96.6
KUJAWSKO-POMORSKIE	29483.18	5155.07	101.2	4.4	5.2	5.2	94.9
POMORSKIE	40845.44	15834.69	99.4	4.0	4.7	4.5	95.3
WARMIŃSKO-MAZURSKIE	28252.60	9146.93	170.5	3.4	4.0	4.4	95.9

Source: own elaboration on the basis of information by GUS, www.stat.gov.pl (accessed on 24 March 2015)

While analyzing data that concerns shaping the values of enterprise current assets (X₁ variable) in the year 2013 one should notice a distinct disproportion between enterprises of the Mazowieckie following voivodeships: Łódzkie, Małopolskie, Śląskie, Wielkopolskie, Świętokrzyskie, Dolnośląskie i Pomorskie. In the year 2013 the middle value of current assets was higher by 5.7% than the value of this ratio in the year 2012 and by 17% in relation to the value from the year 2010. A half of Polish enterprises showed in 2013 long-term liabilities of the value of at least 9739.70 thousand PLN, while the Voivodeship compared with the other regions of the country, for which the average value of current assets was higher by 147.6% than the assets median of all Polish enterprises. A higher value of current assets, in relation to the median amounting 31879.30 thousand of PLN was also recorded in the group of enterprises from the average value of long-term liabilities of enterprises of the Mazowieckie Voivodeship was higher by 264.95% than the median of all Polish enterprises. Moreover, in the year 2013 in relation to the year 2010 enterprises from the voivodeships: Małopolskie, Lubelskie, Śląskie and Świętokrzyskie increased their long-term liabilities in the highest extent by respectively 124.89%, 69.23%, 65.72% i 65.61%, which may indicate their greater use of foreign capital to finance their own activity. On the other hand enterprises of the voivodeships:

Opolskie, Podlaskie and Lubelskie showed a decrease in long-term liabilities, which in 2013 constituted respectively 81.52 %, 94% i 95.75% of long-term liabilities from the year 2010. While analyzing ratios of financial liquidity one can notice that in 2010 the ability to pay short-term liabilities with assets of high liquidity level possessed 64.12% of surveyed enterprises in Poland, in 2012 - 49.52% of economic subjects included in the GUS survey, while in 2013 only 32.58% of the surveyed enterprises in Poland. Moreover, in 2013 a favourable relation between the investment level and short-time receivables and the level of short-term liabilities can be observed in the enterprises of the voivodeships: Mazowieckie (105.1%), Lubelskie (111.1%), Lubuskie (109.1%), Kujawsko-Pomorskie (101.2%) and Warmińsko-Mazurskie (170.5%). It is also worth emphasizing that ratios of gross turnover profitability in the enterprises of the voivodeships: Małopolskie, Lubelskie, Podkarpackie, Podlaskie, Lubuskie and Kujawsko-Pomorskie were not lower than in the year 2010, which concerns only 26.2% of Polish enterprises. However, the statistics are different while comparing data in the years 2013 and 2012, as in 76.4% of Polish enterprises deterioration of financial effectiveness was not observed. Only in case of enterprises of the voivodeships: Śląskie, Świętokrzyskie and Dolnośląskie the gross profitability ratios decreased in 2013 compared to 2012. The last variable included while constructing the synthetic indicator is the cost level ratio, which grew in 2013 in comparison to 2010 for 53.8% of analyzed enterprises, but only for 23.6% of Polish enterprises in relation to the year 2012. It is already at this stage of the spatial analysis of economic ratios that one can notice that situation of Polish enterprises is regionally differentiated and additionally values of decision-making variables were different in the year 2013 than in 2010. Thus, it is possible to observe that analyzed enterprises not always effectively reacted in the difficult conditions of growing uncertainty in the market economic slowdown caused, among other things, by the debt crisis of the Euro zone.

In order to identify voivodeships in Poland where subjects conducting business activity are characterized by best and worst financial condition the author used the statistical method of linear ordering based on the synthetic indicator.

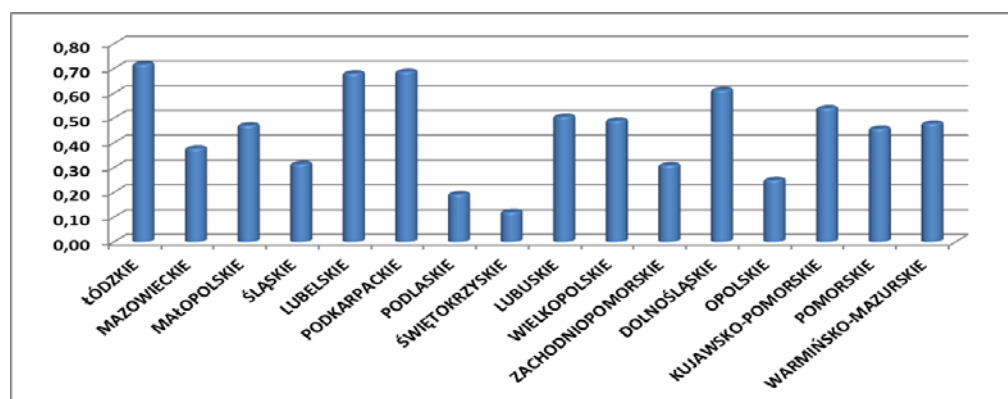


Fig. 3 Value of the taxonomic indicator depicting economic situation of Polish enterprises in 2013 (division according to voivodeships)

Source: own elaboration

The values of particular variables characterizing the economic situation of enterprises in the scale of a given voivodeship (comp. Table 2) were subjected to unitarization procedure in accordance with the formulas(1)-(2). Then, using the relation (3)-(4) values of taxonomic indicator were estimated, which constituted the basis to create a ranking of enterprises in particular voivodeships of Poland with relation to their financial situation in the year 2013 (comp. Fig. 3).

In the elaborated ranking the highest position was taken by the enterprises of the Łódź Voivodeship for which the value of the synthetic indicator amounts 0.72. Therefore, this group was characterized by

best financial condition in the year 2013. Such a high position in the ranking analyzed economic subjects owe to the relatively high profitability ratios and low ratio of cost of overall activity. The second position in the ranking was attributed to the enterprises of the Podkarpackie Voivodeship due to the indicator value equal to 0.69. The third position belongs to the enterprises of the Lubelskie Voivodeship, in their case the value of the synthetic indicator was 0.68. The worst financial condition in the year 2013 presented the enterprises of the Świętokrzyskie Voivodeship, which were close to the anti-model due to the value of the synthetic indicator equal to 0.12 and the enterprises of the Podlaskie Voivodeship which were last but one with the value of the synthetic indicator amounting 0.19.

3. EVALUATION OF ENTERPRISE POSITIONING STABILITY IN POLAND DUE TO ECONOMIC SITUATION

While considering the issue of Polish enterprises positioning stability with reference to their financial condition, in the period connected with the occurrence of debt crisis of peripheral countries of the Euro zone a good idea is to reach for such statistical tools as Spearman's rank correlation coefficient. This indicator is used to measure the correlation level of order sets and it can be determined both for qualitative features described on the ordinal scale as well as the quantitative ones. Spearman's rank correlations coefficient is determined in accordance with the following relation (Szajt 2014):

$$r_s = 1 - \frac{6 \cdot \sum d_i^2}{n \cdot (n^2 - 1)} \quad (6)$$

where:

d_i – is the difference between ranks of corresponding values of x_i feature and y_i feature;
 n – quantity of the statistical sample.

Spearman's rank correlations coefficient is the value standardized in the interval $[-1, 1]$, while the absolute value of the coefficient shows the dependence level between two object rankings, its sign in turn shows the direction of the dependence. Advantages of this measure which indicate its frequent application in empirical research include: its value standardization and the possibility to determine by its means the similarity of pairs of the objects' rankings in time. Additionally, Spearman's coefficient can be used to examine compliance level of classifications obtained as a result of applying several methods ordering a given set of objects (Aczel 2011).

Thus, looking for the answer to the following question: if unstable conditions of the external environment connected with the Euro zone crisis, high volatility of raw materials on commodity markets, currency risk, interest rate risk and strong competition were reflected in the financial results of Polish enterprises in the years 2010-2013 and economic subjects of which voivodeships of Poland dealt with the situation better and worse, it is worth to reach for taxonomic analyses results. Namely, four ranks were prepared for enterprises conducting activity in particular voivodeships of Poland, which made it possible to order them in relation to the value of the synthetic indicator in particular years of the period 2010-2013 (comp. Table 3).

Table 3. The ranking of Polish enterprises in relation to the financial results obtained in the years 2010-2013

Polish voivodeships	2010	2011	2012	2013
ŁÓDZKIE	0.69	0.47	0.68	0.72
MAZOWIECKIE	0.57	0.36	0.48	0.38
MAŁOPOLSKIE	0.45	0.31	0.52	0.47
ŚLĄSKIE	0.50	0.40	0.44	0.31

LUBELSKIE	0.43	0.47	0.69	0.68
PODKARPACKIE	0.42	0.30	0.51	0.69
PODLASKIE	0.11	0.11	0.11	0.19
ŚWIĘTOKRZYSKIE	0.42	0.33	0.36	0.12
LUBUSKIE	0.23	0.22	0.48	0.51
WIELKOPOLSKIE	0.49	0.27	0.36	0.49
ZACHODNIOPOMORSKIE	0.21	0.17	0.33	0.31
DOLNOŚLĄSKIE	0.84	0.89	0.77	0.61
OPOLSKIE	0.40	0.30	0.27	0.25
KUJAWSKO-POMORSKIE	0.36	0.33	0.44	0.54
POMORSKIE	0.45	0.24	0.50	0.46
WARMIŃSKO-MAZURSKIE	0.39	0.22	0.38	0.48

Source: own computation.

When analyzing the presented above values of the synthetic indicator one can observe that in the years 2010-2012 the highest position in the ranking was occupied by the group of enterprises of the Dolnośląskie Voivodeship. Economic subjects from this voivodeship occupied the lowest position in the ranking prepared for the year 2013 due to the decrease in the value of current assets ratio and serious deterioration of the financial liquidity ratio. Such changes of the values of financial ratios may indicate a slow reaction of this group of enterprises to the worse market situation at the time of the Euro zone debt crisis. The enterprises of the Łódzkie Voivodeship in turn were relatively high in the rankings prepared for the year 2010, 2012 and 2013, while in 2011 their position in the ranking fell due to the worsening of net and gross turnover profitability ratios, at a simultaneous growth of the overall activity cost ratio. Nevertheless, the enterprises of the Dolnośląskie and Łódzkie voivodeships even in the conditions of strong competition and instability of the external environment were able to obtain favourable financial results. Turbulent changes on the financial and commodity markets, debt crisis and connected with them slow down of Polish economy correspond to the period when the economic subjects of the Podlaskie, Zachodniopomorskie and Opolskie voivodeships recorded lowest ratios of net and gross turnover profitability, ratio of sales profitability of products, goods and materials and a high ratio of cost level from overall activity of enterprises. The result of this was that these groups of enterprises occupies relatively low positions in all prepared rankings. The aim of the conducted analysis of Polish enterprises financial condition stability was to check the probability of orderings for each pair of periods in which the synthetic indicator was analyzed. In order to do this the author determined Spearman's rank correlations coefficients on the basis of data presented in Table 3.

Table 4. The values of Spearman's rank correlations coefficients

Period	2010	2011	2012	2013
2010	1	0.7662***	0.6294***	0.3346
2011	0.7662***	1	0.6618***	0.4066
2012	0.6294***	0.6618***	1	0.7596***
2013	0.3346	0.4066	0.7596***	1

Source: own computation. *** indicates significance at 1%, level.

Spearman's rank correlations coefficient provides information about the extent to which positioning of enterprises in relation to the financial results obtained in the given period was explained by the ranking prepared earlier on the basis of the same synthetic indicator (Czempas & Majewska 2009). Calculated Spearman's rank correlations coefficients (comp. Table 4) in about 67% were statistically significant, which would indicate the similarity of positions occupied by Polish enterprises in annual rankings, the aim of which was to evaluate the financial condition of these economic subjects. Spearman's coefficient took the lowest level (0.3346) for rankings prepared for extreme periods, that is the years 2010 and 2013. The highest values of Spearman's coefficient in turn correspond to the rankings of enterprises prepared for the years 2010- 2011 (0.7662) and 2012-2013 (0.7596).

4. CONCLUSION

Presented in the article methods of multivariate statistical analysis using financial variables reflecting selected positions of the profits and losses balance allow to group Polish enterprises according to their financial condition. In particular classification of enterprises based on the value of the synthetic indicator made it possible to distinguish voivodeships the enterprises of which are characterized by best and worst economic situation. Analysis of stability of financial results of enterprises conducted with the use of Spearman's rank correlations coefficient allowed the author to identify groups of economic subjects more or less threatened by the effects of the financial crisis. It is also worth stressing that information acquired as a result of conducted in the paper empirical research concerning taxonomic evaluation of the economic situation of Polish enterprises in the regional grasp in the years 2010-2013 can be used to make proper decisions and implement actions aimed at improvement of functioning of enterprises in the given region from the perspective of administrative bodies of the voivodeship. Moreover, the conducted evaluation of enterprise positioning stability in relation to their economic results in the period 2010-2013 may prove useful while predicting future conditions of enterprise functioning and making decisions defining the directions of their development in the future.

REFERENCES

- Aczel, A 2011, *Statistics in Management*, PWN, Warsaw (Polish).
- Czempas, J & Majewska, Z 2009, 'Analysis of the results achieved by the investment funds', *Wiadomości statystyczne*, no. 5, pp. 57-74 (Polish).
- Detlor, B 2010, 'Information Management', *International Journal of Information Management*, vol. 30, no. 2, pp. 103-108.
- Goncharuk , AG & Karavan, S 2013, 'The investment attractiveness evaluation: methods and measurement features', *Polish Journal of Management Studies*, vol. 7, pp. 160-166.
- Grabowska, M, Otol, I & Mesjasz-Lech, A 2014, 'Innovative Strategies as a Determinant of Achievement of the Goals of Enterprise Activity', *Proceedings of the 12th International Academic Conference*, Prague, pp. 465-485.
- Henry, B Ch 2013, 'New Paradigm of Systems Thinking', *International Journal of Economics, Finance and Management*, vol. 2, no. 5, pp. 351-355.
- Jajuga, K & Walesiak, M 2000, 'Standardization of data set under different measurements scales', in R Decker & W Gaul (ed.), *Classification and information processing at the turn of millennium*, Springer-Verlag, Berlin-Heidelberg, pp. 105-112.
- Karim, NSA & Hussein, R 2008, 'Managers' perception of information management and the role of information and knowledge managers: The Malaysian perspectives', *International Journal of Information Management*, vol. 28, no. 2, pp. 114-127.

Kitowski, J 2012, 'Methodological aspects of assessing liquidity in a static approach', *Zeszyty Naukowe Uniwersytetu Szczecińskiego*, no. 689, pp. 283-293 (Polish).

Kolenda, M 2006, *Numerical Taxonomy. Classification, Ranking and Analysis of Multivariable Objects*, Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, Wrocław (Polish).

Łukomska-Szarek, J 2011, *Financial Analysis as a Method of Assessment of Financial Standing in Local Self-Governments*, Publish house Education and Science s.r.o., OOO Rusnauckniga, Praha-Belgorod.

Sierpińska, M & Jachna, T 2009, *Evaluating Enterprises According to World Standards*, PWN, Warsaw (Polish).

Strzelecka, A & Nieszporka, S 2009, 'Taxonomic methods in the assessment of the health care system', in E Nojszewska (ed.), *Trends in development of the health care system in Poland*, Oficyna Wydawnicza SGH, Warsaw, pp. 91-102 (Polish).

Szajt, M 2014, *Space in economic research*, Sekcja Wydawnictw Wydziału Zarządzania Politechniki Częstochowskiej, Częstochowa (Polish).

Włodarczyk, A 2011, 'Evaluation of the stability of the financial condition of the enterprises of transport and storage section under the subprime crisis', *Logistyka*, no. 5, pp. 300-306 (Polish).